Report

Securing a sustainable material supply in the Nordics

– bridging the gap between supply and demand of aggregates

NCC

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Foreword

The Nordic countries are facing a massive societal transition driven mainly by the shift to a climate-neutral economy with net-zero greenhouse gas emissions by 2050.

To achieve this, the Nordic countries are making large and historic investments in fossil free industries and infrastructure to support economic growth, sustainability, and regional connectivity. Significant funding is being allocated to modernizing and expanding road and railway networks, developing residential areas, and enhancing digital and energy infrastructure.

Raw materials for the construction sector are a prerequisite for this societal development. In this context, aggregates in particular play a crucial role. Virtually every construction project relies on some form of aggregates, which is used to build roads, railways, wind parks, airports, residential buildings, offices, industrial facilities, and hospitals.

This makes aggregates one of the most important building materials we have, and the largest geological resource extracted and used in society.

This report shows that the major societal development projects that the Nordic countries are undertaking will increase the aggregate consumption in the Nordics substantially between 2026 and 2045, from approximately 460 million tonnes (Mton) in 2026 to around 625 Mton 2045, representing a 37 percent increase in annual consumption.

At the same time, even though most of the Nordic countries have great access of natural resources and aggregates, scarcity of aggregates is becoming a fact. The overall trend in the Nordics shows a decrease in the number of quarries producing aggregates, caused primarily by unpredictable and ineffective permit processes, conflicts of land use and a lack of local, regional and national material planning.

This has made it harder, not only to sustain a local and regional production but have also raised the climate footprint of aggregates with longer transportations from fewer quarries to more distant areas. But even more fundamentally creating a gap between supply and demand that threatens to endanger the green industrial transformation in the Nordic countries.

The future gap between supply and demand of aggregates is particularly pressing given the scale of this challenge and that the transition is taking place in the light of a rapidly changing world in which we live.

Disruptions in global logistics chains caused by the coronavirus pandemic, the war in Europe and the ongoing global trade war has made it evident that we in the Nordic Region need to find common, long-term and robust solutions to ensure a sustainable material supply.

The solution lies not only in facilitating and expanding our aggregate production but also in addressing key strategies that will ensure a sustainable and long-term supply. There are three primary areas that are vital to meet the increasing demand.

1. **Facilitating the extraction of new aggregate materials.**
2. **Increasing the recycling and reuse of existing materials.**
3. **Optimizing material-use to reduce demand and minimize waste.**

I am certain that if the Nordic countries undertake the right measures, we can bridge the gap between current supply and future demand, securing a sustainable and robust material supply and at the same time reaching our climate goals, despite the geopolitical challenges we face.

Grete Aspelund, Head of NCC Industry

Executive summary

The Nordic countries have set ambitious climate targets, aiming for carbon neutrality by 2045–2050. At the same time, the region is making large-scale public investments in fossil-free industries and critical infrastructure. Major funding is being directed toward modernizing and expanding transport systems, developing residential areas, and strengthening energy and digital infrastructure. These three sectors are particularly important because, together, they account for the majority of aggregate use in the built environment.

Meeting the region's ambitious development and climate goals will require a reliable, sustainable, and large-scale supply of aggregates — at levels far beyond current norms. The findings in this report are based on identified societal needs in the Nordic countries and presents total aggregate consumption from 2020 to 2045 across infrastructure, buildings, and energy systems using two scenarios: a Baseline Scenario and a Societal Transition Scenario (STS).

In 2024, the Nordic region consumed over **420 million tonnes** of construction aggregates, with Sweden leading at more than **160 million tonnes**, followed by Norway, Denmark, and Finland. These volumes reflect the scale of current development – but demand is set to rise significantly. Under a Societal Transition Scenario, aligned with Nordic political goals, annual consumption is projected to grow from **around 460 million tonnes** in 2026 to approximately **625 million tonnes by 2045 – an increase of 37 percent**. Cumulatively, this would require **2,750 million tonnes more aggregates** than the baseline by 2045.

In **Denmark**, annual aggregate demand is expected to increase by 15–25 million tonnes compared to the baseline. By 2045, the country is projected to require 300 million tonnes more than under the baseline — an **increase of approximately 20 percent.**

In **Finland**, demand is projected to rise 40–50 million tonnes compared to the baseline. This translates to a cumulative increase of around 870 million tonnes – **approximately 60 percent more** than in the baseline scenario.

In **Norway**, annual demand is expected to grow by 30–50 million tonnes, By 2045, the country is projected to require 700 million tonnes more than under the baseline – an **increase of approximately 30 percent**.

In **Sweden**, annual demand is projected to increase by 25–60 million tonnes By 2045, the country is projected to require 900 million tonnes more than under the baseline – an **increase of approximately 25 percent**.

At the same time, the report shows that both the number and productivity of quarries have shifted significantly over the past decade. In **Sweden**, the number of operating quarries has declined from 1,750 in 2011 to 1,064 in 2023.

Norway follows a similar trend, with active quarries decreasing from approximately 1,000 in 2013 to around 925 in 2023. In **Finland**, the decline is even more pronounced, dropping from roughly 1,900 to 1,500 over the same period.

Denmark stands out as an exception. While data is measured differently —based on extraction permits rather than direct counts of raw material pits —the trend is notably more stable. Between 2016 and 2023, both the number of permits and the overall volume of extracted aggregates remained largely unchanged, with only a slight dip in 2023.

Taken together, the total number of active quarries across Sweden, Norway, and Finland amounted to roughly **3,473 in 2023**, down from approximately **4,289 a decade earlie**r – a reduction of about **20 percent**.

These projections reveal a growing gap between current supply and future aggregate needs. Bridging this gap is essential to meet future construction and climate goals. Without action, the region risks material shortages, delivery delays, and rising environmental impacts.

The urgency is heightened by broader geopolitical and economic risks. Global events such as the war in Ukraine, price volatility, and rising geopolitical tensions have exposed the vulnerability of international supply chains – especially for construction-critical materials. In this context, aggregate supply becomes a strategic issue, central to both economic and societal resilience.

Addressing this challenge requires a coordinated strategy. No single solution is sufficient. Instead, a combined approach is needed, built on three strategic pillars: enabling new extraction, expanding the use of recycled materials, and improving material efficiency.

All three pillars now demand targeted policy attention if the Nordic region is to meet future demand. Quarry production remains dominant but increasingly concentrated, with fewer sites producing more. Recycling remains limited, hindered by regulatory uncertainty, infrastructure gaps, and weak market signals. Material efficiency, while offering large savings through early design decisions, is still underused.

Closing this gap will not be a matter of geological availability alone. The real obstacles lie in how aggregate supply is governed, coordinated, and planned. The current systems are not equipped to scale the three strategic pillars at the pace or scale required. Declining quarry numbers reflect deeper systemic issues: permitting processes have become increasingly complex and fragmented, with long lead times, costly documentation, and multi-agency coordination challenges.

Regional planning is also underdeveloped. Aggregate supply is often overlooked in broader spatial and infrastructure strategies. As local reserves deplete, materials must be hauled over longer distances—driving up emissions, costs, and pressure on transport infrastructure.

Meanwhile, the uptake of recycled aggregates remains low, despite growing supply capacity and better technical standards. The core barrier is demand-side: outdated procurement practices, rigid material requirements, and a lack of incentives. Procurement based on functional performance, as seen in Norway, offers a promising path forward, but broader adoption is still needed.

Material efficiency – particularly through early-stage collaboration – is another underused opportunity. In many projects, decisions that shape material use are made late in the process, missing key chances to optimise design, standardise elements, or enable reuse. Sequential planning processes, where key actors enter at different stages, make it harder to align around shared targets for efficiency and sustainability. A broader policy shift is needed – one that supports all three strategic pillars in parallel and creates the right conditions for systemic change.

This report sets out nine policy recommendations to close the supply gap. These actions aim to strike a balance between expanding access to materials and minimizing environmental impact – while laying the foundation for a more circular, resilient, and climate-aligned aggregate system.

Contents

“Aggregates play a crucial role in our societal development. Aggregate supply should be a strategic priority for the Nordic countries in order to meet future construction and climate goals.”

Grete Aspelund, Head of NCC Industry

1. The importance of construction aggregates in society

Construction aggregates – rock, gravel and sand – form the invisible foundation of modern society. As the most widely extracted geological resource used in society today, they are essential to virtually every aspect of the built environment, from the roads we drive on and the railways that connect cities, to the homes we live in and energy infrastructure we rely on[1], see Figure 1. Far more than just a commodity, aggregates are the backbone of infrastructure, underpinning economic development, societal resilience, and environmental sustainability.

A clear example is concrete, among the most widely used building materials in the world. Aggregates make up 60–80 percent[2] of its volume, providing strength, stability, and workability. In the Nordics, around 10 percent of all aggregates are used in concrete production[3]. The type and composition of aggregates directly influence the material's performance and durability, underscoring how essential they are to quality, safety, and long-term sustainability in construction.

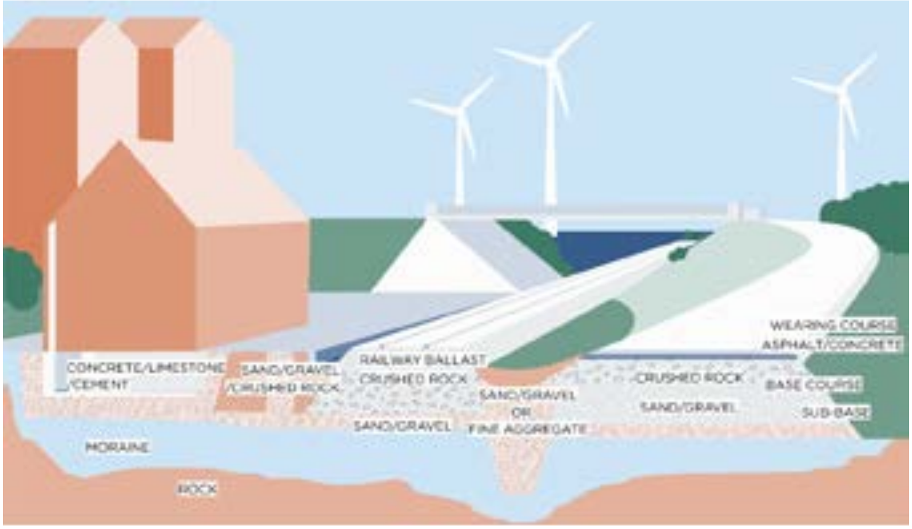


Figure 1. Aggregates are everywhere. Here are a few examples of how we use it in our everyday lives.

This dependency is especially evident in the Nordic countries, where demand for aggregates is high, driven by large-scale infrastructure investments and a relatively high per capita consumption: Norway leads with 20.1 tonnes per person annually, followed by Sweden at 15.3 tonnes, Denmark at 12.8 tonnes, and Finland at 12.8 tonnes.[4] These figures reflect the scale of ongoing

1 SGU, (2024). 'Grus, sand och krossberg 2023'. Available at: https://www.sgu.se/globalassets/produkter/publikationer/2024/grus-sand-och-krossberg-2023.pdf

2 M.D.A. Thomas, K.J. Folliard (2007) Durability of Concrete and Cement Composites A volume in Woodhead Publishing Series in Civil and Structural Engineering

3 Approximate value figure for the Nordics based on 10 percent in Norway (source: Dirmin, 'Harde Fakta 2023') and 12 percent in Sweden (source: SGU, (2024). 'Grus, sand och krossberg 2023')

4 These numbers are based on national aggregate consumption figures, estimated from market activity data (i.e., investment data), and therefore differ from values based on aggregate extraction figures.

development and the critical role aggregates play in building the systems that support everyday life.

The Nordic region is currently undergoing a transformative period of investment. Governments are allocating substantial funding to expand and modernize road and rail networks, build new housing, and upgrade energy infrastructure. In addition, Sweden and Finland's recent accession to NATO has further accelerated efforts to strengthen strategic transport corridors and defense-related infrastructure. These developments underscore the growing importance of a secure and sustainable supply of construction materials.

At the same time, global instability has exposed the fragility of supply chains, especially for raw materials critical to construction. The war in Ukraine, price surges, and rising geopolitical tensions have shown how quickly access to essential resources can be disrupted. In this evolving landscape, securing a stable and sustainable supply of aggregates is no longer just a technical concern – it is a cornerstone of both economic strategy and societal preparedness. As the Nordic region looks to future-proof its infrastructure and accelerate the green transition, access to these materials will determine not only the pace of progress but also its feasibility. Without reliable aggregate supply, even the most well-funded plans risk delay, disruption, or derailment.

Understanding the true significance of aggregates begins with examining how deeply they are embedded in the Nordic region's most urgent development priorities: infrastructure, housing, and energy. These sectors not only drive economic and societal progress but also depend fundamentally on access to construction materials to meet both current needs and future ambitions. They are the cornerstones of modern life – and where the pressure to build sustainably, efficiently, and at scale is most intense.

In the following chapter, we will take a closer look at how aggregates underpin these three areas of priority in the Nordic region, and why securing their supply is essential to meet both current needs and future ambitions.

1.2 Infrastructure

Aggregates play a fundamental role in infrastructure projects, providing essential materials for roads, bridges, railways, and airports. In road construction, crushed rock, gravel, and sand are used in asphalt and concrete pavements, ensuring durability and resistance to heavy traffic loads. The base and subbase layers of roads rely on well-graded aggregates to provide structural stability and effective drainage, preventing deformation and prolonging road lifespan. In Sweden and Norway, 55–60 percent of all construction aggregates were used for road-related purposes alone.[5]

Bridges and tunnels require high-quality aggregates for reinforced concrete, which enhances load-bearing capacity and withstands environmental stresses such as temperature fluctuations and moisture. Railway ballast, made of crushed rock, supports and stabilizes tracks by distributing loads and facilitating drainage, reducing maintenance needs. Airports also rely on aggregates for runway construction, where high-strength materials are necessary to withstand aircraft loads and prevent surface deterioration. Additionally, aggregates are used in stormwater management systems, such as permeable pavements and drainage layers, to control water runoff and reduce flooding risks.

1.3 Energy systems

The development of energy infrastructure is highly dependent on construction aggregates, as it supports the construction of power plants, renewable energy installations, and energy transmission networks[6]. Hydropower plants, for example, rely heavily on concrete structures made with high-quality aggregates to build dams, spillways, and powerhouses, ensuring long-term durability and water resistance.

In wind energy, crushed rock is used as a base or ballast material to support the heavy concrete or steel foundations required to stabilize wind turbines, especially in offshore installations where resistance to strong winds and ocean currents is critical. The primary structural foundations are typically made of reinforced concrete or steel. Similarly, in solar energy, compacted aggregates may be used to stabilize ground conditions – such as for access roads, equipment pads, or in areas with poor soil—but many solar farms are designed to minimize land disturbance and are mounted directly into the ground.

For combined heat and power and nuclear energy plants, aggregates are used in the main facility, in cooling towers, reactor buildings, and containment structures, where high-strength concrete reinforced with aggregates ensures safety and longevity. Transmission networks, including substations and power line foundations, also incorporate aggregates in their structural components.

5 SGU, (2024). 'Grus, sand och krossberg 2023'. Available at: https://www.sgu.se/globalassets/produkter/publikationer/2024/grus-sand-och-krossberg-2023.pdf

6 SGU, (n.d). 'Vindkraft'. Available at: https://www.sgu.se/samhallsplanering/energi/vindkraft/

With the transition to renewable energy, demand for aggregates is expected to shift toward materials needed for wind, solar, and hydropower projects. Sustainable extraction and recycling of aggregates will be essential to support the development of resilient and environmentally friendly energy infrastructure.

1.4 Buildings

Aggregates are also essential for construction of residential and commercial buildings, forming the backbone of buildings through their use in concrete, mortar, and structural foundations. Crushed rock and lightweight aggregates are often used in load-bearing structures, improving the durability and thermal insulation properties of buildings.

Roofing materials also incorporate aggregates, particularly in asphalt shingles and roofing tiles, to enhance weather resistance and longevity. In exterior applications, aggregates are used in decorative concrete finishes, pathways, and landscaping, contributing both aesthetic and functional value to residential spaces. Beyond traditional construction, aggregates play a role in sustainable housing solutions. Recycled materials from demolished buildings can be reused for new construction, reducing the demand for primary materials. Additionally, porous aggregates are increasingly used in green building designs to improve insulation and reduce heating and cooling costs.

Summary

Construction aggregates—gravel, sand, and crushed rock—are the most widely used geological resource and form the backbone of the built environment. Aggregates make up 60–80 percent of concrete's volume, making them critical to concrete production and indispensable to the development of infrastructure, housing, and energy systems. Per capita consumption in the Nordics is high: Norway leads with 20.1 tonnes annually, followed by Finland, Sweden, and Denmark. Ongoing investments and global instability highlight the need for a stable and sustainable supply.

Infrastructure
Aggregates are key to roads, bridges, railways, and airports. In Sweden and Norway, over 55 percent of aggregates are used for road-related purposes. They provide structural strength, drainage, and durability, and are used in stormwater systems and railway ballast.

Energy Systems
Hydropower, wind, solar, and nuclear energy infrastructure depend on aggregates for foundations and resilience. Crushed rock is especially important in offshore wind projects. A sustainable supply will be critical as the region transitions to renewables.

Buildings
Aggregates support building structures through concrete, mortar, and foundations, contributing to strength and insulation. They also play a role in sustainable construction through the use of recycled materials and porous aggregates.

2. The political ambitions of the Nordic countries drive aggregate consumption

The Nordic countries have set clear targets aimed at addressing key societal challenges and responding to global trends, including the transition to low-carbon energy, climate adaptation, and the need to enhance resilience in light of new geopolitical realities. These commitments, presented below for infrastructure, energy and buildings, are influencing a wide range of policy and investment decisions related to the built environment and are the main drivers for the Nordic countries' future aggregate demand.

In the **infrastructure sector**, there is a growing need to expand and modernise road and rail networks across the region. This is driven by shifting patterns in passenger and freight transport, as well as increasing focus on resilience and the need for reliable transportation alternatives. Moreover, the Nordics, and Sweden[7] and Norway[8] in particular, are grappling with significant maintenance debts in their transportation systems. These priorities are reflected in recent National Transportation Plans, which outline historically high levels of investment for transport infrastructure.

In the **energy sector**, the ongoing transition toward a low-carbon economy, alongside a rise in new industrial developments, is leading to a sharp increase in the need for fossil-free electricity production. Realising this transition central for meeting the ambitious climate targets of the Nordic countries[9] and for maintaining long-term economic competitiveness and energy security in the region.

The **building sector** is also expected to expand in response to sustained population growth in Nordic countries. This includes both residential and non-residential construction, with a focus on accommodating demographic changes and evolving societal needs.

Together, these priorities underscore the Nordic region's commitment to shaping a more sustainable, resilient, and forward-looking society. The developments are expected to place substantial and sustained demand on the supply of construction materials, and a reliable supply of aggregates will be essential to support planned investments in infrastructure, energy, and buildings across the region.

7 Trafikverket, (n.d.) 'Nationell plan 2026-2037' Available at: https://bransch.trafikverket.se/for-dig-i-branschen/Planera-och-utreda/langsiktig-planering-av-infrastruktur/nationell-plan/nationell-plan-2026-2037/

8 Regeringen, (n.d.) 'Nasjonal transportplan 2025–2036'. Available at: https://www.regjeringen.no/no/tema/transport-og-kommunikasjon/nasjonal-transportplan/id2475111/

9 Denmark, Finland, and Sweden aim to achieve carbon neutrality by 2050 at the latest. By then, Norway seeks to become a 'low-emission society', defined as a society where GHG emissions, based on the best available scientific knowledge, global emission trends and national circumstances, have been reduced to avert the adverse impacts of global warming, as described in the Paris Agreement.

Estimating aggregate use to realise stated societal development projects

Building on the identified societal development needs in the Nordic countries, this report presents figures on aggregate consumption in the Nordics between 2020-2045 across three categories: infrastructure, buildings and energy systems.

Figures on historic and future near-term aggregate consumption (2020–2026) are based on market activity (i.e. investments), which are translated into aggregate consumption.[10] Using these figures as starting point, the future use of aggregates (2027-2045) is estimated by modelling two scenarios: Baseline and the Societal Transition Scenario (STS).

In the baseline scenario, future aggregate needs between 2027–2045 are estimated based on expected population growth[11] for all countries and categories expect a few specific cases which are described in further detail below.

The STS aims to capture aggregate demand if the Nordic countries realise the investments in infrastructure, buildings, and energy systems that are necessary to deliver on political ambitions and to develop a sustainable, resilient, and competitive transition of the Nordic region. To do so, alternative investment series are defined for each country. However, as these investments are not guaranteed, the STS serves as a high-level estimate of potential future aggregate demand. Given the inherent uncertainties of large-scale infrastructure and energy projects and construction activity, both scenarios should be regarded as indicative forecasts of possible market developments.

The estimates on future construction aggregates use for **infrastructure development** are derived from expected investment levels. Investment estimates for each country are based on two sources:

- Recent National Transportation Plans[12] specifying future (increased) infrastructure budgets and
- other major infrastructure projects that have been identified for each country but currently are not part of the national transportation plans.

10 The figures capture total aggregate consumption, including both aggregates from quarries and other sources of aggregates, such as excavation rock and masses and recycled aggregates, but excluding exports. The energy figures cover aggregates used for construction activities relating to energy production, distribution and storage. The infrastructure figures include investment in road, railroad, water and sewage, waste management systems and 'others'. For buildings, the figures represent both residential and non-residential construction activity.

11 This is a common approach when making projections about future volumes. The population growth rate over this period is assumed to 2.9 percent in Denmark, 6.5 percent in Finland and 6.9 percent and 5.0 percent Norway and Sweden respectively.

12 In Finland, Norway, and Sweden, new national transport plans have recently been adopted—covering the years 2025–2036 in Norway, and 2026–2037 in both Finland and Sweden. In contrast, Denmark has not adopted a new transport plan since 2021, although the existing plan extends to 2035.

For **infrastructure**, a comparison between the two most recent national transport plans indicates an increase in infrastructure-related investments —both in new development projects and in maintenance. More details on the assumptions related to the transport plans, as well as a description of additional identified infrastructure projects, are provided in Section 4.1. While this does not capture all infrastructure-related investments, it provides an indication based on currently identified investments and projects.

Looking at **energy systems**, the STS assumes significant expansion in fossil-free electricity generation capacity between now and 2045, split across different sources: solar PV, onshore wind, offshore wind, nuclear (only in Sweden) and hydropower (only in Norway). The increase is estimated for each country based on scenarios developed by expert authorities or national grid operators.[13] Expected investment needs to deploy new these levels of electricity production capacities is then estimated and based on that the future aggregate consumption is projected. The assumptions on new electricity production and associated aggregate use is presented in detail in Section 4.2, while data inputs for estimating investment needs is provided in the Appendix.

For **buildings,** future aggregate consumption is estimated based on expected demand for residential, multi-family homes (MFH) and single-family homes (SFH), and non-residential buildings. For residential buildings, housing demand is estimated by comparing the expected number of new housing units with the required number to maintain market balance. Non-residential buildings are assumed grow in line with population growth, meaning it follows the baseline in all countries.[14] The assumptions for estimating aggregate use for building construction in each country is further explained in Section 4.3.

13 The timeframes used to project future electricity demand in the identified sources vary slightly across countries. For the purposes of estimating aggregate levels, it is assumed that the electricity demand projections span the period from 2027 to 2045. Given the inherent uncertainties associated with these projections, any potential discrepancies are not expected to have a significant impact on the findings of this report. Unless otherwise specified, investments are assumed to follow a linear trend throughout the entire 2027-2045 period.

14 The future demand for non-residential buildings highly uncertain and difficult to predict, as needs and uses of such buildings may change rapidly due to external factors.

