Ministry of Foreign Affairs

Market study: sustainable building in Norway

Commissioned by the Netherlands Enterprise Agency

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MARKET STUDY

SUSTAINABLE BUILDING IN NORWAY

May 2021
FOG Innovation
For the Embassy of the Kingdom of the Netherlands in Norway

FOG

Kingdom of the Netherlands

Executive Summary

Increasing client demands, ambitious targets and policies to combat climate change and other challenges in society are putting sustainability higher on the agenda in the construction sector. The sector's significant contribution to emissions and resource use, together with the growing need for housing and urban development around the globe, contributes to the increased focus.

Together with its Nordic neighbours as well as the Netherlands, Norway is seen as one of the pioneers when it comes to sustainable building. In the light of this, and the increasing focus on the construction sector's important role to meet sustainability ambitions, the Regional Business Development (RBD) team of the Embassies of the Kingdom of the Netherlands in the Nordics has identified sustainable building in the construction sector as an interesting market for collaboration between the Nordics and the Netherlands. In order to gain more market intelligence a market study on the sustainable building sector in Denmark and Sweden was commissioned in late 2020. This is now followed by this 2021 study on the sustainable building sector in Norway.

This market study shows that there are many interesting opportunities for business and collaboration between the Netherlands and Norway when it comes to sustainable building. These are especially connected to the topics of circular construction and resource use (specifically in the areas of reuse and waste free construction sites) and renewable energy systems (specifically in the areas of zero energy building and energy renovation and emission free construction sites).

Top business opportunities identified within these topics are:

- Digital solutions for identifying, documenting and matching demand and availability of products and materials for reuse
- Accessible and effective ways of dismantling buildings, components and products for reuse in other projects
- Solutions for prefabrication of building elements and products, eliminating waste
- 3D printing technology for on- or offsite production of products and elements adapted for their final use
- Solutions for recovering and reusing leftover materials on construction sites
- Innovative energy technology for new buildings that can meet the Norwegian climate conditions
- Affordable and attractive solutions for energy renovation for homeowners that are easy to implement
- Energy infrastructure providing holistic solutions for renewable energy on emission free construction sites
- Mobile solutions for charging and extra power, such as containers with batteries and charging solutions
- Logistic systems and digital solutions that support the function of local micro-grids
- Solutions for emission free heat on construction sites

Also, there are opportunities for collaboration, especially within circular construction, where many Norwegian actors see the Netherlands as a pioneer. Top collaboration opportunities identified in this study are connected to exchange around pilot projects in reuse, possibilities to increase incentives through procurement requirements, measuring and comparing different circularity measures and the concept of buildings as material banks.

In summary, the construction sector in Norway is considered to be doing quite well when it comes to sustainability but acknowledges challenges ahead. This sets the bar high for Dutch players to provide relevant technology and knowledge but also gives the opportunity to grow and develop together. Building stronger networks with actors from the two countries to share experiences from projects and discuss common challenges can be a good place to start the journey towards more collaboration.

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1 Introduction

Norway and the Netherlands have enjoyed strong trade ties for hundreds of years. Already the Norwegian Vikings are known to have sailed the Dutch rivers to trade and a large part of Amsterdam is built on poles made by Norwegian timber. Today the ties remain close through trade, culture and politics. The two countries are seen as pioneers in sustainability and have high ambitions to cut greenhouse gas emissions and move towards a renewable and circular economy.

In the light of the increasing focus on the construction sector's important role to meet sustainability ambitions, the Regional Business Development (RBD) team of the Embassies of the Kingdom of the Netherlands in the Nordics has identified sustainable building as an interesting market for collaboration between the Nordics and the Netherlands. The RBD Team has therefore formed the ambition to connect the Scandinavian construction industry with the Dutch market. In order to gain more market intelligence, the Embassies and the RBD team, in partnership with FME and InnovationQuarter, first commissioned a market study on the sustainable building sector in Denmark and Sweden in late 2020. This is now followed by this 2021 study on the sustainable building sector in Norway.

1.1 Scope of the Study

The scope of this market study is to investigate the market of sustainable building in Norway and identify topics and market segments for Dutch companies to export to, invest in and collaborate more with the Norwegian sustainable building sector. It has done this by identifying the challenges this market will face in the next years and examining how Dutch technology and innovative solutions can contribute. The main questions that are answered throughout this report are:

- What are the starting points in the sustainable building sector in Norway?
- What topics will be important for a continuing sustainable development the coming five years?
- What are the main challenges within these topics and how could international partners play a part?
- What are the opportunities to set up or intensify cooperation between the Netherlands and Norway in (parts of) specific value chains?

The market study focuses on people-oriented buildings, investigates all parts of the building life cycle and different sustainability-topics (see Figure1). The methodology used and further information can be found in Appendix 2-Methodology.

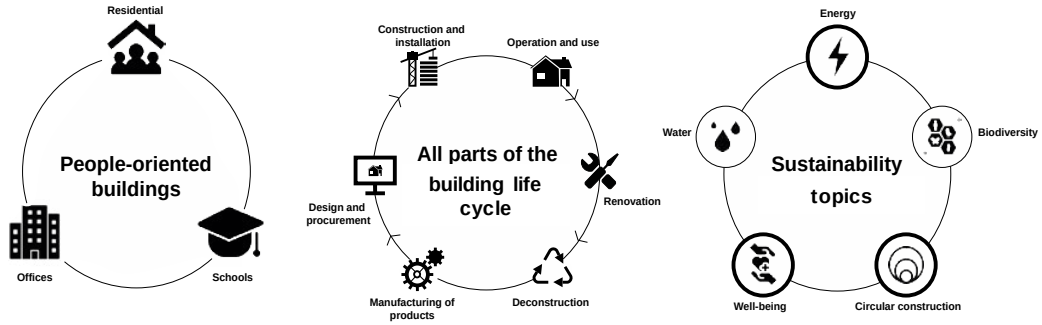


Figure 1. Topics included in the study

1.2 Background - Sustainability and the Built Environment

The global built environment is responsible for up to 40% of global waste and almost 40% of global energy-related CO2 pollution. At the same time, due to increasing population, demographical changes and urbanisation, the world-wide building stock is set to double by 2050. This will increase the pressure from the built environment on climate change and on material resource depletion and presents an important opportunity for change [1] [2].

Sustainability is an important trend in the construction sector and the World Green Building Council reports growth in green building activity across the globe, with dramatic increases expected across all five continents in 2021 [3]. Other studies also suggest a growing interest in environmental and social sustainability across the construction value chain as well as in clients demands [2] [4].

As can be seen throughout this report, this trend is also present in the Norwegian construction sector. With ambitious goals to combat climate change and sustainability increasingly seen as a competitive advantage for policy makers as well as companies across the construction value chain, Norway can be seen as a pioneer in the shift to more sustainable building practices [5] [6].

1.3 Some Basic Facts

Before diving into the market for sustainable building in Norway, this chapter includes some basic facts about Norway, highlighting some of the similarities and differences between the Netherlands and this Nordic country.

There are of course similarities between the Netherlands and Norway: both being coastal countries in western Europe with the corresponding changing of seasons and need for buildings adapted to that. However, Norway stretches much further to the north and has more extreme weather conditions to relate to.

Unlike the Netherlands, Norway is not a member of the European Union (EU) but is a part of the European Economic Area (EEA) and therefore forms a tight relationship and association with the EU. This means Norway is part of the European single market, governed by the same basic rules such as free movement of people, goods, services and capital. Many EU laws and policies, especially within sustainability, are adopted by the Norwegian government and Norway is often part of EU funding schemes such as Interreg and the new Horizon Europe.

Country size and population

Norway has a population of around 5,3 million people and 2,4 million households (see figure 2). Around 1 million people live in the Oslo urban area and the population is concentrated to the southern parts of the country. At the same time Norway has a goal of ensuring that the whole country stays accessible and attractive. To support this there are proactive rural and regional policies and continuous investment in infrastructure, commerce and industry in all parts of the country and universities as well as institutions for education and research are spread out. This has led to good living conditions throughout Norway and

relatively minor regional differences. Since the 1980's the focus has shifted more towards development of regional urban centres and deregulation. Still, compared with the other Nordic countries, Norway stands out with its focus on sustaining existing settlement patterns [7].

