
FutureBuilt
10 years
FUTURE
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# Contents:

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Photo: Geir Anders Rybakken Ørslien

# FutureBuilt 10 years

In 30 years´ time, most of us will be city dwellers. Estimation of world urbanisation is as high as 68 percent by 2050. As economic growth is mainly connected to urban areas, cities will have an important role in fighting climate change.

Norway has signed the Paris Agreement and the UN Sustainable Development Goals. This commitment means that we must act immediately to reduce greenhouse gas emissions with 50 percent by 2030.

The Oslo region is the largest urban area in Norway, and mirroring global trends, the region is rapidly expanding. To meet the needs of this population increase, new housing, workplaces and transport infrastructure will have to be built. At the same time, Oslo has committed to cutting carbon emissions by 95 percent by 2030.

In 2009, FutureBuilt was established to support climate-friendly urban development in the Oslo region, and the aim has been to complete at least 50 pilot projects by 2020. The pilot projects are set to reduce greenhouse gas emissions from transport, energy and material consumption by a minimum of 50 percent, and to inspire and change practices in both the private and public sector.

In 2019 we are celebrating both our 10th anniversary and reaching our goal of 50 pilot projects. 24 projects are completed and 28 are under construction or being planned.

Showcasing our pilot projects is important to us, and at the URBAN FUTURE Global Conference we will share our experiences with 3,000 passionate CityChangers from all over the world.

We hope you will enjoy reading about our work and our projects. If you have any questions or grand ideas, we would love to hear from you.

FutureBuilt is a collaboration between 10 partners: The municipal authorities of Oslo, Bærum, Asker and Drammen, the Ministry of Local Government and Modernisation, the Norwegian State Housing Bank, Enova, the National Agency for Building Regulations, the Norwegian Green Building Council and the National Association of Norwegian Architects.

# Learning by doing

Veitvet School. Photo: Link Arkitektur AS and Hundven Clements photography

FutureBuilt's vision is to show that it is possible to build climate neutral buildings and urban areas with architectural quality.



There is nothing as contagious as a good example. This is why FutureBuilt uses pilot projects as a strategy for changing the way we are developing our buildings and city areas. The pilot projects are meant to inspire and change practices in both the private and public sector.

**Quality criteria**
In order to become a FutureBuilt pilot, a project needs to fulfil certain criteria. The carbon footprint must be reduced by at least 50 percent compared to current regulations and common practice. This is measured by a greenhouse gas accounting tool for buildings. The projects must:

- reduce greenhouse gas emissions from transport, energy and materials and be located near major transport hubs
- be of high urban and architectural quality
- be innovative and have showcase qualities

**Urban environment and architecture**
The FutureBuilt pilot projects must have qualities like walkability, cyclability, safety and comfort, meeting places, relationship to the city structure, universal design, water and biodiversity. To benefit residents, users and the urban population at large the projects are expected to include extra qualities above the minimum demanded by planning authorities.

**Innovation**
FutureBuilt contributes to the green transition in the construction industry. All of the pilot projects must illustrate how the projects contribute to innovation and new thinking. These can be new environmental standards, products, concepts and processes, all aimed at driving change.

**Transport**
The FutureBuilt pilot projects are to be located in urban centres or close to public transport hubs. Green mobility requires fewer motorists and more pedestrians, cyclists and people who use public transport. In FutureBuilt pilot projects the amount of parking spaces should be reduced by at least half and car sharing service provided. Facilities for pedestrians and cyclists must be of high quality.

**Energy**
Technology is rapidly advancing, especially with regards to energy efficiency and local, renewable power. While passive houses where the pinnacle of energy efficiency only a few years ago, plus-energy houses are now a reality, and we are reaching for plus-energy neighbourhoods. For the pilot projects, the energy for the operation of the building must as a minimum be based on forthcoming regulations, which means close to net-zero energy. Plus-energy buildings are particularly interesting, as they make it possible to sell excess power and heat. FutureBuilt seeks to be a driving force for such development by challenging suppliers as well as policy makers.

From 2017 we have adopted fossil free construction sites as a minimum criteria, moving towards emission free sites.

**Materials**
The production of concrete is responsible for five percent of the world's greenhouse gas emissions. For most passive houses, greenhouse gas emissions from production of building materials are equal to the emissions from operation. FutureBuilt's pilot projects must use building materials with low greenhouse gas emissions, for instance wood or low-carbon concrete. Increased focus on circular economy has raised awareness of the intrinsic value of building materials. FutureBuilt has made a standard for circular design, giving principals for reuse of buildings and building materials as well as principals for dismantling building components.

**All of the pilot projects must illustrate how the projects contribute to innovation and new thinking.**

Grensevingen 7.
Photo: Paulina Cervenka

**– The FutureBuilt projects have demonstrated that low-carbon buildings don't require any hocus pocus. Our job is to share experiences in this area, and we are therefore now challenging all developers to build low-carbon buildings.**

Katharina Bramslev, CEO of the Norwegian Green Building Council

Brynseng School. Photo: Tove Lauluten

# Lead by example

There are innovative aspirations, and there is innovation that challenges the status quo. Completed projects that stand as proof of concept and are a testament to what is possible. This is what FutureBuilt pilots are about.

**Text: Kristin Rodland Buick/Felix Media**

"If you always do what you've always done, you will always get what you've always got". This well-worn quote is as true as the many great men who have laid claim to it. For the construction industry, which is contributing as much as 40 percent of the global greenhouse gas emissions, a new approach is both needed and potentially game-changing.

'We aim high, but not so high that the goals are out of reach,' says Birgit Rusten, CEO of FutureBuilt.

Innovation is a pillar in the FutureBuilt vision of carbon neutral urban areas. As well as reducing the carbon footprint by at least 50 percent compared to conventional practices, each FutureBuilt pilot project must have three innovative, showcase qualities.
While there is no set standard for what FutureBuilt ranks as innovative, each pilot project aims to facilitate change within its relevant industries.

'For each project we discuss what new solutions could be explored. We bring experience and expertise to the table to discuss what areas within each project have the potential for breaking new ground,' Rusten says.

After setting the ambitious goal of reducing carbon footprint by half, the innovation happens on the road to getting there. There is no map for developers to follow, but FutureBuilt offer specialist advice, facilitate workshops and arrange visits to other relevant buildings and projects.

## We challenged the market to help us find innovative solutions.

**Focusing the efforts**
Finding new solutions first of all depends on a project group who is willing to go that extra mile looking for what is new and groundbreaking. The political leadership and administration at the Municipality of Asker is just that.

'We are not only looking for what is best, but what is next,' says Ragnar Sand Fuglum. He is director of Culture and Technology at Asker Municipality, situated by the Oslo fjord, a 20 minutes´ train journey south of the capital.

Ruseløkka school Ill.: Gasa arkitekter

Holmen Swimming Pool. Photo: Tove Lauluten

Asker is a self-proclaimed 'innovation municipality' and has, as the first in Norway, incorporated a set of the UN Sustainable Development Goals into their operational plans. Ragnar Sand Fuglum regards FutureBuilt's support as invaluable to achieving these goals for the development of the municipality's public buildings and transport. In his experience, a prerequisite for innovation is focusing one's efforts.

'We don't aim to innovate for every new building. The point is to go to considerable lengths to do something extraordinary on a few selected projects. This way we build competence on the execution of environmentally ambitious building projects, including how they are used and transport to and from the site.'

**The cycle of water and air**
One of these buildings is Holmen Swimming Pool. It was not a FutureBuilt project from the start, but was adopted as a pilot due to its ambitious environmental goals.

A swimming pool uses on average three times as much energy as a sports hall, so the main innovative focus for Holmen is on energy collection, preservation and recovery. With its 650 $m^2$ of solar panels, 1,000 $m^2$ of sun capturers, 15 geothermal wells and internal heat recovery system, Holmen is one of Norway's most energy efficient swimming pools.

'We invited the industry, scientists and other experts to give a presentation on what is possible to deliver in different areas such as cleaning technology, the running of the building, heat recovery and solar capture from the ground,' Fuglum explains.

'We literally scoured the market for what is available out there of the ultimate technological advancements.'

It is estimated that a single visitor to a Norwegian swimming pool could use up to a baffling 250 litres of water and 23,2 kWh per person after showering, swimming and showering again. Innovative functionality of

Kistefossdammen Kindergarten. Photo: Trond Joelson/Byggeindustrien

the cycle of air and water in Holmen Swimming Pool means that happy swimmers in Holmen only use an estimated 112 liters and 11,1 kWh per person.

**Evaporating bills**

This reduction is reached by the following measures: Two heat pumps collect energy from 15 geothermal wells for heating the building. Three other heat pumps recover energy from the ventilation system to both air, pool and tap water. This way the building also utilises the heat evaporating from the pool. In order to reduce the need to heat the pool water, the floor in the therapy pool and in three of the basins in the main pool can be elevated and submerged. When the pools are not in use, the floor is raised and the evaporation is smaller. A heat pump recovers the heat from the water that goes down into the gullies when bathers use the shower facilities.

There is no doubt that innovation on this scale is expensive. The project benefited from several government funded schemes aimed to stimulate climate innovation in the construction sector. That said, it is estimated that Holmen saves about 1,2 million Norwegian Kroner (about 125,000 Euro) on its energy bill yearly, when compared to pools equivalent in size and capacity.

**The power of procurement**

A couple of kilometres from the pool, is Norway's first public plus-energy building situated. Kistefossdammen Kindergarten is predominantly constructed in climate-friendly materials, using wood in both structures and surfaces. It relies solely on renewable energy from geothermal wells and photovoltaic panels, generating more energy than it uses, on average, per year. Kistefossdammen is estimated to have around 60 percent lower greenhouse gas emissions from energy, transport and materials than a comparable kindergarten built to national building standards with typical transport habits for the area.

'Public procurement can play an important role in influencing the market and drives innovation within the industry. When we set high environmental requirements and keep a close dialogue with stakeholders in the industry, the market will adjust,' says Ragnar Sand Fuglum.

**Resurrection**

Undervisningsbygg, the municipal constructor of schools and other educational buildings in Oslo, also enjoy a close dialogue with the industry.

'We challenged the market to help us find innovative solutions for energy storage and efficient use of the surplus energy produced by larger solar power plants. We also wanted advice on how to promote the reuse of building materials,' says Rigmor Hansen, CEO of Undervisningsbygg.

The input on recycling building materials proved useful in Undervisningsbygg's next FutureBuilt project, Ruseløkka School, where a circular economy is key. The old school was carefully demolished, so that bricks, wooden beams and granite staircases could be reused. 30 wooden doors were given free to good homes on an online second hand trading site.

'These days we focus on circular construction and are now in the process of mapping several school buildings for the potential of reusing materials and consider these for new construction projects. New brick façade will be designed with future reuse in mind,' says Hansen.

The brick walls at Ruseløkka will be laid with lime mortar for easier demolition and reuse in the future. Paving new ground, second-generation low-carbon concrete will be used in building the school, which has around 70 percent lower greenhouse gas emissions than standard concrete.

'We're hoping to gain experience with access and delivery, the setting time and processes around casting, which will be continued to inform other new building projects,' Hansen continues.

She says that Undervisningsbygg always wants to be pushing the envelope by having a FutureBuilt project on the go.

'Our buildings are planned with flexibility and changing utility models in mind, so that they can be reconstructed with minimal impact on technical facilities and existing building mass. While we aim to build robust, there is still potential in designing buildings with demolition in mind, so that as little waste as possible has to be incinerated and most materials can be given a new life elsewhere,' Rigmor Hansen says.

Holmen Swimming Pool. Photo: Geir Anders Rybakken Ørslien

Brynseng School.
Photo: Undervisningsbygg Oslo KF

**– In Norway's transition into a low-emission society, Future Built is important for contributing to the materialisation of ideal projects. Projects that utilise innovative energy and climate technology, where transport, buildings, and infrastructure are connected, are crucial for success in this transition.**

Nils Kristian Nakstad, CEO Enova SF

Marienlyst School. Photo: Flashpoint Studio

# On route to zero emissions

There is no hiding the fact that greenhouse gas emissions relating to construction are significant, but so is the industry’s innovation over the past decades. Could the paradoxical notion of building our way out of the climate crisis hold any sway?

Text: Kristin Rodland Buick/Felix Media

Marienlyst School. Photo: Espen Gees

Global greenhouse gas emissions reached an all time high last year, and the idea of decarbonising to net-zero emissions by 2050 or even earlier, seems unachievable. However, if we look at the development of innovation in the construction industry over the past decades, there may be cause for optimism. We have come a long way since the German physicist Dr Feist defied the perception that European houses needed fuel to be warm and built the world's first passive house in Darmstadt in 1991. In 2019, plans for entire zero emission neighbourhoods are on the drawing board. What are the secrets behind this adventurous evolution?

**Spotting opportunities**
As technical manager at Drammen Eiendom, the construction corporation for the Municipality of Drammen, Geir Andersen had long been working on technical, demand-driven solutions for ventilation and heat in buildings. When presented with the architectural drawing for a particularly square looking school in 2008, he got an idea:

**As long as we could ensure there was no heat loss, we essentially had a passive house.**

'I knew that a quadratic shape minimises the surface area in relation to the volume of the building, and that prevents heat loss. So, I thought, here we have the perfect opportunity to build Norway's most energy efficient school.'

He contacted FutureBuilt, who named it a passive house. While some claim that the Norwegian polar explorer Fridtjof Nansen's boat "Fram" is the world's first passive house construction, the first building in Norway to meet passive house standards of significantly reduced energy demand, was built in 2007. It was a residential home, produced and shipped from Germany.



Working closely with experts in SINTEF, Norway's largest research institution, on building a passive house school, Andersen found that technically he was already halfway there.

'We had many of the technical solutions for moving heat and air round the building already, so it was relatively uncomplicated. We added 10 centimetres more insulation than building regulations depict and added triple glazed windows, which had just come on the market. As long as we could ensure there was no heat loss, we essentially had a passive house,' says Andersen.

**Determination and learning**
Even though the specifications met passive house standards, it took a while before the technical facilities in Marienlyst School were functioning optimally.

'The technical knowledge was limited and we worked hard to get the electrical system to operate the way we wanted it to,' he says.

The building has water-borne heating, and an exceptional heat recovery system with an efficiency of 86 percent. The cooling requirements of the building are reduced by, among other things, a relatively low window area, good external solar shading factor through automatic blinds, and a higher solar shading factor in the roof windows than normal. This removed the need for fans and any excess energy was passed on to an outdoor swimming pool close by.

'It upsets me when people are so scared of the technical bit that they shy away from it. It is necessary in order to achieve the environmental benefits we seek, but there is a need for more knowledge and expertise during construction and in the operational phase,' Andersen says, who has never stopped pushing the envelope.

Currently he is working on what may be the world's largest thermos flask. At Fjell, Drammen Eiendom is drilling a hundred wells, 50 metres deep in the rock, which together will work as a gigantic battery. Energy from the sun charges the battery in the summer in order to heat buildings throughout the winter. But this is jumping the gun, we will get back to geothermal wells later.

**Dissemination**
Marienlyst School was finished in 2010 and is one of the early projects of FutureBuilt's portfolio.

'Marienlyst seemed to trigger a passive house enthusiasm in Norway. It may be due to FutureBuilt's remarkable ability to inspire and share knowledge. We had so many visits from people aspiring to do similar builds,' says Andersen.

**The technical knowledge was limited and we worked hard to get the electrical system to operate the way we wanted it to.**

In 2011, FutureBuilt contributed to the first Norwegian standard for passive houses, closely followed by a standard for low-energy buildings. The natural next step was the development of plus houses. With a combination of passive house building techniques and energy production from photovoltaic panels or ground source heat combined with a heat pump, plus houses are self sufficient on renewable energy.

'FutureBuilt has played a significant role in the development of climate-friendly construction over the past ten years,' says Hanna E. Marcussen, the vice mayor for urban development in Oslo from the Green Party.

**Political will**
'Their contribution to capacity building within both the construction industry and local and national governance has been crucial at a

Ulshoftveien 31. Photo: Tove Lauluten

time when there has been a great need for someone be the forerunner and show the way. FutureBuilt has shown us that it is actually possible to bring about major change in the construction industry, paving the way for policy makers to set stricter requirements,' she continues.

Marcussen fills one of two Green Party seats in the Oslo City Council, in a coalition with Labour as of 2017. One of many green ambitions for the current city council is to build all new municipal buildings as plus houses.

'It is a great political ambition, but no one knows exactly how to fulfil it yet, it has been a learning process from project to project. There is a significant need for capacity building when it comes to building new plus houses and the renovation of existing buildings in Oslo,' says Stein Stoknes, programme director at FutureBuilt.

**Demands and incentives**
Inger Andresen, professor of Integrated Energy Design at the Norwegian University of Science and Technology (NTNU), attributes the innovation and developments in the Norwegian construction industry largely to years with a proactive national government.

'The Norwegian government has been very clear, signaling their intentions that building regulations are to get stricter with regards to energy use and environmental specifications. The industry has been prepared for this and some private companies see opportunities to develop further, knowing that they've got backing from the government,' says Andresen.

Governmental funding has also been crucial to the development.

'The public support programmes, for example the Enova passive house program, has been great – easy and predictable. Scientific research programmes have also been decently funded,' she says.

Now, Andresen worries that this upward trajectory is plateauing.

'It may be a natural ebbe and flow in the progress, but I perceive the government to be less proactive now, and I feel impatient. Organisations like FutureBuilt are taking over the role of driving the change.'

**Seeing the bigger picture**
Inger Andresen is currently teaching at the Sustainable Architecture Program at NTNU and is deeply involved in the research centre on Zero Emission Neighbourhoods in Smart Cities. She explains that there is not one big technology or invention that is changing the game, but several solutions working alongside one another. Now is when it is all coming together:

All buildings are designed to a passive house standard, reducing the overall need for energy. During the construction phase building sites are moving towards zero emission, using renewable energy to power machinery. Furthermore, the embodied energy is reduced with the use of new, low carbon building materials. There are various solutions for energy supply, like harnessing solar power, ground source heat and drilling geothermal wells. Digitalisation of buildings aid the control of energy use and tailor it to specific demands. Surplus energy is diverted outside of the building to power other functions, like electric vehicles. The whole area is designed to facilitate the emission free movement of people.

'We are taking every possible measure to lower the energy use within an area to as close to zero as possible. There will always be some consumption leaving a carbon footprint, and for that we compensate with renewable energy produced locally,' Andresen says.

**New old neighbourhood**
While no one has yet successfully created a zero emission neighbourhood, ambitious plans are being developed as part of the development of Furuset, an Oslo suburb built in the 70's and home to 9,500 residents.

'From a scientific research point of view, the micro energy network is maybe the most interesting. We're exploring opportunities to do seasonal heat storage. Excess heat produced in the summer, and stored underground, could be redistributed in the winter using heat pump technology. The heat will be distributed through existing heating systems. The challenge is to retrofit this new technology in the existing heating system. Once we've cracked that code, then we have come a long way,' she says.

**During the construction phase building sites are moving towards zero emission, using renewable energy to power machinery.**

As well as the micro energy network, the improvement of Furuset includes the construction of zero and almost zero emission buildings, first homes in particular, investment in social infrastructure and a green mobility centre at the heart of Furuset, Trygve Lie's plass. It is suitably named after the first Secretary General of the UN, who grew up in the area. The new square is in turn ambitiously attempting to fulfil the UN sustainable development goals on its first steps to becoming, maybe, the world's first zero emission neighbourhood.

'There are reasons to be cautiously positive, but time is running out. People and industries are changing their ways, but we need the full backing of government if we are to harness this momentum,' says Inger Andresen.

Drammen. Photo: Thomas  Bjørnflaten

**– To succeed in the green transition, we must strive for a low carbon society with climate-friendly solutions. The pilot projects of FutureBuilt is an arena for creativity, cooperation and learning where future solutions to climate-friendly cities, dwellings and workplaces are being developed.**

Monica Mæland, Minister of Local Government and Modernisation

# Green movement

Kistefossdammen Kindergarten. Photo: Tove Lauluten

Cars have reigned at the top of the transport pyramid for more than 50 years. For legs and bikes to re-summit, the old carrot and stick approach is what seems to be needed.