Summary

The Nordic countries have set clear political development goals in infrastructure, energy, and buildings to address societal challenges and support the green transition. These ambitions are shaping policy and investment decisions and are key drivers of future aggregate demand across the region.

In infrastructure, there is strong political backing for expanding and modernising transport systems, supported by record-high national transportation plans. Maintenance backlogs, particularly in Sweden and Norway, further add to aggregate needs.

In the energy sector, the transition to fossil-free electricity – driven by climate targets and industrial transformation – is increasing demand for aggregates used in renewable energy infrastructure such as wind, solar, and hydropower.

In the building sector, population growth is expected to drive both residential and non-residential construction. This includes efforts to adapt to demographic changes and evolving societal needs.

To estimate future aggregate consumption, the report models two scenarios:

- **Baseline scenario:** Based on expected population growth and current trends.
- **Societal Transition Scenario (STS):** Reflects political ambitions and the investments required to achieve a sustainable and resilient Nordic region.

Aggregate estimates for infrastructure are based on national transport plans and major identified projects. For energy systems, country-specific scenarios are used to assess needs for expanded fossil-free electricity production. For buildings, estimates are based on projected housing demand and population-driven non-residential growth. Together, these projections provide an indicative view of future aggregate demand to 2045.

3. The construction aggregates sector in the Nordics

This section focuses on the construction aggregates sector in the Nordic countries, with particular attention to how much material is used and where it is sourced. It examines the role of quarries as the primary source of raw materials, outlines current levels of recycling and reuse, and explores how material optimisation is being applied to reduce demand and improve resource efficiency in construction projects.

3.1 Aggregate consumption in the Nordics

The Nordic countries consume substantial quantities of construction aggregates annually, totalling around 400 Mton in recent years. The largest share of aggregate consumption is devoted to infrastructure, representing approximately 70 percent of the total aggregate usage across the region[15], see Figure 2.

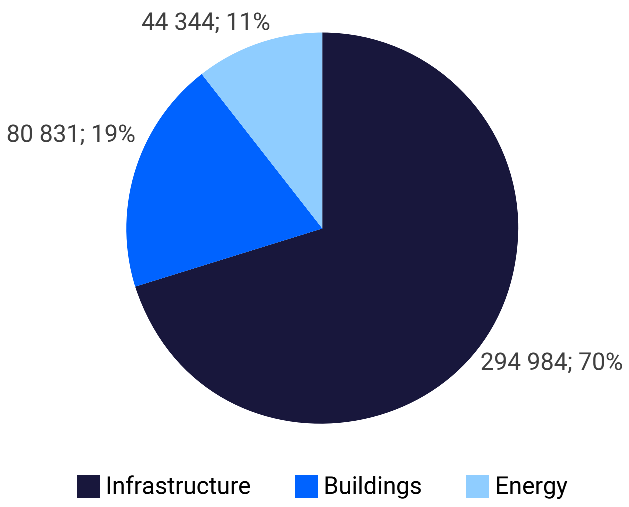


Figure 2. Total aggregate consumption in the Nordic Region 2024, in ktons

Figure 3 illustrates how aggregate use changed between 2020 and 2024. During this period, aggregate consumption increased in Denmark and Norway by 8 and 5 Mton respectively, while Finland and Sweden experienced a decline. A notable trend across all four countries is the decrease in aggregate use for building construction, both in absolute terms and as a proportion of total consumption. This decline is likely linked to reduced economic activity in the building sector during this period.

15 Data provided by Prognoscenter, (2025)

In 2024, Sweden recorded the highest overall aggregate consumption, exceeding 160 Mton, followed by Norway (113 Mton), Denmark (77 Mton), and Finland (69 Mton). The share of aggregates used in building and energy projects varied across countries in 2024, accounting for roughly 20–25 percent and 10–15 percent of total consumption, respectively. One notable outlier is Norway's energy sector, which had significantly lower aggregate use than its Nordic neighbours, just 3.7 Mton, or 3.3 percent of total national consumption.

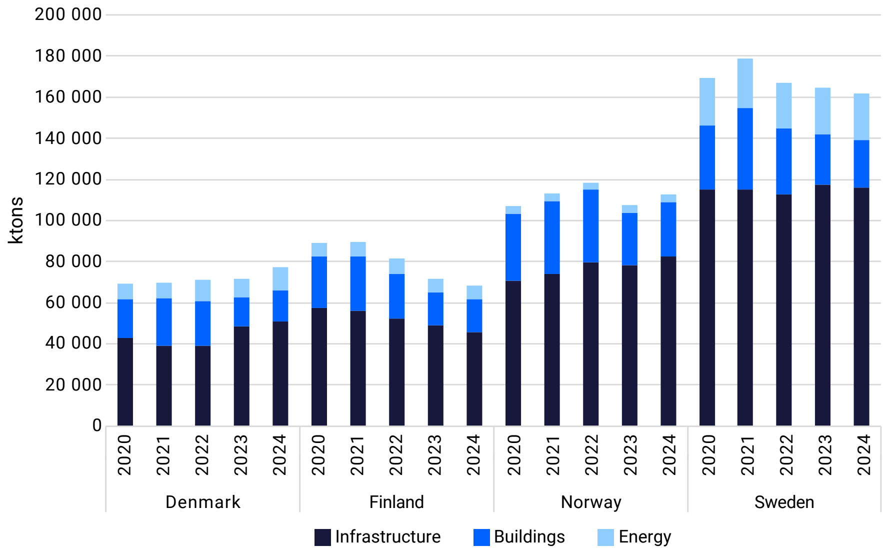


Figure 3. Aggregate consumption in the Nordic countries, 2020-2024 in ktons

3.2 Quarries and gravel pits in the Nordic countries

Quarries are the primary source of aggregates and serve a critical function in supporting infrastructure development and construction across the Nordic countries. Over the past decade, the sector has experienced a structural shift: while the total number of quarries has steadily declined, the average output per site has increased. This suggests a move toward consolidation and greater operational efficiency within the industry. Among the Nordic countries, this trend is most pronounced in Sweden, where production has become increasingly concentrated in fewer, larger extraction sites.

3.2.1 Denmark

Denmark's aggregate extraction is primarily based on raw material pits, with only one operational sand quarry located on the island of Bornholm.[16] This contrasts with other Nordic countries, where quarries play a more dominant role, reflecting differences in geology, land use, and regulatory conditions.

There are no official statistics on the total number of raw material pits in Denmark, but it is estimated that there are currently around 400 active pits in Denmark. These include not only stone, gravel and sand pits, but also other types of raw material extraction. All sites are controlled by the five Danish regions and the island of Bornholm. The number of active pits has remained relatively stable over the past decade.[17]

To create an overview of the development in the number of pits, the five regional authorities and Bornholm were contacted, and they have provided indicative figures for the number of pits used for the extraction of stone, gravel, and sand. In some regions, data is not available on the number of actual raw material pits. Instead, data is available on the number of active extraction permits. This number is typically slightly higher than the actual number of raw material pits, as multiple permits may apply to a single site. This can occur, for example, if changes are made to the permit conditions. Nevertheless, the number of permits can still serve as a useful proxy for estimating the number of active raw material pits.

As illustrated in Figure 4, the volume of aggregates has remained relatively stable between 2016 and 2023, with a slight drop observed in 2023. Furthermore, the total number of raw material pits has also remained stable over the period from 2016 to 2023.

16 Personal communication, Bornholms Regionskommune

17 Personal communication, Dansk Infrastruktur

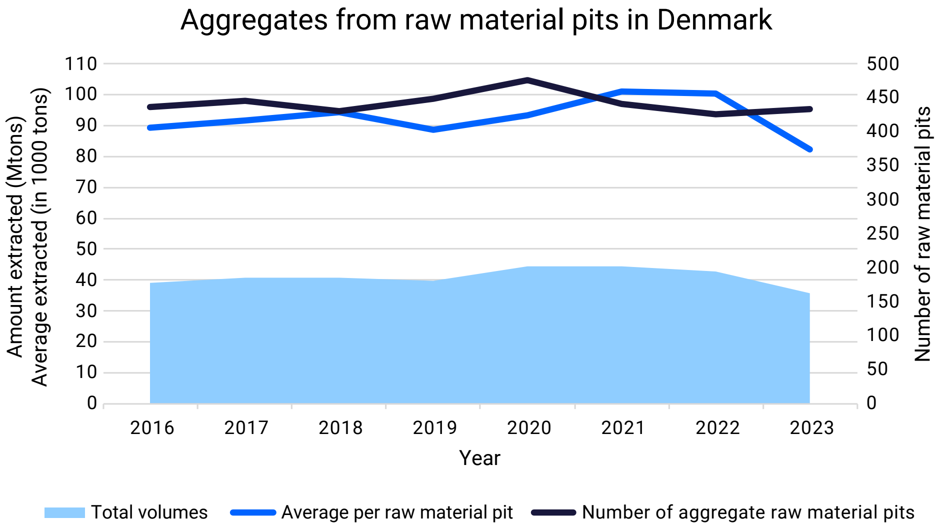


Figure 4. Total volumes of extracted aggregates, the number of land-based raw material sites, and average volume per site in Denmark. Source: Ramboll analysis based on data from Statistics Denmark[18] [19] as well as the Danish regions and Bornholm.

More relevant than the number of pits is the market trend toward consolidation, where larger players increasingly control multiple pits. This is driven by increasing complexity and cost of obtaining extraction permits, which now often involve application documents exceeding 100 pages and lengthy approval processes, including appeals. The process requires significant resources and specialized know-how, leading to a decline in smaller, individual operators and a rise in larger, consolidated actors.[20]

Although land-based extraction is the main source of supply in Denmark, marine extraction still plays a significant role. In 2023, marine extraction accounted for approximately 30 percent of total volumes.[21] While the number of permits for sea-based extraction areas, currently 104, has remained relatively stable, a substantial number are set to expire in December 2025.[22] With only a few expected to be renewed, a decline in marine extraction is anticipated, at least in the short run. This can be attributed to the permitting process, which is both lengthy, taking up to five years, and costly.[23]

18 Statistics Denmark, (2025). 'RST01: Extraction of raw materials in Denmark by region and type of raw material'. Available at: https://www.statistikbanken.dk/statbank5a/default.asp?w=2560

19 Data on total volumes supplied by Statistics Denmark were originally reported in cubic metres (m3) and have been converted to metric tonnes using a bulk density factor of 1.6 tons per m3. Source: GEUS, (2024). Available at: https://data.geus.dk/pure-pdf/GEUS-R_2024-8_web.pdf

20 Personal communication, Dansk Infrastruktur

21 Statistics Denmark, (2025). 'RST01' and 'RST3'. Available at: https://www.statistikbanken.dk/statbank5a/default.asp?w=2560

22 Personal communication, The Danish Environmental Protection Agency

23 Personal communication, Dansk Infrastruktur

3.2.2 Finland

The Finnish aggregate market is relatively fragmented, characterized by a large number of small, locally operated, and independently owned quarries. Data on aggregate extraction in Finland has been available since 2011[24], see Figure 5. At that time, more than 70 Mton of aggregates were extracted from around 2,000 quarries, corresponding to an average output of approximately 38,000 tons per quarry[25]. Since then, total extraction volumes have varied moderately, reaching just under 60 Mton in 2023. In contrast, the number of active quarries has steadily declined, falling to around 1,500 sites in the same year, with an average output of about 40,000 tonnes per quarry.

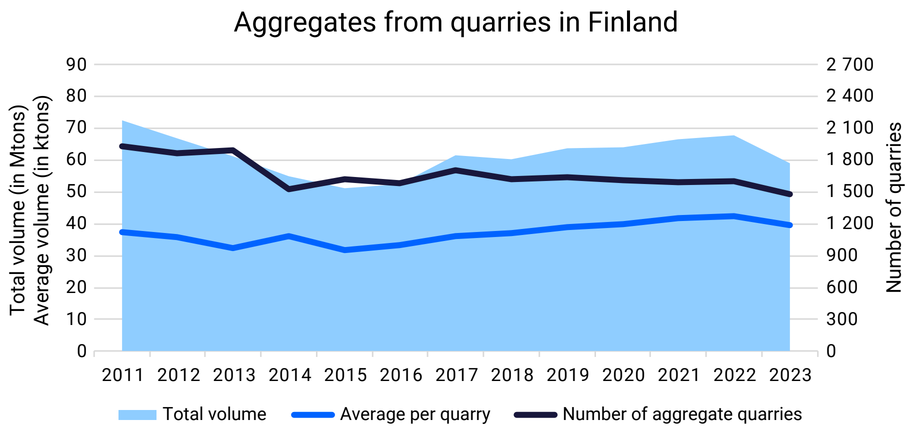


Figure 5. Total volumes of extracted aggregates, the number of quarries and average volume per quarry in Finland. Source: Ramboll analysis based on data from SYKE[26]. Note: Number of aggregate quarries based on number of permits with registered excavation in that year.

Around 600 of the active sites are linked to crushed rock production. As gravel and sand pits near urban areas have become depleted, their share of extraction permits has declined from ca. 61 percent in 2011 to ca. 41 percent in 2023, while crushed rock now accounts for ca. 28 percent[27]. This shift reflects a broader move from local, small-scale supply toward more consolidated and industrialised crushed rock production, highlighting the need for long-term planning and more sustainable extraction practices.

3.2.3 Norway

Aggregate availability in Norway is supported by a well-distributed network of quarry sites. As shown in Figure 6 the number of active quarries has declined over the past decade, falling from approximately 1,000 in 2013 to around 925 in 2023[28].

24 SYKE, (n.d.) Available at: https://syke.maps.arcgis.com/apps/webappviewer/index.html?id=9af59a7f70ee43e5a6cd43cc47980422

25 Ibid.

26 SYKE, (n.d.). Available at: https://syke.maps.arcgis.com/apps/webappviewer/index.html?id=9af59a7f70ee43e5a6cd43cc47980422

27 Ibid.

28 Dirmin, (n.d.). Available at: https://www.dirmin.no/hardefakta

During this period, total aggregate sales initially rose but eventually returned to around 80 million tonnes, the same level as in 2013. Despite the drop in quarry numbers, average output per site has increased by approximately 10,000 tonnes, from 80,000 to 90,000 tonnes, reflecting a trend toward more productive and potentially more specialized operations.

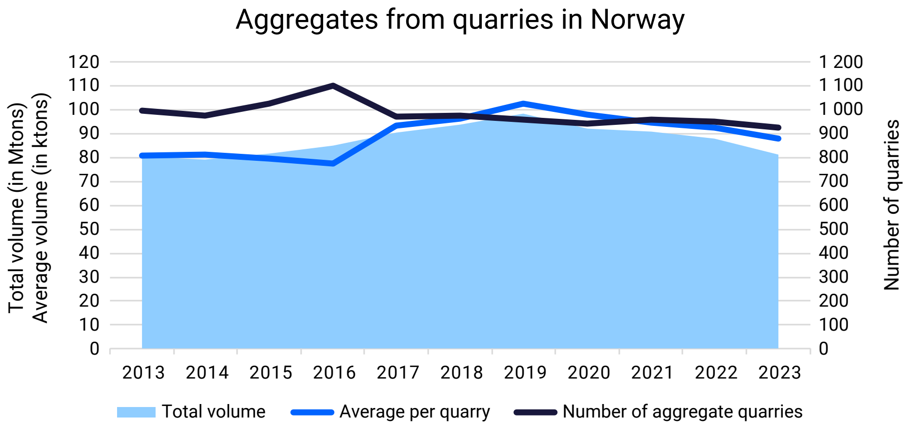


Figure 6. Total volumes of extracted aggregates, the number of quarries and average volume per quarry in Norway. Source: Ramboll analysis based on data from Dirmin[29]

3.2.4 Sweden

Quarries can be found all over Sweden, with the largest production found in the most populated areas of the country. The majority of extraction sites in Sweden produce crushed rock (72 percent), followed by natural gravel (14 percent) and moraine (4 percent). The final 10 percent of Swedish quarries extract a combination of these materials.[30]

In 2023, the number of operating quarries was 1,064, producing on average 82,000 tonnes of aggregates, see Figure 7. Over the past decade, the trend shows a remarkable shift in the number of quarries and the average production per quarry, with the former decreasing and the latter increasing. In 2011, there were 1,750 quarries, each delivering an average of approximately 44,000 tonnes, thus today's quarries produce nearly twice the volumes. Further, the number of natural gravel pits have decreased significantly while more quarries have been opened. This change reflects broader trends in the industry, such as increased production per quarry and a corresponding rise in transportation needs, a trend that is expected to continue going forward.[31]

29 Dirmin, (n.d.). Available at: https://www.dirmin.no/hardefakta

30 SGU, (2024). 'Grus, sand och krossberg 2023'. Available at: https://www.sgu.se/globalassets/produkter/publikationer/2024/grus-sand-och-krossberg-2023.pdf

31 Ibid.

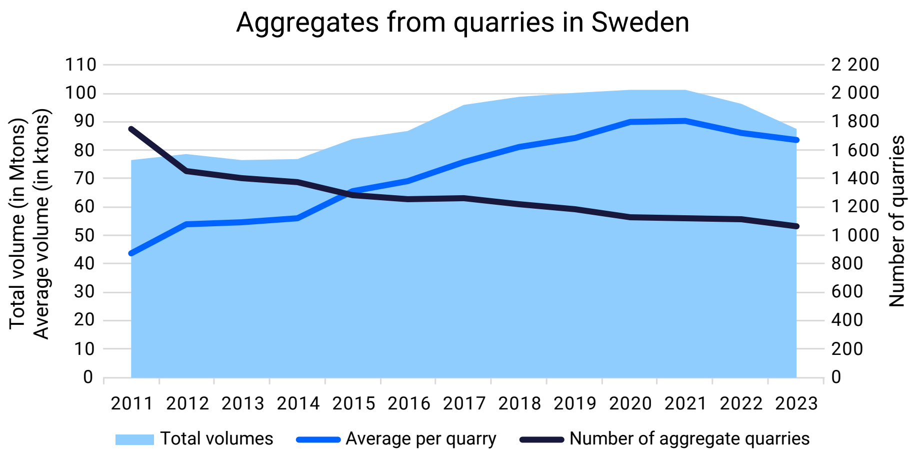


Figure 7. Total volumes of extracted aggregates, the number of quarries and average delivery per quarry in Sweden. Source: SGU.[32]

32 SGU, (2024). 'Grus, sand och krossberg 2023'. Available at: https://www.sgu.se/globalassets/produkter/publikationer/2024/grus-sand-och-krossberg-2023.pdf

Summary

This section shows that both the number and productivity of quarries have shifted significantly over the past decade. In **Sweden**, the number of operating quarries has declined from 1,750 in 2011 to 1,064 in 2023. **Norway** follows a similar trend, with active quarries decreasing from approximately 1,000 in 2013 to around 925 in 2023. In **Finland**, the decline is even more pronounced, dropping from roughly 1,900 to 1,500 over the same period.

Denmark stands out as an exception. While data is measured differently—based on extraction permits rather than direct counts of raw material pits—the trend is notably more stable. Between 2016 and 2023, both the number of permits and the overall volume of extracted aggregates remained largely unchanged, with only a slight dip in 2023.

Taken together, the total number of active quarries across Sweden, Norway, and Finland amounted to roughly 3,473 in 2023, down from approximately 4,289 a decade earlier—**a reduction of about 20 percent.**

20 %
A significant decline in the number of active quarries in the Nordics since 2013

This decline has significant implications. As the number of active quarries decreases, construction and infrastructure projects increasingly depend on long-distance transport of aggregates—leading to higher emissions, elevated costs, and greater logistical complexity. Given that transport over 80 kilometers can double the cost of aggregates, proximity to supply is a key determinant of economic and environmental efficiency. Given the vast geography of the Nordic region and the uneven distribution of aggregate reserves, this dynamic is expected to intensify. As local sources near urban areas become depleted, the distance between extraction and consumption continues to grow. This trend is particularly concerning in high-growth regions where demand for aggregates is rising.

Local sources near urban centers are becoming depleted, further increasing the distance between points of extraction and consumption. In fast-growing urban regions, demand for aggregates will continue to rise as populations expand and infrastructure needs grow. This trend is particularly concerning in high-growth regions where demand for aggregates is rising. Maintaining access to quarries close to areas of consumption is therefore critical—not only to reduce transport-related emissions and costs, but also to support efficient project delivery and supply chain resilience.

Case study: The Södra Sandby quarry – a critical resource at risk

In Skåne, around 11–12 Mton of aggregate are extracted annually.[33] Due to expected population growth and increasing pressure on transport infrastructure, the region faces rising demand for aggregates, projected to reach 13 Mton per year by 2040.[34]

However, Skåne's aggregate production is under pressure. Unfavourable geological conditions, dense population, and high environmental values limit opportunities to open new quarry sites. Currently, the region holds permits to extract 16 Mton annually, including nearly 13 Mton of rock materials. Although this exceeds today's demand, most permits are time limited. Without new approvals, permitted capacity will fall drastically in the coming decades, from 16 Mton today to just 6 Mton by 2030, and continue to decline to zero by 2050.[35] Meanwhile, demand will continue to rise, creating a widening gap between supply and need, and posing serious risks to future construction and infrastructure development.

An important case in point is the Södra Sandby quarry in Southwestern Skåne. It is one of only four in Sweden with permission to extract up to 1 Mton annually and is known for its high material quality that is difficult to find elsewhere. Its permit, however, expires in 2028. Recently, the Land and Environment Court denied the quarry's application for a permit extension. This decision was made despite the quarry´s status as a national interest and key expert authorities approving and supporting the environmental impact assessment bodies.

An assessment by consulting firm Tyréns highlights the impact of closing Södra Sandby. The only viable alternative for securing aggregate supply would be to import aggregates from Norway. This would increase road construction costs in Skåne by up to SEK 1 million per kilometer, and railway construction by up to SEK 8 million per kilometer. The additional transport of aggregates alone would increase costs in Skåne by around SEK 180 million annually. Longer haul distances with heavy loads would also lead to a dramatic rise in emissions, by as much as 500 percent, posing a serious challenge to climate goals.[36]

33 SGU, (2021). 'Förutsättningar för hållbar ballastförsörjning i Skåne län'. Available at https://resource.sgu.se/dokument/publikation/sgurapport/sgurapport202101rapport/s2101-rapport.pdf

34 Länsstyrelsen Skåne, (2023). 'Materialförsörjningsplan Skåne'. Available at: https://www.lansstyrelsen.se/download/18.68fbc90d193243b379e47f3e/1732525958424/Materialförsörjningsplan percent20Skåne.pdf

35 Ibid.

36 Tyréns, (2023) 'Klimat- och kostnadsanalys av minskad ballastproduktion i sydvästra Skåne'. Available at: https://handelskammaren.com/wp-content/uploads/2023/06/Rapport-ballast-Sydvastra-skane-230530-002.pdf

3.3 Circular aggregate use in the Nordic countries

The use of secondary aggregates is becoming increasingly important in efforts to reduce dependency on primary raw materials and to advance more resource-efficient construction practices. For the purposes of this report, circular aggregates are divided into two main categories: **recycling** and **reuse**.

Recycled aggregates are produced from construction and demolition waste, such as crushed concrete and asphalt. These materials are re-processed to meet technical standards and used as substitutes for primary material in applications like road bases and concrete mixes. Recycling supports circular economy goals by reducing landfill waste and the demand for primary materials. However, uptake remains low across the Nordic region, as demonstrated below. While detailed historical data on recycling is limited compared to quarry-based extraction, existing figures reveal that the share of recycled aggregates remains modest across the region, highlighting an untapped potential of adopting recycling practices.