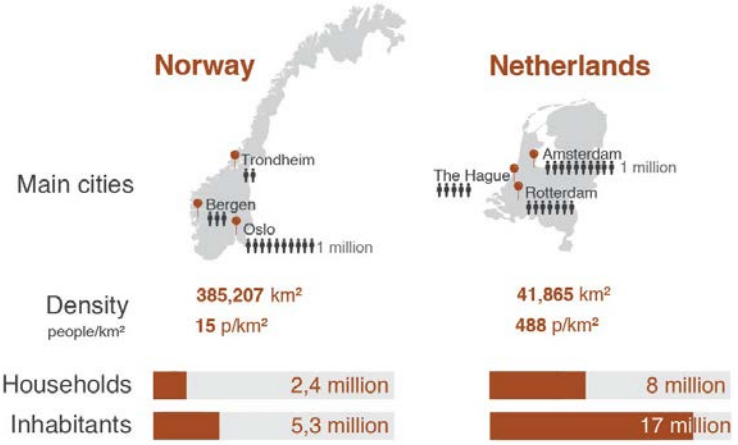


Figure 2. Basic facts of Norway and Netherlands

Building stock and ownership

The building stock in Norway shows a mix of buildings from different time periods. As seen in Figure 3, most residential dwellings were built in the period following the Second World War (1945-1969) and a majority before 1980. This is similar to the building stock of Netherlands. The largest difference lies in the large amount of newer residential dwellings in Norway, more than 10% of the buildings stock has been built after 2010. Most residential dwellings, around 90%, are privately owned in Norway. In contrast to the Netherlands, where social housing is quite prominent, only 4% of the dwellings are owned and rented out by Norwegian municipalities as a form of social housing [8] [9].

When it comes to commercial buildings there are many larger and smaller owners. Statsbygg is one of the larger real estate developers, being the builder commissioner and operator of buildings for all buildings that belong to the Norwegian government. With the operation of 2300 buildings, (around 2.9 million square metres) it is one of the largest property operators in the country [10]. Other public actors, such as municipalities, have their own developers and operators, often with high ambitions on sustainability. Other larger real estate owners with a clear focus on sustainability, include Avantor, Storebrand, Ticon, Entra, KLP, ROM, Höegh, DNB and AspelinRamm [11].

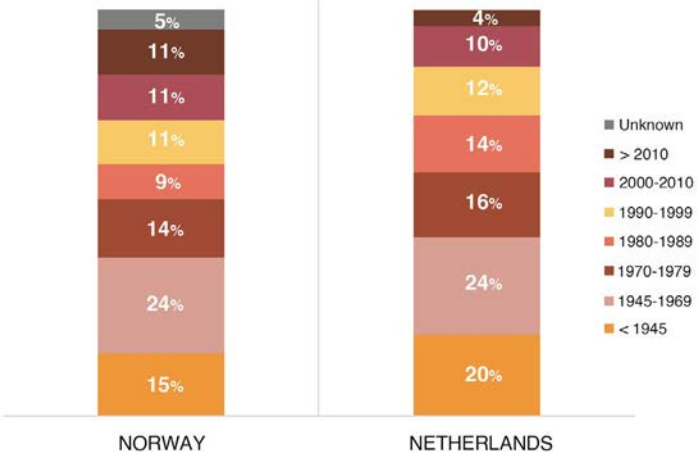


Figure 3. Building stock and construction year for residential dwellings in Norway and the Netherlands

2 The Construction Sector in Norway

2.1 Market Starting Point

The construction sector in Norway is an important part of the economy with 260 000 people employed in the sector and a share of 14% of GDP (the second highest share in Europe, only beaten by Finland). The investments in construction of total almost € 50 billion in 2019 were quite evenly distributed between new construction of buildings, renovation and rehabilitation and infrastructure (see Figure 4).

The turnover and output from the construction sector has seen a continuous growth in Norway the last 25 years. Today, similarly to the other Nordic countries, the growth in investment continues but the pace of growth is slowing. This trend is seen in residential, commercial as well as public buildings. Looking to the coming years, a few things can be said about the trends in these sectors respectively [9] [12] [13].

Residential: around 30,000 new residential dwellings are being built in Norway each year.
The growth in investment as well as the growth in number of new projects is slowing down but expected to stabilize after 2021. There is a continued need for new residential projects, especially in the Oslo region. The gap between housing requirements and completed projects has been narrowing but looks like it will start to grow again (see Figure 5).

Commercial: The short-term investment in development of commercial buildings is expected to decline, by around 4% for 2021 and around 7% for 2022 (see Figure 6). This is probably due to more cautious investors and an uncertainty of the future use of office space after the pandemic. However, in the longer term, this is expected to catch up.

Public buildings: Investment in public buildings in Norway is on the rise and this is expected to continue. Especially hospital projects, and to some extent schools, are expected to see an increase in investment (see Figure 7).

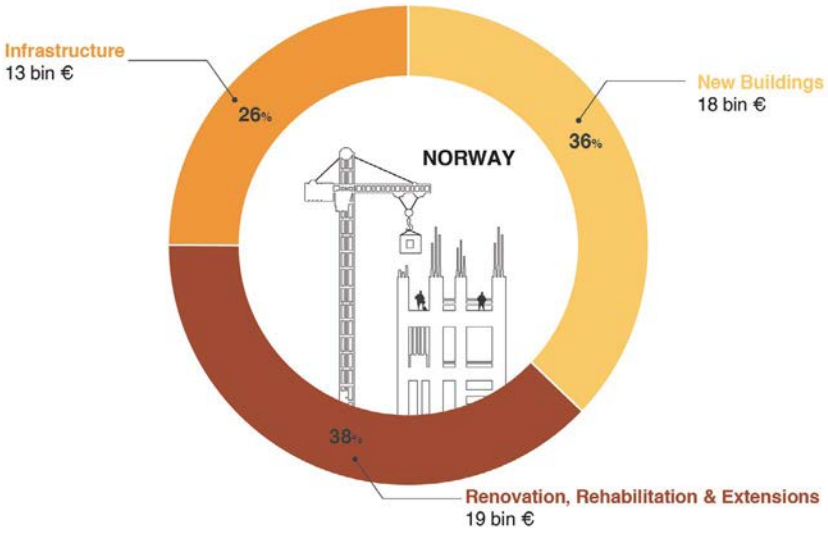


Figure 4. Investments in the Norwegian construction sector in 2019 [33]

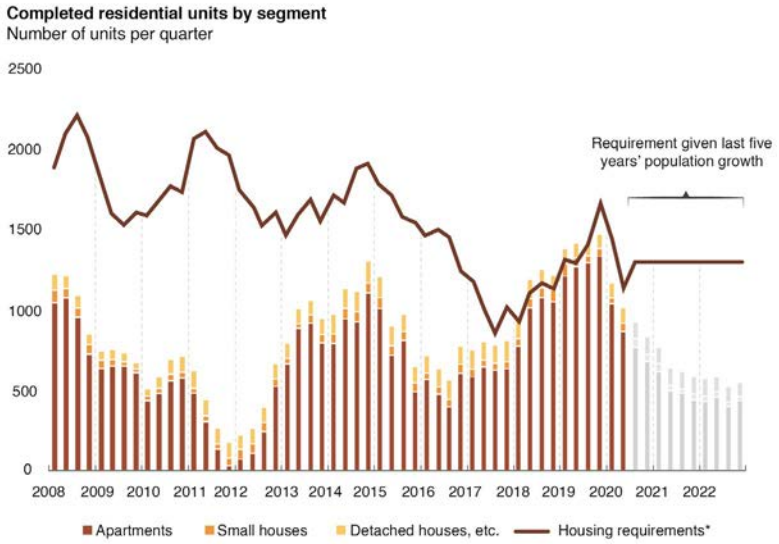


Figure 5. Production trends in the Norwegian construction sector in number of residential units completed (in the Oslo region) [14]