Text: Kristin Rodland Buick/Felix Media



It is 06.55 in the morning and pitch dark. The outside thermometer shows 20 degrees Celsius below zero. Merete Kolberg Tennfjord (37) turns on the headlight and rolls the bike out onto the snowy pavement. The cold bites her face, but two kids aged 3 and 5 are well protected in layers of wool under a cover in the bike trolley.

'We've only had a few exceptionally cold spells this winter, and cycling in cold, dry snow is ok. The challenges are when heavy snow falls in the night and the roads aren't cleared by the morning, or when it's melting and all is slushy and slippery. Those mornings that we can't cycle, we try to go by skis or sledge. The kids seem to like all modes of transport,' she says.

Last year, Merete and her husband Tor-Erik Tennfjord (38) joined a green transport programme when their children started in Kistefossdammen Kindergarten in Asker, south of Oslo. At the time of talking to FutureBuilt, they are well into their second year of cycling to and from the kindergarten.

'Neither of us had done any winter cycling before, but the offer from the kindergarten was the perfect incentive for us to give it a go. It has been much easier than we thought,' says Tor-Erik Tennfjord.

**New habit**

Kistefossdammen is a FutureBuilt project aiming to reduce greenhouse gas emissions by 50 percent compared to a standard Norwegian building of similar size, location and function. In order to reduce transport related emissions from users of the kindergarten, Asker Municipality invited employees and parents to develop a pilot. The results include extended opening hours with a 7 o'clock start, and parents who agree to leave the car at home are rewarded with subsidies to buy electric bikes, winter bike tyres with spikes, bike trolleys or season cards for public transport.

'Merete was more enthusiastic than me at first, I was a bit sceptical. But the early opening hours made the logistics of cycling the kids to kindergarten before work possible and the support to buy an electric bike helped our decision. Now I cycle back and forth to work almost every day,' Tennfjord says.

The family live only one kilometre from the kindergarten, and Merete and Tor-Erik do an equal share of delivery and pick-up. Tor-Erik Tennfjord then continues his journey to work on his electric bike. The round trip between home, kindergarten and work is 24 kilometres long, and a year and a half into the project the counter on the bike has just passed the 3,000k mark.

'The project has made us think differently about transport. We now use the bike for most small errands all year round where we would have taken the car before,' Merete Tennfjord says.

**Impractical parking**

According to national surveys on transport habits in Norway, 18 percent of all single journeys are those made back and forth to work. Out of these, as much as 61 percent are done by car, making emissions from daily travels not an insignificant amount. Transport to and from Kistefossdammen Kindergarten is now predominantly green. It has taken both incentives and deterrents. In all the entries to the architectural competition for the kindergarten, the parking spaces were located by the entrance.

'We suggested moving the carpark further away and give the entrance a different focus. We gained a better outside area and space for parking bikes instead,' says Ulla Hahn, architect and project manager at FutureBuilt.

The Municipality of Asker agreed to move the car parking a few minutes´ walk from the kindergarten entrance, making it quicker to arrive by bike for many parents.

'This is a prime example of what happens when we change old thought patterns,' says Hahn.

Asker Municipality has done similar practical motoring restrictions, like only providing 26 parking spaces, including disabled spaces, outside the new Holmen Swimming Pool which has a capacity of 400 simultaneous visitors.

‘Restricting cars is politically demanding, but often one of the most effective measures we’ve got,’ says Ragnar Sand Fuglum, director of Culture and Technology at Asker Municipality.

Asker has incorporated a set of the UN Sustainable Development Goals in their operational plans.

‘The opportunity to drive a fossil fueled car is a scarce resource that has to be shared. If we are to meet the ambitious targets in our energy and climate strategy, driving a car can’t be a free-for-all,’ says Fuglum. He emphasises that green innovation and change, to a large extent, is raising awareness and shifting mentality.

‘Our experience is that the idea of not using the car is often worse for people than the reality. Our role is to find solutions that make it easy and appealing to lead climate-friendly lives,’ Ragnar Sand Fuglum says.

## Restricting cars is politically demanding, but often one of the most effective measures we’ve got.

**Reversing the hierarchy**
Swedish research shows that in an area which is consciously or unconsciously planned for the use of cars, 80 percent of all journeys are assumed to be made by car. Conversely, planning with the goal of increasing the attractiveness of sustainable travel will result in a significantly lower car usage. Building urban areas with a so-called shared functionality can alone lead to a reduction of up to 15 percent of car journeys.

Population size and density are significant factors influencing how people choose to move from A to B. High density often means shorter distances to daily tasks, and several journeys can be carried out by foot. Additionally, the catchment area for public transport is more concentrated. Furthermore, good facilities for bikes will inspire cycling.

FutureBuilt is calling for a reversed traffic hierarchy, where pedestrians top the pyramid followed by bicycles, then public transport, with cars at the bottom.

‘This new hierarchy will influence the designing and dimensioning of properties, streets and city centres to increase the attractiveness of walking, cycling, public transport and car sharing. It is therefore important that measures are carried out at all levels,’ says project manager at FutureBuilt Ulla Hahn.

**Green influencers**
FutureBuilt puts transport on the agenda by organising seminars, workshops and competitions. They also organise study trips to other progressive places that have adopted a more holistic approach to mobility. Transport has been a strong focus over the last ten years.



Photo: Private

‘Mobility is a very important factor when reducing the overall carbon footprint, but there is varied understanding for this aspect. It was initially met with resistance, but we notice a change now, there has been a learning process. We see different parking norms at the municipal level and that is encouraging,’ says Hahn.

She highlights the normative effect of zero emission travel.

‘The fact that your neighbour chooses green transport alternatives will influence you. Cycling for example, can’t only be for specially interested people. It must be facilitated and safe for everyone.’


Trans’matorn bicycle park, Asker. Photo: Sverre Chr. Jarild

**Taking over the spaces**
A green transport project for people of all interests and abilities is exactly what is paving new ground at Sofienberggata 7 in Oslo. Situated in the gentrified inner-city district of Grünerløkka, a block of sheltered housing is benefitting from a green renovation, a FutureBuilt plus house project. Currently, the ground floor cellar serves as a car park, where many of the parking spaces are rented out. As part of the renovation project, the municipal housing corporation in Oslo, Boligbygg, is repurposing half of the parking lot into a green mobility center.

‘We are seeing a shift towards the removal of cars. When you live right in the centre of Oslo, people are less dependent on them,’ says Silje Ballo Lassesen, project manager in Oslo Boligbygg KF.

# Using bikes for urban development

Cycling is smart. It is good for you, your wallet, society, the environment and the climate. Cycling is cool, and it makes you happy. The bike is cheap, fast, flexible and comfortable. The bike can give the city back to us – but only if we have the ambition.

Today cycling is having a renaissance in European cities. In contrast to how it used to be, pedestrians and cyclists are now prioritised ahead of private cars and public transport. Streets, urban spaces and transport systems are being reorganised to accommodate non-motorists. This leads to thriving, sustainable cities – economically, socially and ecologically.

FutureBuilt is therefore working actively to promote the role of cycling in urban development. All pilot projects must facilitate cycling, and we have written the guide *Sykkelvennlige bygg* (Bike-friendly buildings) to spell out what this means in actual practice.

In 2013 FutureBuilt invited its partners to take part in the 'Get a Bike. Break Free!' idea competition for designers, architects, planners and bike enthusiasts. The aim of the competition was to brainstorm solutions that might turn the Oslo metropolitan area into the top region in Europe for biking as a means of transport. Concrete results included bike hotels at stations and bike playgrounds for kids. A couple of the proposals also demonstrated how a car-free city centre in Oslo might look, and perhaps it was these proposals that inspired Oslo's city government to launch the car-free urban life project that is now being realised in central Oslo?



Oslo Solar was the winning entry in Entra's architectural design competition for Lilletorget 1 in central Oslo. A large commercial building has been designed with good bike facilities and without any parking spots for cars. The project is still on the drawing board. Architect: Code: arkitektur as.

Many of the entries in the competition ´Get a bike. Break free!` suggested secure, weatherproof bike parking at public transport hubs. Bike hotels have subsequently been built at several of the train stations in the region. The bike hotel at Gulskogen Station was built by Drammen municipality in partnership with the Buskerudbyen project and the Norwegian National Rail Administration. Architect: MMW Arkitekter.
Photo: Tove Lauluten

One of the entries in the design competition ‘Get a bike. Break free!’, submitted by the architect Jens Jensen and his eight-year-old son Nilas, suggested bike playgrounds. The City of Oslo has built two mobile facilities that can be borrowed free of charge and easily transported between various places such as schools, kindergartens, events, etc. Photo: Tove Lauluten

Kringsjå Student Village. Photo: Tove Lauluten

# Isn’t it good, Norwegian wood

With its eleven storeys, the student housing block at Kringsjå that was finished in spring 2018 was Oslo’s tallest building made of cross-laminated timber. Now the Student Welfare Organisation (SiO) will be testing additional climate-friendly solutions in family housing units that are set to be completed in 2020.

**Text: Knut Werner Lindeberg Alsén**

With FutureBuilt joining the team, the expansion of Kringsjå Student Village in northern Oslo has become an exciting pilot project in the capital's housing sector, featuring ambitious environmental goals and quality housing for students.

The two nine- and eleven-storey buildings, providing a total of 350 housing units, have been constructed in cross-laminated timber, with a goal of a near-zero energy level. The buildings are part of a housing concept where the intention is to link the city to the nearby recreational areas offered by the vast Nordmarka woodland. The development of the area will include greenspaces and up to 1,500 new housing units for students.

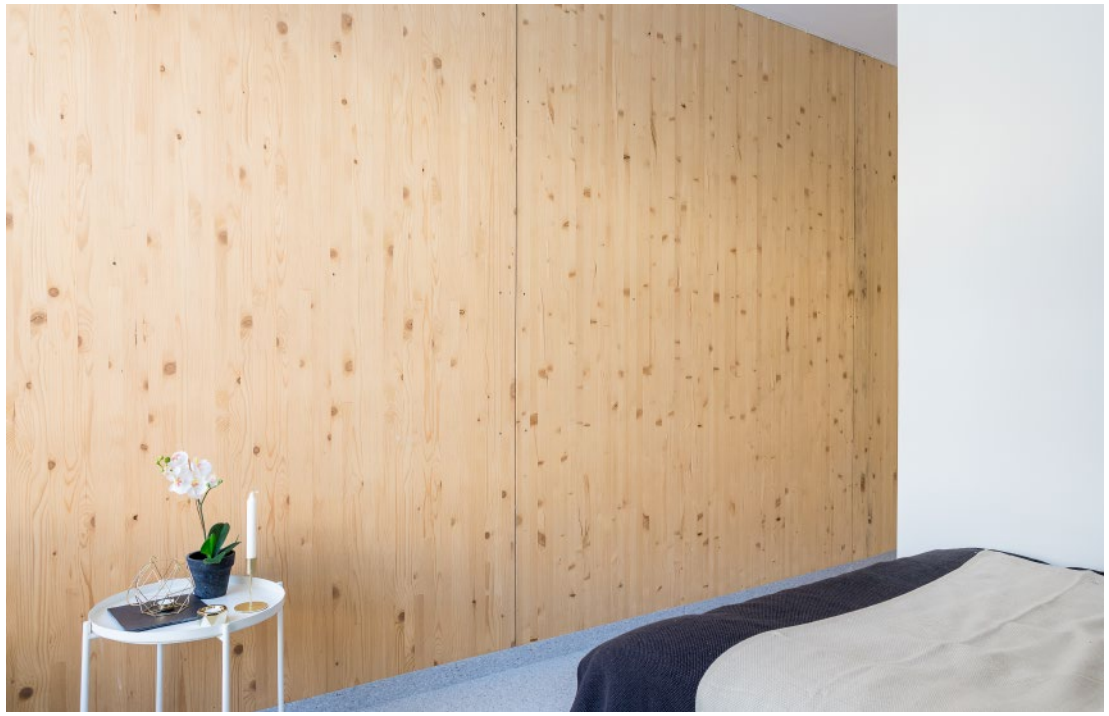
According to Helge Christian Haugen, SiO's estate director, the development's concept is based on the intention 'We'll meet outside', which entails good housing quality in urban surroundings that facilitate the active use of the outdoor spaces and the forest.

The 'new' Kringsjå Student Village will be both green and social. The roughly 3,000 students who live there can frequent the Union864 café, work out at SiO Athletica's training centre, and enjoy the brand-new outdoor areas with orchards, training facilities, an obstacle course, plant crates and other amenities. Thanks to the Wi-Fi and seating, students can even study outdoors in the fresh air. The student village will also feature a multi-use games area, jogging path and slackline, in addition to hammocks and pleasant seating areas that facilitate grilling.

'The purpose is to allow for a gradual transition between the urban spaces and the qualities of nature,' Haugen explains. 'We want to give the Kringsjå students as well as passers-by this combination of experiences.'

The estate director underlines that the expansion, like all other property development SiO engages in, primarily shall take into consideration what is important for the students: a good housing quality and worthwhile experiences, all at a student-friendly price.

'In order to fulfil these objectives, it became natural to use wood and modern construction methods during the initial phase,' Haugen adds. 'Wood is well-suited to the city of Oslo, and the material chimes well with our environmental ambitions.'



Kringsjå Student Village. Photo: Tove Lauluten



**Add-on effects**
Haugen is looking forward to seeing which add-on effects the use of wood will entail for SiO's further student housing development and for the rest of the construction sector in the Oslo region. For SiO, this is part of the work on continuously developing new buildings and managing the 360,000 m² of total building mass in their portfolio.

**We chose cross-laminated timber because it provides for a good residential environment, reliability and low energy costs.**

SiO is now planning 82 new family housing units. The project consists of three standalone three- or four-storey buildings, located in such a way as to preserve the student village's green identity.

'We're continuing to work on implementing eco-friendly measures,' Haugen adds. 'And we're proud that the family units meet FutureBuilt's requirements for being a pilot project. Cross-laminated timber, solar panels and local geothermal heating are features we have had very good experience with at Kringsjå.' SiO plans to drill 16 geothermal wells that are to supply the students with local geothermal heating. The production of heating and electricity will exceed the needs of the three buildings, and the surplus will be exported and distributed among the other buildings in the student village.

**Excitement over SiO taking the lead**
Hanna E. Marcussen, the vice-mayor for urban development in Oslo, thinks it is exciting that the students are willing to take the lead in developing high-rise buildings of cross-laminated timber. The students will both be driving forces in showing what is possible to do for one's own use, and showing how the experiences can be used in the further development of the city at large.

Oslo does not have all that many large-scale wooden buildings,' she notes. 'So I think it's great that SiO is willing to be at the forefront with its own buildings.'

The vice-mayor believes that building at the scale SiO is now doing is in itself enough to influence the sector. She hopes this will create certain add-on effects.

'I hope the experience that SiO is gaining with this pilot project can become a breakthrough for this type of building in Oslo. I also hope that other real-estate developers are willing to think in the same way and experiment with the use of wood, in both private and public commissions. Especially in Oslo, where our climate ambitions are so high, it is important to focus intently on the choice of construction material – and wood has a clear advantage there.'

Marcussen lauds the expansion of Kringsjå for being exciting also in regard to urban development. She emphasises that many of the students, after having lived in these buildings, will be able to endorse and promote such buildings in the future.

'It's wonderful if the project inspires people,' Haugen comments. 'We chose cross-laminated timber because it provides for a good residential environment, reliability and low energy costs. These are factors that are important for the students and for SiO, which will be owning the building for the foreseeable future.'

**Better indoor environment**
SiO believes the residents of the new buildings will enjoy a good indoor environment. One reason is that exposed cross-laminated timber elements will be part of the interior and help regulate both humidity and temperature.

'SiO strongly wants to be environmentally aware when developing its housing,' Haugen says. 'This is why we use prefabricated elements of cross-laminated timber, because this has proven to give a low carbon footprint.'

The estate director adds that the construction method using cross-laminated timber also reduces construction noise, something that benefits the students already living at the student village today.

**Bicycle facilitation**
SiO is also reducing the number of parking spots in favour of bicycle and public transport. According to Haugen, this move was motivated by a desire to raise the quality of the housing. Most students do not own a car and use public transport instead.

'Parking spots will be replaced by high-quality bike stations, and this has made it possible to build more housing units in the same area,' explains Programme Director Stein Stoknes at FutureBuilt.

'The city dwellers of tomorrow don't own their own cars. This applies in particular to young people, who are more likely to share cars. By replacing parking spots with housing, both the developers and the residents save money, and the city becomes a better place to live.'

**FutureBuilt provides recognition**
According to the estate director, the partnership with FutureBuilt has enabled SiO to fulfil their environmental ambitions for Kringsjå.

'Because of the collaboration, we have managed to increase our environmental focus on SiO's buildings in general,' Haugen says. 'Together, we have helped reduce car traffic to the various student villages and student houses and placed a greater emphasis on eco-friendly mobility. This collaboration has also made it easier to communicate with the authorities.'

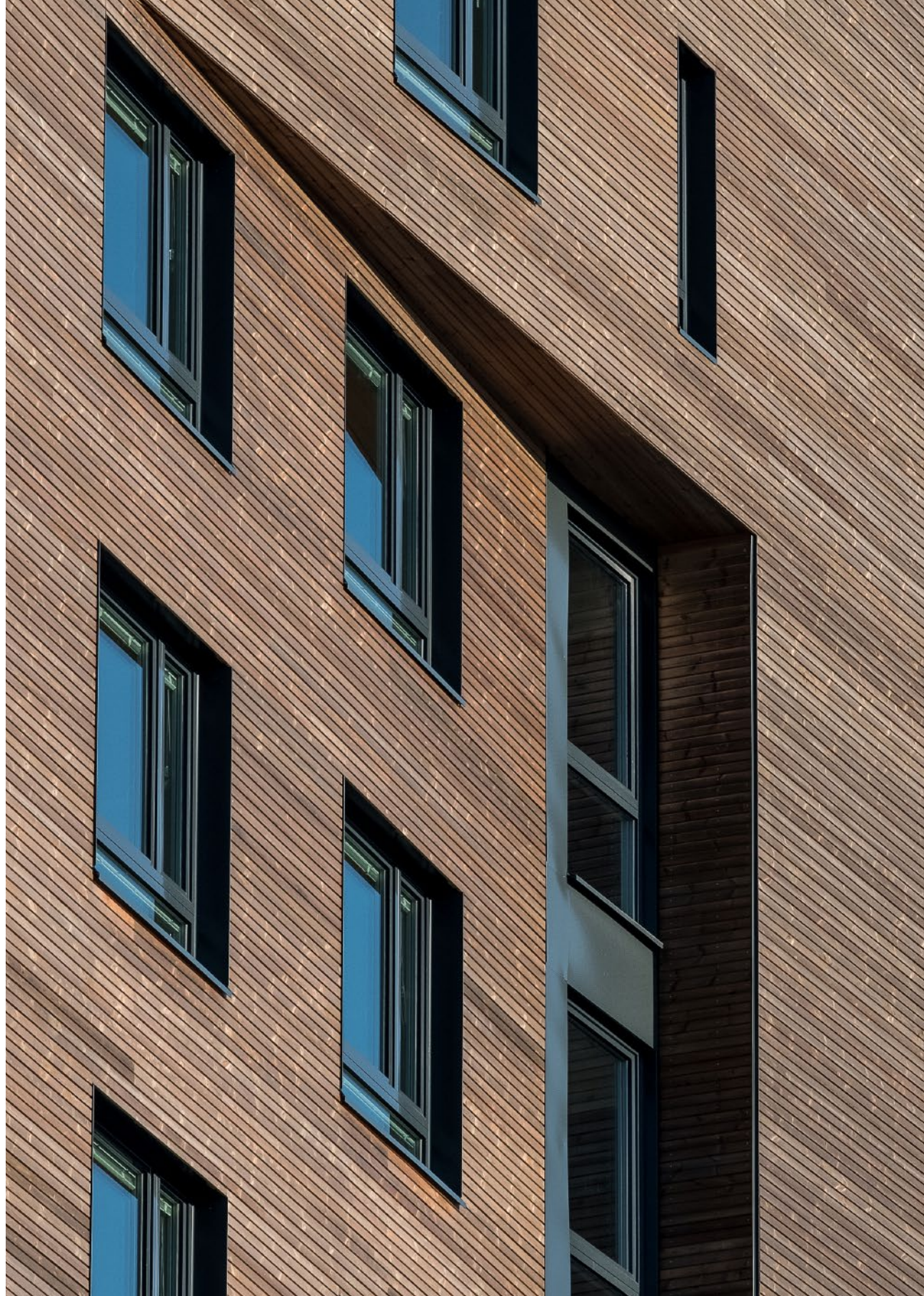
**Helping develop the commercial sector**
'Student housing and schools are being built in timber all over Norway,' Stoknes says. 'The Kringsjå project helps SiO clear the path for using wood in urban architecture, also in the capital.'