In **Denmark**, for example, although around 80 percent of waste generated from gravel and rock extraction is recovered[37], only around 6 percent of total aggregate consumption in 2021 came from recycled sources such as construction waste and reclaimed asphalt. This marks a gradual improvement from 2007, when recycled aggregates accounted for just 2 percent of total use. Regional differences are notable: the Capital Region and Region Zealand report the highest recycling shares (11 percent and 12 percent, respectively), while other regions remain at 5–6 percent.[38]

In **Finland,** aggregate recycling remains underdeveloped. Although 63 percent of construction and demolition waste is recovered, national data on aggregate recycling is currently unavailable. However, estimates from Aggregates Europe suggest that recycled materials make up about 5 percent of Finland's total aggregate consumption.[39] Based on interviews conducted for this study with stakeholders in the industry, it is evident that the recycling rate is low, and many do not view recycling of aggregates as a viable alternative to primary aggregate.

Similar to Finland, **Norway** lacks official national statistics on the share of recycled aggregates, making it difficult to track progress and set clear benchmarks for circularity in the sector. Nevertheless, estimates from Aggregates Europe suggest that recycled materials account for around 4 percent of Norway's total aggregate consumption.[40]

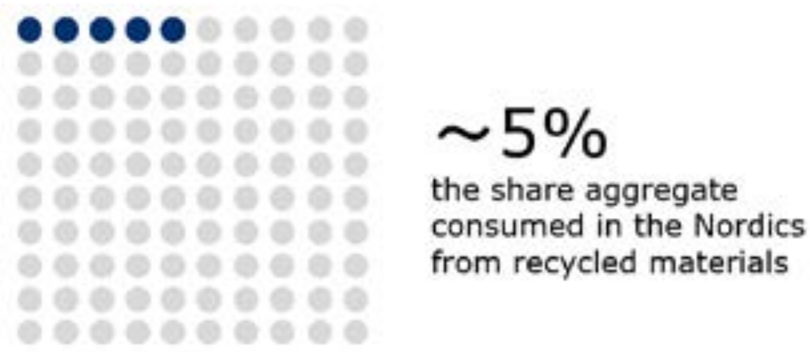
37 Statistics Denmark, (n.d.). 'AFFALD02'. Available at: https://www.statistikbanken.dk/AFFALD02

38 Ramboll, (2023). 'Fremskrivning af råstofforbruget 2022–2040'. Available at: https://backend.miljoegressourcer.dk/media/materialer/60/Modelnotat_-_Fremskrivning_af_r__stofforbruget_2022-2040_FINAL.pdf

39 Aggregate Europe, (n.d.). Figures. Available at: https://www.aggregates-europe.eu/facts-figures/figures/

40 Ibid.

In **Sweden**, the share of recycled products is also small. According to The Geological Survey of Sweden, these products currently account for only about 2 percent of total aggregates[41], while a recent study indicated around 5 percent of aggregates on the Swedish market are derived from recycled sources[42].



In contrast, reuse of excavation rock refers to the use naturally occurring materials removed during construction activities such as tunneling, roadwork, or foundation digging. These materials are typically repurposed with minimal or limited processing. Reuse may take place directly on-site, commonly known as mass balancing, or involve transport to nearby sites in need of material, or to quarries for further processing when necessary. This is a well-established practice within the aggregate sector, helping to reduce the demand for primary material, cut transport needs, lower emissions, and decrease overall project costs.

Compared to recycled aggregates, data on the use of excavated materials is more limited and less systematically collected. However, estimates indicate that in Sweden, approximately 60–80 million tonnes of such materials are reused annually.[43] Based on the total aggregate consumption figures used in this report, this suggests that around 40 percent of aggregates currently used originate from excavation rock. This represents a substantial share and highlights the importance of excavation rock as a compliment to primary aggregates.

3.4 Material optimisation of aggregates in the Nordic countries

Beyond recycling and use of excavated materials, material optimisation offers a powerful yet underutilised pathway to reduce aggregate consumption

41 SGU, (2024). 'Grus, sand och krossberg 2023'. Available at: https://www.sgu.se/globalassets/produkter/publikationer/2024/grus-sand-och-krossberg-2023.pdf

42 Gunaratne et al, (2022). 'Market prospects of secondary construction aggregates in Sweden'. Available at: https://doi.org/10.1016/j.jclepro.2022.132155

43 SGU, (2024). 'Grus, sand och krossberg 2023'. Available at: https://www.sgu.se/globalassets/produkter/publikationer/2024/grus-sand-och-krossberg-2023.pdf

in the Nordic construction sector. By using materials more strategically, from the earliest design stages through to construction execution, projects can achieve the same or better performance while lowering both environmental impacts and material costs. This section explores key approaches to material optimisation, highlighting how smarter design, better material choices, and more efficient construction methods can play a vital role in building a more resource-efficient and sustainable future.

Material optimisation can take many forms. In some cases, it involves refining structural design to reduce material use without compromising performance. In others, it means selecting the most appropriate material for each application, for example, reserving high-quality primary aggregates for critical infrastructure where no viable alternatives exist. Additional strategies include using prefabricated concrete elements in place of in-situ concrete, which can reduce waste and improve precision during construction.

Building on this, both previous studies and real-world project experience from NCC show promising potential for material optimisation in practice. In Sweden, projects that involve early-stage collaboration between contractors and developers have demonstrated reductions in material use of around 10 percent. This aligns with findings from the McKinsey Global Institute, which suggest that improved design and engineering processes can yield material efficiency gains of 8-10 percent.[44]

However, the potential for savings decreases as a project progresses. When contractors are involved early in the planning phase, typical material reductions of 4–6 percent can be achieved. In contrast, if engagement begins only during the construction phase, the potential drops to around 2–3 percent.[45]

This highlights the importance of collaborative and open discussions on the design and positioning of structural elements early in the project. For instance, reducing the depth of a balcony by just a few centimeters can lead to significant savings in aggregate use, not only for the balcony itself but also by potentially eliminating the need for additional structural support. Similarly, replacing a concrete wall with a gypsum wall can substantially reduce the amount of aggregate required, both for the wall and its foundation. Such material reductions can lead to considerable climate benefits, as aggregate production and concrete use are major sources of carbon emissions in construction. By minimising material needs through smart design choices, projects can significantly lower their environmental footprint. These types of design adjustments, identified through early and integrated dialogue, can result in meaningful reductions in material use as well as overall project costs.

44 McKinsey Global Institute, (2017). 'Reinventing Constructions: A route to higher productivity. Available at: mgi-reinventing-construction-executive-summary.pdf

45 Personal commincations with Henrik Böiers, expert at NCC.

Summary

This section focuses on the construction aggregates sector in the Nordic countries, with particular attention to how much material is used and where it is sourced. It examines the role of quarries as the primary source of raw materials, outlines current levels of recycling and reuse, and explores how material optimisation is being applied to reduce demand and improve resource efficiency in construction projects.

In 2024, Sweden recorded the highest aggregate consumption (160 Mton), followed by Norway (113 Mton), Denmark (77 Mton), and Finland (69 Mton). Infrastructure dominates demand, accounting for around 70 percent of total aggregate use. Aggregate consumption increased in Denmark and Norway between 2020 and 2024, while it declined in Sweden and Finland—largely due to reduced building activity.

Quarries remain the primary source of aggregates, although the number of active sites is declining as production becomes increasingly concentrated—especially in Sweden—resulting in significantly higher output per quarry. Taken together, the total number of active quarries across Sweden, Norway, and Finland amounted to roughly 3,473 in 2023, down from approximately 4,289 a decade earlier—a reduction of about 20 percent. Excavation rock from construction sites is also playing a growing role, particularly in infrastructure projects.

Recycling and reuse of aggregates remain limited across the Nordics, highlighting untapped potential for circular practices. The share of recycled materials is still modest, pointing to opportunities for increased use of secondary materials.

Material optimisation is emerging as a key strategy to reduce aggregate demand. Studies and real-world projects suggest that early collaboration in the design phase can reduce material use by 8–10 percent. However, the potential for savings declines sharply if measures are introduced later in the construction process.

4. The future need for aggregates

With growing infrastructure needs and heightened demand for buildings and clean electricity production, understanding the long-term significance of aggregates is vital for the Nordic region. This chapter investigates the overall trends in the Nordic building and construction industry, highlighting stated investment needs in infrastructure, housing and energy systems to meet future societal demands. The trends and developments within these sectors are examined to gain insights into what drives future aggregate demands in the region. Based on this the expected aggregate needs for each Nordic country are quantified.

4.1 Infrastructure

Infrastructure development is one of the most aggregate-intensive sectors in the Nordic countries. This section explores current plans and future investment needs in roads, railways, marine, water, and digital infrastructure, and their implications for long-term aggregate demand in the region.

4.1.1 Denmark

The baseline scenario is based on the most recent infrastructure plan in Denmark, Infrastrukturplan 2035[46], which is a long-term national plan adopted in 2021 providing an overview of public investments in Denmark's transport infrastructure over the period up to 2035. The plan was agreed upon by a broad majority of the Danish Parliament and encompasses total investments of DKK 161 billion. Of this, DKK 105.8 billion is allocated to new infrastructure investments, while DKK 54.8 billion is allocated to ongoing investments, including renewal and maintenance projects. The majority of the funding is allocated to rail and road infrastructure, accounting for 53 percent and 40 percent of the total budget, respectively.

The current Danish infrastructure plan adopted in 2021, remains the most recent comprehensive framework for national transport investments. However, at the end of 2024, it was announced that the projected costs of planned railway projects have increased significantly. In response, the Minister of Transport has indicated that the 2021 plan may be reopened and revised in dialogue with the Danish Parliament. So far, no formal budget adjustments have been made.

To optimize the use of aggregates in road projects, the Danish Road Directorate relies on "Sidetag", a practice where aggregates such as sand and gravel are extracted directly from areas adjacent to the road construction site, rather than being transported from external gravel pits.

46 Transportministeriet, (2021). 'Infrastrukturplan 2035'. Available at: https://www.trm.dk/media/rt1h51td/endelig-aftaletekst-infrastrukturplan-2035-final-a.pdf

This approach is increasingly applied to make better use of local resources and reduce heavy transport during infrastructure projects. The method is in alignment with Infrastructure Plan 2035, where one of the plan's broader goals is to promote more sustainable and resource-efficient practices.[47]

For most Nordic countries, future aggregate demand is estimated based on recently adopted national transport plans, see section 2 and below. However, Denmark's overarching Infrastrukturplan 2035—adopted in 2021 and extending through 2035—remains the most recent comprehensive national strategy, with no new plan adopted since. Consequently, it is not possible to apply the same method as for the other countries. To address this, an alternative scenario has been included to illustrate how future infrastructure demand for construction aggregates might evolve. This scenario assumes a 15 percent[48] increase in infrastructure investments in the upcoming transport plan compared to current levels. Although hypothetical, this assumption provides a reasonable indication of potential future trends in the absence of an updated national framework.

In addition, a number of significant infrastructure projects that fall outside the current transport plan have been included in the analysis. These projects are expected to contribute substantially to future aggregate demand and comprise both large-scale urban development and port expansions. Key projects include Lynetteholm, a major land reclamation and urban development project in Copenhagen, the Fehmarn Belt Tunnel between Denmark and Germany, and the extension of the Copenhagen Metro with the M5 line. Planned expansions at Copenhagen Airport have also been considered and costs related to NATO.

Furthermore, several major port infrastructure projects are included. Port of Aalborg A/S has initiated a project to construct a 500-meter quay extension at its container and multi-terminal, with construction scheduled to commence in 2026 and an estimated budget of 195 million DKK.[49] Odense Port is planning a significant expansion involving a widened and deepened navigation channel as well as a new harbour area encompassing 1 million square meters and 1.4 kilometers of new quays, with a budget of approximately 1.6-1.8 billion DKK.[50] Although the project remains in the planning phase, it represents a substantial future demand driver.

47 Vejdirektoratet, (2025). 'Vejsektorens Klima- og miljødag'. Available at: https://www.konferenceforum.dk/files/Oplaeg_Vejsektorens_klima-_og_miljoedag.pdf

48 The assumption is based on the recent 15 percent increase in Sweden's new infrastructure plan compared to the previous one. While hypothetical, it provides a reasonable indication of potential future trends in the absence of an updated national framework.

49 Licitationen, 2025. Availabe at https://www.licitationen.dk/article/view/1153163/nordjysk_havn_soger_totalentreprenor_til_195_millioner_dyr_udvidelse

50 Odense Havn, (n.d.). 'Odense Havn vokser med fremtiden'. Available at: https://odensehavn.dk/odense-havn-vokser-med-fremtiden/

Similarly, the Port of Hirtshals announced an expansion plan in early 2024, initially budgeted at approximately 1 billion DKK and expected to be completed by 2027[51]; however, this project has since been divided into smaller phases, thereby extending the completion timeline.[52] Together, these additional projects, alongside the three investment growth scenarios, provide a comprehensive basis for assessing potential future aggregate demand in Denmark.

Building on the analysis of current trends and investment patterns, the inclusion of additional infrastructure projects is crucial in shaping future aggregate demand. Figure 8 illustrates the projected impact of these initiatives. Compared to the baseline scenario, the addition of these projects is expected to lead to an estimated **7 percent increase in aggregate demand by 2045.**

In addition to this, a second scenario has been developed to explore the potential effects of a new national transport plan, assuming a 15 percent increase in infrastructure investments relative to current levels.[53] Under this assumption, aggregate **demand is projected to rise by almost 18 percent** compared to the baseline case. This highlights the significant role that both additional standalone projects and broader national infrastructure policies could play in shaping future material demand in Denmark.

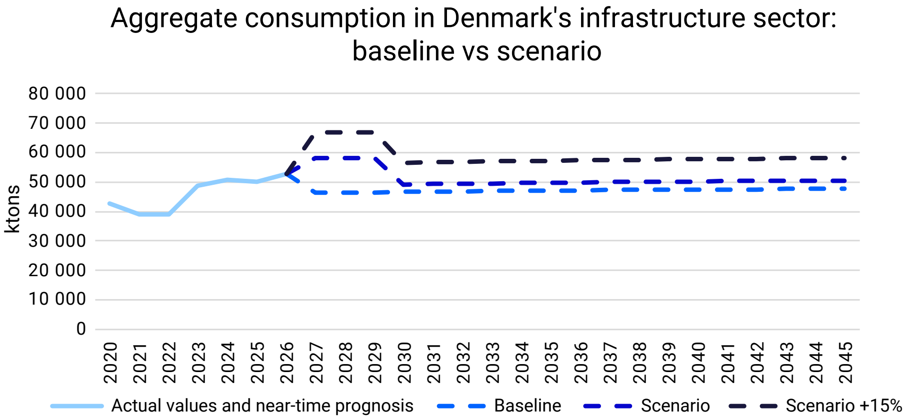


Figure 8. Aggregate consumption in infrastructure in Denmark – comparison of baseline and soceital transition scenario.

51 Hirsthals Havn (2024). 'Nu sendes milliardstor havneudvidelse i udbud'. Available at: https://portofhirtshals.dk/da/nordhavnen/nyheder-om-nordhavnen/hirtshals-havn-skal-vaere-stoerre-nu-sendes-milliardstor-havneudvidelse-i-udbud/

52 Hirsthals Havn (2024). 'Hirsthals Havn fortsætter med havneudvidelse i ny Hirtshals-model'. Available at: https://portofhirtshals.dk/da/aktuelt/nyhedssider/2024/okonomisk-ansvarlighed-hirtshals-havn-fortsaetter-med-havneudvidelse-i-ny-hirtshals-model/

53 The assumed increase of 15 percent reflects the increase in infrastructure spending in Sweden's updated national transport plan,and was therefore used as proxy for Denmark.

Although this increase may not seem much, even under the baseline scenario based on Infrastrukturplan 2035, Denmark's aggregate supply is expected to come under increased pressure. While the country sources aggregates from both land and sea, approximately 80 percent of current consumption is covered by land-used extraction.[54] Although national assessments indicate that Denmark has sufficient aggregate resources to meet future demand in principle, more than 80 percent of the residual resources are sea-based.

This situation is particularly significant because land-based aggregates in Denmark are rapidly becoming more limited. The depletion of gravel pits presents a major challenge, as they have traditionally accounted for the majority of the country's aggregate consumption. As land-based aggregate resources are gradually depleted, Denmark will increasingly need to rely on marine extraction and imports to meet future demand. However, the transition to sea-based resources presents several challenges. Marine extraction permits are time-consuming and resource-intensive to obtain, and many of the existing permits are set to expire by December 2025.[55] In addition, most current marine extractions are allocated for coastal protection purposes, with only a limited share going towards land-based construction.[56] Furthermore, one important development is the growing dependence on crushed rock imported from Norway, transported efficiently by sea. While this cross-border supply chain helps ensure availability, it also exposes Denmark to vulnerabilities related to external market fluctuations, transport logistics, and geopolitical factors.

While national assessments indicate that Denmark has sufficient aggregate resources to meet long-term needs, more than 80 percent of the remaining reserves are located offshore.[57] This shift poses several challenges. Extracting aggregates from the sea is generally more costly and technically complex than land-based extraction, requiring specialised equipment for dredging or seabed mining.[58] It also raises environmental concerns, including potential harm to marine ecosystems and local fisheries, which may lead to stricter regulatory requirements and higher mitigation costs.

As a result, Denmark will face significant pressure on its aggregate supply system in the coming years, not only due to the depletion of land-based gravel pits but also because the transition to sea-based extraction may introduce additional complications. The country will need to address these challenges to ensure a sustainable and reliable supply of aggregates for its ongoing and future infrastructure needs.

54 Ramboll, (2023). 'Fremskrivning af Råstofforbruget 2022–2024'. Available at: https://backend.miljoeogressourcer.dk/media/materialer/60/Modelnotat_-_Fremskrivning _af_r__stofforbruget_2022-2040_FINAL.pdf

55 Miljøstyrelsen, (2025) 'Fællesområdetilladelser'. Available at: https://mst.dk/erhverv/groen-produktion-og-affald/raastofindvinding/raastofindvinding-paa-havet/indvindingstilladelser/faellesomraadetilladelser and personal communication with Dansk Infrastuktur

56 Personal communication, Dansk Infrastruktur

57 GEUS, (2024). 'Et nationalt overblik over de reelt tilgængelige råstofressourcer i Danmark'. Available at: https://data.geus.dk/pure-pdf/GEUS-R_2024-8_web.pdf

58 Velegrakis et al. (2010). 'European marine aggregates resources: Orgins, usage, prospecting and dredging techniques'. Available at: https://www.academia.edu/49942060/European_marine_aggregates_resources_Origins_usage_prospecting_and_dredging_techniques

4.1.2 Finland

In Finland, the investment program serves as the Finnish Transport Infrastructure Agency's proposal for the implementation of new railway, road, and waterway projects, as well as their impacts[59]. The most recent investment program has been prepared for the period 2025–2032 and forms part of the national transport system plan, known as the Transport 12 plan. Parliament will decide on the actual implementation of the proposed development projects. In November 2024, the Finnish Government proposed additional appropriations of over one billion euros for transport projects starting in 2025, with final decisions to be made by Parliament in December.

Compared to the previous investment program, the new plan 2026–2037 shows a shift in priorities: investment in the construction of new roads and railways has decreased, while the budget for maintenance has increased. This reflects a stronger focus on improving and maintaining the existing transport infrastructure rather than expanding the network through new development projects. As a result, a large part of the current infrastructure investments is directed towards maintenance activities.

The new national investment plan covers the period until 2037. For the subsequent period 2038–2045, it is assumed that infrastructure investment levels will remain similar to those of the preceding years. Given the current emphasis on maintenance in the national strategy, it is further assumed that maintenance requirements will continue to be prioritised, with a gradual increase in maintenance investments for both railway and road infrastructure during this period. Together, these assumptions are expected to drive a continued and significant demand for construction aggregates compared to current levels.

In addition to the investments included in the Transport 12 plan, several major infrastructure projects are being planned outside the current program. Notably, three large-scale railway projects are under discussion, which are expected to significantly increase demand for construction aggregates if realised. The Länsirata (Western Rail Line) between Helsinki and Turku, with an estimated budget of €3 billion, aims to enhance connectivity between these two cities, improving travel times and strengthening Finland's transport network. Construction is currently in the planning stages, with work expected to begin in the near future.[60]

59 Finnish Transport Agency, (n.d.). 'Investment programme'. Available at: https://vayla.fi/en/planning-construction/project-planning/investment-programme

60 Länsirata, (n.d.). 'Project schedule and funding'. Available at: https://lansirata.fi/aikataulu-ja-rahoitus/

Similarly, the Lentorata (Airport Rail Line) linking Helsinki to Tampere via Helsinki Airport is projected to require €2,7 billion[61]. This project is also in the planning phase, and once realised, it will significantly improve transportation links between key cities and airports.[62] Although these railway projects are not yet fully decided, they represent substantial future demand drivers for construction aggregates as they progress from planning to construction.

Moreover, Finland faces a significant maintenance debt in its water infrastructure sector. The accumulated maintenance debt for water infrastructure is estimated at approximately €13 billion for the period 2020–2040[63]. The need for large-scale upgrades to water supply and wastewater systems will also influence future aggregate demand.

Figure 9 illustrates the projected demand for aggregates in Finland compared to the baseline scenario, which is expected to increase substantially between 2026 and 2045, **with a total increase of 55 percent**. This growth highlights the critical need for construction aggregates driven by both ongoing infrastructure projects and the broader societal need for major developments. The maintenance of water infrastructure constitutes a substantial and growing component of the total demand.

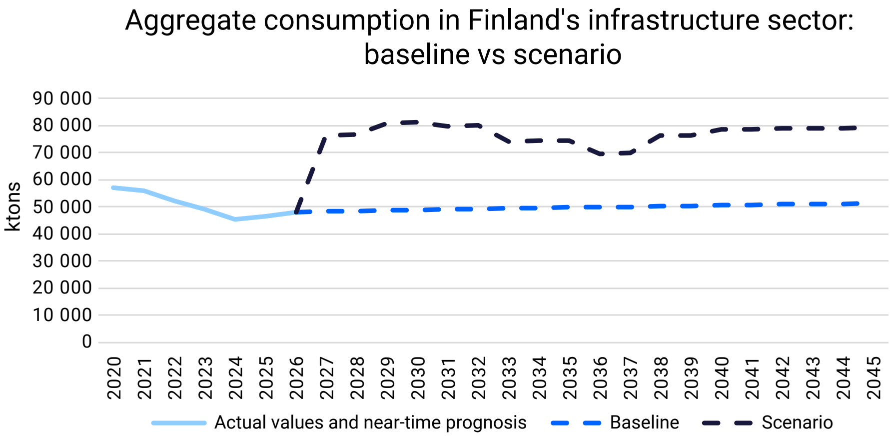


Figure 9. Aggregate consumption in infrastructure in Finland – comparison of baseline and societal transition scenario.

61 VNK, (2023). 'Suurten ratahankkeiden rahoituksen ja investointimahdollisuuksien selvitys' Available at: https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/164565/VM_2023_5.pdf

62 Lentorata, (n.d.). 'Airport Line'. Available at: https://lentorata.fi/hankkeen-aikataulu/

63 Finnish Water Utilities Association, (2020). 'Vesihuollon investointitarpeet vuoteen 2040'. Available at: https://www.vesilaitosyhdistys.fi/site/assets/files/5546/vesihuollon_investointitarpeet_vvy_10092020_final.pdf

4.1.3 Norway

In Norway, the new National Transport Plan (NTP) for the period 2025–2036 was officially adopted on 20 June 2024. In the national budget for 2025, the government proposes an allocation of NOK 95.2 billion for activities under the NTP, representing an increase of NOK 1.7 billion compared to the 2024 budget[64]. This allocation is consistent with the priorities outlined in the new plan, which emphasizes improving the quality and reliability of daily transport for citizens through increased investments in the operation and maintenance of existing infrastructure.