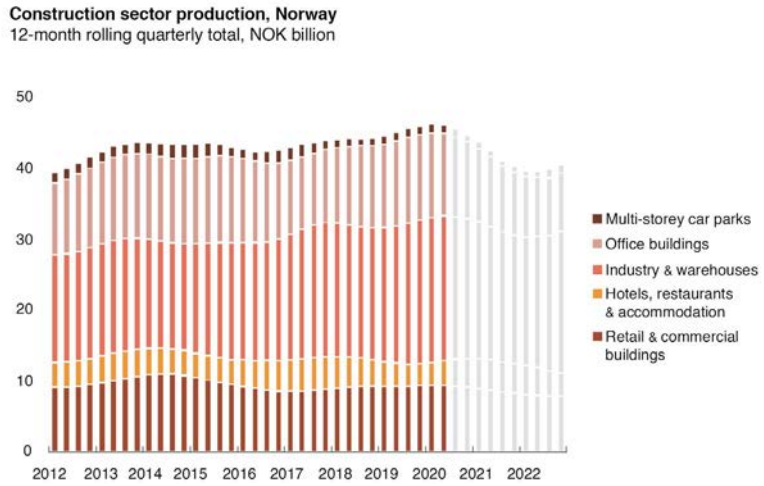


Figure 6. Investment in commercial buildings [14]

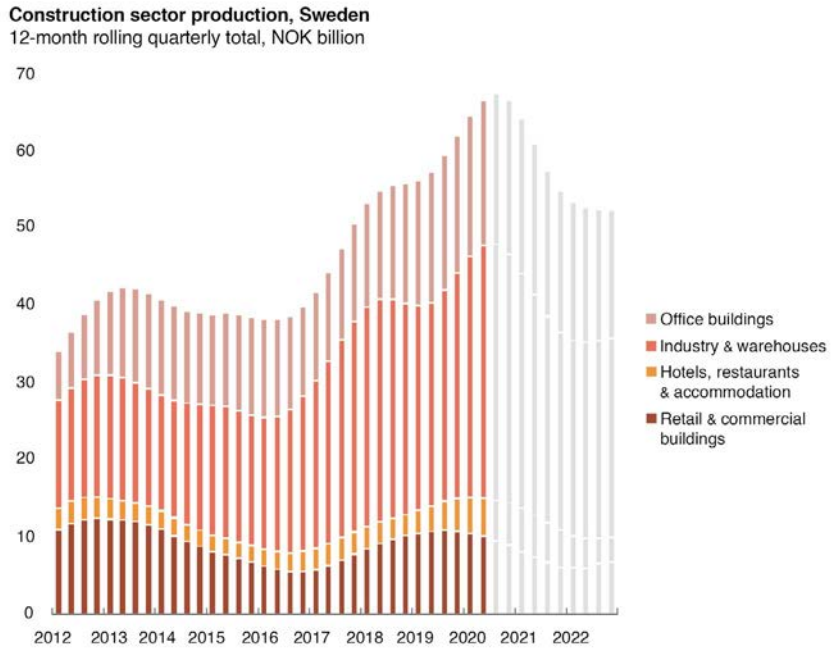


Figure 7.Investment in public buildings [14]

The influence of the COVID-19 pandemic

At the beginning of the COVID-19 pandemic, in March of 2020, the Norwegian government rapidly enforced a strict lockdown. At the same time commodity prices collapsed. Norway's economy was hit twice, contracting by 3.6% in 2020, and construction was scaled back.

The pandemic has especially influenced the residential and commercial markets. Overall, the housing market turned out to be quite resilient and the largest developers showed strong order intakes of residential projects. However, the actual start of new production of residential was negatively influenced and the expectation is lower production of residential in the short term (2021-2022). For commercial, more hesitation in new investment is seen which is expected to contribute to a decline in investment, at least in the short term[14] [15].

Overall, the Norwegian economy is expected to stabilize quite fast following the pandemic. In 2021, GDP growth is expected to increase by 2.6%, and a strong growth is also expected in 2022. However, a full recovery of the economy is not expected until the autumn of 2022 [16].

2.2 Sustainable Building in Norway

Norway is a pioneer when it comes to sustainability and has high ambitions for reducing climate emissions and environmental impact. The country has gained this pioneer position partly, but also paradoxically, due to its large oil and gas sector where revenues are known to have contributed to the country's investments in green technology. Today, Norway has very high shares of renewable energy, amounting to 98% of the energy production in 2019. These preconditions result in a different emission pattern than for the EU27, as can be seen in Figure 8. The Norwegian construction sector is responsible for around 15% of the green-house gas emissions, 40% of energy use, 40% of the resource use and 20% of waste [18] [19] [20].

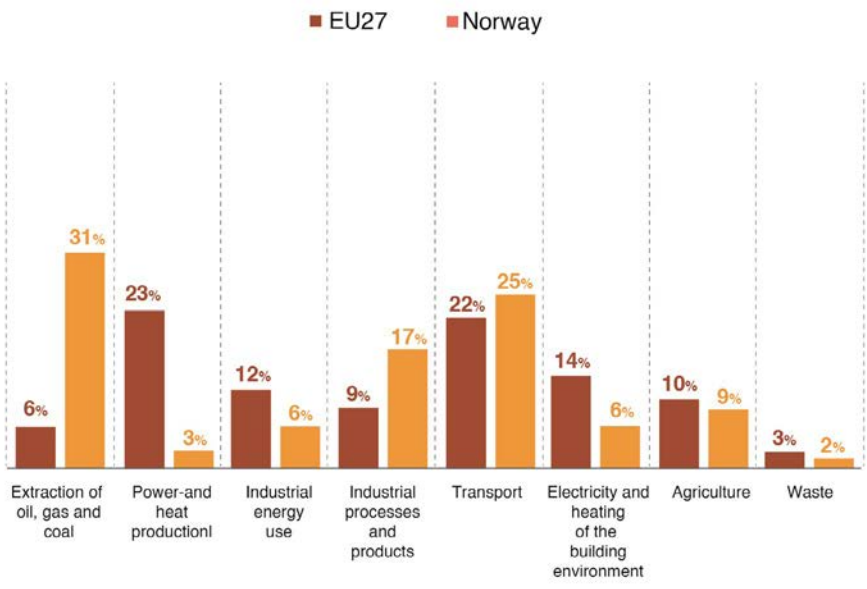


Figure 8. Share of greenhouse gas emissions from different sectors in the EU27 and Norway [17]

Due to the high share of renewable energy in the country, the emissions from construction come mostly from direct emissions on construction sites, production of materials and products and transport. This is different from most EU countries, where a strong focus lies on shifting the energy production from fossil and nuclear power to renewable energy, and heating of buildings is still an important source of emissions. Even if energy has less focus, reducing energy use in buildings is still an important topic in Norway since the share of energy used in buildings is high and the use of energy is expected to increase. After years of focus on energy measures in Norway, there is a shift in focus to resource use and waste. With one of the highest global rates of consumption and 97% of the used materials not being cycled back into the economy, Norway has a long way to go before it can be considered a circular nation.

The construction sector is heavily resource intensive. It accounts for 43 million tonnes of the entire yearly material footprint and has the second largest resource footprint after food production. Circular construction has therefore been identified as one of the keys for the transformation of Norway's economy to a more circular one [21].

When it comes to waste, the construction industry has worked together with the waste industry to achieve increased recycling of construction waste and improved management of hazardous waste. A national action plan resulted in a drop in construction waste going to landfill: from over 80% to 11% over a ten-year period. Current statistics show a total of around 79% recycling: 30% energy recovery and 49% material recycling. This is still not in line with the EU target of 70% reuse and recycling of non-hazardous construction waste and efforts continue to cut the waste produced in construction [18] [17].

Policies and national initiatives

The national climate goal in Norway is being climate neutral by 2050 with a 50-55% reduction by 2030. Some municipalities are more ambitious and especially the City of Oslo stands out with a goal of a 95% reduction of emissions by 2030 and the ambition for the construction sector to become emission free by 2030.