SiO is following what is currently the trend throughout Norway. Ever since SiO built its student housing blocks in Ås in cross-laminated timber in 2013, there has been a nationwide construction boom that has had a major effect on both the education and construction sectors in Norway. In total, over 4,000 housing units have been built for Norwegian students.

According to Krister Moen, senior advisor at Innovation Norway, the know-how from the student housing projects can advantageously be transferred to other apartment blocks, and it has proved instrumental in making the transition to building urban architecture in wood. SiO and the other student welfare organisations enjoy a unique position among Norwegian real-estate developers and have proved indispensable in this development.

**Student housing has been a useful arena for manufacturers and contractors to test out the possibilities of multi-storey wooden architecture.**

'Student housing has been a useful arena for manufacturers and contractors to test out the possibilities of multi-storey wooden architecture,' Stoknes concludes. 'The solutions that have been developed now are so good that it is possible to make the leap over to the regular housing market, which is more demanding. Without innovative student housing projects, this probably wouldn't have been possible.'



Kringsjå Student Village. Photo: Tove Lauluten

Ulsholtveien 31.
Photo: Geir Anders Rybakken Ørslien

**– We are proud to be a partner from the start of this innovative, long-term programme of sustainable, high-quality building.**

Osmund Kaldheim, Managing Director of the Norwegian State Housing Bank

# If mayors ruled the world

Four municipalities participate in FutureBuilt, and we have asked three mayors and a vice mayor two key questions:

1. How can cities take the lead in the transition to a low-emission society?
2. What is the most important issue for you as a mayor?

Photo: CF Wesenberg, kolonihaven

**Hanna E. Marcussen**
Vice mayor for urban development, City of Oslo

**1.**
Cities have an important role to play in the transition to a low-emission society, and there is a huge potential in urban development. It is vital that zoning and transport are planned in a coordinated manner so that we ensure green mobility, greenspaces in the city, and safe local communities where it is natural to share resources and help one another.

Those of us at the municipal level must lead the way, and in Oslo we do this through for example the work on the climate budget. It is also important that we are smarter in regard to sharing municipal infrastructure, and in facilitating greenspaces, parks and the reopening of creeks and rivulets – to name but a few measures. And pilot projects such as FutureBuilt are also key, since they show that another kind of urban development is possible.

**2.**
Greenhouse gas emissions must be lowered, and it is in the world's cities that the sustainable future must be realised. Oslo shall take the lead and show that it is possible to become a zero-emission city while simultaneously creating a pleasant city for everyone.

**Lisbeth Hammer Krog**
Mayor, Bærum municipality

**1.**
Through knowledge, awareness and action, Bærum shall be a climate-smart municipality in 2020. Pilot and demo projects shall show that Bærum is moving in the right direction. Bærum shall be a low-emission society in 2050. In 2030 our emissions shall be reduced by 40 percent, and in 2027 the Fornebu peninsula shall be a zero-emission area.

Bærum municipality's vision is 'Together We Create the Future'. Through involvement, pilot projects and information, we shall increase the populace's awareness of what helps reduce greenhouse gas emissions. We will facilitate a collaboration on developing new solutions, engage people and showcase concrete forms of action.

**2.**
In order to reach our climate goals, it is necessary to mobilise all of society in Bærum. In addition, the municipality shall set our own house by reducing our emissions as well as facilitating for inhabitants, businesses and research institutions to contribute to reduce emissions, for example through the SmartCity Bærum intiative.

**Lene Conradi**
Mayor, Asker municipality

**1.**
Asker has recently adopted a new plan for climate, energy and environment. We have also signed the European Commission's Covenant of Mayors for climate and energy. By setting up guidelines for energy-efficient buildings, improved public transport, good cycling infrastructure and car sharing, we help our inhabitants to reduce their carbon footprint. In order to implement climate solutions that truly have an effect, we must get the populace and the business sector on board and bring about a common understanding of the significance of a low-emission society. Within 2025, Asker municipality's construction sites shall be fossil-free and all new municipal buildings shall be zero-emission buildings. Our partnership with FutureBuilt helps us achieve these goals.

**2.**
From 2020, Asker municipality shall base its policies on the UN's Sustainable Development Goals. This gives us the opportunity to rethink how we want society to be, and this will be integrated in our new municipal plan. We see that these goals inspire our inhabitants, especially young people, businesses and voluntary groups.

Photo: Drammen municipality

**Tore Opdal Hansen**
Mayor, Drammen municipality

**1.**
Cities bear a particular responsibility for making the transition to a low-emission society. In Drammen, we have had a long-term focus on climate and the environment. This has for example manifested itself in sustainable energy solutions in special-purpose municipal buildings, collaborations on new regional traffic solutions, collaboration on new solutions for value creation, and the reuse of resources in waste.

By participating in FutureBuilt, Drammen municipality is carrying out projects with high environmental ambitions. Good examples include the ongoing study of how the existing hospital area in Drammen can be developed into an exemplary model for a low-emission society; Marienlyst School, Norway's first passive house school; and Frydenhaug School, which is a near-zero energy building.

**2.**
Find new and climate-friendly traffic solutions based on public transport, cycling and walking – as adapted in order to meet the expected and desired growth in the region's population and jobs.

Fredrik Selmers vei 4. Photo: Tove Laulute

# Energetic shapes

New forms are emerging as architects are guided by carbon saving principles; the production and conservation of energy.

**Text: Kristin Rodland Buick/Felix Media**

**FutureBuilt**

Powerhouse Kjørbo. Photo: Tove Lauluten

When the American architect Louis Sullivan, known as the ‘father of modernism’, coined the maxim “form follows function” at the turn of the 20th century, it was a reactionary leap from the contemporary and lavish art nouveau style. Sullivan thought that the shape of a building or object should primarily relate to its intended function or purpose. He inspired functionalists to strip new buildings from any unnecessary decor of previous eras.

A hundred years later, functionalism is still prevalent, but is now being reinvented to fit a specific function – the reduction of carbon emissions. The internationally acclaimed Norwegian design practice Snøhetta, paraphrases Sullivan with their vision “form follows the environment” for one of their recent projects.

‘Environmental goals are crucial to anyone who wants to get noticed in the world of architecture these days,’ says Tine Hegli, senior architect at Snøhetta and professor at The Oslo School of Architecture and Design.

**Powerhouse**

Hegli was part of the team working on the projects Powerhouse Kjørbo and Powerhouse Brattørkaia. A powerhouse is a building that during its lifetime produces more renewable energy than it consumes. The embodied energy – being the energy used in demolition and construction and the production of materials – plus the operational energy demand, must in sum be less than the production of quality renewable energy on site.

## We have beautifully designed stairs functioning as ventilation shafts.

Powerhouse Kjørbo is an 80´s office building, situated in Sandvika, just south of Oslo. The old building was energy demanding and needed a complete overhaul. However, the local council required that the building retained its original appearance. The distinct black cubes in the well preserved and public park had to be continued.

The team of architects and engineers reduced the energy demand by 90 percent using passive house climate walls, ventilation and geothermal energy wells for heating and cooling.

‘First the façade, or so called “climate envelope” of the building, must be well insulated and airtight. We were then looking for a black and maintenance free cladding with low embodied energy to replace the existing panels, she says and continues:

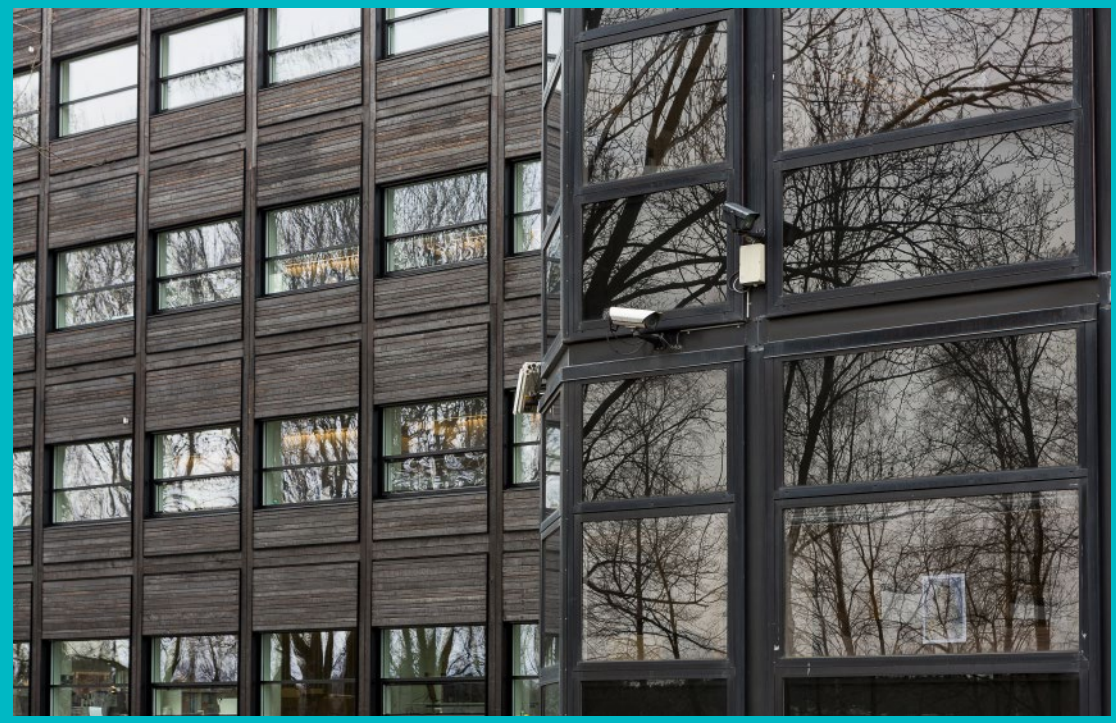
‘It is hard to make maintenance free cladding out of wood, but using the ancient Japanese technique of burning the wood surface, no bacteria will live in it and you have a maintenance free and unique looking façade.’

**Energy and materials**

The burnt aspen on this façade has less embodied energy than glass and metal. Glass panels from the original cladding, are reused as office partition walls inside. Exposed concrete absorbs and releases heat and helps stabilise the indoor climate. To reach a high efficiency for ventilation, heating and cooling, more than 40 percent of the ceiling area is exposed, resulting in a creative solution with acoustic baffles to control sound transmission. Exterior photovoltaic panels are mounted on the roofs and the electricity produced powers the technical systems of the building. Any surplus energy will be fed into the local grid, off-setting the total amount of emissions that the building is responsible for over its lifetime. The primary energy calculation over the 60 year life span of the building results in a surplus of about 200 kWh pr. m² heated area.

The old staircase is used as combined ventilation shafts and stairs. An open flight of circular stairs was introduced both to better communication between workers on the different floors, and to support the air flow throughout the building by letting the heated air rise naturally to the top and lead into a heat exchanger.

‘We have beautifully designed stairs functioning as ventilation shafts, but it means that you have to let the engineer join in to



Powerhouse Kjørbo. Photo: Tove Lauluten

Kilden Kindergarten. Photo: Tove Lauluten

the design process. All we needed for the air to flow easily was a one metre glass railing,' Tine Hegli says, and attributes the success of Powerhouse Kjørbo to cooperation with larger interdisciplinary project teams from the outset.

Until recently, reducing the carbon footprint in the construction industry has mostly focused on energy efficiency in the operation of the building. Now, focusing more on the lifecycle perspectives, experts find that the total amount of emissions relating to the production, construction and waste issues of materials used are often larger than the emissions relating to energy use throughout the building's entire lifetime.

'We need to work closely with expertise within material research and producers to gain knowledge and make the choices that have real emission-reducing impact. Choosing the right materials is crucial and as architects we are perfectly placed to make conscious choices and stimulate the market to produce more climate friendly materials,' Hegli says.

**A mythical animal**
Architect Ingunn Sirevåg Jensen shares the focus on materials and the need for a better selection of materials with low embodied energy. She is one of the architects behind the plus house kindergarten Kilden in Oslo.

'Rather than the solar panels sitting proud of the roofline, we wanted them to be an integrated part of the building. The solar panels we found look like slate and give a seamless transition between the roof and the walls,' says Jensen.

On the walls traditional façade panels, with the same shape as the solar panels, are mounted at 45 degrees so that individual panels can easily be removed to fit windows and let in natural light.

'I like to think of the kindergarten as a mythical animal with scales as skin. The skeleton is the visible wooden frame inside. It is like a dragon crawling across the land and the children are playing inside and around it,' she smiles.

Jensen also emphasises the need for close cooperation with other experts.

'We need specific knowledge and the tools to try out different solutions and quantities. What are the most effective alternative materials? For each project we need to find out where the limitations are and what we have to play with.'

**Filled the gaps**
Where the façade of Kilden Kindergarten is likened to the scales of a dragon, the architect behind the renovation of the public office building in Fredrik Selmers vei 4 in Oslo, is appropriately talking about giving the building a new coat.



'We stripped the original cladding, leaving only the supporting structure and dressed the building in a new coat,' says architect Jan Knoop, of LPO Architects.

**When designing commercial buildings now, we find that the environmental requirements are important to the users and there aren't many added costs.**

Hours of discussions on cladding options led to the decision to use recycled aluminium.

'It was the material with the lowest carbon emissions. Old aluminium was melted and reshaped in Germany. However, the sheets had an unfortunate oxidisation, so we had them lacquered white in Norway,' Knoop recalls.

The ratio of façade to window area is a result of a thorough analysis of insulation and daylight versus solar energy penetration and lighting levels in the office spaces.

'We layered the aluminium sheets to seal the walls, this reduced heat loss and provided sun shade inside. Plain sheets overlayed with perforated sheets gave the façade an interesting pattern,' Knoop says and adds: 'But we made sure to not repeat the pattern, giving it an organic look.'

The perforated cladding is not the only measure making better use of resources in this project. By compressing the building and reducing the surface area of the original H-shaped building, the floor plan increased by 4,000 square metres.

'We filled in the gaps between five almost separate blocks, gaining more floor space and reducing the energy loss from the previously excessive outer surface area.'

The new offices in Fredrik Selmers vei 4 were completed in 2013, one of the first environmental renovations of its kind in Norway.

'At the time of starting this project in 2010, there was a lot of scepticism among the occupants and in the market generally. When designing commercial buildings now, we find that the environmental requirements are important to the users and there aren't many added costs as the market is adjusting.'

**No rules**
Programme director at FutureBuilt, Stein Stoknes, also recalls the resistance of some years ago.

'The environmental movement came from the hippie part of society and modern, urban people, architects in particular, thought it a little too hairy and unattractive. The investors and the construction industry also found it expensive and unsellable. This is not the case anymore. Architects came late, but now, they are key to driving the change. So are some brave FutureBuilt developers,' says Stoknes.

He emphasises that there are no rules or styles attached to environmental buildings. They can take any shape they need.

'Flagship environmental buildings are valuable as they are setting the agenda and paving the way for a new mindset. While the expression 'form follows environment' is fun and inspirational, it is not necessary. A building may be a plus house or zero carbon without looking like one.'

Tine Hegli, senior architect at Snøhetta, sees a future of opportunities:
'This is a standing invitation to us architects to think afresh in all aspects. To inspire the teams we work with to aim high and put innovations on the map for each individual project.'

# From airport to zero-emission city

The real-estate developer OBOS is scaling up its ambitions and is set to build Norway's largest climate-neutral residential and urban area on the Fornebu peninsula just outside of Oslo. With tower blocks of cross-laminated timber, shared facilities, solar panels, e-bike rental and car free areas, OBOS is taking green development to the next level.



Ill.: Transborder Studio/Dyrvik Arkitekter/Tegmark

'Previously, environmental work was something idealists did,' notes the chief environmental officer at OBOS, Birgitte Molstad. 'But now, dealing with environmental issues is something that is a natural part of the job at any major company, and it has become standard practice to see such environmental work in a long-term, strategic perspective. There is an entirely different way of thinking today than for only 15 years ago.'

A new city is being built at the former airport area at Fornebu in Bærum. And this city is going to be climate-neutral. OBOS is a major landowner and is now making plans to build a green neighbourhood featuring up to 700 FutureBuilt housing units within plot 9.4 at Fornebu. The focus is on eco-friendly solutions that use extremely little energy and leave as small a climate footprint as possible, with a shared economy, green mobility, urban agriculture, home automation and communal solutions. The plans also include up to 1,500 square metres of retail and service space on the street level. The project area covers a total of 37,000 square metres.

**A showcase**

36 architect teams from five countries wanted to compete to design the new district, and four teams were short-listed during prequalification. Dyrvik Arkitekter and Transborder Studio won the final competition in partnership with SLA and Bollinger + Grohmann.

'This district shall become a showcase for forward-thinking urban development that focuses on transport, energy and material use,' says the chief executive of OBOS, Daniel Kjørberg Siraj. 'The winner had the best overall solution. Their plans have been thoroughly thought through in regard to architecture, comfort of living and the relationship to the surroundings. These solutions provide energy-efficient buildings and good residential environments.'

Ill.: Transborder Studio/Dyrvik Arkitekter/Tegmark

Both near-zero energy buildings and energy-plus houses will be built, and the buildings will in total use 2 million kWh less energy per year than ordinary housing units. The energy savings equal the ordinary consumption of over 200 households.

**Fantastic Fornebu**
In 2020, the FutureBuilt municipality of Bærum shall have established itself as an eco-friendly and climate-smart municipality. The goal is that Fornebu shall become a zero-emission area already by 2027.

Bærum's mayor Lisbeth Hammer Krog welcomes OBOS's environmental ambitions. 'I'm very pleased that OBOS, as a major and serious actor, is setting ambitious climate goals for its development of the Fornebu area,' she says. 'This is an important contribution to realising what we're calling Fantastic Fornebu. Our goal of a zero-emission area in 2027 is intended to establish Fornebu as a pilot area for forward-thinking and climate-friendly urban development,' she continues. 'In 2027, all building activity should entail a net balance in the greenhouse gas account, and perhaps even produce a net gain. We must also create communities that make it easier for the inhabitants to choose transport solutions and lifestyles that reduce their climate footprint. If we don't entirely achieve a net balance in the total greenhouse gas account by 2027, we shall at least have good examples that show that this is possible.'

'Bærum is a FutureBuilt municipality, and it is therefore especially pleasing that OBOS is joining the team,' Hammer Krog concludes. 'Together we shall build a fantastic, climate-neutral Fornebu.'

**Partnership with FutureBuilt**
OBOS plans to carry out the project in partnership with FutureBuilt, which never before has dealt with a residential area of such a magnitude. 200 of the housing units shall be pilot projects that must satisfy particularly stringent environmental requirements. According to FutureBuilt's programme director, Stein Stoknes, trying to include housing projects was initially a challenge.



'We have mostly dealt with commercial public buildings,' he explains. 'But now the green housing units are coming in earnest. This is partly because developers such as OBOS are taking social responsibility and combating climate change, and are now converting ambitious environmental strategies into concrete facts on the ground. But in part it is also because home buyers have woken up. Today, they demand low-energy, environmentally friendly homes that use healthy building materials and have shared amenities such as car and bike pools, social venues and communal areas both indoors and outdoors. FutureBuilt includes several small and medium sized housing projects, but OBOS's development of urban housing at Fornebu is so far the largest project we have been involved in, and among the most ambitious too.'