The 2025–2036 National Transport Plan (NTP) demonstrates a clear strategic shift compared to the 2022–2033 plan. Notably, investments in new road and railway construction have been reduced, while funding for maintenance has increased substantially. This shift reflects a deliberate policy decision to prioritise the preservation and enhancement of existing infrastructure over the expansion of new projects. In the railway sector, total investments rose from 338.7 billion NOK to 358.8 billion NOK, with a significant portion allocated to maintenance. Similarly, the road sector sees an increase in maintenance funding to 187.4 billion NOK, while investments in new construction experience a slight decline. Coastal infrastructure investments also show a modest increase[65].

The current national investment plan covers the period until 2036. For the subsequent period 2037–2045, it is assumed that new infrastructure investment levels will remain similar to those of the preceding years. Whereas maintenance is assumed to continue in line with the baseline scenario. Together, these assumptions are expected to drive a continued demand for construction aggregates compared to current levels.

In addition to the projects incorporated within the National Transport Plan, several major infrastructure initiatives are being planned outside the program[66]. These projects, many of which are still in the early planning or design phases, are anticipated to further contribute to future aggregate demand. Key planned projects include the Nord-Norgebanen railway[67], a proposed connection that would significantly enhance transport links in Northern Norway; the Hordfast fixed link, aimed at improving coastal connectivity; the Ringeriksbanen[68] railway extension; upgrades to the E18

64 Regeringen, (n.d.) 'Nasjonal transportplan 2025–2036'. Available at: https://www.regjeringen.no/no/tema/transport-og-kommunikasjon/nasjonal-transportplan/id2475111/

65 Regeringen, (n.d.) 'Nasjonal transportplan 2025–2036'. Available at: https://www.regjeringen.no/no/tema/transport-og-kommunikasjon/nasjonal-transportplan/id2475111/

66 Finansavisen, (2024). Available at: https://www.finansavisen.no/samfunn/2024/03/22/8112484/flere-prestisjeprosjekt-ute-av-nasjonal-transportplan

67 NRK, (2025). Available at: https://www.nrk.no/tromsogfinnmark/ny-rapport-om-nord-norgebanen-anbefaler-ikke-utbygging-1.17088503

68 Adressa, (2025). Available at: https://www.adressa.no/nyheter/innenriks/i/vgbRQw/ringeriksbanen-og-ny-e16-blir-mye-billigere-uten-moms-paapeker-hoeyre

highway in Sandvika[69]; and the continued expansion of the Bybanen[70] light rail system in Bergen. Furthermore, substantial investments are envisaged in marine infrastructure, supporting Norway's port and coastal operations, as well as in municipal technical infrastructure, particularly within the sectors of water and wastewater services[71].

An important emerging factor influencing future construction material demand relates to Norway's significant maintenance debt in its water infrastructure sector. The accumulated maintenance debt for water infrastructure is estimated at approximately NOK 332 billion for the period 2020–2040[72]. Addressing this maintenance backlog will necessitate substantial investments in the coming decades, generating increased demand for aggregates and other construction materials associated with the replacement and expansion of underground infrastructure networks.

Figure 10 illustrates the projected need for aggregates in Norway, compared to the baseline scenario. Between 2026 and 2045, aggregate demand is expected to increase by approximately 40 percent. This growth is driven by the significant infrastructure investments required to expand and upgrade transport networks, marine infrastructure, and municipal services. As Norway enhances its connectivity and sustainability, the demand for aggregates will rise to support these essential projects, highlighting the critical role of infrastructure development in shaping future aggregate need over the next two decades.

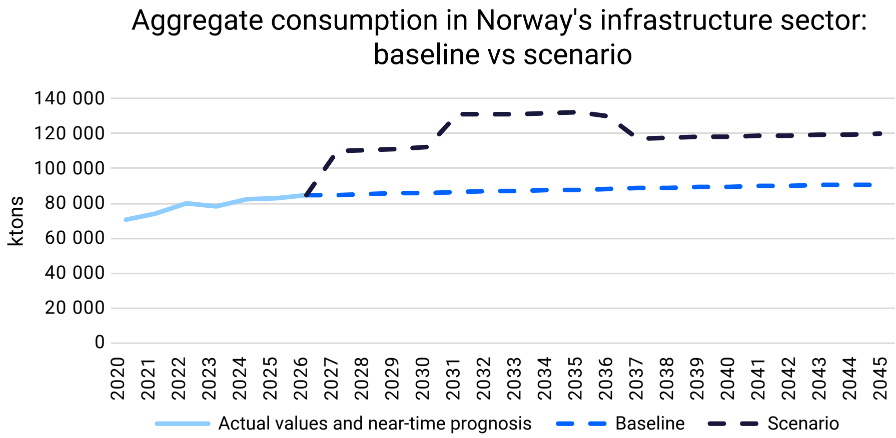


Figure 10. Aggregate consumption in infrastructure in Norway - comparison of baseline and societal transition scenario.

69 NRK, (2025). Available at: https://www.nrk.no/stor-oslo/ny-prislapp-pa-e18-forbi-sandvika-1.17205019

70 TU, (2025). Available at: https://www.tu.no/artikler/anslar-at-bybanen-i-bergen-blir-over-3-milliarder-kroner-dyrere/528987

71 Norsk Vann, (2021). 'Kommunalt investeringsbehov for vann og avlopp 2021-2040'. Available at: https://va-kompetanse.no/butikk/a-259-kommunalt-investeringsbehov-for-vann-og-avlop-2021-2040/

72 Ibid

4.1.4 Sweden

In October 2024, the Swedish government presented a new national transport infrastructure plan for the period 2026–2037[73], which was approved by the Swedish parliament in December of the same year. This new plan represents a historic investment in Sweden's infrastructure, with the total budget increasing by 200 billion SEK, bringing the overall investment to 1,171 billion SEK. This substantial increase reflects the government's commitment to improving Sweden's transportation networks, addressing both long-standing maintenance needs and future demands driven by population growth and urban development.

A key aspect of the new plan is the increased focus on maintaining and upgrading existing infrastructure. In particular, the budgets for roads and railways have been adjusted to reflect these priorities. The allocation for road maintenance has been increased by 48 percent, recognizing the growing need to preserve and enhance Sweden's extensive road network. The railway sector, however, sees a softer boost, with an increase of 5 percent. In addition to these maintenance investments, the plan includes a 15 percent increase in funding for new infrastructure projects that are deemed to be socio-economically efficient, reflecting a balanced approach between maintaining the existing network and investing in new, high-priority projects.

The national investment plan covers the period until 2037. For the subsequent period 2038–2045, it is assumed that new infrastructure investment levels will remain similar to those of the preceding year, with only a slight increase. The suggested infrastructure plan assumes no further maintenance needs for roads following the completion of the ongoing investment program. However, for railways, the current plan addresses only 10-15 percent of required maintenance, suggesting that a larger portion of future maintenance budgets will be allocated to railway infrastructure. Given the ongoing emphasis on maintenance within the national strategy, it is expected that maintenance investments will increase for railways, contributing to a continued and significant demand for construction aggregates in the upcoming years.

Despite these increases, the specifics of which projects will be excluded from the national transport plan remain unclear. Unlike neighbouring countries such as Norway and Finland, where detailed project lists are available, the Swedish government has not yet provided information on which major infrastructure projects will fall outside the scope of this plan. This information is expected to be revealed in the autumn of 2025. Based on current infrastructure proposals and the identified priority areas, it can be assumed that several key projects, such as the Östlig Förbindelse[74]

73 Trafikverket, (2025). 'Nationell Plan 2026-2037'. Available at: https://bransch.trafikverket.se/for-dig-i-branschen/Planera-och-utreda/langsiktig-planering-av-infrastruktur/nationell-plan/nationell-plan-2026-2037/

74 Stockholms Handelskammare, (2025). 'Bygg Östlig förbindelse – så kan vi finansiera och färdigställa Stockholms ringled'. Available at: https://stockholmshandelskammare.se/wp-content/uploads/2025/02/shk_report_bygg_ostlig_forbindelse_digital.pdf

(Eastern Connection) project, the double track between Luleå and Boden[75], and the expansion of the Malmbanan railway[76], will likely fall outside the main framework of the plan. These projects are considered crucial for improving connectivity in the north of the country but may not be included within the current national transport budget. Furthermore, large-scale infrastructure projects such as the expansion of the Luleå Port[77], Skandiaporten[78] in Gothenburg, Kustkajen[79] in Gothenburg, and Norra hamnen[80] (Malmö) are also anticipated to be excluded, as they are more focused on port and coastal infrastructure rather than the traditional road and rail network.

In addition to the growing demands of the transport sector, Sweden faces a significant challenge related to its water infrastructure. The country has accumulated a substantial maintenance backlog, particularly in the areas of water supply and wastewater systems. National assessments estimate that the maintenance debt for water infrastructure will exceed 500 billion SEK between 2021 and 2040.[81] This backlog presents a major challenge for the country, as many of Sweden's existing water infrastructure systems are aging and in need of urgent upgrades. The required investments will likely involve extensive work to replace aging pipelines, improve water treatment facilities, and upgrade wastewater management systems. These upgrades will also have a considerable impact on the demand for construction materials, including aggregates used in the replacement and expansion of underground infrastructure networks.

Figure 11 illustrates the projected need for aggregates in Sweden, compared to the baseline scenario. Between 2026 and 2045, aggregate demand is expected to **increase by approximately 21 percent.** This growth is primarily driven by substantial infrastructure investments, particularly in the maintenance and upgrading of existing road and railway networks, as well as in water infrastructure. As Sweden continues to prioritize infrastructure development, both in terms of maintenance and new projects, the demand for construction aggregates is set to rise significantly in the coming decades.

75 Järnvägsnyheter, (2025). Available at: https://www.jarnvagsnyheter.se/20250219/17166/dubbelspar-lulea-boden-kan-bli-verklighet-finansiering-ifragasatts

76 Di, (2024). Available at: https://www.di.se/nyheter/trafikverkets-tidsplan-sagas-maste-kunna-ga-fortare/

77 Järnvägsnyheter, (2024). Available at: https://www.jarnvagsnyheter.se/20241218/16977/33-miljoner-till-upprustning-av-lulea-hamns-jarnvagsanlaggning

78 SVT, (2024). Available at: https://www.svt.se/nyheter/lokalt/vast/muddring-for-miljarder-framtidssakrar-goteborgs-hamn

79 Göteborgshamn, (2024). 'Kustkajen 2.0'. Available at: https://www.goteborgshamn.se/om/projekt/kustkajen2/

80 Personal communication with Malmö stad.

81 Svenskt Vatten, (2023). 'Investeringsbehov och framtida kostnader för kommunalt vatten och avlopp – en analys av investeringsbehov 2022-2040'. Available at: https://vattenbokhandeln.svenskvatten.se/wp-content/uploads/2023/05/SvensktVatten_Investeringsrapport_2023.pdf

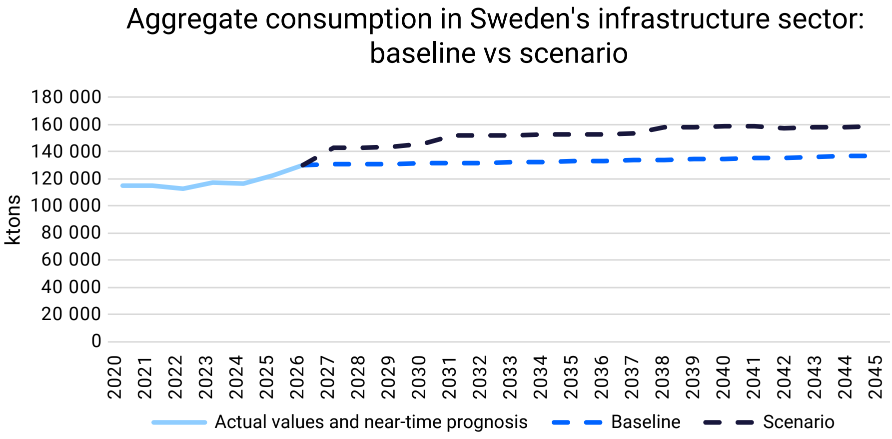


Figure 11. Aggregate consumption in infrastructure in Sweden – comparison of baseline and societal transition scenario.

4.2 Energy systems

The transition to a greener economy and new industrial investments, as well as new commitments to regional energy security across the Nordics is rapidly increasing the demand for fossil-free electricity production.

Across the Nordics, the projected need for additional electricity production coincides with a portion of existing electricity generation facilities approaching the end of its technical lifespan between now and 2045. Consequently, future investment needs are twofold: addressing the growth in demand and replacing ageing infrastructure to maintain existing capacity. Importantly, such reinvestments in existing capacity, as well as investments in electricity distribution networks or energy storage systems, are not included in the analysis.

4.2.1 Denmark

Total annual electricity production in Denmark is expected to increase from approximately 40 TWh in 2024 to around 155 TWh by mid-century, resulting in an increase of around 115 TWh.[82] The majority of this additional capacity is expected to be delivered through the expansion of offshore wind energy, which is forecast to contribute roughly 80 TWh of the increase. Solar power is projected to add nearly short of 35 TWh, while onshore wind developments are anticipated to contribute an additional 1-2 TWh. This energy mix reflects Denmark's strategic emphasis on leveraging its offshore wind potential while diversifying with solar capacity to support system flexibility and resilience.

82 Danish Energy Agency. (2024). 'Analyseforudsætninger til Energinet'. Available at: https://ens.dk/analyser-og-statistik/analyseforudsaetninger-til-energinet

Despite the ambitious scale of planned energy expansion, it is important to note that the current and near-term levels (2020-2026) of construction activity in the Danish energy sector are already at historically high levels. As a result, it is difficult to isolate how much of the projected increase to 155 TWh represents a net increase in construction activity beyond the levels already observed or planned through the mid-2020s.

To account for this uncertainty, the baseline scenario for Denmark is calibrated using the average annual aggregate material consumption associated with energy infrastructure construction between 2020 and 2026, see Figure 12. Accordingly, a decrease in aggregate demand is observed in the model between 2026 and 2027 under the baseline scenario, which is not the case for the rest of the Nordics.

In contrast, the STS assumes that the high levels of construction activity observed up to 2026 will be maintained throughout the 2027–2045 period. This assumption reflects a continuation of investment in energy infrastructure at high capacity. **As a result, annual aggregate material consumption under the STS is projected to be around 3 Mton (30 percent) higher than the baseline scenario.** Looking at the entire period, this corresponds to a cumulative increase of approximately 60 Mton of aggregate materials attributed to energy sector developments.

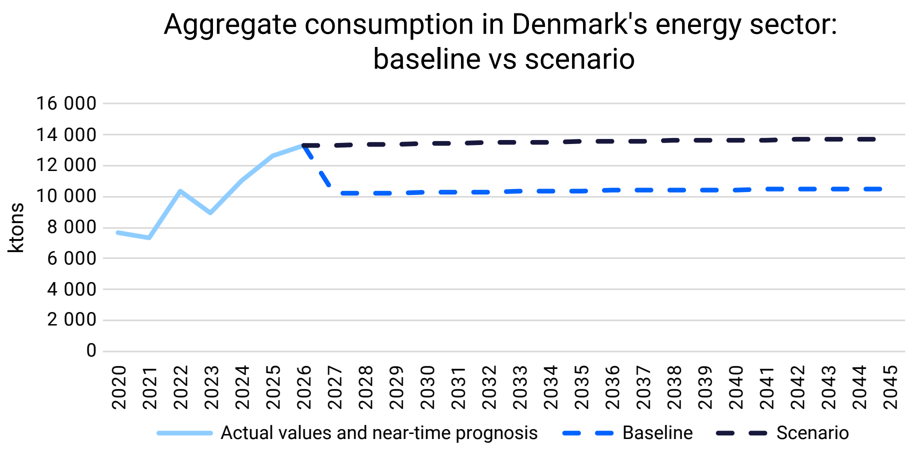


Figure 12. Aggregate consumption in energy sector in Denmark- comparison of baseline vs societal transition scenario.

4.2.2 Finland

Finland is preparing for a substantial increase in electricity demand over the coming decades, largely driven by its national commitment to achieve carbon neutrality by 2035. To support this shift, a large pipeline of renewable energy projects is currently planned or under development across the country, driving aggregate demands.

According to projections from Finland's national transmission system operator, Fingrid, total electricity production is expected to increase significantly by 2045, with additional output reaching approximately 242 TWh.[83] The expansion will be led primarily by onshore wind, projected to contribute 154 TWh, followed by offshore wind at 47 TWh and solar PV generation at 41 TWh.

The impact of this energy transition, would it be realised, is reflected in material consumption projections under the STS. Notably, an annual increase of approximately 18.5 Mton of aggregates is expected compared to baseline levels, representing an increase of over 200 percent, see Figure 13. Over the full period up until 2045, the cumulative additional demand for aggregate materials under the STS amounts to more than 350 Mton, relative to the baseline scenario.

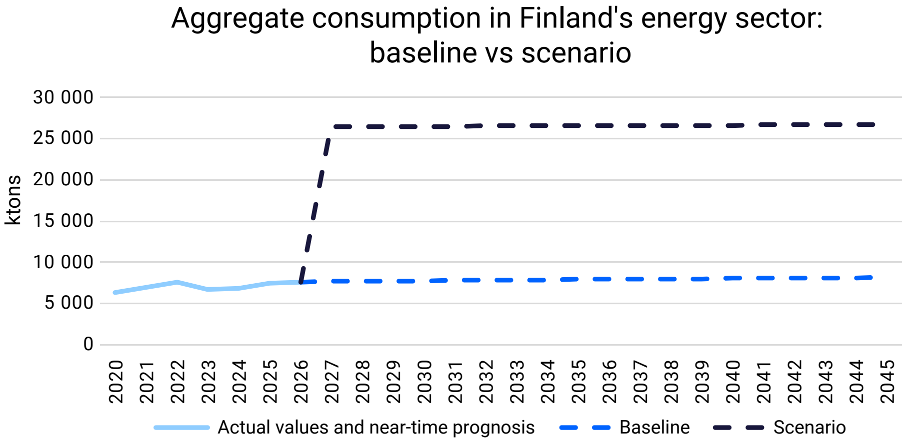


Figure 13. Aggregate consumption in energy sector in Finland - comparison of baseline and societal transition scenario.

4.2.3 Norway

Norway's future energy needs are strongly tied to its push for reducing carbon emissions and embracing electrification. According to projections by the Norwegian Water Resources and Energy Directorate (NVE), total electricity generation is anticipated to rise by over 60 TWh by 2045.[84] The industrial sector is poised to be a major driver of electricity demand. As more industries become electrified, including petroleum-related processes and the production of green hydrogen, electricity consumption will rise accordingly.

83 Fingrid. (2023). 'Sähköjärjestelmävisio 2023'. Available at: https://www.fingrid.fi/globalassets/dokumentit/fi/tiedotteet/sahkomarkkinat/2023/fingrid_sahkojarjestelmavisio_2023.pdf. Assumptions are in line with the 'electricity to product' scenario following the suggestion by Fingrid. It is important to note that Fingrid's scenarios vary in the use cases for electricity, e.g., the degree of electrification of industry, as well as the electricity production methods.

84 NVE. (2024). 'Utviklingen i kraftmarkedet mot 2050'. Available at: www.nve.no/media/17596/utviklingen-i-kraftmarkedet-mot-2050.pdf.

As illustrated in Figure 14, this will lead to an annual increase in **aggregate consumption of about 4 Mton in the STS, relative to the baseline, marking a 100 percent growth**. The majority of the additional electricity production will be delivered through the expansion of wind power. Offshore wind is projected to contribute the largest share, with an expected increase of 29 TWh, reflecting Norway's strategic effort to leverage its extensive maritime areas and offshore wind potential. Onshore wind is also set to grow, adding approximately 14 TWh to national electricity production. Solar PVs, while currently representing a relatively small share of Norway's energy mix, is expected to grow significantly over the coming decades, with production projected to increase by 11 TWh. Finally, hydropower, which currently accounts for the vast majority of Norway's electricity generation, is expected to grow by 9 TWh.

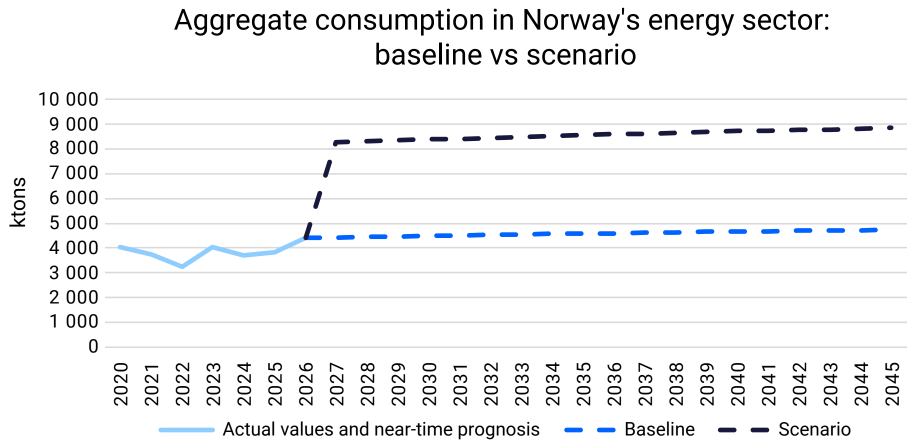


Figure 14. Aggregate consumption in energy sector in Norway - comparison of baseline and societal transition scenario.

4.2.4 Sweden

According to the Swedish Energy Agency's long-term scenario for the development of the energy system, approximately 144 TWh of new electricity generation capacity is expected to be added between 2025 and 2045.[85] Wind power, both onshore and offshore, is anticipated to account for most the new capacity, with each contributing an estimated 60 TWh over the period. Solar PV generation is projected to increase by 14 TWh.

Combined, wind and solar energy developments in STS are projected to drive an annual increase in aggregate material demand of approximately 8 Mton, see Figure 15.

85 Swedish Energy Agency. (2025). Scenarier över Sveriges energisystem - Vägar till ett energisystem med nettonollutsläpp 2050'. Available at: https://energimyndigheten.aw2m.se/System/TemplateView.aspx?p=Arkitektkopia&id=1173312576a844f5a08e2c4a2005ccfb&l=t&cat= percent2FPrognoser percent20och percent20 Scenarier&lstqty=1. Assumptions are in line with the 'global environmental perspective' scenario (Swedish: globalt miljöperspektiv).

Nuclear power is expected to contribute an additional 10 TWh, with new capacity expected to be deployed between 2035 and 2045. This timeline is reflected in the modelling of aggregate material needs, which show a marked increase in the later years of the projection period, coinciding with the construction phase of new nuclear facilities. It is important to note that while nuclear power accounts for a smaller share of additional electricity generation, the construction of nuclear power plants is significantly more material-intensive compared to other generation technologies.

As such, the aggregate demand attributed to nuclear development is substantial, with over 30 Mton of materials required annually. However, due to the inherent complexities and uncertainties connected to nuclear energy projects, this estimate should be interpreted with caution.

In total, the STS implies **40 Mton additional aggregate consumption per year (150 percent) over the 2035-2045 period**, compared to baseline. When viewed across the assessment period, this results in a cumulative increase of nearly 500 Mton in aggregate material demand.