Policies that are supporting these climate goals, that are or will be impacting the Norwegian construction sector, include:

- A national goal for fossil-free construction sites by 2025. Oslo, together with six of the other largest municipalities in Norway (Bergen, Drammen, Kristiansand, Stavanger, Tromsø and Trondheim), have launched a more ambitious target of fossil-free construction sites by 2021 and emission free by 2025 [22].
- A national ban on using fossil oil for heating of people-oriented buildings (since 2020) and for heating and drying during construction and rehabilitation. Also, there are moves to ban the use of natural gas for heating [17] [18].
- Increasingly stricter regulation in the building code, especially connected to energy use. The energy requirements for buildings are still becoming stricter. Since 2015 the requirements are passive house level and the government is working on new requirements that will be close to energy neutral[17] [23].
- The Norwegian standard for green house gas calculations for buildings (NS 3720:2018 "Method for greenhouse gas calculations for buildings").

- The climate action plan for 2021-2030, focusing on electrification, circular economy and energy measures in the built environment was presented by the Norwegian government in the beginning of 2021 [17]. For now, this has not led to any concrete measures for the construction sector.[1]
- The law for sustainable public procurement: environmental criteria should be weighted with minimum of 30 per cent in public procurement.

There is, however, criticism that these policies do not do enough to drive the sustainable building agenda in Norway. Rather, local public actors, together with private developers and product manufacturers are pushing each other to achieve more ambitious targets. This has led to more use of sustainable materials such as timber, a massive shift towards low-emission concrete and buildings that go far beyond the national energy target [23]. Initiatives that are an important driving force in the sustainable building agenda in Norway are:

FutureBuilt initiative with actors in and around the Oslo area focusing on the development of demonstration projects that showcase excellence in energy efficiency or environmental qualities. The goal of the programme has been to develop 50 pilot projects that show a reduction in greenhouse gas emissions by 50% with a focus on cutting emission from transport, energy and materials.
Bygg21 launched in 2011 as a public–private strategic partnership platform with the goal to establish and document best practices. The initiative has developed a guide for project developers to become more sustainable in all parts of the buildings process. Since 2019, the initiative has been taken over by actors in the construction sector.
Grønn Byggallianse the Norwegian Green Building Council, driving the sustainability agenda in the construction sector and work with sustainable certifications such as BREEAM-NOR.

Building certifications

Tenants, brokers, investors and banks in all of Norway have begun to request third-party certified documentation of a building's environmental properties. In Norway, BREEAM-NOR is by far the most common third-party documentation that is requested and used. This Norwegian version of BREEAM was launched in 2011. Since then, a large majority of building developers have adopted this certification and, even though it remains voluntary, it is now considered more or less a hygiene factor. In 2013, 70 per cent of the new office buildings in Oslo achieved or were in the process of obtaining a BREEAM certification, now this is almost at 100 per cent. The tool is also widespread in other parts of the country[18].

Financing and funding

Financing in and funding of the construction sector in Norway mostly requires sustainability measures, often connected to a certain sustainability certification level. This will be further enforced with the new EU Taxonomy for financing where, for instance, there is a condition for energy use in new buildings.
The Norwegian government has announced a few different funding schemes in the last year, all connected to restarting, and at the same time greening, the economy after the effects of the COVID-19 pandemic.

1 The Norwegian parliament voted on the plan in April 2021, showing little unity and only agreeing on a few of the many concrete measures presented. This shows a political union in that something needs to be done but a continued divide in what that should be.

Around € 10 million have been announced for the transition to a circular economy in Norway (however, no specific allocation for funding of circular construction). Furthermore, considerable funding has been announced for innovation and green technology development. The construction sector is not pointed out specifically as a receiver of this funding, but the renewable energy sector is.

These funding schemes have been, or are expected to be, announced and distributed through the public funding organisation Enova. This is the national platform for handing out public funding for the transition to a low-emission society. Enova has funding schemes for private consumers as well as companies. Funding is mostly aimed at Norwegian companies and their partners but this changes depending on the funding scheme. Areas for funding aimed at companies in the construction sector can be found here. In the spring of 2021, there is funding for emission free construction sites, concept studies for innovative energy and climate solutions and development of green business models. For private consumers there is funding available for instance for energy measures (see the technologies that can get funding here).

2.3 Main trends in the sector

Looking at the developments around policy, funding and pilot projects, the main trends and developments for the Norwegian construction sector in general and sustainable building in particular can be summed up as follows:

- *Shortage of residential, especially in the Oslo area and more investments and projects are expected.*
- *Investor uncertainty for the commercial market will show a decline in investment in new commercial buildings on the short term.*
- *Increased investment in health and care due to increased life expectancy and following the effects of the COVID-19 pandemic.*
- *Customers and investors are putting more emphasis on climate and cutting emissions in construction projects.*
- *Within sustainable building the focus is on:*

  Circularity and resource use:** a general discussion about circular construction and resourse use, especially linked to **reuse** and **waste free construction sites

  Renewable energy: zero-energy buildings** and the need for **energy renovation** and **emission free construction sites

3 Market Deep Dives

This market study has analysed the most prominent trends and developments within sustainable building in Norway, taking different aspects of sustainability into account, in order to identify the most relevant topics for business opportunities or opportunities for collaboration for Dutch partners. This part of this report examines a selection of the most interesting topics more closely. Each market deep dive covers background, important policies and legislation, interesting actors and technologies and points out specific opportunities for Dutch partners.

It is important to note that this is one way of looking at the current developments in Norway and one selection of topics with interesting opportunities for Dutch partners. These deep dives give important insights, but this study does not claim to give the whole picture of the market and all of its opportunities. Sustainable building is a topic in development, technologies develop fast, new policies and strategies are drafted continuously and new businesses will continue to change the market. Thus, this should be seen as a snapshot of the market that is relevant the coming years.

Selected topics and areas of interest

The topics for the market deep dives have been identified through trend analysis and interviews with actors in the Norwegian construction sector. Factors that were taken into account in the selection were trends in the Norwegian sustainable building context, possible benefit from international collaboration or competition as well as current Dutch expertise and knowledge. The topics and areas that have been selected for the market deep dives are found in the table below. More information about the selection of areas of interest can be found in Appendix 2 – Methodology.

Topics	Areas of interest	Collaboration / Business opportunities
Circular resource use	Reuse	Both
	Waste free construction sites	Both
Renewable energy systems	Zero energy buildings and energy renovation	Business
	Smart energy solutions for emission free construction sites	Business

3.1 Circular Resource Use

The Norwegian construction sector is very resource intensive and accounts for 40% of the recourse use in the country and 20% of the waste produced. This material footprint, as well as the emissions from the production of materials and products, has led to a strong focus on more circular resource use in the last years. Within the concept of circular economy, reuse and waste on construction sites are getting the most attention in the construction sector at the moment. Design for disassembly and flexible use of buildings are also seen as important topics but not as widely discussed.

Reuse

Reuse is an important focus in the efforts of cutting resource use and working towards a more circular construction sector. For instance, making sure reuse and future deconstruction of buildings is possible is one of the ten most important measures identified in the road map for 2050 from the Norwegian real estate sector[24]. However, as of now, most construction companies still demolish buildings with a view to recycling rather than capturing and reusing building elements, products and materials [21]. Looking at policy, so far, there are no direct goals for increased circular economy in the construction sector in Norway. Norway has, however, requirements for waste plans when building a new building, when buildings are renovated and when buildings are demolished [25]. Also, there are moves to modernise legislation to make reuse more accessible. For instance, CE marking is suggested to no longer be mandatory when reusing materials from before 2013 [26].

Due to the lack of incentives, the market for reuse is underdeveloped and there are few companies that occupy this space. The last few years have however, showed some interesting pilot projects, such as the ambitious rehabilitation of the office building Kristian Augusts Gate 13 in Oslo and the efforts to reuse part of the hollow core slabs in the building of the new governmental area. There are some platforms dealing with the distribution and reselling reused materials from construction but there is no national marketplace.