**Urban grid plan**
The winning entry proposes an urban grid plan along the circular Forneburingen road, with commercial shops on the street level. The architecture towards the Nansen Park will be a mix of city blocks and standalone high-rises. This will allow as many of the housing units as possible to have contact with the park, even as the transition between the park and the housing is made less rigid by the green spaces being allowed to seep into the built environment.

Progress on the project will depend on amongst other things the planning and zoning work, but OBOS aims to begin selling units in 2020.

**Manglerud as a trial run**
Before OBOS tackles the Fornebu project, however, the plan is to get some practice in the Manglerud district in eastern Oslo, where OBOS is to build a climate-friendly landmark building of cross-laminated timber. The project has been designed by the architects Helen & Hard, who won the commission in competition with two other architect firms.

'Oslo is set to grow by 200,000 housing units by 2050,' notes Kjørberg Siraj, the chief executive of OBOS. 'And during the same period, the city aims to become climate-neutral. The increased use of wood may become a necessity if Oslo is to succeed in reaching its ambitious goals. Wood is the most environmentally friendly construction material we have. OBOS wants to use the Manglerud project to test out such wood in order to compare the costs with other materials.'

Våronnveien 17 is a corner site between a housing cooperative's 19 blocks of in total 464 flats from 1960. Vacant since 2009, when the original building there burnt down, the site is only 300 metres from the local metro station and shopping centre.

**Home buyers have woken up. Today, they demand low-energy, environmentally friendly homes.**

Stein Stoknes at FutureBuilt is enthusiastic about this meticulously conceived project. 'The stair-shaped building will incorporate many exciting solutions, for example the way the residents' shared electric bikes and cars get their electricity from solar panels on the roof. The building will include green roof terraces where it will be possible to grow vegetables. You can repair your bike at the bike café. When you have visitors, they can overnight in a guest room the residents share. And the building shall use almost no electricity at all, since OBOS will be testing out FutureBuilt's near-zero energy definition.'

Since most of the flats are of a modest size, the complex includes large communal areas both indoors and outdoors. Such shared amenities will for example include a kitchen and dining room the residents can use for both festivities and meetings. The idea is that the residents shall together be able to set up the communal arrangements they want.
If everything goes according to plan, the building will be ready for a moving-in party in early 2020.

# Circular buildings – soon a reality?

Circular buildings and architecture are on everyone's lips. Now, the buzzword has become concrete by virtue of FutureBuilt establishing specific criteria for such buildings. And developers are currently busy testing out the concept – right in the heart of Oslo.



Circular design is all about reusing and redesigning buildings, components and materials in an innovative way. It is a matter of thinking in the long term and planning for future renovation and dismantling. It is a matter of digitising and gaining an overview of the materials that are available in our buildings and cities. And it is a matter of new business models and new types of ownership. It is all that and a good deal more.

But until now there has been a lot of talk and perhaps not so much action. In order to make progress in this area, FutureBuilt have therefore launched a definition of circular buildings that can be tested out in practice in the construction sector, and – not least – full-scale pilot projects shall now be carried out with support from the Norwegian Environment Agency. Asker municipality wants to convert an old barn into housing according to the circular philosophy, and the Entra real-estate company intends to revamp and build a new circular building at Kristian August gate 13 in Oslo, with MAD as the architects and Asplan Viak serving as the experts on reuse. And the time-honoured Agriculture Quarter in eastern Oslo shall be completely transformed with for example reused bricks.

FutureBuilt's criteria for circular buildings developed in collaboration with Asplan Viak and SINTEF, the criteria have been set up in order to provide the concept of circular buildings with specific content. The criteria have been divided into five focal points that reflect the principles of good material use in various stages of a building's life-cycle:

- environment-based decision to renovate or demolish
- reuse of materials from demolitions
- reuse of materials in general
- reusability
- adaptability

The criteria contain both qualitative and quantitative requirements to documentation

Landsbrukskvartalet. Ill.: Transborder Studio

Stein Stoknes, programme director at FutureBuilt, is pleased that these criteria have been established.

'These criteria are probably not perfect,' he admits. 'But they should be a good basis for getting started on the circular use and design of buildings. We aim to revise the criteria as we gain practical experience. Reuse, upcycling and design for reuse are the way to go if the construction sector is to keep up with the green transformation.'

**Circular pilot project**
Entra is a driving force behind environmental and climate innovation and have now included their project in Kristian Augusts gate 13 in the FutureBuilt pot as a pilot project for circular buildings. The project is amongst the first and most ambitious in Norway with regard to circular design and re-use of building materials.

Material use will be the most distinct aspect of the project. The aim is to retain as much as possible of the materials in the existing buildings and to extensively reuse building parts both in the existing buildings and in the new, smaller annex. The plans call for reusing hollow core slabs, steel, insulation and cladding materials in the 400 m² annex, as well as reusing technical installations and interior surfaces such as construction boards, carpets and flooring.

For Entra, it is important to challenge the construction sector on what it is possible to reuse, and to clarify which parts of the current legislation oppose reuse. The company also wants to inspire manufacturers and the various construction actors to rethink the processes of demolition and renovation. Inger Aas, project officer in Entra, explains.

Ill.: Transborder Studio AS



Ill.: MAD Arkitekter

'As a large real estate company in Norway we see it as a core responsibility to take care of the environment and to work for solutions that can prevent further climate changes. Taking climate action is also an important measure for Entra in supporting Norway's response to UN´s sustainable development goals. In Kristian Augusts gate 13 we want to prove that a redevelopment project based on re-used building materials actually can meet today's requirements for modern and attractive office space. Redevelopment projects are a significant environmental sinner as large quantities of building materials, floor coverings and lighting systems that could have been re-used are instead disposed for recycling, energy recovery or even worse for landfill.'

'We target to reduce our carbon footprint by at least 70 percent by 2030, and we have an ambition to drive the development of our industry through collaboration, innovation and sharing of knowledge. If we, together with the construction industry, find new ways of thinking about production lines we believe we will succeed in increasing the level of re-used building materials in the future,' Aas says.

**The Agriculture Quarter to be transformed**
The Agriculture Quarter (Landbrukskvartalet), situated right by the Oslo Central Station, is also on the verge of being transformed. Steeped in history, the quarter is to be renewed and infilled in order to satisfy future demands regarding urban space and multifunctionality and to become a thriving neighbourhood with new social arenas. The Agriculture Quarter is being developed in collaboration with the Norwegian Agrarian Association, Aspelin Ramm and Vedal Utvikling.

'The Agriculture Quarter will become a showcase for how the agricultural sector, as represented by the Norwegian Agrarian Association, can help bring about the green transformation,' says Marie Indrelid Winsvold, special advisor in circular economy at Vedal. 'In the quarter, the agricultural sector itself shall be the main supplier of innovative wood- and biobased materials and solutions.'

**It is important to challenge the construction sector on what it is possible to re-use.**

**From cradle to cradle**
The climate and environmental aspect will be essential when the Agriculture Quarter is to be revamped. And the principle underlying the transformation is that of the circular economy.

'Over the next forty years, the world will be constructing the same total building volume as throughout all of previous world history, so we can no longer afford to consume and destroy materials as before. Circular economy is based on the cradle-to-cradle principle. This thinking requires us to look at components and materials as high-quality resources that should remain in a single, closed loop and to eliminate both waste and the destruction of waste, so that everything can be reclaimed and reused,' Winswold explains. 'It is high time that the construction sector transitions from a linear to a circular philosophy and to healthy buildings.'

Bjørnsletta School.
Photo: Hundven-Clements Photography/L-2 Arkitekter

**– The future solutions for architecture and social development are created when great expectations meet experimentation and creativity. FutureBuilt shows that it is possible to reach new milestones when public and private developers and innovators set high sustainability goals together. FutureBuilt is a good arena for collaboration and experimentation, as well as a good platform for showcasing the best and most innovative solutions, so as to stimulate collective learning and experience.**

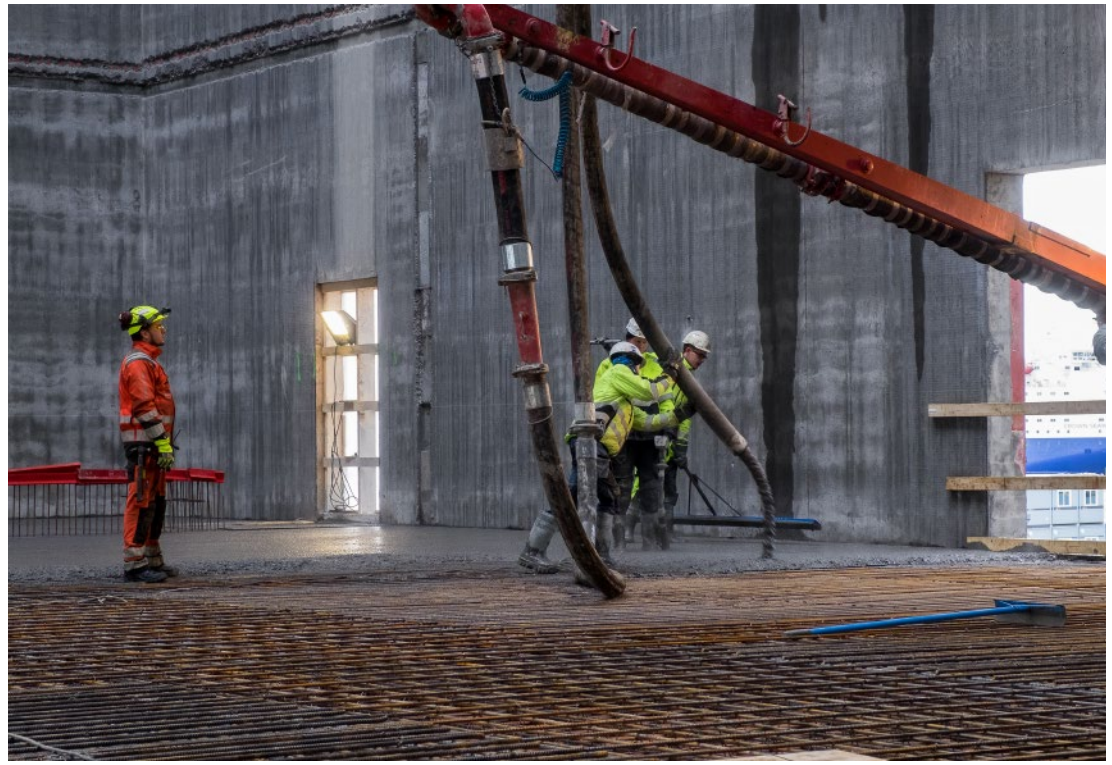
Gisle Løkken, president of the National Association of Norwegian Architects (NAL)

# Zero emission concrete?

New buildings are becoming ever more energy-efficient. Today, material usage represents the single largest source of greenhouse gas emissions. But this picture may quickly change if the vision of zero emission concrete becomes a reality. Exciting new developments are taking place in today’s concrete industry.

**Text: Knut Werner Lindeberg Alsén**





The new Munch Museum. Photo: Tove Lauluten

Worldwide, around six percent of human-caused greenhouse gas emissions stem from the production of concrete. That percentage is just as much as from the entire air transport industry. The primary raw material used to make concrete is cement, and this is where the problem lies. Roughly 90 percent of the emissions caused by conventional concrete stem from the production of cement, specifically from the crushing of limestone and from fuel used in the chemical process. Fortunately, however, remedies do exist.

**Pilot projects**

In a host of construction projects, FutureBuilt has actively promoted the testing out of low carbon concrete, a material that has a reduced carbon footprint because the binder, amongst other things, contains a lower percentage of cement clinker. Such low carbon concrete reduces emissions by up to 30 per cent as compared with standard concrete.

But the plans today are even more ambitious. This is because concrete products that lead to significantly lower emissions have become a possibility. Some of these products are available on the Norwegian market, but as yet they have not been used commercially in building constructions. Examples include slag concrete, which lowers emissions by approximately 75 percent compared with standard concrete. From a climate perspective, such concrete is far superior to Class A low carbon concrete, which is currently regarded as the sector’s best practice.

‘Yes, there is a possibility for what we may call “near-zero emission concrete”, and even a vision of zero emission concrete is possible,’ says Programme Director Stein Stoknes at FutureBuilt. ‘But refining and using these solutions depends on the production and demand sides cooperating well.’

‘This is why FutureBuilt has entered into a dialogue with the concrete industry, which has itself put the green turn on the agenda,’ he continues. ‘And we have also received funding from the Norwegian Environment Agency’s “Klimasats” scheme in order to carry out model projects that use low emission concrete.’ The real estate developer Avantor is already on board with Nydalen Vy, a new commercial

and residential complex in the Nydalen district in Oslo, while Statsbygg (the Norwegian Directorate of Public Construction and Property) and the Royal Palace shall test out innovative concrete solutions in the new logistics building at the Palace Park. Moreover, Undervisningsbygg (the Municipal Enterprise for Educational Buildings and Property in Oslo) and the University of Oslo shall test out near-zero emission concrete in the new school at Ruseløkka and in the new Climate House at the Botanical Garden in Tøyen.

'The goal is to mobilise leading, high-profile real estate developers to actively use their market power and demand the concrete solutions of the future,' Stoknes explains.

**Hybrid concrete in Nydalen**
The development of 'hybrid concrete' is a continuation of the industry's work on low carbon concrete, and the FutureBuilt project Nydalen Vy incorporates greenhouse gas ambitions that make it natural to use this concept. For this new 18-storey building with apartments, offices and shops, the contractor Skanska has studied the use of hybrid concrete, something that challenges the material and technical basis. This is due to the high content of fly ash, which complicates the technical aspects of production.

'Since the focus of standard concrete is primarily on durability, part of the Nydalen project is about demonstrating that the solutions we implemented when modifying the concrete's ingredients do not reduce the long life-cycles expected of standard concrete constructions,' explains Sverre Smeplass, chief adviser at Skanska and adjunct professor at NTNU in Trondheim.

'The challenge of using concrete with a high fly ash content is the long setting time, low heat of hydration and increased temperature sensitivity, something that is problematic for wintertime operations,' Smeplass says.

## Such an ambition requires something of a 'moon landing'.

The aim of this project is that the post-tensioned slabs shall be produced with concrete that contains 50 percent fly ash. This will reduce greenhouse gas emissions by 35 percent compared with low carbon concrete and by roughly 60 percent compared with the current industry standard.

Nydalen Vy. Ill.: Snøhetta/MIR

The additional costs of the hybrid concrete have been calculated to be an extra NOK 100 per cubic metre of conventional concrete.

Hybrid concrete is temperature sensitive, something that effects the progress of construction. In order to ensure an effective curing, warm concrete (22–24° C) from batching plants is used. All the exposed concrete surfaces must be covered, and the underlying storey must be warmed up with air heaters that use district heating or biodiesel.

'For the Nydalen Vy project we're also considering using concrete with a high slag content,' Smeplass says. 'This type of concrete may lead to extremely low greenhouse gas emissions, but its properties may be less well-suited to winter conditions than the hybrid concrete is.'

**Zero emission concrete?**
The ultimate ambition is of course zero emission concrete. But in addition to the fine-tuning of concrete formulas, such an ambition requires something of a 'moon landing'.

Vetle Houg, communication manager at HeidelbergCement, states that in line with the corporate vision of zero emissions of $CO_2$ by 2030, the company is striving to reduce the carbon footprint of its concrete products. HeidelbergCement's Norwegian operations include, amongst other things, the cement producer Norcem. According to Houg, the company has already made great strides in reducing its greenhouse gas emissions and is well under way in its further work on carbon-neutral concrete products, as gaged by a life-cycle assessment (LCA) of the product.

The final piece of the puzzle concerns effective carbon capture. In this area, Norcem hopes to be able to submit the necessary project documentation for receiving public funding for this project by August 2019. If the company succeeds with its efforts, the solution might be a vital contribution to the work on mitigating climate change and transforming the cement industry, both in Norway and the world at large.

## New Munch Museum

The new Munch Museum has been planned in accordance with FutureBuilt's criteria of at least a 50 percent cut in greenhouse gas emissions compared with today's standards. A greenhouse gas inventory has been developed that covers the areas of materials, transport and energy. In total, around 16,350 cubic metres of low energy concrete will be used, and 2,500 tonnes of recycled reinforcement steel has been used in the building envelope, including the foundation.

'In total, we are meeting the targets that were set for the building in regard to reducing $CO_2$ equivalents related to the concrete,' notes the project manager of the new Munch Museum, Jard Bringedal at ÅF Advansia. 'But we have faced a few challenges with the visible surfaces and have therefore been forced to try something new. When we mix fly ash into the concrete, so that it achieves a Class A grading, bubbles develop that mar the appearance of the visible parts of the building. We therefore reduced the fly ash content in these areas, which makes the solution less eco-friendly. But in order to achieve our overall target for reducing emissions, we have countered this by mixing in a bit more fly ash in other parts of the building. Ultimately, this helps us achieve the target.'

**Unexpected environmental boon**
Bringedal also recounts how ÅF Advansia was unexpectedly able to implement an eco-friendly solution during the process. District heating, which was first to have been switched on after the building's completion, was used already while it was being built.

'Since the district heating is ready, we used it instead of diesel and gas, which are the usual sources of heating when we build,' he explains. 'This was not originally planned, but we found out that we had to be climate-smart also while we were carrying out the project.'

Bringedal adds that the company has not calculated the financial costs. 'We are doing it for the sake of the environment and are hoping that this can become standard practice.'

# Reinventing Cities

Bygata. Furuset. Ill.: PBE

Around the world, the organisation C40 Cities connects 94 of the world's greatest cities to take bold climate action, leading the way towards a healthier and more sustainable future.

Representing 700+ million citizens and one quarter of the global economy, mayors of the C40 cities are committed to delivering on the most ambitious goals of the Paris Agreement at the local level, as well as making livable cities. As an Innovator City Oslo is a proud member of the C40.

By model from the *Reinventing Paris* competition, Ann Hidalgo, the mayor of Paris, took the initiative to host *Reinventing Cities*. This is an unprecedented global competition to drive carbon neutral and resilient urban regeneration. What is special about this competition is that both developers and designers participate, and the prize of the concept that wins is that they have access to buy the plot and realise the project.

15 cities have identified 39 underutilised spaces to redevelop, including several empty plots of various sizes and abandoned buildings, historical mansions, underused markets, a former airport site, car parks to transform, and an abandoned incinerator and landfill. Through this competition, C40 and the participating cities have invited architects, developers, environmentalists, neighbourhood groups, innovators and artists to build creative teams and to compete for the opportunity to transform these sites into new beacons of sustainability and resiliency. They will also have to demonstrate how innovative climate solutions can be achieved in combination with noteworthy architecture and local community benefits. The winning teams will get the opportunity to buy and develop the property in line with their project proposals.

Oslo participates in *Reinventing Cities* with two sites located in suburban areas in Groruddalen. The projects are Bygata at Furuset (approx. 2,000 m²) and Fossumdumpa at Stovner (approx. 10,000 m²). The competition took place in 2018–2019, and the winning projects will be presented during the URBAN FUTURE Global Conference in May. In Oslo, it is proposed that the two *Reinventing Cities* projects will be included as part of FutureBuilt's pilot project portfolio.

All the finalists for the sites in Oslo propose common gardens, cultivation of vegetables on green areas, green roofs/façade, reuse of water/reduced water consumption, shared car and bicycle parking solutions. The proposals show different ways of co-working and shared rooms, waste strategies, electricity production solutions and sharing economics. Some of the projects are proposed in cross laminated timber and seek to use a prefabricated production method to reduce waste on site. Several of the teams suggest solutions for reuse of materials to reduce carbon footprint. Various activities for residents and the local community are proposed, such as a bike shop, youth facilities (work training, career guidance), a refurbishment workshop, kindergarten, microbrewery, guesthouse/hostel (rental). Some of the projects seek to create a small and partly self-sufficient small community.