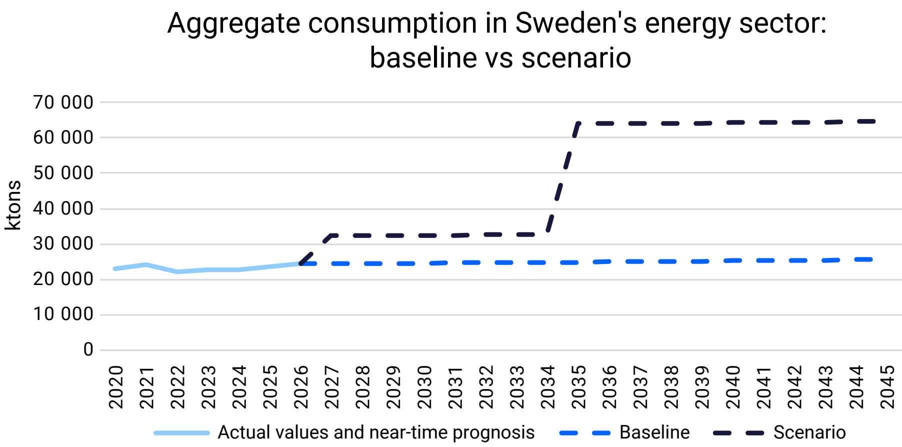


Figure 15. Aggregate consumption in energy sector in Sweden – comparison of baseline and societal transition scenario

4.3 Buildings

The building sector in the Nordic countries is also expected to grow in response to sustained population increases and changing societal needs. This section examines projected investments in both residential and non-residential construction, and their implications for future aggregate demand across the region.

Denmark, Finland and Norway

In Denmark, Finland, and Norway, there are currently no indications of a structural housing shortage at the national level until 2045. This suggests that the existing housing stock is largely sufficient to meet the population's current needs, and that future demand for new housing will be driven by projected population growth[86] rather than an existing deficit in housing supply. Although there may be growing demand for housing in urban areas, this does not indicate a national shortage, but it could still impact localized housing markets. Consequently, the anticipated increase in housing demand, and the corresponding investments in housing construction as well as aggregate needs, will align with baseline demographic trends. This means that the STS follows baseline.

This assumption also extends to the construction of non-residential building sector, meaning the demand for such buildings will scale in direct proportion to changes in population size. As a result, no surge in non-residential construction is expected between 2027-2045.

Taken together, the anticipated increase in construction activity across both residential and non-residential sectors translates into a moderate rise in aggregate consumption. Specifically, it is projected that from 2027 to 2045, Denmark will see an increase of approximately 1.5 Mton in aggregate consumption, Finland will experience an increase of around 1.4 Mton, and Norway will require about 2.2 Mton more aggregates over the same period.

Sweden

According to the long-term housing demand projection published by the Swedish National Board of Housing, Building and Planning (Boverket), approximately 523,000 new residential units will be required between 2024 and 2033 to meet national housing needs.[87] This figure represents the number of homes necessary to maintain market balance, accommodate anticipated population growth, and address the current shortfall in adequate housing. The projection assumes a relatively even distribution of this requirement across the ten-year period, equating to an average annual demand of approximately 52,000 new dwellings.

In contrast, around 32,000 housing units currently constructed each year. This indicates an annual gap of around 20,000 additional housing units that are required between 2024 and 2033 in order to address the housing shortages.[88] The identified shortfall reflects both the need to accommodate population growth and to compensate for past underinvestment in residential construction.

In response to this projected housing deficit, the STS assumes construction of an additional 16,000 multi-family homes and 4,000 single-family homes per year between 2024-2033[89], which manifest in increased aggregate need by about 5 Mton per year over this period (Figure 16). Over the entire period

86 2.9 percent for Denmark, 6.5 percent for Finland and 6.9 percent for Norway

87 Boverket, (2024). Available at: https://www.boverket.se/sv/om-boverket/nyheter-aktuellt/nyheter/523-000-nya-bostader-behovs-de-narmaste-tio-aren/

88 Ibid.

89 The 80:20 ratio of multi-family homes and single-family homes is derived from recent trends in residential development.

(2026-2033), this represents an increase of approximately 20 percent in aggregate demand. Following 2033, once the structural housing shortage is considered to have been addressed, the scenario assumes a return to baseline housing construction levels consistent with the baseline projection. At that stage, new housing demand is expected to correlate closely with demographic growth alone, without the need to compensate for an accumulated shortfall.

Construction of non-residential buildings is expected to follow the baseline scenario, as for the other Nordic countries.

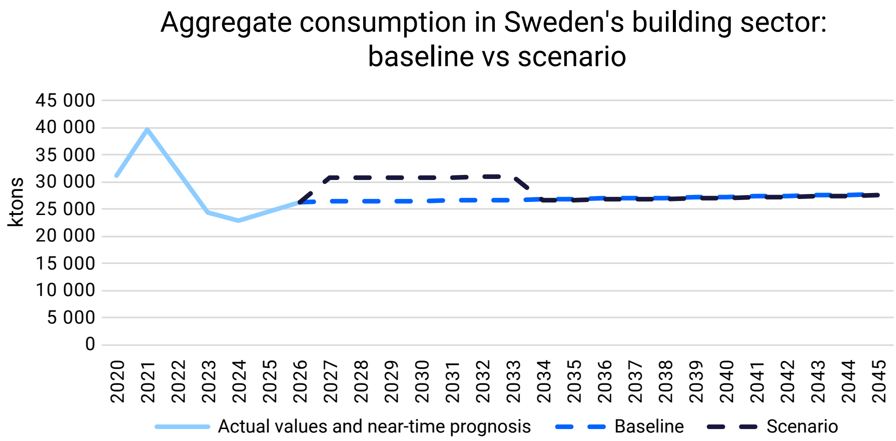


Figure 16. Aggregate consumption in building sector in Sweden - comparison of baseline and societal transition scenario.4.4 Total future demand of construction aggregates

4.4 Total future demand of construction aggregates

Across the Nordic countries, the implementation of projects outlined under the STS is expected to require significantly increased volumes of construction aggregates. This projected growth in aggregate demand is primarily driven by large-scale infrastructure investments.

Annual increases in aggregate consumption under the STS scenario vary by country, from 15-25 Mton in Denmark to 25-60 Mton in Sweden. When assessed over the full modelling period, the cumulative increase in aggregate demand is considerable across all countries. These volumes underscore the scale of the physical transformation required to meet climate and energy objectives in the region.

4.4.1 Denmark

Under the STS, aggregate consumption in Denmark is projected to increase by approximately 15–25 Mton annually, compared to the baseline scenario. The most significant spike in aggregate demand is expected to occur between 2027 and 2029, with aggregate consumption reaching nearly 100 Mton over these three years, see Figure 17. This surge corresponds with the intensive build-out phase of key infrastructure projects in the country.

From 2030 onwards, the demand for aggregates under the STS scenario is projected to stabilize at around 90 Mton per year, reflecting a more consistent level of construction activity over this period.

In cumulative terms, compared to the baseline scenario, an additional 300 Mton of aggregates will be required between 2027 and 2045, a 20 percent increase, as shown in Figure 18.

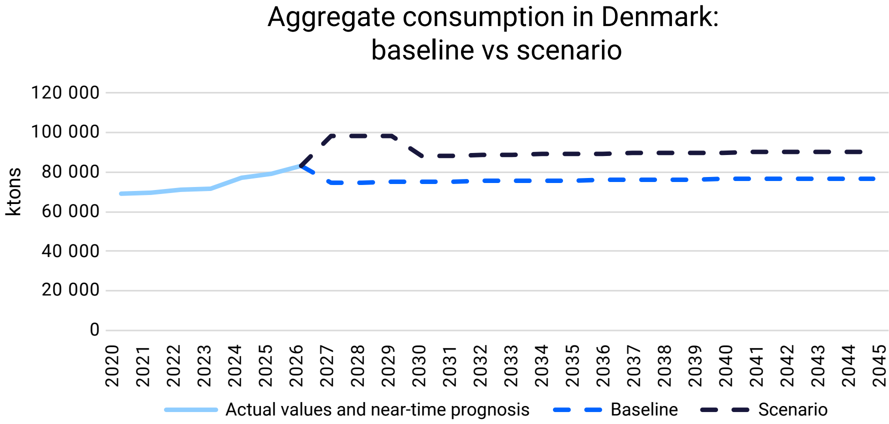


Figure 17. Aggregate consumption in Denmark – comparison of baseline and societal transition scenario.[90]

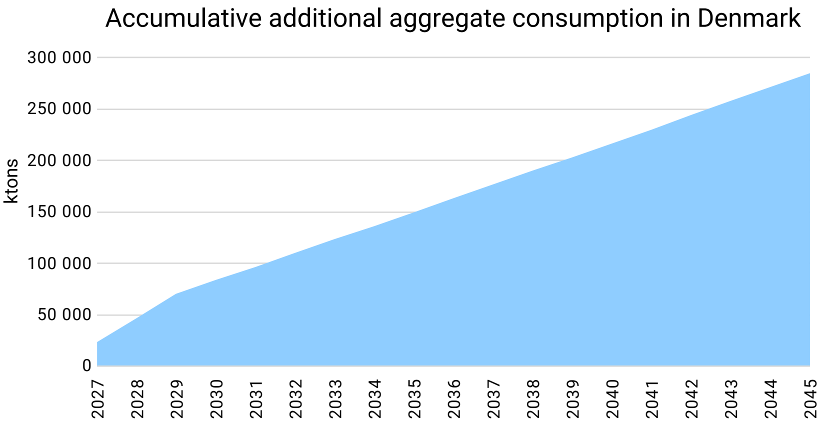


Figure 18. Accumulative additional aggregate consumption in Denmark between 2027–2045 in scenario compared to baseline.

4.4.2 Finland

Under the STS, Finland is projected to experience a significant increase in aggregate material demand, with annual aggregate consumption expected to rise by approximately 40–50 Mton compared to the baseline scenario, as shown in Figure 19.

90 The societal transition scenario for Denmark assumes a 15 percent increase in transport infrastructure investments in the upcoming national transportation plan, see section 4.4.1.

From 2027 to 2045, total aggregate consumption in the STS scenario is projected to range between 120–130 Mton, driven primarily by infrastructure investments. When viewed over the entire modelling period, the STS scenario is estimated to result in a cumulative increase of around 870 Mton in aggregate consumption, or 60 percent, relative to the baseline scenario (see Figure 20). This total underscore the extensive aggregate needs associated with the ambitious energy and infrastructure projects envisioned for Finland in the coming decades.

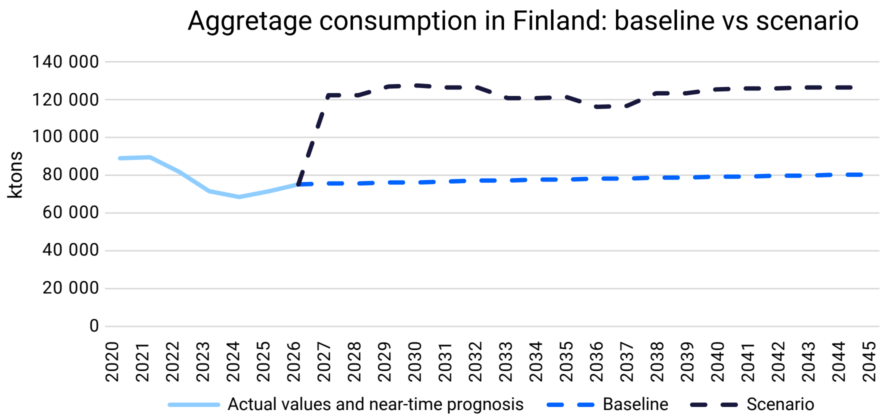


Figure 19. Aggregate consumption in Finland – comparison of baseline and societal transition scenario.

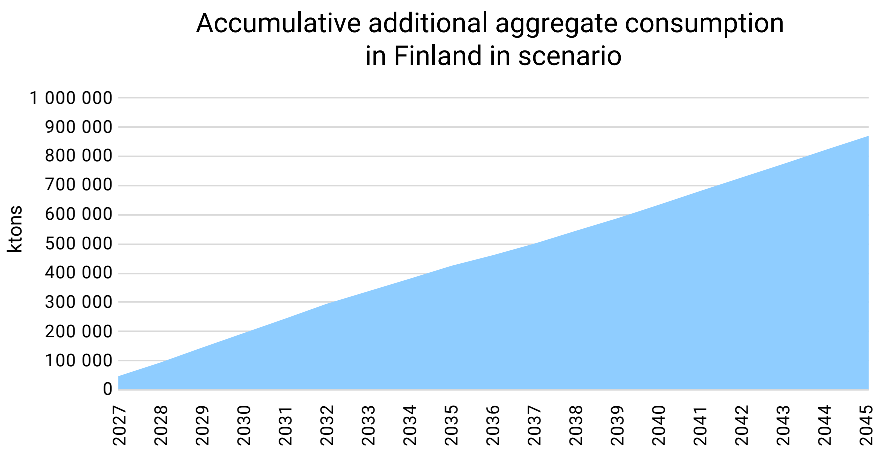


Figure 20. Accumulative additional aggregate need in Finland between 2027–2045 in scenario compared to baseline.

4.4.3 Norway

In Norway, the STS foresees a significant increase in aggregate consumption across three key categories. Aggregate demand is projected to rise by approximately 30–50 Mton annually compared to the baseline scenario, as seen in Figure 21.

The highest volumes of aggregates are expected to be consumed between 2031 and 2036, during which period aggregate consumption is expected to reach around 170 Mton. This level corresponds with the most intensive phase of energy infrastructure development. For the remaining years of the period, aggregate consumption is projected to stabilise at around 155–160 Mton per year. Cumulatively, compared to the basline scenario, the STS is expected to generate an additional demand of nearly 700 Mton of aggregates over the period from 2027 to 2045, see Figure 22. This represents an increase of nearly 30 percent[91].

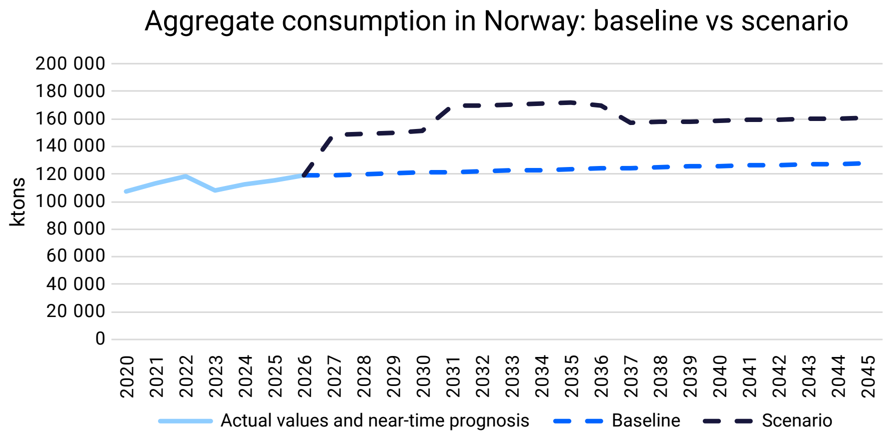


Figure 21. Aggregate consumption in Norway – comparison of baseline and societal transition scenario.

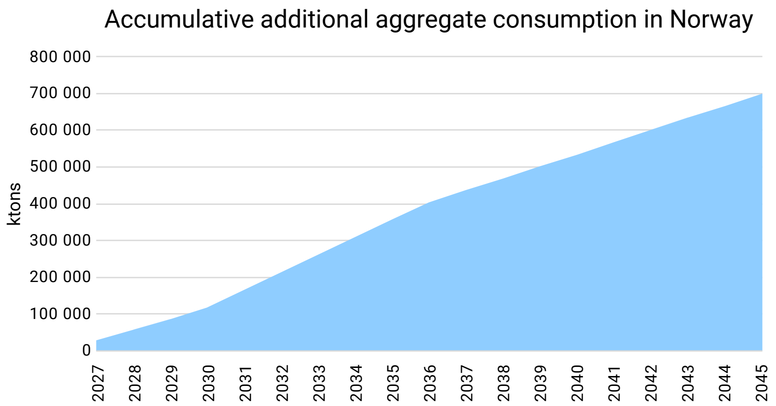


Figure 22. Accumulative additional aggregate need in Norway between 2027–2045 in societal transition scenario compared to baseline.

91 While Norway's domestic consumption of aggregates is expected to rise significantly toward 2045, it is important to note that the country is also a major exporter of aggregates. As national infrastructure and construction needs grow, export volumes may decline, but the distinction between production, consumption, and actual domestic need remains important when interpreting aggregate supply and demand figure

4.4.4 Sweden

In Sweden, the implementation of the STS is expected to drive a substantial increase in aggregate consumption, with annual demand projected to rise by between 25 and 60 Mton relative to the baseline scenario, as illustrated in Figure 23. This increase is driven by extensive infrastructure developments as well as housing construction and expansions of the energy systems.

Between 2027 and 2045, total aggregate demand under the STS is expected to range from 200–250 Mton. A notable increase in aggregate consumption is anticipated in 2035, marking the beginning of construction for new nuclear power plants. These plants will contribute an additional 10 TWh of electricity production by 2045, a key component in Sweden's strategy to diversify its low-carbon energy sources and maintain a stable electricity supply.

Figure 24 shows the cumulative increase in demand in the STS, totaling just under 900 Mton, an increase of around 25 percent over the 2027-2045 period compared to the baseline scenario.

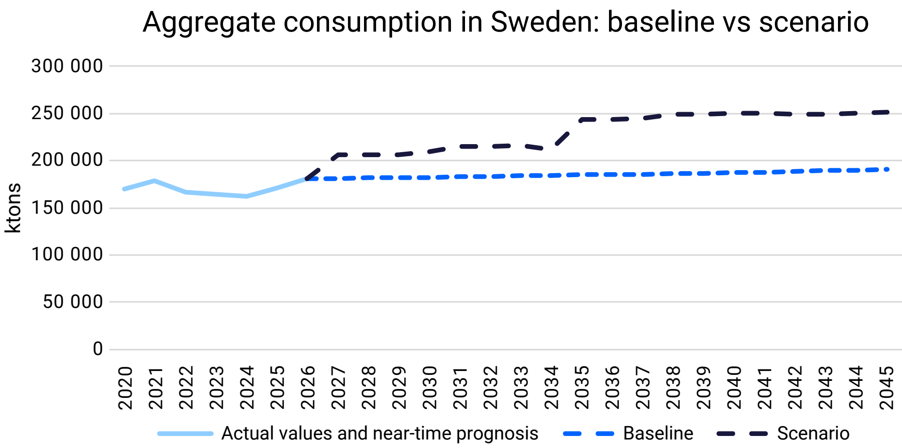


Figure 23. Aggregate consumption in Sweden - comparison of baseline and societal transition scenario.

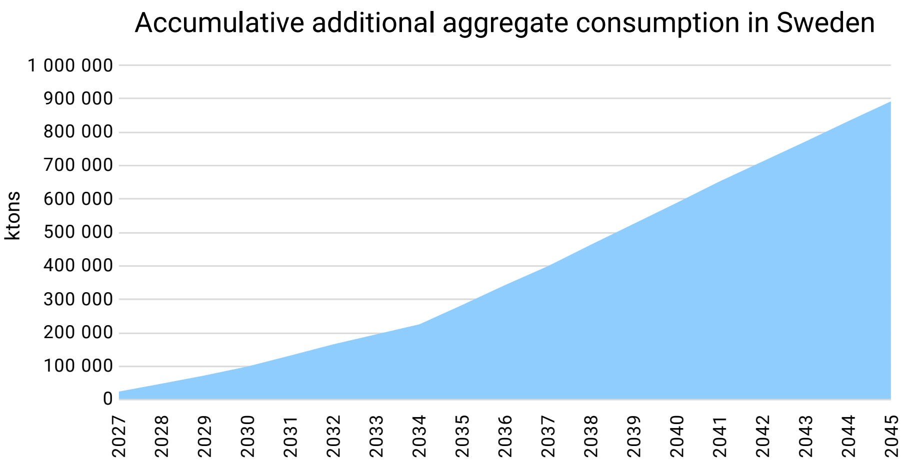


Figure 24. Accumulative additional aggregate need in Sweden between 2027–2045 in scenario compared to baseline.

4.4.5 Total for Nordic countries

Looking at the Nordic countries combined, aggregate consumption is expected to increase substantially under the STS when compared to baseline, see Figure 25. Between 2027 and 2045, the STS anticipates an additional annual consumption of approximately 120–150 Mton of aggregates relative to baseline levels. As a result, total aggregate consumption in the region is projected to rise from approximately 460 Mton in 2026 to around 625 Mton by 2045, representing a 37 percent increase in annual consumption. In cumulative terms, the STS is expected to result in the consumption of approximately 2,750 Mton more aggregates across the Nordic region compared to the baseline scenario over the full period to 2045 (see Figure 25).

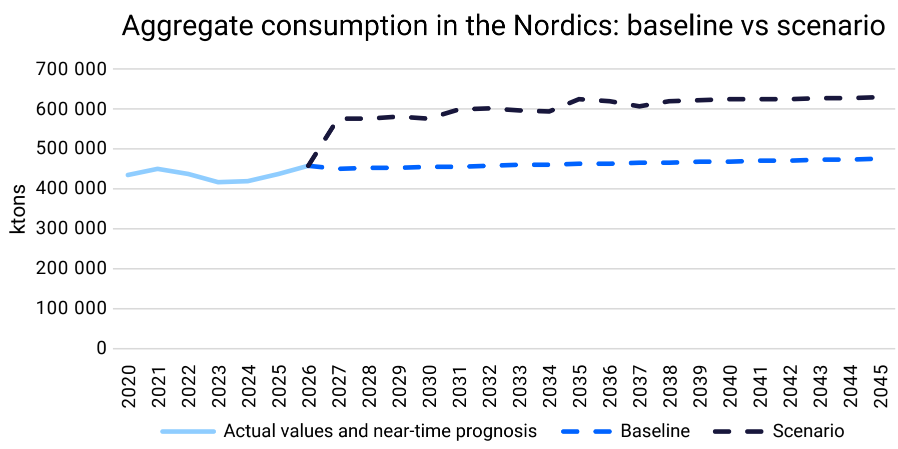


Figure 25. Aggregate consumption in the Nordics – comparison of baseline and societal transition scenario.

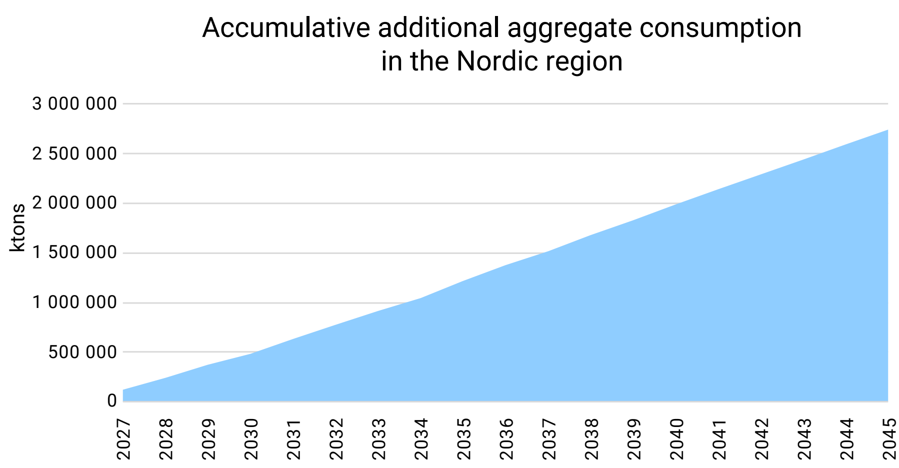


Figure 26. Accumulative additional aggregate need in the Nordic region between 2027–2045 in scenario compared to baseline.

4.5. Growing gap between supply and demand

The analysis reveals a growing gap between the current levels of construction aggregate consumption and the significantly higher volumes required to meet future infrastructure and energy demands under the STS scenario. Although current aggregate consumption under the baseline scenario may suffice for present needs, the STS projections indicate that the Nordic countries must dramatically increase supply to support large-scale projects vital for achieving climate and energy goals.

Annual aggregate demand increases under STS range from 15–25 Mton in Denmark to 25–60 Mton in Sweden, with similarly large rises in Finland and Norway. This added demand translates into massive cumulative increases —300 Mton extra in Denmark, over 900 Mton in Finland and Sweden, and nearly 700 Mton in Norway between 2027 and 2045.