Policy related changes are needed to scale up reuse in the construction sector. These include more direct goals that increase the incentives for reuse as well as better documentation requirements for traceability of materials and products. Alongside these policy changes, development of general knowledge of circular economy and more pilot projects are needed [25] [27] . Opportunities lie in technology and business ideas that can solve the issues of matching demand and availability, accessible information on building products and materials.

Current actors, competition & technologies

- **Resirqel** reuse consultancy and material management, has also been involved in research projects connected to the possibilities of reuse in Norway.
- **Madaster,** this Dutch company, working with digital ecosystems for materials in construction, opened an office in Norway in 2021.

- **Loopfront,** Norwegian platform for exchange of materials and materials in construction projects, launched in 2019 as “the first digital reuse platform in Norway” with a new updated form of the platform released in 2021.

Developers with high ambitions and experiences with reuse include:

- **Entra,** real estate developer that has reuse and cradle2cradle as an important part of its activities. Examples of projects are the pioneering project on Kristian Augusts Gate 13 and projects on Lilletorget 1 and Fredrik Selmers Vei 4, all in Oslo.
- **Oslo Areal,** developer with high ambitions and experience from the rehabilitation of Grensevingen 7 in Oslo
- **Undervisningsbygg,** part of the City of Oslo, developing schools and education centres. Recently started the construction of the ambitious reuse project of the Ruseløkka school where materials from the old school are reused in the new construction. Several new developments of schools will be started in the coming years, to be found here (on the national procurement site Doffin).

Suppliers of reused materials include:

- **Hoine,** Danish company for reused bricks, now also active in Norway.

Research and development within the area:

- **Sintef,** the national research agency runs the research project Rebus. The project is going to look into methods for reuse as well as develop recommendations for procurement.

Business and collaboration opportuities

Within the topic of reuse, the identified opportunities are as follows.

Business:

- Digital solutions for identifying, documenting and matching demand and availability of products and materials for reuse.
- Solutions for accessible and effective ways of dismantling buildings, components and products for reuse in other projects.

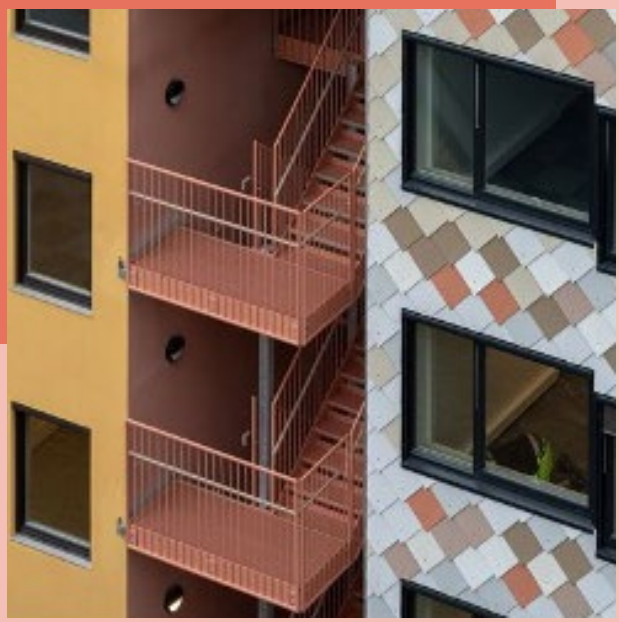
Collaboration:

- Exchange of experiences from pilot projects reusing materials, products and components.
- Exchange on possibilities to increase incentives through procurement requirements.
- Exchange on how to effectively measure and compare different circularity measures, including reuse.

Featured Project : Kristian Augusts Gate 13

Dubbed the first full-scale circular building in Norway and expected to be completed with 80% reused materials, this is a true pioneer project in Norway. This office building from the 1950’s is being refurbished and new parts are being added. To realise these high ambitions, the developer Entra is working together with MAD architects, IWG group and Futurebuilt.

More information can be found here and here.



Waste free construction sites

The construction and real estate sector accounts for around 20% of waste in Norway. 40% of this comes from buildings being demolished, 25% from rehabilitation and 35% from new construction. In new construction, a significant part of the waste are simply materials that are left over.

Today, there is a requirement that at least 60% of the construction waste is sorted at the site of construction. [25] However, many actors in the sector mean this is not enough and through a call in 2019 the initiative "Avfallsfrie Byggeplasser" (waste free construction sites) was launched to combat the issue. 11 actors, mostly public developers, are behind the initiative with the goal of making waste free construction sites mandatory from 2022. Now, different working groups have been formed to work on solutions across the whole value chain with the idea that different developers focus on eliminating different fractions of waste[28]. The ambition is to go from merely recycling to actually eliminating waste being produced on construction sites. To scale this up, industrialisation and prefabrication of elements as well as smart solutions for recovering and reusing leftover materials are needed.

Current actors, competition & technologies

The 11 developers initially signing up to the national initiative for waste free construction sites are:

- The municipalities of Kristiansand, Bergen, Tromsø, Trondheim and Bærum, Undervisningsbygg and Omsorgsbygg (City of Oslo), Drammen eiendom KF, Sandnes eiendomsselskap KF and Statsbygg.

Since the start, other developers have joined and Skanska and NCC are also involved in the development of this initiative. To date no results in terms of technologies or suppliers of solutions have been found.

Business and collaboration opportunities

Within the topic of waste free construction sites, the identified opportunities are as follows.

Business:

- Solutions for prefabrication of building elements and products, eliminating waste.
- 3D printing technology for on- or offsite production of products and elements adapted for their final use.
- Solutions for recovering and reusing leftover materials on construction sites.

Collaboration:

- Exchange around the broader concept of buildings as material banks, where Norwegian actors point out the Netherlands, and especially the city of Amsterdam, as a pioneer.

3.2 Renewable Energy Systems

The high share of renewable energy in Norway and low uses of fossil fuel in the heating and powering of buildings gives a good starting point for the transition towards a fully renewable energy system. Expected increases in energy consumption, electrification of industry and transport and challenges in power transmission, make ongoing focus and development within this topic necessary. The areas that have been identified as the most interesting within renewable energy systems are zero energy buildings and energy renovation and smart energy systems for emission free construction sites.

Zero energy buildings and energy renovation

Due to the demanding Norwegian climate, reducing the energy use in buildings has long been a focus in Norway and it has one of the world's strictest building requirements on energy. Since 2015, passive housing is the standard for new buildings and the government is currently working on requirements for nearly zero-energy buildings.[2]

For existing buildings there is political consensus on a national goal of reducing the energy use in existing buildings by 10 TWh by 2030 (compared to 2016). The energy use today is around 80 TWh. Different initiatives are put in place to realise this, but no real progress has yet been made [29].
There has been a lot of investment and development in technology for energy reduction, especially for new construction. However, with 40% of the energy in the country being used in buildings and the average annual use of energy in dwellings being 200 kWh per square meter (see Figure 9), reduction of energy use in buildings continues to be an important area for continued efforts.[3]

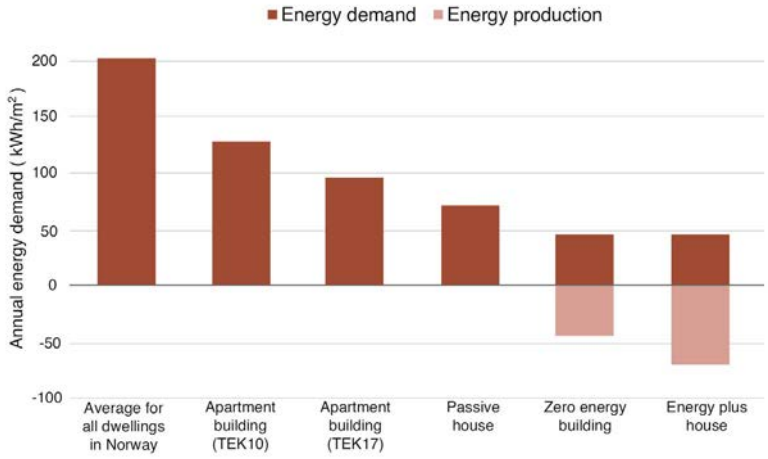


Figure 9. Energy demand for dwellings in different energy categories in Norway. TEK17 is the latest building code (2017) and TEK10 is the building code before that [20]

For new buildings, there are constantly new technological developments and new combinations of technologies that put pressure on the energy demand. One example is a new development of a zero-energy building in Oslo with only natural ventilation. The project, called Nydalen Vy, has been commissioned by the real estate developer Avantor in collaboration with architect Snøhetta and developer Skanska among others. Another internationally praised Norwegian example is Powerhouse, a concept developed in collaboration between the property company Entra, the developer Skanska, the environmental organization ZERO, architect Snøhetta, and the consulting company Asplan Viak. New technology and products that can further contribute to innovative ways of improving energy in new buildings are interesting. However, there is some scepticism towards international technology not being adapted for the Norwegian climate.