## Oslo participates in Reinventing Cities with two sites located in suburban areas in Groruddalen.

The *Reinventing Cities* method is interesting, especially in relation to the development of properties that otherwise do not attract much attention. Both sites are situated in areas of the city with relatively low property prices. The competition contributes positively to areas with challenges regarding living conditions. The way in which teams are formed multidisciplinary, in the early stages, gives the opportunity to emphasise other criteria, such as innovation, green solutions and new economic models – which is not very common in traditional sequential planning processes.

# Innovation and R&D across the board

Nydalen Vy. Ill.: Snøhetta/MIR

FutureBuilt is an innovation programme for new urban climate solutions within the construction industry and urban development.



FutureBuilt approach this field with a twofold strategy. On the one hand, we collaborate with ambitious developers to set bold climate goals and request new, untested green solutions. This requires suppliers who are on their toes, something that in itself helps drive innovation. On the other hand, we also collaborate directly with R&D communities in Norway to develop new competence, new concepts and new technologies. The most extensive initiative we are participating in is with the ZEN research centre, whose aim is summarised by its full name: Zero Emission Neighbourhoods in Smart Cities.

**Naturally**

The most successful option, however, is to combine both strategies – developers should preferably not only let consultants and contractors have a say, but also invite research and innovation environments to the drawing board. One recent example concerns a developer who wanted to revolutionise how we adjust the indoor climate of eco-friendly buildings. What must we do to be able to deliver heating, cooling, ventilation and daylight with little energy consumption, high architectural quality and a minimum of technical installations? Or in other words, can we throw out the HVAC system and save both the environment and money?

In order to find an answer, a research project titled *Naturligvis* (Naturally) was set up with the intent of 'developing knowledge, concepts, technologies and strategies for the passive regulation of the indoor climate of buildings'. The project ran for three years, from 2015 to 2017.

The developer was Avantor, which hired the contractor Skanska, which in turn launched the research project in partnership with SINTEF Building and Infrastructure, Snøhetta, FutureBuilt and several other actors. Funding came from the Research Council of Norway.

**Nydalen Vy**

The result of this project is Nydalen Vy. A multi-purpose, 18-storey building with spectacular architecture, generous space, large-scale material use, both natural and hybrid ventilation, low-temperature heating and high-temperature cooling, a near-zero energy level and no need to buy energy for ventilation, heating or cooling. Mission accomplished? Well, Nydalen Vy is at least ready on the drawing board. All that remains is the construction work itself, which will hopefully start in 2019.

Project Director Terje Løvold at Avantor says the following about the project: 'As a result of our experiences with new office buildings, schools and flats, we have gradually reflected on how ever more buildings are becoming technically complex, in regard to both construction and operation. When new tenants move in, we must often replace or revamp the technical systems. We consider this to be scarcely sustainable from both an economic and an environmental perspective. With the Nydalen Vy project, we want to explore the possibilities of greener and more permanent solutions that are easier to operate. We are convinced that over the life cycle of a building, simplified technical systems and high-quality materials will provide greater robustness and flexibility. By participating in the *Naturligvis* research programme, we are a part of developing new solutions that we see the need for. Nydalen Vy is a pilot building, but we strongly believe that the technical solutions there can also be implemented in other projects.'

**With the Nydalen Vy project, we want to explore the possibilities of greener and more permanent solutions that are easier to operate.**

# The climate calculator

Architect: Kjellhues + Schuwerk. Ill.: MIR/Statsbygg

From curiosity project to national standard. The story of how climate accounting in the building industry became the done thing.

**Text: Kristin Rodland Buick/Felix Media**



The year is 2006, and no physical threats of climate change have yet reached the Norwegian door step. There are concerns of rising sea levels, drought and deforestation, but most Norwegians are so far blissfully unaffected. Although the UN Intergovernmental Panel on Climate Change has presented the figures, the construction industry has by and large not yet connected the dots that show their contribution to global greenhouse gas emissions.

In an office in the Norwegian government agency for public construction, Statsbygg, a group of people are on a mission. They have set themselves the mind boggling task of creating a calculation tool estimating the total carbon footprint in construction projects. Would it be possible to "order" a building with a set limit on greenhouse gas emissions per square metre? To everyone but themselves, it is a pipedream.

'We had to use existing data, not data we wished that we had,' says scientist and climate change specialist Eivind Selvig, who was hired in by Statsbygg to lead a research and development project.

One parameter was set: The materials were to be lifecycle based. He recalls trawling through scientific papers and European science institutions. They found databases with life cycle analysis, but none specifically for construction projects.

'Of the stuff we found, you needed to be an expert scientist to make any sense of it,' he says.

Based on scientific papers, they started with the sources they knew were the highest contributors to greenhouse gas emissions; building materials and transport. The tool was intended for accounting, but they soon realised that it needed to be a planning tool.

'We needed a tool that allowed us to test the sustainability of different components, so that we could make the right choices. There was none of this out there. We had to tailor our own software,' he says.

**Ambitious goals**

A few years later in 2009, FutureBuilt approached Statsbygg and Selvig in search of a calculation method that showed the potential of climate friendly construction in comparison to standard building practices at that time. The challenge was to find a comparative building, in the same location, with the same properties. Based on existing statistics from a Norwegian construction surveyor, Norsk Bygganalyse, they formed the data for a so-called 'reference building'.

'As far as I am aware, FutureBuilt is the first, both nationally and internationally, to systematically approach the commercial market and set greenhouse gas calculation as a prerequisite in the building sector,' says Stein Stoknes, programme director, at FutureBuilt. 'And being led by ambitious climate goals forces us to make other decisions, which give new and unexpected results,' he adds.

FutureBuilt's method is developed by Selvig in cooperation with FutureBuilt and divided into three main stages: 'The reference building', 'The projected building' and 'As built'. The reference building is a digital model developed in the climate accounting tool. It is based on expected emissions in a comparative building, in the same location, where no mitigation is done. 'The projected building' is designed with the main goal of reducing greenhouse gas emissions by 50 percent compared to

**FutureBuilt is the first to systematically approach the commercial market and set greenhouse gas calculation as a prerequisite in the building sector.**

that of the 'The reference building'. The 'As built' stage is a documentation of the physical building once finished to see whether it matches the goals of 'The projected building'. Two years later, the actual emissions of the building while in operation is measured, including the collective carbon footprint of users of the building.

**Initially the industry resisted the change, producers felt that we were pushing them out of the market. After a few years they realised that they had to follow the changing demands.**

**Changing an industry**
One of the first building projects to apply the climate accounting tool was going to change the way the Norwegian construction industry regarded and used building materials. The Norwegian Meteorological Institute was finished in 2011, a FutureBuilt project using low-carbon concrete.

'Looking at carbon footprint in building materials was relatively new at the time. There was some conscious use of wood, but security criteria for the institute required the use of concrete,' says Birgit Rusten, CEO of FutureBuilt.

Although low-carbon concrete existed, the use had been limited to roads and tunnels. For the Meteorological Institute it meant a 30 percent reduction of greenhouse gas emissions.
'It was the first building project in Norway using low-carbon concrete, and it came about as a consequence of setting emission requirements for the building materials,' says Rusten.

Many developers followed suit, and as the discovery swept through the building industry, producers started feeling the pressure.

Architect: Kleihues + Schuwerk. Ill.: MIR/Statsbygg




Ill.: Tegmark/Cadl og Kaels/Statsbygg

'Initially the industry resisted the change, producers felt that we were pushing them out of the market. After a few years they realised that they had to follow the changing demands and recently we have even seen a brand new type of concrete and armouring,' says Eivind Selvig.

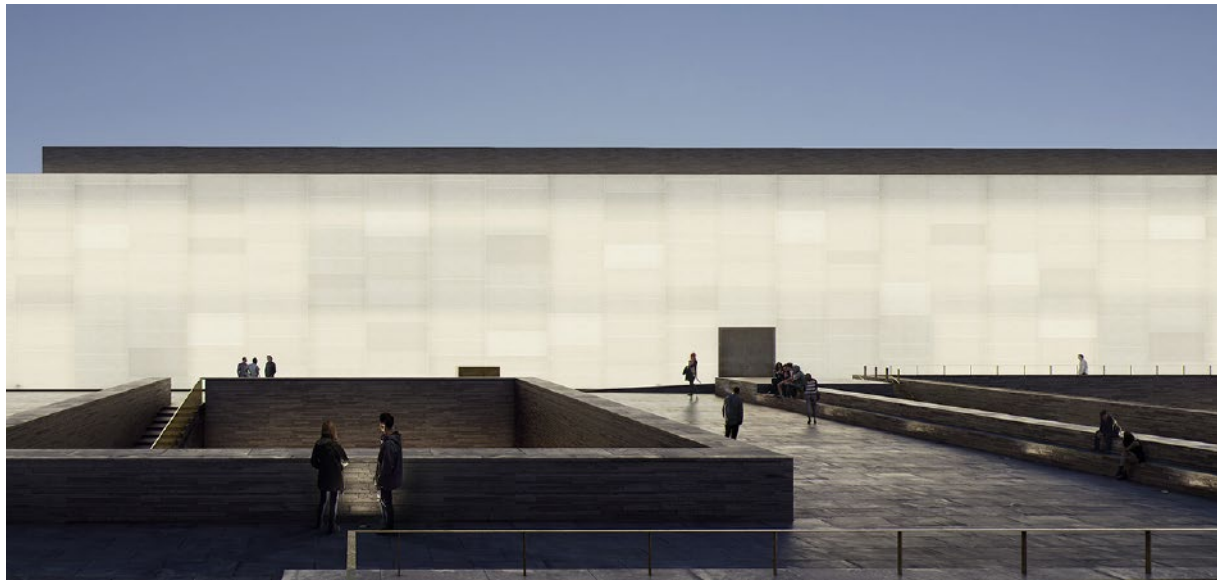
He adds: 'It vitalised an important discussion with producers of various building materials. Now, the new products are not only used in FutureBuilt projects, many public and private developers are choosing environmentally friendly materials.'

**Withstanding the test of time**
In 2020 Statsbygg will complete one of Norway's prestige buildings; The National Museum of Art, Architecture and Design. Tasked with the daunting management of 6,000 artworks, a significant slice of Norwegian cultural heritage, demands and expectations have been exceptional. In terms of square feet, it will be one of the largest art museums in the world. What environmental consequences and responsibilities does this entail?

As early as in 2009, Statsbygg put carbon footprint accounting as a criteria in the tender for the architectural bid. A fundamental idea was to use available resources cautiously and source solid materials which can withstand the test of time – creating a building that will age gracefully. A passive-house standard and the use of local energy was stipulated. The museum got a central location by the fjord, in the heart of the capital. Being a FutureBuilt project, the bar was raised even higher, to a 50 percent reduction of greenhouse gas emissions.

The methodology for climate accounting at the start of the building project in 2012 included the calculation of energy consumption from operational energy, materials and the transport of users to and from the building. Estimates of emissions during the construction or demolition phase were not commonly used.

**Sea water energy**
The energy consumption in the museum consists of a combination of electricity and cooling and heating energy from a locally



Architect: Kleihues + Schuwerk. Ill.: MIR/Statsbygg

produced heat exchange, which uses water from the fjord. Peak heating requirements are covered by district heating. Built as a passive-house, the national museum consumes 85 kWh per square metre per year, giving an energy efficiency of almost half the minimum national requirement. Building materials account for the largest carbon footprint reduction.

**Statsbygg aims to influence the market through high environmental demands to their suppliers.**

‘Requirements for materials were demanding, but necessary. The climate accounting tool showed the benefit of, for example, choosing low-carbon concrete and recycled metal for reinforcement and structural steel,’ says Elin Anita Hansen, environmental advisor for Statsbygg.

**Visitor footprints**

Adding transport and location is relatively new in the history of climate accounting for buildings. Calculations of the carbon footprint from users of the building are based on return journeys. The estimated total amount of users of the National Museum are 273 employees and about 700,000 visitors a year. The central location and a good public transport network help reduce emissions, and in the near future the public transport provider, Ruter, aims to transport people with zero emission.

‘The fact that visitors will be able to travel emission free throughout most of the building’s life time is a significant bonus, as transport is the largest remaining contribution to greenhouse gas emissions in the project,’ says Hansen.

The total reduction of emissions for the National Museum is almost on target; 48 percent compared to the reference building. Materials contributes to 46 percent, energy 21 percent and transport makes out 42 percent of the total reduction of emissions.

‘It was new to us to set a general goal of 50 percent reduction so early. It was challenging, and we really had to strive to reach the last percent,’ says Harald Vaagaasar Nikolaisen, CEO of Statsbygg. ‘It is critical to set intrepid goals early in projects with a long planning and building phase, otherwise we risk that the goals are outdated when the building is completed,’ he continues.

Nikolaisen regards FutureBuilt’s pilot projects as an important arena for learning and the sharing of experiences, spurring new and different ideas. As a public procurer, Statsbygg aims to influence the market through high environmental demands to their suppliers.

‘Whilst being a demanding contractor, we also share experiences and collaborate with developing projects, the climate accounting tool being a good example. We started the development of the tool, we were integral to the development of the standard and provided the tool to others to develop it further and make it commercially available to everyone,’ he says.

**New standard**

The autumn of 2018, ten years after the first version of the tool, a new Norwegian standard for the methodology of calculating greenhouse gas emissions in building projects was set. Contractors can now commission buildings with a given percentage reduction of greenhouse gas emissions. The climate accounting tool itself is currently being further developed by a Finnish company, with experts on material production and transport.
After ten years of using the tool, there is a significant quantity of data on emissions from different types of buildings, such as offices and schools. Time is now ripe to find a more constant parameter. Rather than a percentage reduction from a “reference building”, FutureBuilt and Statsbygg are now aiming to find an absolute amount of kilogram of greenhouse gas emissions per square metre and set a guiding level for future building projects. Not far off the pipedream in a Statsbygg office 13 years earlier.

In 2019, a paradigm shift is putting the construction industry at a crossroad.

‘The most environmental square metres are those we don’t build,’ says Nikolaisen, the CEO of Statsbygg, the Norwegian government agency for public construction. He emphasises that it is impossible to lower emissions in line with our obligations in the Paris Agreement through new buildings. ‘The greatest potential lies in better utilising the buildings, materials and areas we already have.’

Ill.: Kleihues + Schuwerk

Bergsliens gate 12
Photo: Tove Lauluten

**– We need trail-blazers – someone must go ahead in order to show the way. And then we, as a building authority and a national centre in the field of housing and building quality, can learn from their experiences and incentivise others to follow their path.**

Per-Arne Horne, director of the Norwegian Building Authority (DiBK)

Ulsholtveien 31. Photo: Are Carlsen

# It pays to build green

Previously, environment and climate considerations were seen as worthwhile, but expensive. Now, however, ecological and social considerations are at the forefront.

Contract signing of a new FutureBuilt project. Jan Ivar Thomas (Landbrukskvartalet Utvikling AS), Knut Hoff (Landbrukskvartalet Utvikling AS), Birgit Rusten (FutureBuilt), Gunnar Oveland (Landbrukskvartalet Utvikling AS), Ellen de Vibe (chief town planner at Planning and Building Services Agency, City of Oslo). Photo: Geir Anders Rybakken Ørslien

How has the new green economy come into being? We spoke with Katharina Bramslev, chief executive officer of the Norwegian Green Building Council.

'The costs of eco-friendly measures have gone down,' Bramslev explains. 'For example, solar panels, windows with a low U-value, and good heat recovery systems have become more reasonably priced. An important reason is the greater demand for such solutions, through for example BREEAM and FutureBuilt pilot projects. The sector has also gained more experience with new eco-friendly solutions, and many contractors can deliver green buildings at a lower cost than before because they have learned that they should implement the measures in an effective manner.'

**The Norwegian construction industry is among the world's most ambitious.**

And the international survey Green Building Trends, carried out under the auspices of the World Green Building Council, shows that around half of the over 2,000 respondents from 86 countries expect that the majority of their future projects will be green. According to the survey, the Norwegian construction industry is among the world's most ambitious.

'This shows that the construction industry is well on its way to taking responsibility for the global threat to the environment we are now facing,' Bramslev points out. 'The Norwegian Green Building Council is currently experiencing a strong willingness among both members and others to roll up one's sleeves and do what's possible to reduce greenhouse gas emissions, as well as to make better use of the resources at hand and stop pollutants from being emitted. The Green Building Trends survey shows that the primary driver in Norway is market demand and an awareness that this is the right thing to do.'

'Previously, there was a question about whether it makes financial sense to build green, whether it pays off, but that is the entirely wrong question – also for leaders in the private sector. "We're building green not just to make money, we do it because that is what we have to do" is something we're hearing ever more often. There is a genuine interest in building green, but going forward it is also the only way to survive in the marketplace.'

**Triple bottom line**

Sustainability has become business. Green buildings give a triple bottom line, with investors, customers and the world itself as the winners. 'People, planet and profit' is a business mantra that has been given a boost. According to Bramslev, saving the world and creating healthy buildings is simply good business.

'It is important that green buildings give added value to the owner, the user and society as a whole. In order for a building to be sustainable, it must deliver on the environment, comfort level and the economy alike. We have to bust the myth that one excludes the other.'

The Norwegian Green Building Council is interested in involving banks, insurance companies and investors in this effort, and already now some banks are already providing favourable loans to developers who can document that the building in question is green. The reason is that green buildings are less a risky proposition than grey buildings. There is talk of how buildings that don't follow the green shift become 'stranded assets' that are a major risk to own, rent or invest in.

'Grey buildings are not in line with the increasing regulatory and market demands, which take the Paris Agreement on reducing greenhouse gas emissions seriously. DNB is one of the banks that have declared that building green will soon be an absolute requirement in order to receive a loan. They simply do not want to invest in buildings that aren't adapted to the future.'

**Paris-proof**

'The Paris Agreement is historical and shows that world leaders now understand the gravity of the situation. We will notice stricter demands to greenhouse gas reductions. The EU is also committing itself to a circular economy, and that decision will be reflected in stricter legislation and other incentives also in regard to resource use and waste management. Our suggestion is that we begin talking about 'Paris-proof' buildings. If we build and run 'Paris-proof' buildings going forward, by implementing measures to reduce $CO_2$ throughout the building's entire life cycle, we can really contribute to reaching the goals of the Paris Agreement. And given the demands the finance sector is set to impose, we can manage this during the 11 years we have at our disposal.'

**The EU is also committing itself to a circular economy, and that decision will be reflected in stricter legislation and other incentives also in regard to resource use and waste management.**

Bramslev also hopes for many more FutureBuilt projects.

'I strongly believe in pilot projects – learning by doing is the way to go in the construction industry. The risk level seems a bit lower in a pilot project, so that people are more ambitious, and that gets results,' Bramslev concludes.

Source: Interview with Katharina Th. Bramslev and www.grønnbyggallianse.no, an online magazine published by the Norwegian Green Building Council.

# Ambitious developers

FutureBuilt cooperates with ambitious developers who see it as a competitive advantage to be innovative and an environmentally leading company. They explore practices that are not “business as usual” in the construction industry, such as new concepts, methods, technologies and products. Some of the pilot projects also serve as research case studies.



Construction site Ulsholtveien 31. Photo: Geir Anders Rybakken Ørsilen

**The FutureBuilt method**
The process with the pilot projects follows more or less the same path:

1) Contact is established between FutureBuilt and the developer of a pilot project. The municipality is part of this dialogue.

2) Discussions on ambitions for the pilot project. If the project is ambitious enough the developer submits an application to join FutureBuilt.

3) A committee led by the municipality decides if the project can join FutureBuilt, and an agreement is signed between the developer, the municipality and FutureBuilt.

4) If there is not yet a design team commissioned for the project, FutureBuilt will help the developer to organise an architectural competition.

5) The building application is given high priority by the municipality.

6) FutureBuilt serves the developer and the construction team with workshops to help the projects achieve their ambitious environmental targets.

7) The developer uses a greenhouse gas accounting tool and estimates the carbon footprint for the pilot project. This is done for a reference building, the building as designed, as built and in use.