Looking across the Nordic region as a whole, aggregate consumption is set to increase steeply under STS. By 2045, total annual consumption is projected to rise from around 460 Mton in 2026 to approximately 625 Mton —a 37 percent increase. This growth means an additional 120–150 Mton of aggregates will be needed each year compared to the baseline scenario. In cumulative terms, the STS would require approximately 2,750 Mton more aggregates than in the baseline scenario by 2045.

Meeting this level of demand will require changes across the entire aggregate system. Quarry production remains dominant but is becoming more concentrated, with fewer active sites and higher output per quarry —especially in Sweden. Recycling is still limited across the Nordics and material optimisation is still underused, even though early-stage planning and design can cut demand by up to 10 percent.

Together, these trends highlight a critical gap: under current conditions, aggregate supply systems are not equipped to deliver the volumes required to support the region's large-scale transformation. Meeting future infrastructure, housing, and energy demands will require a coordinated Nordic effort to dramatically scale up aggregate supply. The challenge—amounting to nearly 2,750 Mton of additional material across the region—calls for urgent and collective action. Bridging this gap will require not only scaling up supply, but also planning frameworks, and policy efforts across the Nordic region —an imperative explored in greater detail in the following chapter.

Summary

This chapter analyses long-term aggregate needs in the Nordic region in light of growing investment ambitions in infrastructure, energy and housing. Based on projected development trends and political targets, it quantifies future aggregate demand under two scenarios: **Baseline** and **the Societal Transition Scenario (STS)**.

While current aggregate consumption may be sufficient to meet short-term needs under the baseline scenario, the STS highlights a significant long-term supply gap. Delivering on the region's climate targets, energy transition, and infrastructure ambitions will require a substantial and sustained increase in aggregate availability. Across the Nordic countries, this translates into a massive cumulative rise in demand over the coming decades.

In **Denmark**, annual aggregate demand is expected to increase by 15–25 million tonnes compared to the baseline. By 2045, the country is projected to require 300 million tonnes more than under the baseline—**an increase of approximately 20 percent.**

In **Finland**, demand is projected to rise 40–50 million tonnes compared to the baseline. This translates to a cumulative increase of around 870 million tonnes— **approximately 60 percent more than in the baseline scenario.**

In **Norway**, annual demand is expected to grow by 30–50 million tonnes, By 2045, the country is projected to require 700 million tonnes more than under the baseline—**an increase of approximately 30 percent.**

In **Sweden**, annual demand is projected to increase by 25–60 million tonnes By 2045, the country is projected to require 900 million tonnes more than under the baseline**—an increase of approximately 25 percent.**

By 2045, total annual consumption in the Nordic region is projected to rise by **37 percent**. This growth means an additional 120–150 Mton of aggregates will be needed each year compared to the baseline scenario. In cumulative terms, the STS would require approximately **2,750 Mton more aggregates than the baseline scenario by 2045.**

Meeting this demand will require urgent, coordinated action across the region—not just in scaling up supply, but also through long-term planning and supportive policy frameworks.

5. Bridging the gap – aligning aggregate supply with future demand in the Nordics

The analysis in Chapter 4 highlights a critical gap between current aggregate consumption levels and the significantly higher volumes required to meet the Nordic countries' future aggregate needs. The projections under the Societal Transition Scenario suggest that to support the large-scale infrastructure, housing, and energy projects crucial for achieving climate and energy goals and increasing resilience, the Nordics must substantially increase their aggregate supply.

This challenge is particularly pressing, as the region may require nearly 2,750 Mton of additional aggregate materials to meet the anticipated demand. Given the scale of this need, the Nordic countries must act swiftly. Given the scale of this challenge, the solution lies not only in expanding aggregate production but also in addressing key strategies that will ensure a sustainable, long-term supply. There are three primary areas that need to be tackled to meet this increasing demand while minimizing the environmental impacts associated with aggregate consumption. **These are:** enabling the increase of primary aggregate materials, increasing the recycling and reuse of existing materials, and optimizing material used to reduce demand and minimizing waste.

Each of these areas are integral to reducing the dependence on primary aggregates and mitigating the environmental footprint of the construction industry — and at the same time bridging the gap between current supply and future demand. However, to truly bridge that gap, these strategies must be developed, integrated, and prioritized within long-term regional planning and policy frameworks. Focusing on these areas will help ensure that the Nordic countries can meet the growing demand for aggregates in a manner that is both efficient and environmentally responsible.

This chapter analyses the challenges and opportunities across three interconnected key areas. Together, they offer the Nordic countries a strategic foundation for securing the materials needed to support future infrastructure, housing, and energy projects. By promoting a more balanced, circular, and resilient aggregate supply, these efforts will help the region meet its growing demand sustainably in the decades to come.

5.1 The need for new quarries and gravel pits in the Nordic countries

This section provides an overview of the current status of aggregate operations across the Nordic countries, the need for new extraction sites to meet rising aggregate demand, and the key opportunities and efforts to support low-carbon and reliable aggregate supplies.

5.1.1 Denmark

As Denmark continues to experience rising consumption of raw materials, a key question emerges: will new gravel pits be needed to meet future demand? With many existing sites nearing depletion, particularly in certain regions, the country must explore new sources to sustain its construction and infrastructure needs. This section examines the growing demand for new gravel pits, the permitting process, and the challenges associated with managing raw material extraction from both land and sea-based sources.[92] [93]

Currently, most raw materials in Denmark are extracted on land, but as these gravel pits approach exhaustion, pressure is mounting to open new extraction sites. This shift has led to increasing land-use conflicts, as proposed gravel pits often compete with residential development and other land interests. At the same time, more than 80 percent of Denmark's remaining aggregate reserves are located offshore.[94]

While national assessments indicate sufficient long-term supply, the pivot toward marine extraction presents new challenges. These include higher operational costs, technical complexity, and environmental concerns, particularly the potential impacts on marine ecosystems and fisheries.

For the current extraction of marine aggregates, a large share goes towards coastal protection, which is included in Denmark's aggregate extraction statistics. Only an estimated 10 percent of these materials are directed toward land-based construction. This means that while offshore aggregates are technically available, they are not widely utilized for general market supply, limiting their immediate role in meeting inland construction demand. For large-scale infrastructure projects such as the Fehmarn Belt tunnel and the Eastern Ring Road, specific marine extraction areas have been designated based on specific material requirements needed for the project.[95]

The pivot towards marine extraction is further challenged by the permitting process which has become more administratively heavy and costly, with applicants bearing high costs for the gathering of necessary documentation. In addition, permits for approximately 75 percent of active marine extraction areas are set to expire by December 2025, with only a small share currently planned for renewal. As a result, a significant drop in the extraction of marine aggregates is expected, at least in the short term. Compounding these challenges, obtaining a new marine extraction permit from the Danish Environmental Protection Agency can take up to five years, making it difficult to scale up marine sourcing in response to market needs.

92 Ramboll, (2023). 'Fremskrivning af råstofforbruget 2022-2040'. Available at: https://backend.miljoeogressourcer.dk/media/materialer/60/Modelnotat_-_Fremskrivning_af_r__stofforbruget_2022-2040_FINAL.pdf

93 Miljøstyrelsen, (n.d.). 'Råstofindvinding'. Available at: https://mst.dk/erhverv/groen-produktion-og-affald/raastofindvinding

94 GEUS, (2024). Available at: https://www.geus.dk/om-geus/nyheder/nyhedsarkiv/2024/maj/ny-geus-rapport-giver-for-foerste-gang-overblik-over-den-samlede-maengde-raastoffer-i-danmark

95 Personal communication, Dansk Infrastruktur

Regional disparities further complicate the picture. Supply and demand for aggregates vary significantly across Denmark's five regions, creating spatial imbalances that strain national planning efforts. In the Capital Region, dense population and limited geological resources prevent sufficient local extraction of materials such as sand, gravel, stone, and chalk. As a result, the region relies heavily on imports, mainly from Region Zealand and through ports, leading to high transport volumes, increased emissions, and additional wear on infrastructure[96].

Region Zealand, by contrast, is a major supplier of raw materials to neighboring areas. In 2021, more than half of the aggregates extracted in Zealand were exported to the Capital Region, surpassing its own local consumption. This growing dependence on regional redistribution highlights the interdependence of supply chains across the country[97].

A similar dynamic can be observed in the Southern, Central, and Northern regions, where land-based extraction accounts for the vast majority of supply. Sea-based sources remain marginal, and recycling and imports play only a limited role. This widespread reliance on land-based extraction, combined with uneven distribution of resources and growing demand, reinforces the need for more circular and regionally coordinated approaches.

As construction activity continues to rise, particularly in the eastern regions, existing sites in the Capital Region and Region Zealand are projected to be depleted by 2033 and 2038, respectively. Both regions face growing difficulties in identifying new extraction areas, increasing their reliance on materials transported over long distances, often from Western Denmark or marine sources. This shift carries environmental, climate, and economic costs. A common rule of thumb suggests that the cost of aggregates doubles when transported more than 80 kilometers[98].

In response, there is growing support for a coordinated, long-term national aggregate strategy that ensures a balanced and resilient supply of raw materials. A centralized approach would enable more holistic and forward-looking management of Denmark's resources – accounting for land-based and marine sources as well as secondary materials such as recycled aggregates and waste[99] [100]. The Danish Society for Nature Conservation has also emphasized the urgency of such a strategy, calling for stronger national leadership to align raw material policy with environmental sustainability and future societal needs.

96 Personal communication, Dansk Infrastruktur

97 The Capital Region of Denmark, (n.d.). Available at: https://www.regionh.dk/english/Climate-and-environment/Mineral-and-raw-material-resources/Pages/Mineral-and-raw-material-resources-supply-in-the-Capital-Region-of-Denmark-.aspx#:~:text.

98 Danske Regioner, (2020). 'Bæredygtig råstofforsyning for fremtid'. Available at: https://www.e-pages.dk/regioner/191/

99 Danmarks Naturfredningsforening, (2022). Available at: https://aktiv.dn.dk/media/89730/hb-2022-02-04-bilag-5-1-2-høringsudkast-til-dn-s-råstofpolitik.pdf

100 Dansk Industri, (n.d.). Available at: https://www.danskindustri.dk/politik-og-analyser/dis-politiske-udspil/rastofstrategi/

This is further illustrated by projections of future demand for land-based extraction sites. As seen in Section 3.2.1, the number of extraction sites in recent years has remained stable. If this trend continues through 2045, the average volume of aggregates produced per site would also need to remain relatively constant in order to meet the aggregate demand under the Societal Transition Scenario. In Denmark's case, this suggests that future demand can be satisfied by maintaining the current number of extraction sites with present levels of aggregate extraction. However, the challenges outlined above cast doubt on the feasibility of maintaining the current number of sites going forward and highlights the need for bold and coordinated efforts to secure future aggregate supply in Denmark.

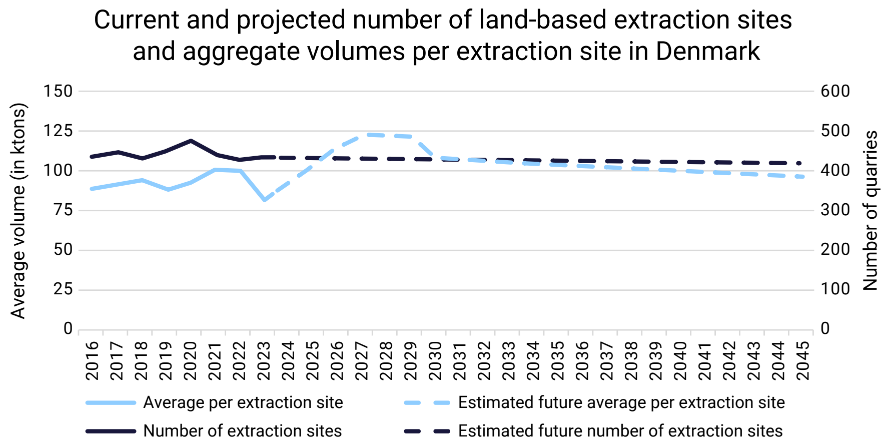


Figure 27. Number of land-based extraction sites and average volume per site in Denmark, historical and future projected values to cover increased aggregate demand under the societal transition scenario.

5.1.2 Finland

As established in the previous chapter, aggregate demand in Finland is projected to grow significantly in the coming decades. While current quarry reserves with valid excavation permits may be technically sufficient to meet this demand—through expansion or deeper extraction—economic and geographic realities present substantial challenges. In many cases, demand for aggregates does not align geographically with existing supply, resulting in high transportation costs. Additionally, deeper excavation tends to be more expensive than surface-level extraction, further increasing overall costs.

To optimise logistics and reduce transport-related expenses, new quarries will likely be required, particularly for large-scale projects in remote areas, such as the planned railway developments situated far from urban centers. Even within population centers, there may be a growing need for new quarries. However, these are often met with social resistance, environmental concerns, and zoning constraints, making it more probable that existing quarries in these areas will instead be expanded in both size and depth. Given the economic limitations associated with aggregate recycling in Finland, combined with the country's plentiful reserves of rock suitable for aggregate use, recycling and imports are unlikely to play a major role in meeting short-term supply needs.

In Finland, aggregate demand is generally met on a local basis, with materials rarely transported over long distances—except in larger urban centres such as Helsinki[101]. However, regional disparities in both demand and supply exist. The Uusimaa region due to its dense population and high volume of construction projects, represents the largest demand for aggregates. As local reserves deplete, more distant sources, such as ridge and bedrock aggregates, are increasingly being utilized, which in turn heightens transportation needs. For construction projects in central Helsinki, aggregates may need to be transported over distances of 40–50 km[102].

In less densely populated areas of Finland, aggregate demand is often project specific. While the overall supply is not as depleted as in Uusimaa, and quarry locations are less constrained by social concerns, the required quality of aggregates may not always be available near the project sites. Certain large-scale projects, such as the railway developments, demand higher-quality aggregates, which are not found uniformly across the country. This results in transport distances of up to 200 km for high-quality aggregates[103]. The increased need for transport not only raises aggregate costs but also contributes to higher emissions.

The changes in demand and supply across regions is largely determined by the location of undertaken projects. Most of the projects are likely to be located in the "growth triangle" between Helsinki, Tampere and Turku and the demand will likely be covered by local supply. As discussed previously, only the Helsinki region is suffering from depleted supply and challenges in opening new quarries in close-by areas. This brings attention to the broader issue of the permitting process for new quarries, which remains a significant challenge across Finland.

Opening new quarries in Finland remains a significant challenge due to the complexity and length of the permitting process. New extraction sites must comply with strict environmental and social regulations, and the process is often prolonged by stakeholder appeals, particularly when local opposition arises.[104] The typical permitting process takes up to 2–2,5 years[105] to complete but can vary significantly depending on location and proximity to residential areas[106]. It is often shorter in rural areas, while urban or densely populated regions tend to face longer timelines. Even without major complications, the process can be delayed—and when appeals are involved, it may

101 Stakeholder interviews and Ramboll expertise

102 Ramboll expertise

103 Ramboll expertise

104 The Ministry of Environment in Finland Available at: https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/160707/YMra_13_2018_Kiviaineshuollon_kehittaminen.pdf

105 SOU 2024:98 En ny samordnad miljöbedömnings- och tillståndsprövningsprocess

106 Ramboll expertise

extend to 5–10 years[107]. Industry representatives have noted that this issue is becoming more pressing, and discussions are underway to explore ways to streamline the process without compromising environmental or social standard[108].

In light of these challenges, it is important to note that there are currently around 3,000 active licenses for soil extraction in Finland. Of these, approximately 1,600 pertain to gravel and sand, while 1,200 are related to rock aggregates. Over the past decade, there has been a clear shift towards crushed rock, with its share increasing from 34 percent in 2011 to 41 percent in 2023[109]. This shift is largely due to the depletion of natural gravel and sand reserves near Finland's largest urban areas, making crushed rock a more viable and necessary alternative to meet the demands of construction projects.

As Finland faces increasing demand for aggregates driven by urban growth and large-scale infrastructure projects, combined with a potential further decline in number of quarries, the challenge of securing a reliable and sustainable supply becomes more pressing. While local sources can typically meet demand in many regions, the depletion of gravel and sand reserves in urban centers like Helsinki, combined with the lengthy permitting process for new quarries, underscores the need for innovative solutions. The growing shift toward crushed rock highlights the need to adapt to these evolving demands, yet the complexities of environmental regulations and local opposition to new quarrying sites may require a re-evaluation of the permitting process to ensure timely access to critical resources. Addressing these issues will be crucial to meeting future aggregate needs while balancing environmental, social, and economic considerations.

Finland has also seen a consistent decline in the number of active quarries in recent years. If this downward trend continues linearly through to 2045, the average aggregate output per quarry would need to increase more than fourfold; from approximately 20,000 tonnes today to around 90,000 tonnes per quarry annually, to meet projected demand, as illustrated in Figure 28. Such a sharp increase in output per site is highly unlikely, given technical, environmental, and logistical constraints. This scenario underscores the importance of maintaining and developing a geographically distributed and resilient network of quarries to ensure long-term security of aggregate supply across the country.

107 Ramboll expertise

108 Stakeholder interviews

109 Ramboll analysis based on SYKE data. Available at: https://syke.maps.arcgis.com/apps/webappviewer/index.html?id=9af59a7f70ee43e5a6cd43cc47980422

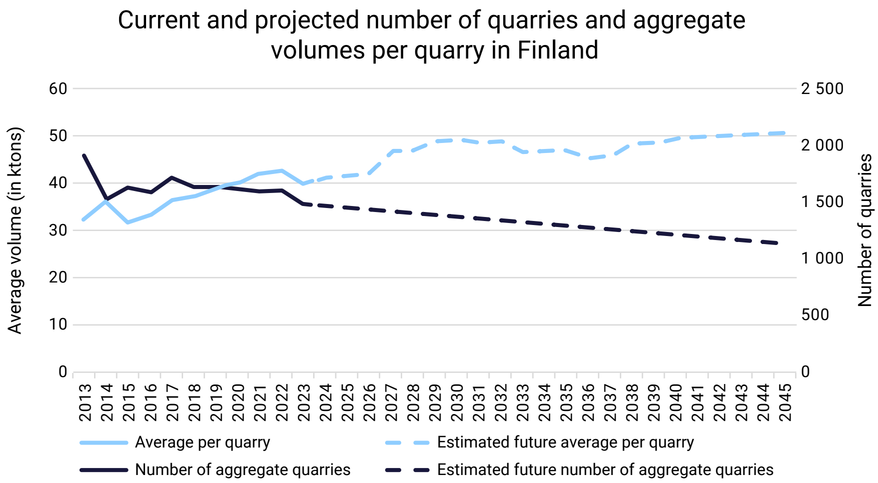


Figure 28. Number of quarries and average volume per quarry in Finland, historical and future projected values to cover increased aggregate demand under the societal transition scenario.

5.1.3 Norway

As in Finland, Norway is experiencing growing pressure to secure a reliable and sustainable supply of aggregates—especially in and around major urban areas. While the country benefits from a relatively well-distributed network of quarry sites, aggregate demand significantly outpaces local supply in many cities. In Oslo, for example, the volume of aggregates consumed per capita is far greater than what is extracted within the city limits. As noted in the Dirmin Harde Fakta report, a large portion of Oslo's aggregates is sourced from the surrounding Viken county, reflecting a broader national pattern in which large urban centers depend on nearby municipalities for supply.[110]

This pattern extends beyond Oslo. Other rapidly growing municipalities, including Trondheim, Lillestrøm, Lørenskog, Asker, Bærum, Ullensaker, Bergen, Kristiansand, and Nordre Follo, are also projected to experience significant increases in aggregate demand due to population growth and continued construction activity. As these areas expand, surrounding municipalities will likely face mounting pressure on local resources. Given Norway's vast geography and uneven distribution of aggregate reserves, this dynamic results in increasingly long transport distances, which in turn drive up costs, emissions, and logistical complexity. Transport has therefore become one of the most critical factors in securing a stable and sustainable aggregate supply. Understanding not only where aggregates are extracted but also where they are consumed is essential for future planning, particularly as local sources near urban centers become depleted.[111]

110 Harde Fakta om mineralnæringen 2023, page 13. https://dirmin.no/sites/default/files/harde_fakta_2023.pdf

111 Kortreist stein sluttrapport (2019), page 5. https://www.sintef.no/globalassets/project/kortreist-stein/kortreist-stein-sluttrapport-final.pdf

Although Norway's current network of extraction sites provides a solid foundation, long-term supply security varies significantly by region. According to an analysis by the Norwegian Directorate for Mineral Management, 51 percent of municipalities have more than 20 years of crushed rock supply remaining[112]. However, 35 percent are expected to exhaust their resources within the next decade, and 27 percent currently have no active crushed quarries at all. These regional imbalances point to growing supply challenges, particularly around the country's largest and fastest-growing cities.

These regional disparities underscore the importance of strategic planning to ensure long-term access to aggregates where they are most needed. As urban demand continues to rise and local sources become increasingly constrained. Norway will need to invest in smarter transport logistics, regional coordination, and forward-looking land-use policies. Without proactive measures, the growing mismatch between supply and demand could pose a serious bottleneck for future infrastructure and housing development, particularly in the country's most dynamic urban regions.

Norway has also experienced a decline in the number of active quarries over the past decade, although at a slower pace than in Finland. If the historical trend continues, the number of quarries could fall from over 900 today to just above 700 by 2045, a reduction of approximately 20 percent, see Figure 29. In parallel, to meet expected domestic demand under the societal transition scenario, the average output per quarry would need to increase by approximately 10,000 tonnes annually[113]. This highlights the growing pressure on remaining quarries and the importance of strategic planning to secure future aggregate supply capacity.

Current and projected number of quarries and aggregate volumes per quarry in Norway

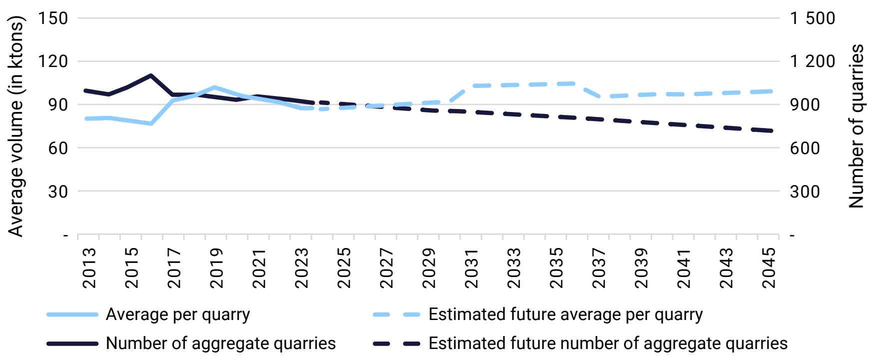


Figure 29. Number of quarries and average volume per quarry in Norway, historical and future projected values to cover increased aggregate demand under the societal transition scenario.

112 Dirmin (2024) Levetidsanalyse av byggeråstoff i Norge (2023)

113 The estimates exclude material extracted from quarries that is intended for export.

5.1.4 Sweden

Sweden has historically benefited from an abundant supply of high-quality rock materials, which has enabled large-scale construction and infrastructure development with relatively low environmental impact[114]. However, in recent years, it has become increasingly challenging to meet rising demand for aggregates—particularly in regions experiencing rapid urbanization. One key reason is that regional and municipal planning processes have often lacked clear strategies for managing aggregate resources. As a result, long-term access to critical materials is becoming more uncertain, especially in fast-growing metropolitan areas.