For existing buildings, less progress has been made. This is not due to the lack of technology but primarily because most residential dwellings are privately owned and there being few real incentives for energy renovations.

2 For the energy thresholds for all different kinds of buildings, see the building code TEK17

3 A recent study from the Norwegian research association Sintef analysed different scenarios with the conclusion that rehabilitation contributes to around half of the emissions from the construction of a new building and that rehabilitation needs to be a central part of the Norwegian strategy to reach the climate goals. In the end, most of the buildings that are going to be around in 2050 have already been built. [20]

There is a knowledge platform for consumers and possibilities to get funding through Enova but the € 25 million that are available each year are rarely fully committed. In the commercial sector there is a stronger focus on energy renovation since there is more energy, and thereby money, to be saved [28]. There is a need for accessible and attractive holistic solutions to spur the development of energy renovation in existing buildings, especially for homeowners.

Current actors, competition & technologies

Developers focusing on innovative energy technology:

- Skanska, one of Norway's largest developers and partner in the Powerhouse project and a lot of inhouse expertise regarding zero- and plus energy buildings.
- NCC, another of Norway's largest developers, an example of an interesting project with passive house standards using waste heat is an *office building* in Oslo.
- Drammen Eiendom, public actor developing for the municipality of Drammen, interesting projects include a passive house, low-temperature school project called *Marienlyst.*
- City of Oslo, high standards and ambitions for energy in new construction.

Innovative suppliers of insulation and other technology for zero-energy buildings and energy renovation:

- Hunton, Norwegian company producing insulation solutions for roof, wall and floor using wooden fiber. One of their latest innovations is insulation *using residuals from the wood industry.* The company also has subsidiaries in the other Nordic countries as well as the UK and the Middle East.
- Glava, Norwegian actor in insulation and energy reduction technology. Recent innovations include reusing local glass for the production of its glass insulation, the insulating façade elements *Front* that have proven to reduce the energy consumption by up to 80% and a pre-insulated ventilation called *Climaver*.
- BMI, Norwegian actor that has for instance developed an innovative vapor barriers.
- Rockwool, international actor with a prominent role in the Norwegian insulation sector. The company has local production in two parts of the country and invest a lot in sustainability, also in their own production facilities.
- FreeEnergy, Norwegian company that has developed a heating system combining solar and ground heating technology.

Suppliers of full building solutions:

- Nordic Smart House, a Norwegian modular housing concept with low energy usage using insulated containers.

National initiatives for research and development:

- ZEN Research Centre, working on solutions for zero emission neighbourhoods and buildings with private and public partners. Have *9 pilot projects* all over Norway that can be interesting to look at and collaborate with.

Business opportunities

In the area of zero-energy buildings and energy renovation there are business opportunities in:

- Innovative energy technology for new buildings that can meet the Norwegian climate conditions.
- Affordable and attractive solutions for energy renovation for homeowners that are easy to implement.

Featured Project: Powerhouse

Extremely energy efficient concept developed by leading actors in Norway: the property company Entra, the developer Skanska, the environmental organization ZERO, architect Snøhetta, and the consulting company Asplan Viak. As of 2021, there are four projects realised in the Powerhouse concept, an energy-positive office building in Trondheim, an 11 floor office building called Telemark, a school being called the "most environmentally friendly school in Norway" and a refurbished office building in Sandvika.
More information can be found here.

Smart energy solutions for emission free construction sites

With 15% of the national emissions in Norway, construction sites have become areas of interest for climate mitigation. This has led to a push for fossil free construction sites where the City of Oslo is pioneering and the use of bio-diesel is already standard. The next step is working towards emission free construction sites meaning electrifying equipment used on and around construction sites and using central heating, heat pumps or electricity for heating. This puts pressure on the implementation of smart energy technology to ensure renewable and reliable energy on these sites.

The recent declaration for a climate neutral construction sector, signed by mayors of the largest cities in Norway (Bergen, Drammen, Kristiansand, Oslo, Stavanger, Tromsø and Trondheim), includes a goal for emission free construction sites by 2025. To achieve this, dialogue and collaboration with entrepreneurs, developers and other interested about possibilities are as crucial [22]. Due to the push from the municipalities, especially the City of Oslo, construction site machinery has gone through a rapid development and more and more companies are able to deliver emission free equipment [28]. There is a need for smart energy technology to continue to improve the emission free construction equipment as well as the energy infrastructure on these emission free construction sites.

Ensuring renewable energy is used and charging of equipment is worry-free are two crucial factors in moving forward. The Norwegian innovation funding agency Enova has recently closed a call of € 50 million to be invested in projects to solve these issues [30].

Current actors, competition & technologies

Energy companies are important actors in this area, such as:

- BKK, Norwegian energy company that has been awarded funding from Enova for a emission-free construction site project. They will be testing battery and charging technology in a container solution on construction sites the coming three years. Collaboration partners in the project are four construction machinery companies: Fyllingen Maskin, Drange Maskin, Nasta and Cramo.

Clients driving and enforcing the development of emission-free construction sites:

- The City of Oslo, an important actor as they are and have been very much the driver of this development. The city also provides *funding* for conducting investigations of how a construction site (in Oslo) can become emission free.
- Enova, the national funding agency closed a call in April of 2021 regarding funding for smart energy solutions for emission free construction sites. Keep an eye on the *site* for updates on what projects are rewarded and possible collaboration partners.

Actors in this area include companies producing emission free construction machinery:

- Nasta has developed a series of all-electric construction machinery called ZERON.
- Pon Equipment, a company that has developed a new battery driven excavator that is now being produced commercially.
- NorBetong, Norwegian concrete company that, together with the supplier Liebherr Gmbh, developed a concrete truck that can be electrically powered once it has reached the construction site.
- RoMy Clima has developed an emission free and carbon neutral heating central for construction projects called SmartHeater.

  Other suppliers of battery powered machinery such as excavators, dumpers and wheel loaders include Wacker Neuson AS, Hesselberg, Cramo, Epiroc Norge AS and Utleiesenteret.

Actors that provide (smart) charging solutions:

- EST-floattech, Dutch company initially focusing on clean shipping now also offering mobile land based energy storage. The Norwegian branch of the company has developed the BoostCharger, a mobile fast charger for EV mobility and electronic construction equipment supported by the City of Oslo.

Research and development:

- Sintef, the Norwegian research organisation is doing research in this area to improve knowledge on how emission-free construction sites can be implemented and around the needed technology development. This research is being done together with Skanska, Omsorgsbygg (part of the City of Oslo), the construction equipment supplier Nasta and the non-profit climate organisation Bellona among others.

Business opportunities

In the area of smart energy solutions for emission-free construction sites there are business opportunities in:

- Energy infrastructure providing holistic solutions for renewable energy on construction sites.
- Mobile solutions for charging and extra power, such as containers with batteries and charging solutions.
- Logistic systems and digital solutions that support the function of local micro-grids.
- Solutions for emission free heat on construction sites.

4 General Opportunities and Barriers for Foreign Partners

The construction sector in Norway is dominated by a few large actors but the main bulk of companies are Small or Medium sized Enterprises (SMEs): more than 90% of the companies in Norway have fewer than 20 employees [31]. As a non-Scandinavian company, it can be challenging to enter the Norwegian construction market. The sector is quite small and transactions are often built on personal connections. However, an attractive price-quality ratio can lead to opportunities.