8) FutureBuilt arranges construction site visits and opening seminars connected to each pilot project. The annual FutureBuilt conference and several seminars and study trips are also important in order to showcase the pilot projects and share experiences with other projects.

9) FutureBuilt communicates the pilot projects through newsletters and web-site, social media, articles in newspapers and magazines.

10) The pilot projects are documented in the national database of sustainable architecture.

**URBAN FUTURE global conference is Europe's largest event for sustainable cities and the place to meet the most passionate and inspiring CityChangers from all over the world. In 2019 the  event takes place in Oslo, the European Green Capital 2019, with FutureBuilt as the local partner.**

Photo: Geir Anders Rybakken Ørslien.

# Pilot projects:

**Asker x 3**
Completed: 2
In process: 1

**Bærum x 6**
Completed: 2
In process: 4

**Oslo x 35**
Completed: 15
In process: 20

**Drammen x 8**
Completed: 6
In process: 2

## Kilden Kindergarten/Oslo

Photo: Tove Lauluten

Kilden Kindergarten is built for 216 children and is one of the first Oslo plus-energy house kindergartens. Local energy production is central to the project and was addressed by using photovoltaics as the roofing material. The gable roof angle and the direction are optimised for the placement of the cells. The building´s outer surface is conceived of as a weather skin that knits together the roof and walls as a structural whole.

**Low carbon strategies**

- Plus-energy house
- Local energy production by using photovoltaics as the roofing material
- Environmental and climate-friendly material use
- Reuse parts of existing building in outdoor structure
- Good solutions for cyclists and pedestrians

**Project information**

- Client: Omsorgsbygg Oslo KF/City of Oslo
- Architect: LINK Arkitektur AS
- Contractor: Varden Entreprenør AS
- Completed: 2018

## Kringsjå Student Village/Oslo

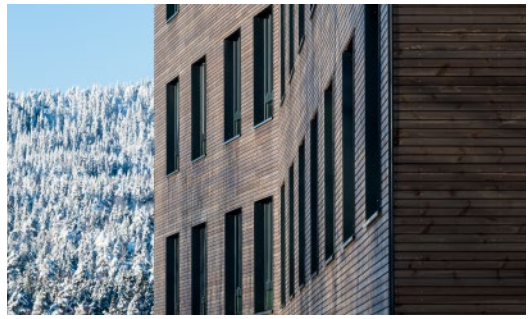


Photo: Tove Lauluten

The expansion of the Kringsjå Student Village in Oslo is underway. The first building phase was completed in the spring of 2018 and consists of two buildings with 349 student residences. Kringsjå is an urban recreational student village, with green corridors that connect to the surrounding landscape. The two new buildings are close to zero energy with up to 11 storeys in cross-laminated timber.

**Low carbon strategies**

- Passive house, close to zero energy, PV on the roof
- Work with an energy plan for the whole Kringsjå Student Village area
- Cross-laminated timber up to 11 storeys
- New walking and bicycle connections
- Bike facilities

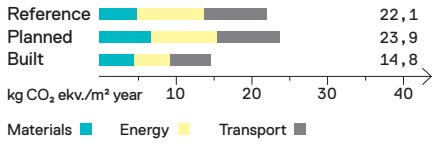
**Energy consumption**

- Net energy: 83,2 kWh/m² year (NS3031/NS3701)
- Supplied energy calculated: 46 kWh/m² year (NS3031/NS3701 )

**Project information**

- Client: Studentsamskipnaden i Oslo og Akershus
- Architect: AT Plan & Arkitektur AS
- Landscape architect: Snøhetta
- Main contractor: Ove Skår AS
- Project management: OEC Consulting AS
- Completed: 2018

**Emission numbers for Kringsjå Student Village**




## Brynseng School/Oslo

Photo: Tove Lauluten

Brynseng School is a primary school in the eastern part of Oslo. The school has four parallell classes for 840 pupils from class 1 to 7. The building is located in the immediate vicinity of metro, bus and train stops, providing convenient and safe access by public transport for both pupils and staff. Brynseng school has a 1046 m² building integrated solar façade, and is Oslo's first 'almost zero-energy building' (nNEB definition).

**Low carbon strategies**

- Nearly net-zero energy building
- Solar panel façade of 1046 m²
- Location close to public transport
- No car parking
- 440 bicycle parking places

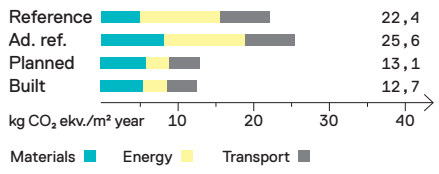
**Energy consumption**

- Net energy: 39 kWh/m² year (NS 3031)
- Supplied energy calculated: 62 kWh/m² year (NS 3031)

**Project information**

- Client: Undervisningsbygg Oslo KF/City of Oslo
- Architect: HRTB arkitekter AS MNAL
- Landscape architect: Bjørbekk & Lindheim AS
- Enova support: MNOK 4,5
- Completed: 2017

**Emission numbers for Brynseng School**




## Ulsholtveien 31/Oslo

Photo: Tove Lauluten

The low carbon first-home residences in Ulsholtveien 31 are situated at Furuset, which is the City of Oslo´s area project in FutureBuilt. An existing residential building has been rehabilitated and converted to house nine flats with communal area on the ground floor. In addition, two new buildings with 27 flats have been built adjacent to each other.

**Low carbon strategies**

- Compact building and area-efficient homes
- New buildings built as passive houses
- Geothermal heat, PV panels, solar thermal collectors, greywater recycling
- Ventilation with heat recycling in the wall for each residential unit
- Sollid wood construction
- Good bicycle fascilities

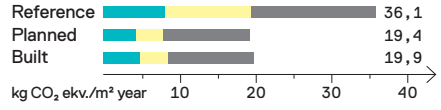
**Energy consumption**

- Net energy new buildings: 76 kWh/year (NS 3031)
- Supplied energy calculated: 46,7 kWh/m² year (NS 3031)

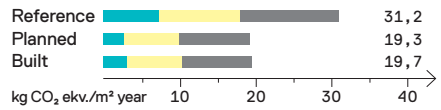
**Project information**

- Client: Stiftelsen Betanien Oslo
- Project management: CM Prosjekt AS
- Architect: Haugen/Zohar Arkitekter AS
- Landscape architect: Dronninga Landskap AS
- Completed: 2017

**Emission numbers for Ulsholtveien 31 - new building**




**Emission numbers for Ulsholtveien 31 - existing building**



## Holmen Swimming Pool/Asker

Photo: Tove Lauluten

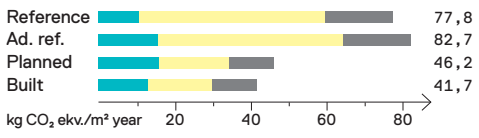
The Holmen area is being developed as a local centre with shopping, services, bus station, meeting places and recreation areas, maritime business and residences. In this area the municipality of Asker has built one of Norway´s first passive house swimming pools. By combining technical solutions Asker has built the swimming pool of the future. Holmen swimming pool is not only saving electricity – photovoltaics also ensures production of electricity.

**Low carbon strategies**
- Passive house
- 15 geothermal wells for energy supply
- 650 m² roof of photovoltaic panels
- Solar thermal collector on the car parking area
- Use of low carbon concrete
- Good bicycle parking and close to public transport

**Energy consumption**
- Net energy: 376 kWh/m² year (NS 3701 and calculations for swimming pool facilities)
- Supplied energy calculated: 131 kWh/m² year (NS 3701 and calculations for swimming pool facilities)

**Project information**
- Client: Asker municipality
- Project management: OP-AS
- Architect: Arkís
- Contractor: Trio entreprenør AS
- Support Enova: MNOK 10
- Completed: 2017

**Emission numbers for Holmen Swimming Pool**




## Kistefossdammen Kindergarten/Asker

Photo: Tove Lauluten

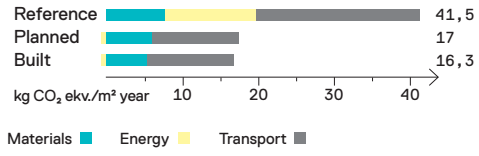
The kindergarten is built as the first public house in Norway according to FutureBuilt´s plus-energy house definition. On average per year the building will generate more renewable energy than it uses. The kindergarten is supplied with 100 percent local renewable energy from geothermal wells and photovoltaic panels. Integrated photovoltaic panels and windows are placed on 'roof hats'.

**Low carbon strategies**
- Plus-energy house
- Environmentally and climate-friendly material use
- Good facilities for cycling and walking
- Located near Heggedal train station and centre of Heggedal
- Pilot mobility project for families and employees

**Energy consumption**
- Net energy: 64 kWh/m² year (NS 3031)
- Supplied energy calculated: 32 kWh/m² year (NS 3031)

**Project information**
- Client: Asker municipality
- Architect: Christensen & CO arkitekter a/s
- Main contractor: NCC Building
- Support: Enova MNOK 1,1, Husbanken NOK 400,000, Klimasats NOK 170,000
- Completed: 2017

**Emission numbers for Kistefossdammen Kindergarten**






## Bergsliens gate 12 B-C/Oslo

Photo: Elvind Røhne

Bergsliens gate 12b-c is a housing project rehabilitated according to antiquarian principles and by testing a new method of insulation. The project included drainage around the building, replacing and insulating the roof and restoring the façade with 70 mm super insulating lime plaster, a new and innovative product. The project will provide important data on the material´s suitability to the Norwegian climate.

**Low carbon strategies**
- Reinsulate the building while safeguarding the original character
- Test and explore innovative insulating lime plaster
- Upgrading the inner courtyard
- Better storm water handling
- Establish bicycle and pram parking with a green roof

**Energy consumption before**
- Net energy: 647 kWh/m² year (NS 3031)
- Supplied energy calculated: 718 kWh/m² year (NS 3031)

**Energy consumption after**
- Net energy: 324 kWh/m² year (NS 3031)
- Supplied energy calculated: 355 kWh/m² year (NS 3031)

**Project information**
- Client: Boligbygg Oslo KF/City of Oslo
- Architect: Rik Arkitektur AS
- Main contractor: Thorendal AS
- Completed: 2016

## Rykkinn School/Bærum

Photo: Tove Lauluten

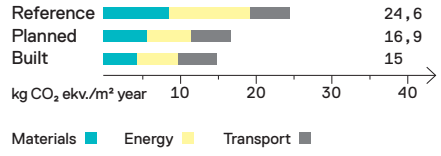
Rykkinn School has three parallel classes for 650 pupils from class 1 to 7. In addition to the teaching spaces, the school contains a multi-purpose hall and an assembly room for large events. The passive house school Rykkinn has good daylight conditions in all rooms, and a variety of outdoor spaces facilitate outdoor teaching.

**Low carbon strategies**
- Passive house standard
- Optimising of the building frame with respect to material usage, U-values and air-tightness
- Efficient heat pump and local energy wells
- Extra attention to good daylight conditions
- Transport solutions that facilitate walking and cycling

**Energy consumption**
- Net energy: 50 kWh/ m² year (NS 3031)
- Supplied energy calculated: 35 kWh/m² year (NS 3701)

**Project information**
- Client: Skuleveg AS
- Architect: Arkitektgruppen Lille Frøen AS
- Main contractor: Veidekke Entreprenør AS
- Support Enova: NOK 71,000
- Completed: 2016

**Emission numbers for Rykkinn School**



## Veitvet School/Oslo

Photo: LINK arkitektur AS / Hundven-Clements Photography

Veitvet School is a primary and secondary school for grades 1 to 10, including a multi-use hall. Veitvet School is part of a planned culture and environmental street along Veitvetveien. The school has a clear environmentally friendly profile with a tilted entrance façade covered in solar panels.

Low **carbon strategies**

- Passive house
- Use of thermal mass
- District heating and solar heat collector in the façade
- Low carbon concrete and external cladding in wood
- Proximity to public transport and good facilities for bicycles

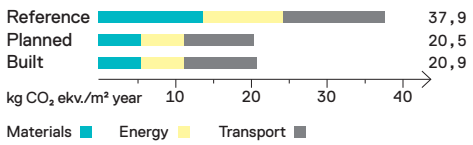
**Energy consumption**

- Net energy: 73/62 kWh/m² year (NS3031/ NS3701)
- Supplied energy calculated: 76/65 kWh/m² year (NS3031/NS3701)

**Project information**

- Client: Skanska Eiendomsutvikling
- Architect: LINK Arkitektur AS
- Landscape architect: LINK Arkitektur AS Landskap
- Support Enova: MNOK 3,3
- Completed: 2015

**Emission numbers for Veitvet School**




## Granstangen School/Oslo

Photo: Tove Lauluten

Furuset is the City of Oslo´s pilot area for climate-friendly city development. The new Granstangen secondary school was the first project in the FutureBuilt programme to be completed in the area. Designing a compact building form with a high area-efficiency, low surface to reduce the loss of heat and the possibility for subdividing the building in the evenings, was a priority for the team.

**Low carbon strategies**

- Passive house
- Geothermal heat pump
- Use of low carbon concrete and recycled steel
- Façade clad in iron vitriol treated larch
- Parking facilities for cars at a minimum. Good facilities for bikes.

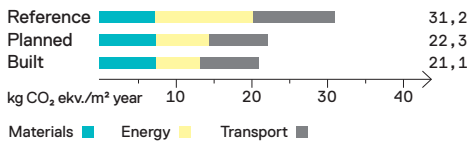
**Energy consumption**

- Net energy: 61 kWh/m² year (NS3701)
- Supplied energy calculated: 49 kWh/m² year (NS3701)

**Project information**

- Client: Gran Skolebygg AS (Backe Prosjekt AS)
- Architect: Arkitektgruppen Lille Frøen AS
- Landscape architect: Asplan Viak AS
- Main contractor: Agathon Borgen AS
- Support ENOVA: MNOK 2,1
- Completed: 2015

**Emission numbers for Granstangen School**






## Papirbredden 2 and 3/Drammen

Photo: Thomas Bjørnflaten

Papirbredden 2 and 3 are part of the Papirbredden Knowledge Park in Drammen. The two office buildings achieve passive house standard, energy class A and good facilities for cyclists. Papirbredden 3 continues the high ambitions of Papirbredden 2, but with further improvements such as a sedum roof, eliminating mechanical cooling and lower energy use.

**Low carbon strategies**

- Passive house and Energy Class A
- Energy from geothermal wells and district heating
- Optimised material consumption through prefabrication and conscious choices in the early stages of the project
- Centrally located and close to a transport hub
- Large number of bicycle parking places and a bicycle workshop

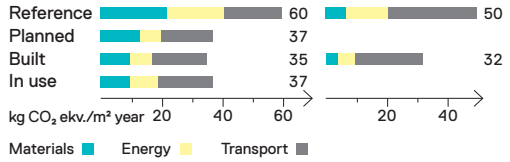
**Energy consumption**

- Papirbredden 2–Papirbredden 3
- Net energy: 70 kWh/m² year–72,3 kWh/m² year (NS 3031)
- Supplied energy calculated: 58 kWh/m² year–56,4 kWh/m² year (NS 3031)

**Project information**

- Client: Papirbredden Eiendom AS
- Architect: LPO Arkitekter AS
- Main contractor: Strøm Gundersen AS
- Support Enova: MNOK 3,4
- Completed: Papirbredden 2: 2012/ Papirbredden 3: 2015

**Emission numbers for Papirbredden 2 and Papirbredden 3**




## Frydenhaug School/Drammen

Photo: Drammen municipality

Frydenhaug School in Drammen is a multi-district elementary school and resource centre for students with disabilities. It is designed as a passive house with energy class A and climate-effective building materials. The project includes bicycle parking and moderate car parking. A solar thermal system and drilled wells with seasonal restocking reduces the need for delivered energy. Frydenhaug School has a strong focus on universal design.

**Low carbon strategies**

- Passive house, energy class A, near-zero energy school
- Solar thermal system on the roof and sedum roof
- Drilled wells with seasonal recharching
- Low-carbon concrete and recycled steel
- Materials with low greenhouse gas emissions

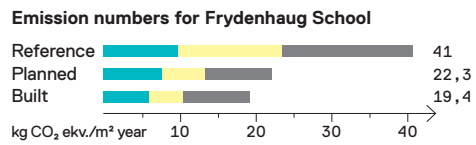
**Energy consumption**

- Net energy: 53 kWh/m² year (NS 3031)
- Supplied energy calculated: 37 kWh/m² year (NS 3031)

**Project information**

- Client: Drammen Eiendom KF
- Architect: Terje Grønmo Arkitekter AS, Rambøll AS
- Landscape architect: Hindhamar Landskapsarkitekter AS, Rambøll AS
- Main contractor: Bøhmer Entreprenør AS
- Support Enova: MNOK 1,9
- Completed: 2014

**Emission numbers for Frydenhaug School**



## Stasjonsfjellet School/Oslo

Photo: Tove Lauluten

Stasjonsfjellet School in Oslo is one of the country´s first schools rehabilitated to achieve passive house standard. The outer skin was upgraded, and one objective was to achieve the lowest possible heat loss. The project does not meet all passive house requirements in relation to the standard, but the total energy requirement is significantly reduced.

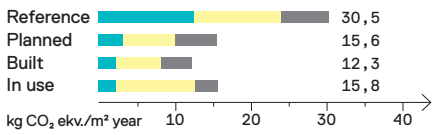
**Low carbon strategies**
- Roof and façades are well insulated to achieve the lowest possible heat loss
- Water-borne heating with a geothermal heat pump
- New ventilation system
- Maintenance-free façade of heartwood of pine gives low greenhouse gas emissions
- Upgraded path and new staircase from the train station

**Energy consumption**
- Rehabilitation
- Net energy: 74 kWh/m² year (PH-calculation)
- Supplied energy calculated: 56 kWh/m² year (PH-calculation)

**New building**
- Net energy: 68 kWh/m² year (PH-calculation)
- Supplied energy calculated: 57 kWh/m² year (PH-calculation)

**Project information**
- Client: Undervisningsbygg Oslo KF/City of Oslo
- Architect: Heggelund & Koxvold AS
- Contractor: Oslo Byggentreprenør AS
- Support Enova: MNOK 1,92
- Completed: 2014

**Emission numbers for Stasjonsfjellet School**




## Bjørnsletta School/Oslo

Photo: Tove Lauluten

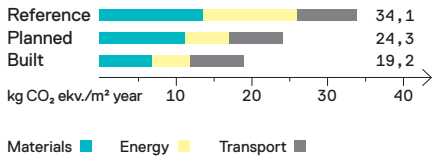
This primary and secondary school for 792 pupils achieves passive house standard and scores highly on environmentally-friendly material use and transport. Optimising of the technical systems and detailed material analyses have been an important part of the project. The school is located centrally next to Åsjordet metro station in Oslo and has good bike facilities.

**Low carbon strategies**
- Passive house
- Extensive use of automation to ensure an optimal indoor climate and energy use
- Demand controlled ventilation with high heat recovering
- Minimised materials consumption, i.e. use of bubble deck
- Minimum parking allocation, new walkway and extended bike parking

**Energy consumption**
- Net energy: 64 kWh/m² year (NS 3031)
- Supplied energy calculated: 45kWh/m² year (NS 3031)

**Project information**
- Client: Undervisningsbygg Oslo KF/City of Oslo
- Architect: L2 arkitekter AS
- Landscape architect: Østengen & Bergo AS
- Contractor: Veidekke Entreprenør AS
- Completed: 2014

**Emission numbers for Bjørnsletta School**






## Powerhouse Kjørbo/Bærum

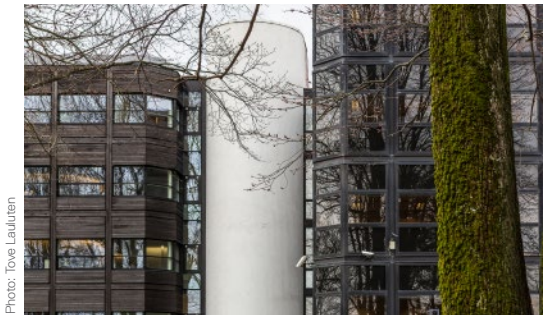


Photo: Tove Lauluten

Powerhouse Kjørbo consists of two ordinary office blocks from the 1980´s that have been transformed to an up-to-date and modern office facility. The goal over the lifetime of the buildings is to produce more energy than they use. With help of photovoltaics Powerhouse Kjørbo will produce over 200,000 kWh per year. The electricity will be delivered to the technical systems of the building and periodically also to the local grid.