Regional differences in construction activity and geological availability create distinct challenges across Sweden. In the Mälardalen region, for example, there are currently 16 active gravel pits and rock quarries producing approximately 2.7 Mton of construction aggregates annually. These quarries, however, have an average remaining lifespan of less than 20 years, signaling an urgent need for either new extraction permits or entirely new quarries to sustain supply[115]. With the region's rapid population growth, the demand for aggregates is expected to rise significantly[116].

Further, by 2050, the Stockholm area is projected to grow by around 1 million residents compared to 2020, increasing the need for infrastructure and housing[117]. However, the existing quarries in the region are becoming more distant from urban centers. As a result, aggregate must be transported over longer distances, which raises both costs and environmental impacts. This trend is likely to intensify unless new extraction sites can be developed closer to areas of high demand, a process complicated by zoning restrictions, environmental regulations, and local opposition.

These regional pressures highlight the importance of a more proactive and integrated approach to resource planning. To ensure a stable and responsible supply of aggregates, greater integration of resource planning into urban and regional development is needed. Regional aggregate management plans—where they exist—offer a valuable tool for aligning material needs with local geological conditions and land-use priorities. However, implementation remains uneven across the country, and more systematic approaches are required to secure future supply.

Addressing these issues will be critical to Sweden's ability to meet growing construction demand while minimizing environmental impact and ensuring access to essential raw materials. Without stronger coordination between land-use planning, resource management, and permitting, regional imbalances

114 SGU, (2024). 'Grus sand och krossberg 2023'. Available at: https://www.sgu.se/globalassets/produkter/publikationer/2024/grus-sand-och-krossberg-2023.pdf

115 SGU, (2020). 'Bergkvalitet Mälardalen'. Available at: https://resource.sgu.se/produkter/k/k647-beskrivning.pdf

116 Ibid.

117 Ibid.

in supply and demand could threaten the pace and sustainability of future infrastructure and housing development.

Similar to the other Nordic countries, Sweden has also experienced a decline in the number of active quarries between 2013 and 2023. If this trend continues, the number of quarries could fall to fewer than 500 by 2045 (see Figure 30). Under such a scenario, the average extraction volume per quarry would need to increase significantly, from approximately 100,000 tonnes today to over 300,000 tonnes, to meet aggregate demand under the societal transition scenario. Given the challenges associated with such a sharp increase in per-quarry output, this projection highlights the critical importance of maintaining and developing a well-distributed and resilient quarry network to ensure the long-term security of aggregate supply nationwide.

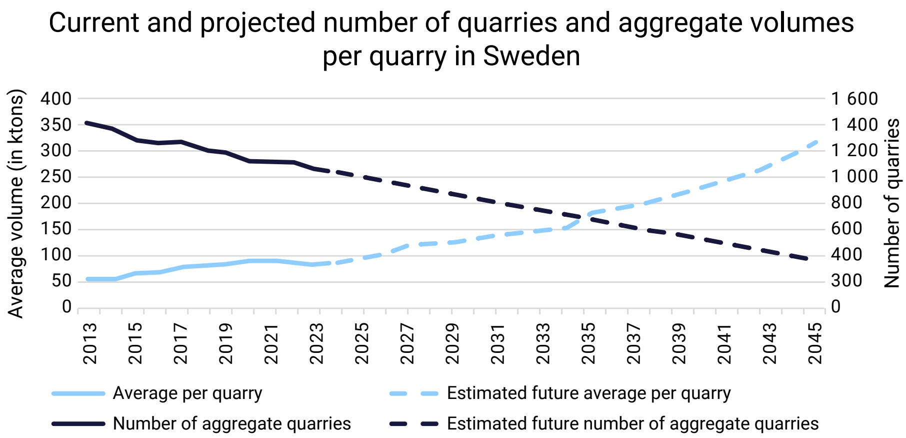


Figure 30. Number of quarries and average volume per quarry in Sweden, historical and future projected values to cover increased aggregate demand under the societal transition scenario.

Summary

This section examined the growing need for new quarries and gravel pits across the Nordic countries, driven by rising aggregate demand and increasing pressure on existing extraction sites. In **Sweden**, the number of active quarries has already declined significantly since 2013. If this decline continues at the same pace, the number of operational quarries could fall below 500 by 2045. To meet expected demand under the STS, **average extraction per quarry would need to triple**, rising from approximately 100,000 tonnes today to over 300,000 tonnes. This level of output per site is considered highly challenging and points to the urgent need for a **resilient and well-distributed quarry network** to support sustainable supply.

In **Finland**, the situation appears particularly stark. The number of active quarries has consistently declined, and if this trend continues, each quarry will need to **increase output more than fourfold**, from around 20,000 tonnes today to approximately 90,000 tonnes by 2045. Given the **technical, environmental, and logistical barriers**, such a dramatic increase is considered unrealistic. This highlights the critical need to **halt or reverse the decline in quarry numbers** to maintain sufficient national supply capabilities.

Norway has also seen a reduction in the number of quarries, though the pace of decline has been slower than in Sweden or Finland. Projections suggest that quarry numbers could decrease by roughly 20 percent, from over 900 today to just above 700 by 2045. At the same time, **average output per quarry would need to increase by around 10,000 tonnes annually** to meet future demand. This gradual increase in output still represents a substantial burden on the remaining sites and emphasizes the importance of **strategic planning and investment in capacity**.

Denmark stands out as an exception, with the number of extraction sites remaining stable in recent years. If this trend continues through 2045, current output levels would need to be sustained to meet projected demand under the STS. However, many land-based pits—especially in the Capital Region and Region Zealand—are nearing depletion, and establishing new sites is increasingly difficult due to land-use conflicts and limited geological availability. Although over 80 percent of Denmark's remaining reserves are offshore, marine extraction remains limited by high costs, complex permitting, and environmental concerns. With most marine permits set to expire by 2025 and few renewals planned, the feasibility of maintaining current supply levels is uncertain, underscoring the need for coordinated national action.

Rising aggregate demand across the Nordics is colliding with a shrinking quarry base, creating structural vulnerabilities in long-term supply. Sweden, Finland, and Norway all face declining site numbers and rising production demands per quarry, while Denmark, despite stable site numbers, must contend with depleting land-based reserves and limited marine extraction capacity. Under ambitious scenarios like the STS, which assume increased construction and infrastructure activity to 2045, these trends pose significant risks. Without coordinated policy efforts to preserve, modernize, and strategically distribute quarry capacity, the region may face significant risks to its material supply security in the coming decades.

5.1.5 Role of quarries to meet expected additional aggregate consumption in scenario

The projections indicate that approximately 2,750 Mton of additional aggregates will be required across the Nordic countries to support envisioned development in the STS, compared to the baseline scenario. While advances in aggregate recycling and an increasing emphasis on circular construction practices, combined with the continued use of excavation rock, are expected to reduce the reliance on primary raw materials, aggregates from quarries will remain essential to ensure necessary supplies.

During the period 2027–2045, nearly 50 percent of the additional aggregate demand, compared to the baseline scenario, will need to be met by material sourced directly from quarries, see Figure 31. This share is higher in the late 2020s and early 2030s, when quarry-derived aggregates are projected to constitute approximately 50–55 percent of total aggregate consumption. While gradually declining to around 45 percent by 2045 due to increased recycling, the absolute volume of quarry-extracted material remains substantial over the entire time period.

These figures underscore the importance of sustainable quarry development as a cornerstone of regional infrastructure planning. Without continued investment in well-managed quarry operations, alongside policies that promote land access, environmental stewardship, and stakeholder engagement, there is a significant risk of supply constraints that could delay or escalate the cost of future construction initiatives.

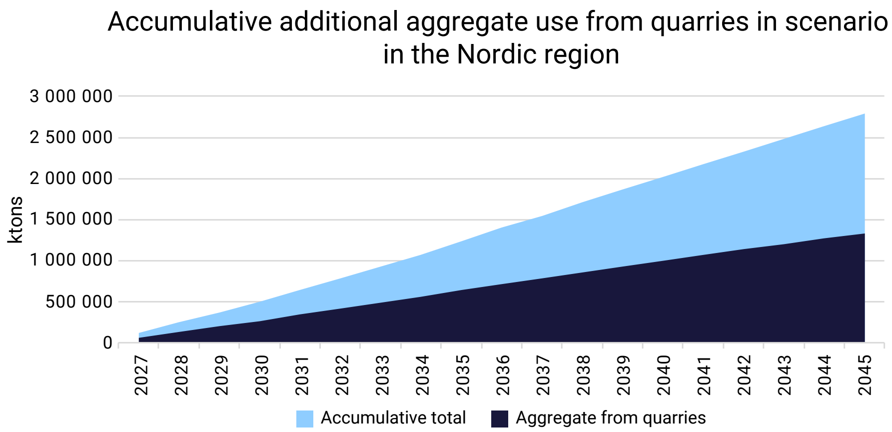


Figure 31. Aggregates from quarries in the Nordic countries as share of total accumulative aggregate consumption in scenario compared to baseline.

5.2 Current progress and future potential of circular aggregate use in the Nordics

Increasing the use of aggregates from circular sources is essential for reducing the demand for raw material extraction across the Nordic region. As pressure increases to decarbonise the construction sector, extend the lifespan of resources, and minimise environmental impacts, the importance of circular approaches is becoming more widely recognised. Increasing recycling of aggregate products and improving the use of surplus materials in construction projects can reduce the need for new quarrying, shorten transport distances to and from extraction sites and landfills, lower CO_2 emissions, and cut overall project costs.

This section explores the current state of circular aggregate practice in the Nordic countries, identifying key barriers and highlighting opportunities to scale up circular solutions that align with both environmental and economic goals. Circular aggregates in this report include both recycled aggregates as well as excavation rock[118], as discussed in Section 3.3.

5.2.1 Denmark

Recycling efforts in Denmark focus on reducing the need for new resources, especially in the road, concrete, and utility infrastructure sectors. The road sector has seen significant progress, with the Danish Road Directorate promoting the use of recycled materials such as broken asphalt for road construction[119].

In addition to efforts in road construction, Denmark's concrete sector is also advancing in terms of recycling. Innovations in concrete recycling are focusing on developing new types of concrete that reduce cement content and incorporate recycled materials.

To increase demand for recycled aggregates, the Danish Regions have recommended that the Danish government introduce market-based incentives to make recycled materials more financially attractive for developers. As a source of inspiration, they highlight the Netherlands, which in 2010 launched a pioneering Green Deal for Sustainable Concrete to reduce the environmental impact of concrete through the increased use of recycled aggregates and market creation for secondary materials. A key measure includes tax relief in the form of subsidies for developers using concrete with at least 30 percent recycled content. Such initiatives have positioned the Netherlands as a front-runner in the circular use of aggregates[120]. The use of recycled materials in concrete not only supports the circular economy but also contributes to sustainability goals by minimizing waste and conserving resources.

118 In this report the term excavation rock refers to all naturally occurring rock materials removed during construction activities.

119 Danske Regioner, (2018). 'Råstoffer – en regional opgave'. Available at: https://www.e-pages.dk/regioner/155/html5/

120 Danske Regioner, (2020). 'Bæredygtig råstofforsyning for fremtid'. Available at: https://www.e-pages.dk/regioner/191/

Further, the Danish Regions are committed to increasing the share of recycled aggregates across all regions in the future, with plans to optimise and expand the use of construction waste. For instance, Region Zealand has launched the project "Saving raw materials" to promote more circular use of resources. The project aims to ensure that 20 percent of the region's raw material consumption is covered by recycled or reused materials by 2030. It includes pilot projects, knowledge sharing, and the testing of innovative solutions among stakeholders with high raw material demand[121].

5.2.2 Finland

Finland has taken a systemic approach to integrating circular economy principles into its economy, aiming to make circularity the foundation of all economic activity by 2035[122]. The Ministry of the Environment's Circular Economy Programme lays out measures such as material taxes, sustainable public procurement criteria, and research into utilizing quarry by-products. Public agencies, including The Finnish Infrastructure Transport Agency (FITA), now require circular economy plans for all major road and rail projects. This framework considers circular economy broadly and strives to optimise resource use (see more on optimisation in section 5.3) while minimizing environmental impacts[123]. The potential for using circular aggregate is mainly found in urban centers, where demand for aggregates and transport costs are high, and in smaller projects requiring less aggregates and being less sensitive to availability issues compared to larger projects.

Despite these efforts, increasing the circularity of aggregates in Finland faces several significant challenges. A key obstacle is the large number of smaller quarries and the typically short distance between construction sites and the nearest quarry, especially in rural environments. Transport costs play a crucial role in the economics of aggregates, making it economically unfeasible to transport reusable aggregate waste from a site to a storage location, and then to another project site, especially when primary materials are readily available. Stakeholders shared real-life examples where even a short additional transport distance of 10 km could make the use of secondary aggregates less viable compared to primary materials. Currently, secondary aggregates do not offer sufficient added value to justify the extra transport costs.

Another challenge is the low volume of secondary aggregates relative to overall demand. Aggregate needs are often tied to specific project timelines and locations, and the availability of secondary materials in the required quantity at the right time can be a risk—especially for larger projects with high aggregate demands. When secondary aggregates can only meet part of the total requirement, it may not be economically practical to source circular aggregates. Additionally, the lack of sorting in the recycling process limits the usability

121 Gate21, (n.d.). Available at: https://gate21.dk/projekt/spar-paa-raastofferne/

122 Ministry of the Environment in Finland, (n.d.). Available at https://ym.fi/kiertotalousohjelma

123 Finnish Infrastructure Transportation Agency, (n.d.). Available at: https://vayla.fi/ymparisto/kiertotalous

of secondary aggregates. Currently, aggregates are not sorted by geological properties, which reduces their potential applications in projects requiring specific quality standards[124]. This lack of sorting further hinders the adoption of recycled aggregates, particularly for specialized construction projects. Sorting of aggregates would also increase the need for space in recycling centers. This may pose an issue specifically in urban environments which feature most potential for recycling activity as it may prove challenging to secure large enough areas for aggregate recycling in close enough areas to make recycling economically attractive. Some industry experts have suggested underground storage as a potential solution to this issue in the future.

In response to these challenges, Finland's Ministry of the Environment has underscored the importance of optimising the excavation and usage of aggregate materials[125]. To improve material circularity, Finland has promoted the use of moraine, quarry by-products, and recycled materials like industrial ash and slag.

A key strategy for advancing secondary aggregate use is early-stage material planning in infrastructure projects, with a focus on identifying opportunities for circularity. For example, FITA, as of February 2025, integrates circularity into the planning phase by requiring designers to have expertise in circularity and by mapping opportunities for circular material selection[126]. While these approaches are in place, their implementation is still relatively new, and not all projects automatically incorporate these practices.

Another important avenue for advancing circularity in the aggregate industry is the use of side-streams, which are already being explored in Finland to some extent. For example, concrete waste is repurposed for aggregate use[127]. Other potential side-stream sources include broken asphalt and mining by-products. However, the widespread use of side-streams is hindered by transportation costs. Many mines in Finland that produce abundant side-streams of rock suitable for aggregate use are located far from population centers, where demand is highest. As aggregate pricing is highly sensitive to transportation costs, utilising these side-streams is often not economically viable nor necessarily sustainable.

A practical example of circularity in the sector in Finland is the recycling of disposed asphalt in roadwork. The City of Helsinki has been a forerunner in implementing the practice and currently features a 108 percent recycling rate, indicating that the City of Helsinki is using more recycled asphalt than it has disposed to contractors[128].

124 Stakeholder interviews.

125 Ministry of the Environment in Finland, (2018). 'Kiviaineshuollon kehittäminen'. Available at: https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/160707/YMra_13_2018_Kiviaineshuollon_kehittaminen.pdf

126 Finnish Infrastructure Transportation Agency, (n.d.). Available at: https://vayla.fi/ymparisto/kiertotalous

127 Betoroc, (n.d.). Available at: https://www.rudus.fi/tuotteet/kierratys/betoroc-murske-luonnonkiveakin-parempi

128 Stara, (2024). Available at: https://omainfra.fi/media/kvehziaa/6-laristo-heikki.pdf

In conclusion, while there are significant opportunities to enhance circularity in Finland's aggregate sector, challenges such as transportation costs, lack of zoned areas for storing secondary aggregates, and the need for better sorting and availability remain obstacles. Additionally, the price of new materials further complicates the widespread adoption of circular practices.

5.2.3 Norway

Despite growing awareness of the environmental benefits of circular construction practices, secondary aggregate use in Norway remains limited in scale and unevenly implemented across the country. At the national level, strategies to promote recycling have focused more on enabling conditions, such as financial incentives, legal reforms, and regulatory adjustments, than on setting specific technical standards or targets[129]. While these efforts support innovation and private-sector engagement, they have not yet translated into a unified, nationwide strategy for increasing the recycling and reuse of aggregates.

Recycling practices vary significantly between regions. In areas with high urban demand and constrained local supply, such as Oslo and Viken, recycling has gained more traction. Recycled aggregates products have been commercially available in Oslo for a few decades, leading to the emergence of specialized businesses such as Resirqel[130]. Innovations like Foamrox[131], a recycled glass-based material used in tunnel construction, are further expanding the role of secondary materials in infrastructure projects.

Oslo has also emerged as a national leader in circularity within the built environment. High-profile public projects such as Kristian Augusts gate 13, where nearly 80 percent of structural materials were reused[132], and the Løren Sports Hall and Activity Park, which incorporated reused steel and concrete panels, demonstrate how reuse can be integrated into municipal construction strategies[133]. These projects are part of a broader shift toward zero-emission construction and a reduced carbon footprint for public buildings.

Despite these efforts, several barriers continue to limit the broader adoption of secondary aggregates in Norway. Outside of major cities, natural aggregates remain plentiful, affordable, and of high quality, reducing the economic incentive to use recycled alternatives. In addition, technical standards for construction, particularly in road and infrastructure projects, can be difficult for secondary materials to meet. Finally, logistics remain a persistent

129 Nærings- og fiskeridepartementet, (2023). 'Norges mineralstrategi'. Available at: https://www.regjeringen.no/contentassets/1614eb7b10cd4a7cb58fa6245159a547/no/pdfs/norges-mineralstrategi.pdf

130 Resirqel, (n.d.). Available at: https://www.resirqel.no/

131 Foamrox, (n.d.) Available at: https://www.foamrox.no/en/

132 FutureBuilt, 2025. https://www.futurebuilt.no/Forbildeprosjekter#!/Forbildeprosjekter/Kristian-August-gate-13

133 Oslo Kommune 2025. https://www.oslo.kommune.no/slik-bygger-vi-oslo/loren-aktivitetspark-og-flerbrukshall/

challenge: when recycling or reuse facilities are not located near construction sites, transportation costs can quickly offset the environmental and economic benefits of circular material use.

5.2.4 Sweden

Sweden has long recognized the importance of sustainable resource management, but aggregate recycling has historically played a limited role in the country's construction sector. However, this is beginning to change. A growing number of industry actors and policymakers are actively exploring ways to increase the recycling of materials from construction and demolition activities, signaling a shift toward more circular material flows.

The use of secondary aggregates in Sweden has seen steady growth in recent years, particularly in the recycling of bound materials such as asphalt and concrete, where processes are relatively well established[134]. Several research and innovation initiatives have emerged to support this trend. For example, the *Circular Construction Materials*[135] project focuses on minimising residual volumes of crushed asphalt, concrete, slag gravel, and other materials by integrating them into new products and processes. Similarly, *Circular Concrete*[136] aims to develop new technical solutions and business models for increased reuse and the substitution of primary raw materials in concrete products.

On the product side, companies like Heidelberg Materials have introduced innovations such as *Bio Recycle*, a precast concrete product in which a portion of the aggregate is replaced with recycled concrete material[137]. In parallel, the Swedish Aggregates Producers Association (SBMI) has launched a new industry guidance on producing circular aggregates[138]. This document outlines common procedures and working methods for recycling both bound materials and excavation rock, offering a practical framework for producers looking to increase circularity in their operations.

At the policy level, the Swedish government has adopted a national strategy for a circular economy, which prioritizes the construction sector as one of six focus areas. The strategy calls for increased use of recycled materials, stronger financial incentives, more resource-efficient design standards, and greater use of public procurement to drive market transformation. As part of this agenda, the Swedish National Board of Housing, Building and Planning

134 SGU, (2024). 'Grus, sand och krossberg 2023'. Available at: https://www.sgu.se/globalassets/produkter/publikationer/2024/grus-sand-och-krossberg-2023.pdf

135 RISE, (n.d.). Available at: https://www.ri.se/en/circular-construction-materials

136 KTH, (n.d.). 'Circular Concrete'. Available at: https://www.arch.kth.se/en/forskning/forskningsprojekt/pagaende/cirkular-betong-produkter-och-affarsmodeller-for-okat-aterbruk-och-materialatervinning-1.1350985

137 Heidelberg Materials, (n.d.). 'Bio Recycle'. Available at: https://www.betong.heidelbergmaterials.se/sv/bio-recycle-atervunnen-betongballast-for-ett-mer-hallbart-byggande

138 Sveriges bergmaterialindustri, (n.d.). 'Vägledning för produktion av cirkulär ballast '. Available at: https://sverigesbergmaterialindustri.se/handbocker/cirkular-ballastproduktion/

(Boverket) has been tasked with advancing circular practices in the construction and real estate sectors. In its final report, Boverket concludes that while the interest is high, the market remains immature and in need of clearer policy instruments and viable business models[139]. Complementing this, a 2024 Government Official Report proposed financial measures to accelerate circularity[140], though these have not yet resulted in formal regulation.

Furher, a variety of circular approaches to material handling and construction are gaining traction at the local level, particularly in urban planning and infrastructure projects. For example, in Stockholm's Norra Djurgårdsstaden area, a material logistics center at Värtahamnen processes between 1,000 and 1,500 tonnes of material daily, reducing transportation needs and saving 87,000 heavy vehicles round trips by 2020[141]. Similarly, in Nacka, a construction project for 600 homes reused 10 percent of blasted rock on-site, saving 8.8 million SEK and alleviating traffic congestion[142]. Tyresö municipality's ambitious 2035 plan further highlights local innovation, with a dedicated site for processing and crushing rock that has saved the municipality 16.7 million SEK over five years[143]. These efforts align with the government's vision and show how circular practices, when applied locally, can drive cost savings, minimize environmental impact, and foster a more sustainable built environment.

In sum, recent initiatives from both industry and policymakers suggest a growing momentum toward increased use of recycled aggregates. These efforts indicate a likely upward trend in aggregate recycling in the coming years, paving the way for a more sustainable, circular economy and contributing to the Sweden's long-term material resilience.

139 Boverket, (2024). 'Uppdrag att främja en cirkulär ekonomi i bygg- och fastighetsbranschen'. Available at: https://www.boverket.se/sv/om-boverket/publikationer/2024/uppdrag-att-framja-en-cirkular-ekonomi-i-bygg--och-fastighetssektorn/

140 It is noted that while national product quotas might conflict with EU law, building-level quotas could be a viable alternative, requiring developers to use a certain amount of recycled or reused materials.

141 Länsstyrelsen Stockholm, et al, (2023). 'Strategi för hantering av massor i Stockholms län – 2023'. Available at: https://www.lansstyrelsen.se/stockholm/om-oss/vara-tjanster/publikationer/2023/strategi-for-hantering-av-massor-i-stockholms-lan---2023.html

142 Ibid.

143 Ibid.

Summary

This section examines national strategies and current efforts to promote circularity in the aggregate sector across the Nordic countries. While progress varies, each country faces a common challenge: how to increase the use of secondary materials to reduce reliance on primary aggregates and limit environmental impacts.

In **Denmark**, recycling is well integrated in the road sector and expanding in concrete construction. Regional initiatives aim to increase recycled aggregate use, and national actors are calling for financial incentives to boost market demand.

Finland has taken a systemic approach to circularity through policy and procurement, but high transport costs, fragmented supply, and limited sorting capacity hinder large-scale adoption. Early planning and use of by-products are seen as key strategies going forward.