Main actors and events

Below is a list of some important and ambitious actors in the construction sector, connected to sustainable building. These can also be found in the online actor map which can be accessed here.

Interesting and Important links

- *National notification database for public procurement Doffin*
- *Innovation funding agency Enova (only in Norwegian)*
- *Product certification through Sintef Certification. This documentation is required by the national technical regulation for all products, constructions, elements, materials and technical applications used in construction.*
- *Commissioned and planned projects in Norway can be found through ByggFakta and Byggeindustrien (only in Norwegian)*
- *The most ambitious sustainability building projects in Oslo area from the last few years can be found through FutureBuilt*
- *The National Association of Norwegian Architects has gathered some of the most ambitious sustainable building projects in all of Norway.*

Role	Actor	Information
Collaboration	Bygg21	Cooperation between the construction sector and national authorities for sustainability and productivity.
	Futurebuilt	Collaboration for realising pilot project with high sustainability ambitions in Norway launched in 2019. Focused on the region of Oslo.
	Norwegian Wood Cluster	Collaboration of 25 companies within the value chain of forest, industry and construction with the goal of becoming an internationally leading business cluster for industrial, sustainable wood construction.
Authority	Direktoratet for byggkvalitet (DiBK)	National authority for housing and construction, responsible for building requirements. Also invests in research and development of knowledge for updates in requirements.
Developer	Veidekke Norway	The absolute largest developer in Norway with almost 3000 employees in the building construction (9000 total). The turnover and number of employees are both almost double of that of the second largest actor in the sector, AF group.
	AF Group	The second largest developer in Norway. Has done some projects with high ambitions in sustainability and at least one in the FutureBuilt programme. This was a passive house rehabilitation project of an office building in Oslo.
	OBOS	One of the largest developers of residential in the Nordics. Focusing a lot on building in and around the larger cities in Norway and Sweden. Also has activities in development of offices and operation of buildings. An interesting development is OBOS' ambition to build Norway's largest climate-neutral residential and urban area on the Fornebu peninsula just outside of Oslo.
	NCC Norge	One of the largest developers in the Nordics with a lot of activity in Norway. Has at least one project connected to FutureBuilt: a passive house office building built with low emission concrete in Oslo.
	Skanska Norge	One of the largest developers in the Nordics (and the world) with a lot of activity in Norway. Also involved in ambitious sustainability projects such as Powerhouse and pilot projects within FutureBuilt.

Developer, client and commissioner	Statsbygg	Stadsbygg is the Norwegian governments building commissioner, property manager and developer. In their latest sustainability strategy, they have identified three prioritized areas of interest: climate, circular economy and local economy.
	City of Oslo	Ambitious municipality with high sustainability goals. Has commissioned many of the pilot projects connected to the project FutureBuilt. In 2021 the municipality is combining the tasks of commissioning and operation of buildings in a new entity within the municipality called Oslobygg KF. This entity will commission and operate the city's schools, kindergartens, health and care centres, hospitals, culture centres, sports centres etc.
Real estate owner and developer	Avantor	Real estate owner of around 250.000 m2 office space, mostly in Nydalen in Oslo. Interesting actor since they are involved in an innovative development of a new zero-energy building using natural ventilation. The development is called Gullhaug Torg.
	Entra	Real estate owner and developer of commercial buildings. Has contributed to a few interesting and ambitious sustainability pilot projects connected to FutureBuilt, for instance one office building in the Powerhouse portfolio.
Architect	Lille Frøen	Architect with two of their school projects in Oslo connected to the FutureBuilt programme.
	Bølgeblikk	Ambitious small-scale architect based in Oslo with at least two interesting projects linked to FutureBuilt, one nursing home in Oslo and one area development in Bærum.
	Snøhetta	One of the most known architects in Norway working on ambitious sustainability projects like Powerhouse and pilot projects within FutureBuilt.
	LPO	Architect with high sustainability ambitions. Three interesting projects in commercial sector in the FutureBuilt programme, one of which was an ambitious passive house rehabilitation project.
Event	Boligkonferansen	Conference for residential development in Norway. The dates for 2021 are September 8-9.
	Bygg Reis Deg	Yearly fair for the construction sector with 530 exhibitors, 150 foreign exhibitors from 20 countries in 2019. The dates for 2021 are 20-23 October.
Financing	Enova	Norway's funding agency for the transition to a low emission society.
Investment	Selvaag	Norwegian investment group with activities primarily focused on real estate investments, housing and urban development.
Media	Byggeindustrien	Magazine and news site focusing on the construction industry. Also has a calendar for construction related events.
	Byggfakta	News site for the construction industry.
Interest Organisation	Byggenæringens Landsforening (BNL)	National organisation for construction
	Boligsproducenterne	Interest organisation for residential development in Norway. The association has close to 800 members. For the list of members click here.
	Norsk eiendom	National organisation for real estate.
	NBEF	Association for builders, property managers and other companies active in the construction and real estate sector. Focuses on knowledge sharing within sustainable construction and buildings and advocating for policy changes.
	Green Building Norway	Green building council of Norway, driving the sustainability agenda in the construction sector and managing certifications such as BREAAM-Norway.

Culture

Norway can be considered to be quite similar to the Netherlands in terms of culture but there are some minor differences that can be good to keep in mind when collaborating and doing business. Geert Hofstede has been one of the pioneers of the research done on how culture influences the workspace in different cultures. Based on his studies the following can be said about cultural differences between Norway and the Netherlands, see Figure 10. These are some insights and should not be seen as fundamental truths for all individuals or these societies as a whole [32].

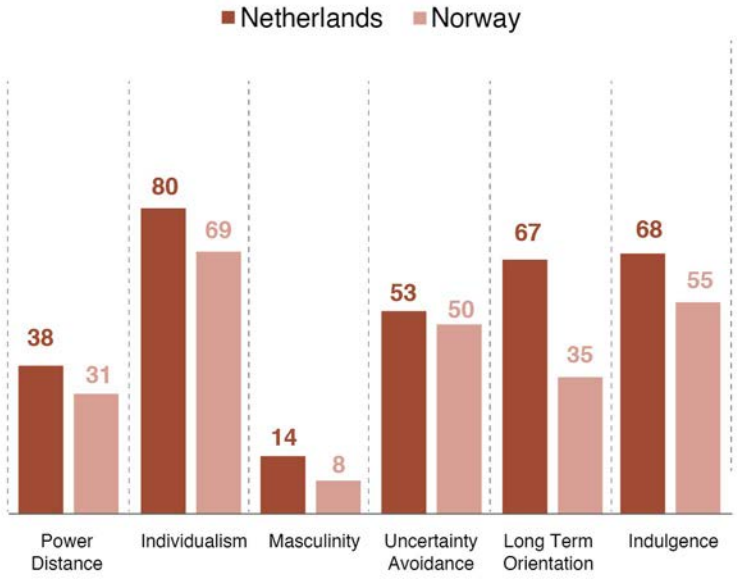


Figure 10. Cultural differences between Norway and the Netherlands

Power distance: "The extent to which the less powerful members of institutions and organisations within a country expect and accept that power is distributed unequally". Norway scores low on this dimension meaning being independent and equal rights is important, power is distributed and everyone, including managers, are on a first name basis. These traits are similar to those in the Netherlands.

Individualism: "The degree of interdependence a society maintains among its members." Norway, as well as the Netherlands, is considered an individualist society meaning personal opinions are expressed and there are clear lines between work and private life. The degree of individualism is a bit higher in the Netherlands which might mean that people are slightly more prone to expect individuals to take care of themselves and their direct family members only.

Masculinity: A high score on this dimension suggests a society more driven by competition, achievement and success and a low score indicates more focus on caring for others and quality of life. Both countries score very low on this dimension. With the lower score of the two, the Norwegian society is considered to be a bit more prone towards consensus. Trying to be better than others is not rewarded.