**Low carbon strategies**
- Energy concept based on integrated and holistic solutions
- Energy efficient and building-integrated ventilation solution
- Thermal energy supply based on energy wells, heat pumps and use of excess heat from server facilities, optimised according to heating and cooling requirements
- A large photovoltaic system
- Materials with low embodied energy, such as external cladding of burnt wood

**Energy consumption**
- Net energy: 61,5 kWh/m² year
- Supplied energy calculated: 37 kWh/m² year

**Project information**
- Client: Entra ASA
- Powerhouse Kjørbo is developed in cooperation with Skanska, Snøhetta, Asplan Viak, Hydro, Sapa Building Systems, ZERO and ZEB
- Support Enova: MNOK 15,9
- Completed: 2014

## Grensesvingen 7/Oslo

Photo: Johnny Syversen

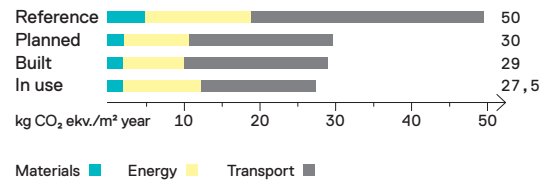
The rehabilitation of this office building from the 1980´s has halved greenhouse gas emissions through the retention of the existing structure and most of the façade, the use of climate-friendly materials and energy efficient solutions. Daylight quality in the relatively deep office spaces was improved by new glazed openings in the façades. The building´s location in Helsfyr is very advantageous, with both the metro and bus stations in the immediate area.

**Low carbon strategies**
- Energy class A
- Decentralised ventilation, demand controlled
- Extensive reuse of materials
- Retention of the existing structure and much of the brick façade
- Location close to public transport

**Energy consumption**
- Net energy: 87 kWh/m² year (NS3031)
- Supplied energy calculated: 75 kWh/m² year (NS3031)

**Project information**
- Client: Grensesvingen 7 I AS
- Architect: KIMA arkitektur as
- Landscape architect: Grindaker landskapsarkitekter
- Project manager: Aase Byggadministrasjon AS
- Main contractor: BundeBygg AS
- Support Enova: MNOK 5,9
- Completed: 2014

**Emission numbers for Grensesvingen 7**



## Økern Nursing Home/Oslo

Photo: Tove Lauluten

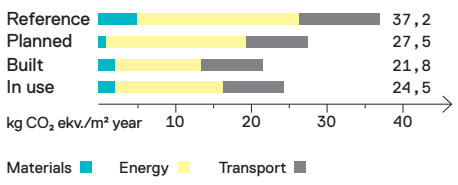
The newest part of Økern Nursing Home, a four-storey block with underground parking, has been rehabilitated. Constructed in 1975, the building has space for 140 residents. With a large solar panel installation on the roof the owner Omsorgsbygg will reduce energy requirements by 68 percent.

**Low carbon strategies**
- Upgrading of the building envelope
- Installation of photovoltaic system, which satisfies a minimum of 10 percent of the building´s total energy needs
- New ventilation system with demand management
- Low-energy lighting system
- Installation of a buildings management system

**Energy consumption**
- Net energy: 111,7 kWh/m² year (NS 3031)
- Supplied energy calculated: 116,7 kWh/m² year (NS 3031)

**Project information**
- Client: Omsorgsbygg Oslo KF/City of Oslo
- Architect: Bølgeblikk arkitekter as
- Contractor: LKC AS
- Completed: 2014

**Emission numbers for Økern Nursing Home**




## Østensjøveien 27/Oslo

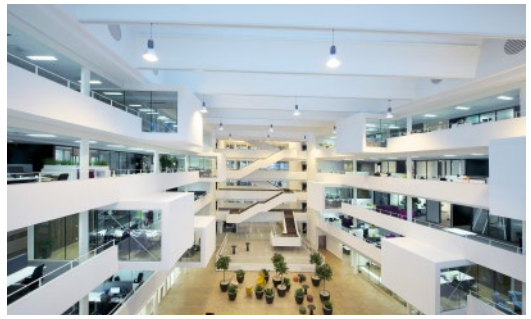


Photo: NCC /kolonihaven

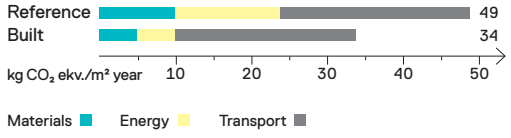
Østensjøveien 27 is an office building located close to Helsfyr metro station, built as a passive house and designed with an emphasis on climate-friendly building materials and good bicycle parking. The building has an open office concept with the possibility of changing to residential accommodation.

**Low carbon strategies**
- Passive house, compact building and optimised building geometry
- Solar screen integrated in the façade
- Heating uses waste heat from neighbouring industry
- Optimisation of material usage, use of low carbon concrete and recycled steel
- Reduced car parking and good facilities for bicycles

**Energy consumption**
- Net energy: 89/68 kWh/m² year (NS 3031/PH)
- Supplied energy calculated: 87/67 kWh/m² year (NS 3031/PH)

**Project information**
- Client: NCC Property Development AS
- Architect: Henning Larsen Architects AS
- Landscape architect: PK3 Landskabsarkitekter
- Main contractor: NCC Construction AS
- Support Enova: MNOK 4,3
- Completed: 2013

**Emission numbers for Østensjøveien 27**






## Fredrik Selmers vei 4/Oslo

Photo Tove Lauluten

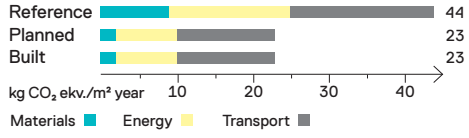
The building was originally designed as a government office building and was finished in 1982. It was fully rehabilitated in 2013. Fredrik Selmers vei 4 is an example that rehabilitating a building is cost-effective, also when seen from a climate perspective. In this project the total area of the building has been increased by about 4,000 m² to 38,000 m², and the building now houses about 1,500 office spaces.

**Low carbon strategies**
- Passive house standard, energy class A
- Local energy centre for heat, cooling and domestic hot water
- Energy effective and demand controlled lightning
- Use of recycled aluminium, low carbon concrete
- Location close to public transport

**Energy consumption**
- Net energy: 72 kWh/m² year (NS3701)
- Supplied energy calculated: 68 kWh/m² year (NS3701)

**Project information**
- Client: Entra ASA
- Architect: LPO arkitekter AS
- Landscape architect: Atsite
- Project management: Insenti AS
- Main contractor: AF Gruppen, Caverion Norge AS, Insenti AS
- Support Enova: MNOK 18,5
- Completed: 2013

**Emission numbers for Fredrik Selmers vei 4**




## Tallhall, Meteorological Institute/Oslo

Photo: Espen Gees

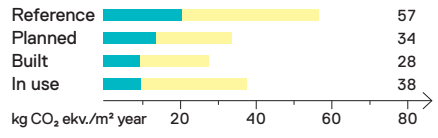
The Meteorological Institute is Norway´s most important supplier of information, news and research about climate and meteorology, and Talhall is the institute´s newest building in Oslo. The building is designed to house extremely technical areas on the ground floor, but also meeting and eating spaces on the first floor. Tallhall is built as a passive house using innovative material solutions and is the first building in Norway with low carbon concrete.

**Low carbon strategies**
- Passive house on the first floor
- Local heat pump and waste heat from data centre
- Low carbon concrete
- Location close to bus and metro
- Reduced car parking and covered, secure bicycle parking

**Energy consumption first floor**
- Net energy: 90 kWh/m² year (PH-calculation)
- Supplied energy calculated: 74 kWh/m² year (PH-calculation)

**Project information**
- Client: The Meteorological Institute
- Architect: Pir II Oslo AS
- Landscape architect: Arkitekturverkstedet i Oslo/Asplan Viak AS
- Main contractor: Eide Entreprenør AS, Årnes
- Support Enova: MNOK 1,5
- Completed: 2011

**Emission numbers for Tallhall: 1. floor**



## NSB Kompetansesenter/Drammen

Photo: Terje Borud

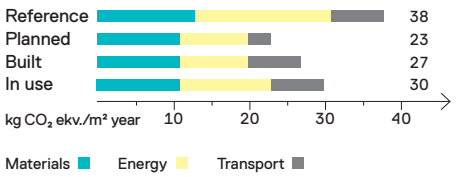
NSB Kompetansesenter is the first building stage of a new campus area located in Drammen. The centre consists of a college and offices and can house up to 450 people. The façade with moveable glass louvres and perforated steel sheeting showcase the buildings´ low energy strategies.

**Low carbon strategies**
- Compact building and efficient use of space
- External solar shading reduces the need for cooling
- Simple geometry which simplifies airtightness, insulation and makes the building less vulnerable to wind
- Materials with low environmental impact

**Energy consumption**
- Net energy: 81 kWh/m² year (NS 3031)
- Supplied energy calculated: 71 kWh/m² year (NS 3031)

**Project information**
- Client: Rom Eiendom AS
- Architect: alt. arkitektur AS
- Landscape architect: Landskapsfabrikken, Hindhamar Landskapsarkitekter AS
- Main contractor: OKK Entreprenør AS
- Completed: 2010

**Emission numbers for NSB Kompetansesenter**




## Marienlyst School/Drammen

Photo: Espen Gees

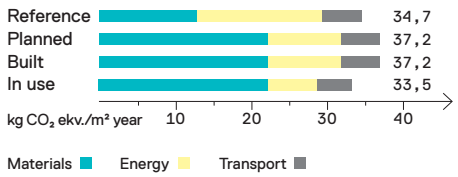
The Marienlyst passive house school in Drammen is compact, well insulated and has an efficient heat recovery system. The school is centrally located in Drammen, adjacent to Marienlyst Sports Park and is connected to a communal low-temperature local heating network. The building is formed as a simple volume where all functions are collected in one three-storey building and has a capacity of about 500 students.

**Low carbon strategies**
- Passive house
- Ventilation, heating and lighting is demand controlled
- Connected to a communal low-temperature local heating network
- Reduced car parking facilities
- Good facilities for bike parking

**Energy consumption**
- Net energy: 70,4 kWh/m² year (NS3031)
- Supplied energy calculated: 77 kWh/m² year (NS3031)

**Project information**
- Client: Drammen Eiendom KF
- Architect: div.A arkitekter AS
- Landscape architect: Bjørbekk og Lindheim AS
- Main contractor: OBAS Øst Entreprenør AS
- Support Enova: MNOK 4,8
- Completed: 2010

**Emission numbers for Marienlyst School**






## Fjell Kindergarten/Drammen

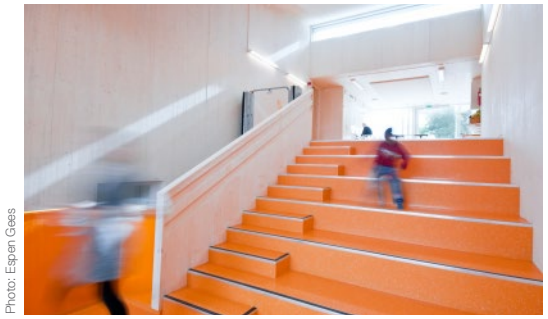


Photo: Espen Gees

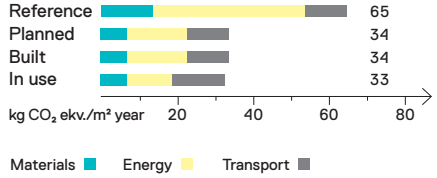
Fjell Kindergarten was one of the first FutureBuilt projects. It is situated on a hill with a view over Drammen town centre and planned to accommodate 90 children. The kindergarten is built as a passive house with a ground-source heat pump based on an energy well. It is built in massive wood construction, using a robust and precise sandwich-building system with a high degree of prefabrication.

**Low carbon strategies**
- Passive house
- Ground source heat pump (form energy wells)
- Prefabricated solid wood elements
- Reduced parking facilities

**Energy consumption**
- Net energy: 66 kWh/m² year (NS3031)
- Supplied energy calculated: 51 kWh/m² year (NS3031)

**Project information**
- Client: Drammen Eiendom KF
- Architect: Code: arkitektur AS
- Landscape architect: Hindhamar Landskapsarkitekter AS
- Main contractor: Holtefjell Entreprenør
- Completed: 2010

**Emission numbers for Fjell Kindergarten**




## Bellona headquarters/Oslo

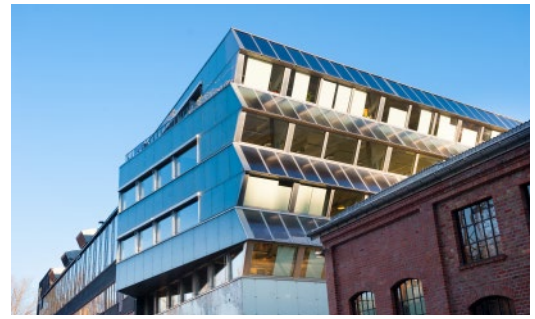


Photo: Aspelin Ramm

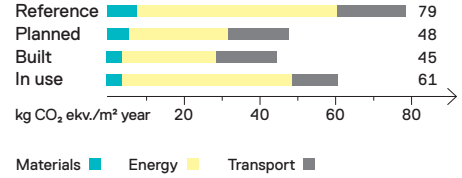
The headquarters of the Bellona Foundation in the Vulkan area in Oslo has a characteristic south façade with integrated solar panels that reduce solar exposure. On sunny days the building delivers energy to the local energy centre. The centre supplies the whole area with heat, cooling and warm water from the solar panels, a local ground source pump and district heating at peak load. The area is easily accessed by public transport.

**Low carbon strategies**
- Passive house standard, energy label A
- Local energy centre for the whole area
- South-facing façade with solar panels, external sunscreening
- Choice of climate friendly materials in the planning process
- Central location and close to public transport

**Energy consumption**
- Net energy: 96 kWh/m² year (NS 3031)
- Supplied energy calculated: 76 kWh/m² year (NS 3031)

**Project information**
- Client: Aspelin Ramm Eiendom AS
- Architect: LPO arkitekter AS
- Main contractor: Veidekke Entreprenør AS
- Support Enova: 2,5 MNOK
- Completed: 2010

**Emission numbers for Bellona headquarters**



## Deichman Bjørvika - Oslo Public Library/Oslo

Photo: Jiri Havran/Kultur- og idrettsbygg Oslo KF

The new main library in Oslo is located in the centre of the city close to the opera. The architectural concept of the five-storey building is based on a large, central, continuous space that stretches up through the storeys. The library will open out to the city with a translucent façade and still achieve passive house standard. Ventilation is supplied via the floor structure in the second to fifth storeys, thus reducing the need for fan energy.

**Low carbon strategies**

- Passive house
- Cooling of concrete slabs
- Transparent composite façade
- Use of low carbon concrete, recycled steel reinforcement and recycled steel
- Central location and no car parking facilities

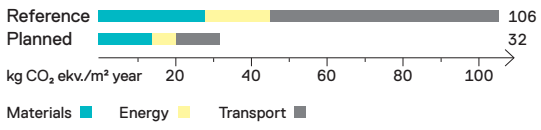
**Energy consumption**

- Net energy: 71 kWh/m² year (NS 3031)
- Supplied energy calculated: 80 kWh/m² year (NS 3031)

**Project information**

- Client: Kultur- og idrettsbygg Oslo KF/City of Oslo
- Project management: ÅF Advansia AS
- Architect: Lund Hagem Architects, Atelier Oslo AS
- Support Enova: MNOK 17,6
- Opening: 2020

**Emission numbers for The New National Museum**




## The Munch Museum/Oslo

Photo: Kultur- og idrettsbygg Oslo KF

The new Munch museum is located in Bjørvika close to the opera. The concept is based on the idea of a vertical museum with a tower of 12 storeys, placed on a three-storey podium. The tower consists of a static and a dynamic part. The static part satisfies the requirements of security, climate and daylight control, the dynamic part contains the vertical area for visitors, with a transparent and open façade and with a view across the city.

**Low carbon strategies**

- An external skin with good insulation, very good windows and low cold-bridging values
- High heat recovery and a high use of recycled air
- Few windows in the static part of the building and relatively high temperature variation in the dynamic part
- Energy efficient lighting system
- Location near Norway´s most important public transit hub

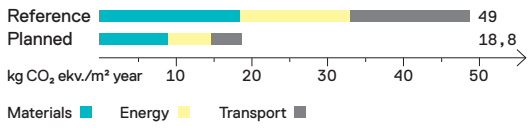
**Energy consumption**

- Net energy: 72 kWh/m² year (NS 3701)
- Supplied energy calculated: 74 kWh/m² year (NS 3701)

**Project information**

- Client: Kultur- og idrettsbygg Oslo KF/City of Oslo
- Architect: estudio Herreros, LPO Arkitekter AS
- Project management: ÅF Advansia AS
- Support Enova: MNOK 13,4
- Opening: 2020

**Emission numbers for The Munch Museum**






## New National Museum for Art, Architecture and Design/Oslo

Ill.: MIR kommunikasjon AS

Norway´s largest cultural building, The New National Museum for art, architecture and design is located at Vestbanen, adjacent to Aker Brygge on Oslo´s waterfront. The basic idea for the New National Museum is to use the available resources carefully. The museum is being built using robust materials that can withstand the test of time with dignity and at the same time in line with ambitious climate criteria.

**Low carbon strategies**

- Compact building
- Passive solutions to reduce energy use (heavy wall construction)
- Climate friendly materials
- Central location, near public transport and central functions

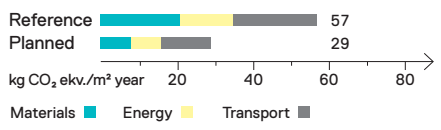
**Energy consumption**

- Net energy: 85 kWh/m² year (NS 3031)
- Supplied energy calculated: 59 kWh/m² year (NS 3031)

**Project information**

- Client: Statsbygg
- Architect: Kleihues+Schuwerk Gesellschaft von Architekten mbH
- Landscape architect: Østengen og Bergo Landskapsarkitekter AS
- Support Enova: MNOK 17,6
- Opening: 2020

**Emission numbers for The New National Museum**




## Klimahuset/Oslo

Ill.: Lund Hagem Architects/Atelier Oslo AS

Klimahuset – The Climate House – is a new exhibition building in the Botanical garden in Tøyen in Oslo. Its focus will be on communicating knowledge of climate change and the world´s climate. Through an interaction between high and low technology and the use of innovative and local materials, including a significant amount of wood, the Climate House will show the way to the building solutions of the future.

**Low carbon strategies**

- Zero emission building (in accordance with ZEB-COM)
- Decentralised energy production with PV panels
- Natural ventilation (chimney effect)
- Use of local materials including a wooden structure/low-carbon concrete
- Fossil free building site

**Project information**

- Client: Estate Services/University of Oslo
- Architect: Lund Hagem Architects, Atelier Oslo
- Contractor: Seby AS
- Estimated completion: 2020

## Nydalen Vy/Oslo

Ill.: Snøhetta/MIR

Nydalen Vy is a mixed-use building with 16 storeys where the office part of the building is planned with purely natural ventilation. Despite this the building will almost meet zero-energy level and not require externally supplied energy for ventilation, heating or cooling. The building will demonstrate that environmental buildings can be made more simply than today.

**Low carbon strategies**

- 'Triple-zero': 0 kWh delivered energy for ventilation, heating and cooling
- Natural and hybrid ventilation
- Building-integrated solar panels on the roof and roof gardens
- Location next to a public transport hub, no parking for cars in the building
- Material use and solutions with low maintenance and replacement requirements, simplified operations and a long service life

**Energy consumption**

- Offices/housing/business:
- Net energy: 56/103/120 kWh/m² year (NS 3031)
- Supplied energy calculated: 24/45/57 kWh/m² year (NS 3031)

**Project information**

- Client: Avantor AS
- Architect: Snøhetta AS
- Consultants: Skanska Teknikk/Skanska Norge, Erichsen & Horgen AS, Fokus rådgiving AS, Brekke & Strand Akustikk
- Estimated completion: 2021

## Nydalsveien 32B/Oslo

Ill.: SAAHA AS/Lala Tøyen

I LOVE NYDALEN is the slogan of the winning team in the design competition for the development of Nydalsveien 32B. Ten teams were challenged to show how the historical industrial building at Nydalsveien 32B can be preserved, while at the same time building new high quality climate-friendly residences.

**Low carbon strategies**

- Nearly net-zero energy building 'active house technology'
- Reuse of an existing, listed building, reuse of building materials
- Extensive use of timber will be explored
- Green roofs, local surface water solutions, urban farming
- Location close to public transport and good facilities for indoor bike parking

**Project information**

- Client: Avantor AS
- Architect: SAAHA AS
- Landscape architect: Lala Tøyen AS
- Consultants: Gether AS, Asplan Viak, Degree of Freedom AS, WSP Engineering AS



## Posthuset, Biskop Gunnerus gate 14/Oslo

Ill.: Authors of the winning concept

Nordic Built Challenge was an open, interdisciplinary design competition with climate-friendly building rehabilitation as the theme. Five buildings, one in each of the Nordic countries, were included in the competition, and Norway participated with Posthuset. Urban Mountain was the winning concept. The building is conceived as a sustainable organism with a focus on clean air, natural/hybrid ventilation, sensory environments with green plants, water, light and shade, comfort and high technology, and smart solutions.

**Low carbon strategies**

- Centrally located with a direct connection to Norway´s largest public transport hub
- Energy use is halved and the ambition is for zero energy
- "Cradle to Cradle" as design strategy, including re-use of the existing primary structure and other materials and components
- Reallocation of underground parking from cars to bicycles

**Project information**

- Client: Entra ASA
- Competition: november 2012–november 2013
- Winner team: schmidt hammer lassen architects, LOOP architects, COWI (DK og NO), Transsolar Energietechnik GmbH and Vugge til Vugge Danmark

## Lilletorget 1/Oslo


Ill.: Code: arkitektur as

Lilletorget 1 has a very central location in Oslo by Akerselva river and Vaterland Park. Oslo S, the country´s largest public transport hub, is only minutes away. The new office building of 27 storeys will replace the current building on nine storeys, and is planned as a plus house with 8,300 m² integrated PV on the roof and the façades.

**Low carbon strategies**

- Plus house: production of excess energy at a minimum of 2 kWh/m²
- C2C principle: reuse instead of just recycling
- Use of rainwater for cooling and plants for air filter
- Especially well planned solutions for bicycles
- A study area for urban biodiversity is integrated in the project

**Low carbon strategies**

- Client: Entra ASA
- Competition: 2014–2015
- Winning team: Code: arkitektur as, Rambøll, Institutt for Energiteknikk

## Furuset hageby nursing home/Oslo

Ill.: NORD Arkitekter/3RW

Furuset Hageby is a new housing and treatment centre for 110 people with cognitive impairments. 3RW and NORD Arkitekter won the Furuset Hageby architecture competition in 2018 with their entry 'The green village'. The project will be designated as a plus-energy building with transparent solar cells in the pergola, wall-integrated CIGS solar cells, solar thermal collector and geothermal heat storage with a reversible heat pump for water-borne heating and potential cooling and energy storage.

**Low carbon strategies**

- Preparing to connect to the micro energy system at Furuset
- Plus house and local energy production: solar panels, PV
- Cross-laminated timber
- Green roofs and gardening
- Minimising car parking and good facilities for bikes

**Project information**

- Client: Sykehjemsetaten/Omsorgsbygg Oslo KF/ City of Oslo
- Architect: 3RW arkitekter, NORD Arkitekter
- Project management and consultants: ÅF

## Tåsenhjemmet nursing home/Oslo

Ill.: Arktema

The goal of Tåsenhjemmet is to be the world´s best nursing home, and the project´s environmental ambitions are high. One priority is to use simple passive solutions to meet the requirements of a plus house with low greenhouse gas emissions. Built in cross-laminated timber, it will deliver excellent indoor air quality. Tåsenhjemmet also has the ambition of being a new meeting place for the local community in the area.

**Low carbon strategies**

- Plus-energy house
- PVT (PhotoVolatic/Thermal) on the roof
- Cross-laminated timber and extensive use of exposed wood
- Innovative low carbon concrete
- Fossil free construction site

**Project information**

- Client: Omsorgsbygg Oslo KF/City of Oslo
- Architect: Arkitema Architects
- Main Contractor: HENT AS
- Estimated completion: 2021

## Våronnveien 17/Oslo

Ill.: Helen&Hard

Våronnveien 17 is a housing project initated by the largest Nordic cooperative building association, OBOS. A limited architecture competition challenged the participants to think innovatively with respect to climate, area efficiency and new housing solutions. The vinner team presented a near-zero-energy building in cross-laminated timber with strong social solutions and innovative floor plans. The building will include green roof terraces where it will be possible to grow vegetables.

**Low carbon strategies**

- Zero-energy building and local renewable energy
- Cross-laminated timber
- High density hybrid typology and social housing forms
- Small units with access to shared spaces, green roof
- Effective plan solutions with integrated furniture and extra ceiling height
- No parking, only carpool for two cars; good bicyle facilities

**Project information**

- Client: OBOS Nye Hjem
- Architect: Helen & Hard Oslo
- Estimated completion: 2020

## Fyrstikkbakken 14/Oslo

Ill.: Link arkitektur as

Fyrstikkbakken 14 consists of approximately 118 flats. The housing project will facilitate a forward-looking and climate-smart lifestyle for its residents and neighbours. The buildings are planned with cross-laminated timber and solar panels, and solar collectors will harvest energy for electric bicycles, electric cars and for the homes. Compact buildings and smart flat layouts will attract different groups of buyers.

**Low carbon strategies**

- Near-zero energy buildings
- Local renewable energy will be produced on site
- Cross-laminated timber construction and new type of low carbon concrete
- Building control system as an app for the residents
- Fossil free building site

**Project information**

- Client: Birk & Co AS
- Architect: LINK Arkitektur AS

## Landbrukskvartalet/Oslo

Ill.: Transborder Studio AS.

Landbrukskvartalet in the centre of Oslo has since the early 20th century had dairy operations and later been office for agricultural organisations. Landbrukskvartalet will be a showcase for how agriculture is contributing to the green shift at both the urban and the construction industry levels. The project will be the first complete city block in the FutureBuilt programme and a showcase for climate-friendly urban development.

**Low carbon strategies**

- Car-free city life
- Zero energy and smart city
- Urban wooden buildings
- Circular economy and reuse of building materials
- Food production and greenery

**Project information**

- Client: Landbrukskvartalet Utvikling AS
- Architect: Transborder Studio AS, Asplan Viak
- Support Enova: MNOK 1,0

## Oksenøya centre/Bærum

Oksenøya center is the first and largest project for the municipality of Bærum where purpose buildings for young and old are co-located on the same site. A 5-parallel primary school, kindergarten for 300 children, multi-use hall, 9-art football pitch, local environment facilities and living and treatment center with 150 residential units will be established.

**Low carbon strategies**

- Zero emission neighbourhood
- Reduction in energy consumption of approx. 65 percent compared to TEK17
- Solar cells of approximately 2,550 m²
- BREEAM-NOR Excellent (option Outstanding)
- Rubber granules are replaced by other types of artificial turf which safeguard the functionality
- Green mobility, facilitating the least possible car-based traffic through good and traffic-safe solutions for cyclists and pedestrians

**Project information**

- Client: Bærum municipality
- Architect: Bølgeblikk arkitekter as
- Landscape architect: Bjørbekk & Lindheim AS
- Contractor: Veidekke Entreprenør AS
- Estimated completion: 2022/23

## Drammen hospital area/Drammen

Photo: Birgitte Simensen/Drammen municipality

In 2018 the municipality of Drammen and Vestre Viken helseforetak invited to a parallel project for proposals for the existing hospital area with surroundings. Drammen hospital will move to Brakerøya in 2025, and an area of 10 hectares close to the city centre of Drammen will be transformed with the goal of establishing a zero emission neighbourhood.

**Low carbon strategies**

- Zero emission neighbourhood
- Circular resource use, reuse of existing buildings and materials
- Near-zero energy area, use of renewable energy
- Storm water management
- Green mobility

**Project information**

- Client: Drammen municipality, Sykehuset Vestre Viken Helseforetak
- Parallel assignment 2019

## Kringsjå family homes/Oslo

Ill.: LMR arkitektur

Kringsjå Student Village expands with 82 new family homes. Here, good experiences with the cross-laminated timber construction and ambitious energy solutions from the Kringsjå student housing, completed 2017/2018, will be continued. The project consists of three single-storey buildings from three to four floors with flats about 50 m². Three different solar cell solutions will be tested on the roof.

**Low carbon strategies**

- Zero emission energy
- Test of different PV panels on the roof
- Cross-laminated timber construction
- Good bicycle facilities
- Fossil free construction site

**Project information**

- Client: Studentsamskipnaden i Oslo og Akerhus
- Architect and landscape architect: LMR arkitektur as
- Contractor: Seby AS
- Estimated completion: 2020

## Sofienberggata 7/Oslo

Ill.: tegn3

The apartment building at Sofienberggata 7 in Oslo is being rehabilitated. New highly-insulated façades, a new ventilation system, thermal energy wells and solar energy collection on the roof and the façades will reduce energy consumption by more than 70 percent. The underground parking garage will be converted to a green mobility and sharing centre, the contents of which are yet to be decided.

**Low carbon strategies**

- Ambitious energy rehabilitation
- Photo voltaic cells on the roof
- Climate-friendly materials
- Conversion of parking lots in the garage for alternative use
- Social meeting place

**Project information**

- Client: Boligbygg Oslo KF/City of Oslo
- Architect and landscape architect: Tegn 3 AS
- Estimated completion: 2020

## Ruseløkka School/Oslo

Ill.: Arkitektkontoret GASA AS.

Ruseløkka school in Oslo will be a primary and secondary school for 690 students with many special rooms such as a large dance hall and a family room adapted for cultural activities also after school hours. The school is a test field for re-use of old building materials. It is also planned with flexibility and changing utility models in mind to have the possibility to reconstruct the building with minimal impact on technical facilities and existing building mass.

**Low carbon strategies**

- Near-zero energy building
- PV on roof and walls
- Pilot for new low carbon concrete
- Reuse of building materials
- Fossil free construction site

**Project information**

- Client: Undervisningsbygg Oslo KF/ City of Oslo
- Architect: Arkitektkontoret Gasa AS
- Landscape architect: Asplan Viak AS
- Estimated completion: 2020

## Residential units at Korpåsen/Asker

Ill.: Linje arkitektur AS

Korpåsen in Asker will be the site of 12 new homes for people with reduced abilities. The flats are divided into three groups of four units each, placed around a shared courtyard. They are planned as near-zero energy homes with innovative use of wood and biomass-based solutions in the structural elements and on indoor and outdoor surfaces. Solar collectors will be installed on the roof, and the units will have simplified, building-integrated ventilation solutions.

**Low carbon strategies**

- Close to zero energy standard
- Simplified, building-integrated ventilation solutions
- Innovative use of wood and biomass-based materials
- Fossil free building site
- Sharing of parking spaces in the area

**Project information**

- Client: Municipality of Asker
- Architect: Linje Arkitektur AS
- Contractor: Finstad og Jørgensen A/S
- Estimated completion: 2020

## Eikeli School/Bærum

Photo: Akserhus fylkeskommune

Eikeli School was built in 1960. Due to an increase in the number of students and the need for a multi-purpose community facility locally, the climate-friendly renovation and expansion of the school and sports hall is now in planning. When completed, the school will accommodate 720 students.
Eikeli school and sports hall will be built as a plus energy building, meaning that it will produce more electricity than it will use.

**Low carbon strategies**

- Plus-energy building
- Reuse existing building and building materials
- Use of cross-laminated timber and other natural materials for the new building
- Test of batteries to store energy
- Fossil free building site

**Project information**

- Client: AFK Eiendom FKF
- Architect zoning plan: Lerche arkitekter AS
- Estimated completion: 2021

## Zero emission facility for industrial waste/Drammen


At Eikhaugen in Drammen Ragn Sells AS wants to establish a zero emission facility for treatment of industrial waste. The plant will have built-in and closed processes that prevent emissions to air, soil and water and also minimise the danger of noise, dust and odor to the neighborhood. The project wants to look at the possibilities of demonstrating large-scale, industrial and repeatable utilisation of recycling materials.

**Low carbon strategies**

- Plus energy house
- Local renewable energy
- Selection of preferred simplified ventilation solutions
- Green mobility plan for the operation of the facility
- Electrification of the machinery, alternative low-emission fuel

**Project information**

- Client: Ragn-Sells AS
- Architect/landscape architect: Asplan Viak AS

## Kristian Augusts gate 13/Oslo

Ill.: Mad arkitekter

Kristian Augusts gate 13 is an existing office building from the 1950s which is located in the centre of Oslo. The existing building has eight floors and will be retained. A new extension with a base area of 50 m² will be built in the quarter with the same height as the existing building. The project will be a pilot project for the reuse of buildings and building materials, where also the new extension will be built of reusable materials and get what the quality program calls a “clear reuse ethics”.

**Low carbon strategies**

- Reuse of building and materials
- Reusable materials
- Near-zero energy for the new building
- Green roof

**Project information**

- Client: Entra ASA
- Architect: MAD arkitekter
- Estimated completion: 2020

## The logistics building at the Royal Palace/Oslo

Ill.: NAV A.S Arkitekter

The logistics building is a sustainable and future-oriented new building that will be the first to be built on the Palace property since King Haakon and Queen Maud expanded the Royal stables more than 100 years ago. The building is 1,000 m² and will be placed discretely by the existing stables and Dronningparken. The building will be a positive example of how a new building can be integrated into a formally protected cultural area.

**Low carbon strategies**

- Innovative materials and piloting the use of slag/ hybrid concrete
- Minimum ‘near zero energy’ with an ambition of plus-energy
- Building-integrated solar cells, customised to be in keeping with the listed surroundings
- Bicycle facilities for all of the employees of the Palace

**Project information**

- Client: Statsbygg
- Architect: NAV A.S Arkitekter
- Landscape architect: Link Landskap
- Estimated completion: 2020

## Bike hotels in Oslo and Bærum

Ill.: SPISS Arkitektur og Plan AS

In 2017, the municipalities of Oslo and Bærum collaborated with FutureBuilt on an architectural competition for a bicycle hotel concept. The winning project, “The bicycle wave”, has a rolling wall in wood that can adapt to different locations. The bicycle hotels will provide an opportunity for attractive and safe bicycle parking in connection with the metro network, as well as contributing to the upgrading of the station environments. Oslo chose two sites in the competition, one at Grorud and one at Ryen metro station. The Bærum sites are located at Østerås and at Kolsås metro station.

**Low carbon strategies**

- Contribute to increased bicycle use
- Constructions and material use based on “cradle-to-cradle” and possible reuse
- Fossil free construction site

**Project information**

- Client: Bymiljøetaten/City of Oslo and Prosjektenheten/Bærum municipality
- Architect: SPISS Arkitektur og Plan AS
- Estimated completion: 2019

## Furuset/Oslo

Photo: Jens Fremming Anderssen

Furuset is an area project in FutureBuilt, and the 1970´s suburb will be developed to be an example of climate-friendly city development.

Five prioritised projects will form the starting point for the desired development of the area. The projects have been chosen on the basis of feasibility and the effect the initiatives are expected to have on greenhouse gas emissions, the overall project goals, and the potential for learning to be transferred to other projects. The city council is central to the execution of these five projects and will lead the way in defining the desired development of the area.

1) Climate-friendly building: The city council will test out new ways of developing its own properties that contribute to climate-friendly city development.
2) Trygve Lies plass: This square will contribute to make the spaces Bygata and Trygve Lies plass attractive, and will also show in practice how pedestrians, cyclists and public transport can be given clear priority.
3) Energy solutions: A climate-friendly, economically-viable, innovative and attractive energy solution for the area.
4) New school
5) New nursing home

## Hamang/Bærum

Photo: Tove Lauluten

Hamang and Industriveien cover an area of about 310 hectares and lie approximately 500 metres from the Sandvika train station. The area was previously an important industrial area and continues to house many businesses. Running through the area is Sandvikselva (Sandvika river), which is an important asset for biodiversity and recreation. The E16 motorway currently crosses through the area, but the road is being relocated in a tunnel, which will be completed in 2019. This will free up large areas for other use.

Sandvika city council approved a council master plan in 2010, which designated the area to housing and commercial use in addition to park and recreation. Within the area there is space for 1,500 to 2,000 homes.

**Low carbon strategies**

- Reuse of industrial buildings and high environmental qualities for the new development
- Handling the storm water challenge as an important design parameter
- Use of the BREEAM Communities system for the planning process

## Strømsø/Drammen


Photo: Tove Lauluten

Strømsø is an area in the city of Drammen that will be developed into a low carbon neighbourhood with both businesses and residences. Drammen´s train station, which is the fourth busiest in Norway, is located in Strømsø. In 2009 a competition was announced for the development of the area. Norconsult and Alliance architects won with their suggestion 'Look to Strømsø'.

**Low carbon strategies**

- Increased density with high architectural and environmental quality
- Increased energy-efficiency of the existing building stock
- FutureBuilt pilot projects located in the area

## FutureBike


Photo: Sverre Chr. Jarild.

FutureBike is a joint political declaration of intent concerning bicycle initiatives that Oslo, Bærum, Asker and Drammen municipalities aim to cooperate on leading up to 2020. The national cross-party climate agreement states that all growth in personal transport in Norway´s capital region will be with public transport, walking and bicycles. This is the background for the declaration by the FutureBuilt municipalities.

The FutureBike declaration includes the following initiatives:

1) Ambitious standards for bicycle parking
2) The municipality leads the way – bike-friendly municipal organisations
3) Bike & Ride – bike-friendly public transport stations and hubs
4) Building a bike culture amongst children and teenagers

# What is FutureBuilt

FutureBuilt´s vision is to show that climate neutral urban areas, based on high quality architecture, are possible. The aim is to complete 50 pilot projects with the lowest possible greenhouse gas emissions. These prototypes will also contribute to a good city environment.

Man-made climate change is one of the big challenges of our time. Our climate gas emissions must be reduced drastically, and this will in turn have big consequences for urban planning and architecture. The Oslo region is the largest urban area in Norway. The region is rapidly expanding, and this implies development of new housing, workplaces and transport infrastructure.

To support climate friendly urban development the municipalities in the western part of the Oslo region – Oslo, Bærum, Asker and Drammen – have launched FutureBuilt.

The pilot projects are set to reduce greenhouse gas emissions from transport, energy and material consumption by at least 50 percent. They will involve high quality architecture and contribute to a better environment for urban dwellers. The pilot projects are meant to inspire and change practices in both the private and the public sector.

By May 2019 FutureBuilt includes 52 pilot projects dealing with:

- Urban areas
- Schools
- Kindergartens
- Office buildings
- Cultural centres
- Housing projects
- Nursing homes
- Swimming pool
- Cycling projects

**Partners**

FutureBuilt is a collaboration between 10 partners: The municipal authorities of Oslo, Bærum, Asker and Drammen, the Ministry of Local Government and Modernisation, the Norwegian State Housing Bank, Enova (Norwegian energy national fund), the National Office of Building Technology and Administration, the Norwegian Green Building Council  and the National Association of Norwegian Architects.

**FutureBuilt partners:**

Oslo

DRAMMEN KOMMUNE

BÆRUM KOMMUNE

Asker kommune

KOMMUNAL- OG MODERNISERINGSDEPARTEMENTET

Norske arkitekters landsforbund

GRØNN BYGGALLIANSE

DIREKTORATET FOR BYGGKVALITET

Husbanken

ENOVA

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