Uncertainty Avoidance: “The extent to which the members of a culture feel threatened by ambiguous or unknown situations and have created beliefs and institutions that try to avoid these”. Both Norway and the Netherlands score average on this dimension which does not indicate any preference.

Long Term Orientation: Low scores indicate societies that prefers to maintain traditions and norms, high scores indicate societies that are more pragmatic and encourage preparing for the future. Norway has a relatively low score, indicating great respect for traditions. In the Netherlands on the other hand, traditions can more easily adapt to changed conditions and there is more of a long-term view on things.

Indulgence: “The extent to which people try to control their desires and impulses”. Norway scores average on this dimension meaning no conclusion can be drawn whereas the higher score of the Netherlands indicates a society where leisure time and realising impulses is important.

Tips for entering the market

- Focus on selling a solution to a problem, unique value propositions and combining products with relevant, accessible services. Have an answer to the question “why should a customer buy or invest in something from the Netherlands instead of choosing a local company?”.
- Language should not be a barrier as English is widely spoken but can be a challenge when it comes to direct business negotiations. Also, often documents for procurement and public financing are often only in Norwegian.
- Invest in local partners and contact foreign investment promotion agencies
- Start with building a relationship and exchanging experiences with future customers and partners.
- Keep similarities and differences with the Netherlands in mind, such as climate, population density, distances and cultural differences
- Understand how far Norway has come in terms of sustainability, how important the topic is for the company you want to do business or collaborate with and what is happening in the broader market of sustainable buildings.
- As sustainable building is a topic in development, keep an eye on new developments.

5 Conclusion

The Norwegian sustainable building sector is mature and can be seen as a pioneer, especially when it comes to energy performance in new buildings. There are however challenges ahead that open up opportunities for collaboration and business between the Netherlands and Norway. There is a lot to learn from each other, opportunities to collaborate on further development as well as opportunities to spark more trade for products and services within sustainable buildings.

The construction sector in Norway is performing well, despite the drop in the economy due to the COVID-19 pandemic. The need for residential projects is high and investments expected to grow for health and care buildings as well as for education. While the commercial sector is likely to experience a drop in investment, this is expected to be temporary.

Topics where most of the focus in Norwegian sustainable building is right now are circular construction, especially in the area of reuse and waste free construction sites and renewable energy, especially zero-energy buildings and energy renovation and smart energy solutions for emission free construction sites.

The top business opportunities connected to these topics are:

- Digital solutions for identifying, documenting and matching demand and availability of products and materials for reuse
- Solutions for accessible and effective ways of dismantling buildings, components and products for reuse in other projects
- Solutions for prefabrication of building elements and products, eliminating waste
- 3D printing technology for on- or offsite production of products and elements adapted for their final use
- Solutions for recovering and reusing leftover materials on construction sites
- Innovative energy technology for new buildings that can meet the Norwegian climate conditions
- Affordable and attractive solutions for energy renovation for homeowners that are easy to implement
- Energy infrastructure providing holistic solutions for renewable energy on construction sites
- Mobile solutions for charging and extra power, such as containers with batteries and charging solutions
- Logistic systems and digital solutions that support the function of local micro-grids
- Solutions for emission free heat on construction sites

Also, there are opportunities for collaboration, especially within circular construction, where many Norwegian actors see the Netherlands as a pioneer. Top collaboration opportunities identified in this study are connected to exchange around pilot projects in reuse, possibilities to increase incentives through procurement requirements, measuring and comparing different circularity measure and the concept of buildings as material banks.

The challenges and opportunities described for Norway are similar to the ones seen in Denmark and Sweden. However, in Norway there is more focus on circular construction and resource use and less on renewable energy and energy renovation. Also, sustainability challenges connected to construction sites are getting more attention in Norway than in the other two Nordic countries.

To turn these opportunities into real exchanges and trade, more connections need to be made and stronger networks built. Entering the Norwegian market, establishing contacts and getting to business opportunities is not always straight forward. This may be especially true in the construction sector where margins are tight, traditions strong and SMEs rely on local businesses and create local jobs. At the same time, the sustainable building sector in Norway sees challenges ahead and is looking abroad for new ideas, technologies and knowledge.

In summary, the construction sector in Norway is considered to be doing quite well when it comes to sustainability but acknowledges challenges ahead. This sets the bar high for Dutch players to provide relevant technology and knowledge but also gives the opportunity to exchange ideas and experiences and to grow and develop together.

Next Steps

Advice on the next steps following this market study is to focus on the following:

- *Build connections between Dutch and Norwegian actors, for instance by setting up exchanges between public and private actors within sustainable building, connected to the business and collaboration opportunities pointed out in this study, focusing on exchange of experiences, pilot projects and common challenges.*
- *Continue to look at developments in pilot projects and funding, also in the sustainability topics of biodiversity and water. These topics are not very prominent in the Norwegian context today but are expected to become more important in the coming years, especially climate adaptation such as water retention and green roofs.*
- *Other sustainable building topics that can be interesting to investigate for collaboration and exchange are; urban planning and transport and infrastructure.*

Appendix 1 – More Interesting Reading

Interesting reading on sustainable building in Norway:

FutureBuilt 10 years (2019): a book with extensive information about the pilot projects that have been launched within the FutureBuilt project. This gives an insight into some of the most ambitious projects and actors in the Norwegian sustainable building sector, what technologies have been used and what lessons have been learnt. The projects can also be found on the website of FutureBuilt.

Bouwsector in Noorwegen (2020, only in Dutch): an overview of the construction sector of Norway in general terms with some tips for entering the sector. Made by Flanders Investment and Trade.

Appendix 2 – Methodology

This market study was conducted through desk-research and interviews with actors in the Norwegian construction sector. Information was gathered through looking at sources with different perspectives: national organisations, national advocacy organisations for sustainable construction, developers & real estate, architects, suppliers to the construction sector, academia and academic consultancy reports, knowledge centres and national authorities. Important and interesting Norwegian actors were found by looking at pilot projects in the FutureBuilt programme and top innovations listed by Byggevareindustrien and TheExplorer.

Interviewees

The interviewees were chosen and contacted through an investigative interview method, contacting people working with sustainability in the construction sector from different perspectives.

Role & Organization	Interviewed on
Head of Sustainability, Skanska Norway	16/3/2021
Head of procurement, Oslo Municipality	25/3/2021
Technical Chief, Byggvareindustrien	9/4/2021
Sustainability advisor, NCC Norway	12/4/2021
Responsible for construction and materials, ZERO	15/4/2021

Selection of topics for the market deep dive

Selection of the topics for the market deep dive was done through looking at trends and developments identified in reports, research and through interviews.

An overview of the sources used and the selection can be seen in the table below.

Mentioned as trend or focus for the coming years	Norwegian Climate Action Plan	Statsbygg	Norsk Eiendom	Bygg 21	Green Building Council	Futurebuilt	Interviews (Number of mentions)	Total
Circular economy: reuse	1	1	1	1	1	1	4	**10**
Waste free construction sites	1		1	1		1	4	**8**
Energy: low energy buildings and energy renovation	1	1	1	1	1	1		**6**
Fossil free and emission free construction sites	1	1		1	1		3	**7**
Low emission materials and products			1	1	1	1	1	**5**
Wood as building material	1					1		**2**
Circular economy: building for flexibility and future reuse		1	1		1		3	**6**
Circular economy: longer lifetime of products and buildings		1		1			2	**4**
Energy: local renewable production			1		1	1		**3**
Biodiversity		1					1	**2**
Climate adaptation		1			1		2	**4**

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This is a publication of
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This publication was commissioned by the ministry of Foreign Affairs.

Publicationnumber: RVO-115-2021/RP-INT

NL Enterprise Agency is a department of the Dutch ministry of Economic Affairs and Climate Policy that implements government policy for Agricultural, sustainability, innovation, and international business and cooperation. NL Enterprise Agency is the contact point for businesses, educational institutions and government bodies for information and advice, financing, networking and regulatory matters.

Netherlands Enterprise Agency is part of the ministry of Economic Affairs and Climate Policy.