In **Norway**, circular practices are mostly concentrated in urban areas like Oslo, where innovation and municipal leadership have driven progress. Elsewhere, abundant natural resources and regulatory hurdles limit the use of secondary aggregates.

Sweden is experiencing growing momentum, supported by national policy, research projects, and local reuse initiatives. Recycling of asphalt and concrete is increasing, but market maturity and regulatory clarity remain challenges.

Across all countries, stronger policy instruments, better planning, and clearer market signals are needed to scale circular practices and reduce reliance on primary aggregates.

5.2.5 Importance of circular aggregate practices to meet expected additional aggregate consumption in scenario

In the coming decades, it is anticipated that circular aggregate practices will advance across the Nordics, leading to a shift in the sourcing of aggregates. Specifically, the use of recycled aggregate products is expected to rise in all Nordic countries, as both enabling conditions improve and technology advances.

The increased adoption of circular aggregates is expected to significantly alter the aggregate use mix in the Nordic region. According to Aggregate Europe and sector experts, recycled aggregates could meet approximately 20 percent of total aggregate demand.[144] This represents a substantial increase from current levels, which stand at around 5 percent[145], with the 20 percent target anticipated to be reached by 2045. Concurrently, the share of aggregates sourced from excavation rock is assumed to decline slightly, from 40 percent today to approximately 35 percent by 2045, driven by an expected reduction in construction projects generating large amounts of excavated materials.

Under these assumptions, circular aggregate sources (including recycled and excavation-derived materials) are projected to account for nearly half of the additional aggregate demand in the STS scenario, relative to a baseline projection over the same period, as illustrated by Figure 32. This shift underscores the growing strategic importance of recycled aggregates in supporting sustainable construction and infrastructure development across the Nordics.

To realise this, targeted interventions will be required to accelerate the adoption and upscaling of circular aggregate practices. This includes measures to support the recycling of aggregate materials such as concrete and asphalt, alongside securing the right conditions for well-functioning management, processing and reuse of excavation rock.

144 Aggregates Europe, (n.d.). 'Circular Economy', Available at: https://www.aggregates-europe.eu/policy-focus/technical/circular-economy/

145 Due to limited and inconsistent data across the region, a standard recycled aggregate rate of 5 percent is applied uniformly for all Nordic countries. However, available estimates indicate slight national variations: approximately 6 percent in Denmark, 5 percent in Finland, 4 percent in Norway, and between 2 percent and 5 percent in Sweden

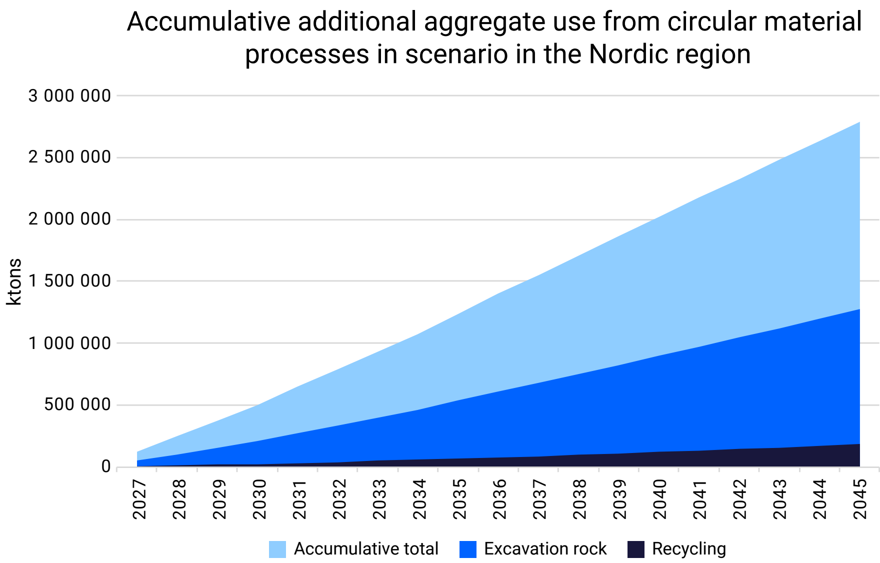


Figure 32. Aggregates from circular material processes in the Nordic region as share of total accumulative aggregate consumption in societal transition scenario compared to baseline.

5.3 Smarter use of aggregates: material optimisation as a strategic response

In the face of rapidly rising aggregate demand across the Nordic countries, it is clear that both increased material extraction and the adoption of more circular processes will be necessary to meet this growing demand. While higher extraction rates and improved recycling are essential components of the solution, a third and equally critical pillar is the smarter and more efficient use of the materials already available.

5.3.1 Material optimisation efforts to reduce aggregate consumption

Smarter and more efficient use of materials involves rethinking how aggregates are planned, designed, and allocated, that is optimizing every step of the construction value chain to reduce unnecessary use, extend the lifespan of existing resources, and minimize environmental impact.The benefits of this approach are twofold: it not only eases the pressure on primary aggregate sources, but also supports the region's climate ambitions by lowering the carbon footprint of construction activities. In a Nordic context, where aggregate demand is expected to grow substantially over the coming decades—driven by investments in energy, housing, and infrastructure—the intelligent use of materials becomes a strategic necessity. This is not just a theoretical concept; across the region, practical examples are already demonstrating how smarter design and planning can lead to significant material and carbon savings.

The following examples from Nordic countries illustrate practical measures that have been implemented to promote more efficient use of raw materials. They demonstrate the significant impact that thoughtful design choices can have on reducing aggregate demand—without compromising structural performance, functionality, or durability:

- **In Denmark**, a recent study by Ramboll for Danish Concrete (Dansk Beton) found that improving the structural design of residential buildings —such as adjusting concrete strength, wall thickness, and reinforcement layout—can lead to material savings of **21–25 percent in concrete** and **5–35 percent in reinforcement steel**, resulting in a **total CO_2 reduction of around 25 percent**[146].
- **In Norway**, the government's **Mineral Strategy (2023)** emphasizes material optimisation as a guiding principle throughout the resource value chain. New extraction permit applicants are required to present circular business plans that justify material needs and outline how by-products and extractive waste will be reused—marking a shift toward integrated, low-waste systems.
- **In Sweden**, projects where contractors and developers collaborated early in the design phase have demonstrated material savings of around 10 percent. However, the potential for savings decreases as a project progresses. When contractors are involved early in the planning phase, typical material reductions of 4–6 percent can be achieved. In contrast, if engagement begins only during the construction phase, the potential drops to around 2–3 percent[147].
- **In Finland** there is an ongoing debate regarding aggregate quality requirements, which could lead to inefficiencies in material usage, even in the absence of strict regulations. For example, aggregates of very high quality are often used in railway construction, even when regulations would allow for lower-quality alternatives. This excess in quality can result in inefficiencies, such as increased transportation costs, as higher-quality aggregates need to be transported over long distances rather than using locally available, lower-quality materials. As Finland continues to invest in major infrastructure projects, such as the Länsirata and Lentorata railway routes, these inefficiencies are increasingly relevant.

In a Nordic context, where aggregate demand is projected to rise significantly in the coming decades, the ability to optimise material flows will be a key determinant of how well each country can meet its needs—without overburdening natural systems or becoming overly reliant on imports.

The smarter use of aggregates is not a secondary consideration—it is a foundational strategy for achieving sustainability, economic efficiency,

146 Dansk Industri, (2024). 'Dansk Beton: Vi bruger for meget beton i betonbygninger'. Available at: https://www.danskindustri.dk/medlemsforeninger/foreningssites/dansk-beton/nyheder/pressemeddelelser/dansk-beton/2024/dansk-beton-vi-bruger-for-meget-beton-i-betonbygninger

147 Stakeholder interviews.

and climate goals. As the Nordic countries enter a period of unprecedented infrastructure investment, material efficiency must become standard practice across the sector, ensuring that resources are used where they are most needed—and only in the amounts truly required. Realizing this potential will require not only technical innovation but also supportive policy frameworks, clear incentives, and cross-sector collaboration.

Summary

This section highlights the critical importance of using aggregates more efficiently across the construction value chain. Smarter material use—through optimized planning, design, and allocation—offers significant potential to reduce demand, ease pressure on primary resources, and lower the carbon footprint of construction.

Examples from across the Nordic region demonstrate the benefits of this approach. In **Denmark,** structural design improvements in residential buildings have shown material savings of over 20 percent and CO_2 reductions of around 25 percent. In **Norway,** new extraction permit requirements mandate circular business plans to encourage low-waste systems. **Sweden** has seen material savings of up to 10 percent through early collaboration between developers and contractors. In **Finland,** debates over quality standards highlight how over-specification can lead to unnecessary use and higher transport emissions.

As aggregate demand continues to grow across the Nordics, material efficiency will be essential to meeting future needs sustainably. Embedding this approach as standard practice will require supportive policies, incentives, and collaboration across sectors.

Case: Material optimisation of wind turbine foundations

With the right planning during design and production, along with systematic efforts where we constantly evaluate and make active choices based on our expertise in construction technology, we can make significant strides in reducing our climate impact.

In a research and development project, NCC has created a tool to optimise wind turbine foundations. The tool was developed based on NCC's experience in constructing wind farms and uses a set-based design approach, which combines parametric sizing, advanced calculation methods, and decision analysis based on multiple criteria. This approach involves conducting thousands of calculations with varying parameter values to find the best solution, such as the one with minimal climate impact.

The development of the optimised gravity foundations — the most common type of foundation for wind turbines — took place alongside the construction of the infrastructure for the first phase of the Markbyggden wind farm in Piteå, between 2017 and 2019. In the park, NCC built foundations for 179 wind turbines.

In developing the optimised foundations, NCC focused on optimizing parameters with regard to various indicators, such as the environment, constructability, economics, and material use. Using a digital 3D model, reinforcement solutions were developed to facilitate the installation of the rebar. Thanks to the tool, the goal of reducing climate impact and costs by more than 10 percent was achieved, as NCC found the right geometry and ratio between concrete volume and rebar quantity, while also improving the working environment and reducing construction time.

By optimising designs and making good choices of materials, design, and constructive solutions, it is possible — with the methods and materials available today — to achieve an overall reduction of up to 50 percent in greenhouse gas emissions.

5.3.2 Potential of material optimisation efforts to reduce aggregate consumption

The implementation of material optimisation strategies in construction projects presents a significant opportunity to reduce overall aggregate consumption. Figure 33 illustrates the potential impact of such optimisation measures on the projected additional aggregate consumption in the Nordics under the STS, as compared to baseline. Two optimisation levels are considered, assuming material savings of 10 percent and 15 percent, respectively. Under these assumptions, the cumulative reduction in additional aggregate consumption across the region between 2027 and 2045 would amount to approximately 280 Mt in the 10 percent case, and up to 420 Mt in the 15 percent case.

These reductions would ease pressure on primary aggregate supply, alleviate environmental impacts associated with extraction and transport, and support broader policy objectives related to resource efficiency and climate mitigation.

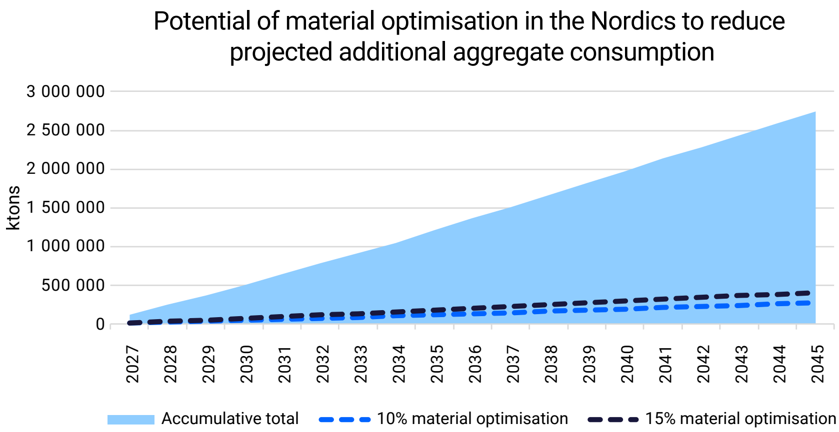


Figure 33. Illustrative example of potential of material optimisation in the Nordics to reduce projected additional aggregate consumption in societal transition scenario compared to baseline

5.4 The development of aggregates in the Nordic countries

Assuming advancements in circular practices, namely increased recycling, the composition of aggregate sources for use in the Nordics is expected to change going forward, as seen in section 5.2. Figure 34 illustrates aggregate supply from different sources to meet total demand in the STS (compare Figure 25), broken down by recycled materials, excavation rock, and aggregates from quarries.

By 2045, aggregates sourced from quarries are projected to remain the dominant supply stream, accounting for approximately 280 Mton, or around 45 percent of total aggregate demand. This marks an increase of over 40 Mton compared to 2025 levels.

The remaining 55 percent of demand is expected to be met through circular sources, namely, recycled aggregates and excavation rock. Recycled aggregates are projected to reach 125 Mton in 2045, representing 20 percent of total aggregate volumes and a significant rise of over 100 Mton from current levels. Meanwhile, the use of excavation rock is expected to increase from 175 Mton in 2025 to approximately 220 Mton in 2045, an increment of 45 Mton.

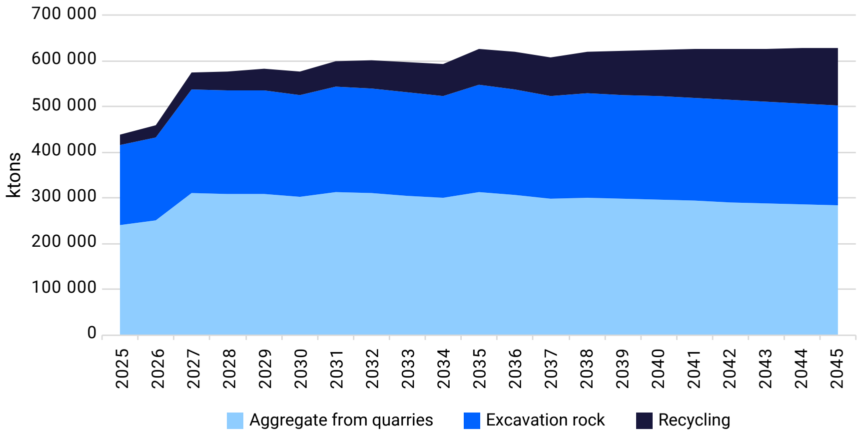


Figure 34. Aggregate sources to meet aggregate demands under STS

These projections underscore the critical role of both primary materials from quarries and circular aggregates in meeting future demand. While circular practices are expected to expand significantly, quarry-derived materials will continue to form a foundational element of the region's aggregate supply, supporting the growing infrastructure and construction needs across the Nordics.

Ultimately, it demonstrates that a strategic mix of actions is needed to meet the demand: enabling the extraction of new materials, scaling up recycling of secondary aggregates, and improving material efficiency. Each of these pillars plays a vital role, but their full potential can only be realized through integrated planning and long-term policy alignment. By acting early and decisively, Nordic countries can ensure that aggregates remain a secure, sustainable, and enabling resource for the green transition and the resilient societies they seeks to build.

Summary

This chapter addresses the widening gap between current aggregate consumption and the significantly higher volumes needed to meet the Nordic region's future infrastructure, housing, and energy goals under the Societal Transition Scenario (STS). Projections show that meeting this demand could require nearly **2,750 Mton** of additional aggregates by 2045.

To meet this challenge sustainably, three strategic areas must be prioritized:

1. **Enabling increased extraction of primary materials**
2. **Scaling up recycling and reuse of secondary materials**
3. **Optimizing material use to reduce overall demand and waste**

These pillars are essential not only for closing the supply gap but also for reducing the environmental footprint of construction. However, their success depends on long-term policy alignment and integrated regional planning.

By 2045, quarry-sourced aggregates are expected to remain the largest supply source, providing around 280 Mton or 45 percent of total demand in the STS, an increase of over 40 Mton from 2025. The remaining 55 percent is projected to come from circular sources, with recycled aggregates reaching 125 Mton and excavation rock rising to 220 Mton in 2045, reflecting a substantial shift toward more sustainable material use.

Together, these shifts illustrate the need for a strategic mix of actions. While circular practices will play a growing role, quarry production and primary materials will continue to underpin the Nordic region's ability to build resilient, low-carbon infrastructure. Early, coordinated action across these areas will be essential to ensure that aggregate supply supports long-term societal and climate goals.

6. Bridging the Gap – challenges to securing future aggregate supply

Chapter 5 outlined the scale of the challenge: to meet future infrastructure, housing, and energy needs, the Nordic countries must significantly increase aggregate supply by 2045. It introduced three strategic pathways to close this gap — increasing extraction of primary materials, expanding recycling, and optimising material use.

This chapter shifts focus to why that gap exists, and what stands in the way of closing it. Ensuring a reliable and sustainable supply of aggregates in the Nordic region is no longer just a question of geological availability — it is fundamentally a question of governance, coordination, and systems design. As demand grows, the ability to secure future supply will depend on how effectively countries can balance the three core strategies identified in the previous chapter.

Today, that balance is difficult to achieve. The potential to increase extraction is often constrained by lengthy permitting processes, fragmented land-use planning, and regulatory uncertainty. Despite growing interest in circular construction, the use of recycled aggregates remains limited, hampered by inconsistent standards, unclear responsibilities, and the absence of enabling procurement frameworks. Meanwhile, material optimisation remains underused, despite its significant potential to reduce demand.

To meet future needs governance must evolve. This means aligning planning systems, environmental regulation, and market incentives to support all three strategies in an integrated, coherent way. A resilient aggregate system is not only essential for delivering on climate and infrastructure goals, but also for ensuring long-term material security in the Nordic region.

This chapter examines how current systems fall short and explores the barriers that limit progress. It identifies what challenges must be addressed to bridge the gap between aggregate supply and demand and to secure a resilient, long-term material system in the Nordic region. It also highlights the opportunities to create more predictable, coordinated, and climate-aligned frameworks that can support innovation and ensure sustainable aggregate supply for decades to come.

6.1. Tackling the decline in quarry numbers: A structural challenge for the Nordic aggregate sector

Across the Nordic region, the number of active aggregate extraction sites is steadily declining, see section 5.1. While demand for raw materials is rising in line with infrastructure, housing, and climate transition needs, the capacity to meet this demand is eroding, see section 4. This decline is not primarily due to a lack of geological resources, but rather to the increasing difficulty of maintaining and opening new quarries.

A key driver of this erosion in capacity is the growing complexity, cost, and duration of permitting processes. Lengthy approval times, fragmented responsibilities, and substantial administrative burdens have made it progressively harder to sustain existing operations, let alone establish new ones. As a result, many sites are shutting down while fewer new ones are opening a particularly concerning development given the local nature of aggregate markets. With fewer quarries, transport distances increase, emissions rise, and construction costs for both public and private sectors escalate.

Environmental and social safeguards remain essential, but the systems designed to enforce them have become increasingly complex, slow, and difficult to navigate. For many stakeholders, the unpredictability and administrative weight of permitting have become critical barriers to securing timely access to the materials needed for vital infrastructure and climate-related projects.

Despite shared environmental values and similar legal principles, the Nordic countries differ significantly in how their permitting systems are structured and function. These differences extend beyond approval timelines to include how responsibilities are divided among authorities, how Environmental Impact Assessments (EIAs) are integrated into permitting, and how appeals and oversight are handled. The result is a fragmented regional landscape that complicates cross-border investment and adds uncertainty to long-term project planning[148].

All four countries are subject to supranational frameworks such as the Environmental Impact Assessment Directive (EIA), the Industrial Emissions Directive (IED), and the Strategic Environmental Assessment Directive (SEA). Denmark, Finland, and Sweden apply these through EU membership, while Norway adopts them via the European Economic Area (EEA[149]). However, national implementation diverges considerably. Sweden and Denmark tend to integrate the EIA into the permitting process itself, which can streamline coordination and reduce duplication. Finland and Norway, by contrast, often treat the EIA as a separate administrative track involving different authorities. While this separation preserves procedural checks and balances, it can also introduce delays and increase the burden on applicants.

Permitting timelines reflect these structural differences. In Sweden, the full permitting process—including consultation—takes on average 1.7 years, though this varies with case complexity. In Finland, the total process typically ranges from 2 to 2.5 years[150], with environmental assessments taking 12 to 17 months and the permitting phase around 10 months. Denmark's permitting duration is estimated at a minimum of two years, though national

148 Nordic council of ministers (2023). Nordic Environmental Permitting Processes: Results from a comparative study of environmental law and processes in Denmark, Norway, Iceland, Sweden and Finland

149 Ibid.

150 SOU 2024:98En ny samordnad miljöbedömnings- och tillståndsprövningsprocess

statistics are lacking. Environmental assessments there may take 1.5 to 3 years, while permit reviews require 4 to 7 months. Norway does not publish consolidated data, but estimates suggest similar total timeframes of 1.5 to 2.5 years, depending on the project and authorities involved[151].

These figures typically reflect only the time between application submission and decision. In reality, total approval periods are often much longer —especially for complex or contested projects. For example, in Denmark, stakeholders report that the full process—from pre-application to final decision—can approach a decade. Appeals mechanisms add further divergence: Sweden and Finland resolve appeals through independent administrative courts with full reformatory powers, while Norway handles appeals within the executive branch, often via county governors, with potential escalation to ministries or directorates. This adds layers of political discretion and can prolong outcomes.

Another important difference lies in how permits are structured and coordinated across the Nordic countries. In Sweden, a single permitting process (samprövning) is typically used for projects requiring multiple approvals. While this streamlines the formal structure, the process still involves input from several authorities, which can create administrative complexity, longer timelines, and increased uncertainty. In Finland, the system is more fragmented, with separate permits often required for mining, environmental impacts, and water use—each issued by different agencies. In Denmark, municipalities typically issue permits for smaller projects through a more consolidated process, but national authorities become involved in larger or more complex operations, potentially requiring multiple consents. Norway is generally the most centralized, with a single authority issuing comprehensive permits that cover entire operations, reducing compliance burden. These differences in scope and coordination influence not only processing time and predictability, but also project costs. Enforcement structures follow a similar pattern: Denmark and Norway tend to consolidate permitting and enforcement, while Sweden and Finland separate these functions—often at the cost of procedural efficiency[152].

In recent years, environmental assessments have become more demanding, and permit conditions more detailed. Applicants face long waiting periods, vague or shifting requirements, and frequent requests for additional studies. In many cases, these delays bring limited environmental benefits, instead creating bottlenecks that obstruct projects critical to resilience and decarbonisation.

151 Nordic council of ministers (2023). Nordic Environmental Permitting Processes: Results from a comparative study of environmental law and processes in Denmark, Norway, Iceland, Sweden and Finland

152 Ibid

Permit duration and cost further exacerbate the problem. In Denmark, most permits are valid for only ten years—an especially pressing issue given the long and costly approval process. This is particularly critical in marine extraction, where around 80 percent of permits are set to expire by December 2025[153]. Acquiring these permits from the Danish Environmental Protection Agency can take up to five years and involves significant expense for documentation. As a result, only a small share of expiring permits have been reapplied for. The same trend is seen on land, where growing complexity and requirements—often involving applications of up to 100 pages—have driven smaller operators out of the market.[154]

These challenges are not unique to Denmark. In Sweden and Finland, stakeholders report similar patterns: long delays, fragmented review processes, and increasing legal and administrative demands that stall urgently needed development. For small and medium-sized operators—often critical to local markets—the rising costs and complexity of permitting represent a serious threat. Over time, this risks reducing competition, driving up prices, and weakening supply chain resilience.

Streamlined permitting is also essential for better spatial planning. Locating quarries and terminals closer to urban areas can reduce emissions, lower transport costs, and improve infrastructure efficiency. But without predictable and timely permitting, such opportunities are difficult to seize.

Recognising these structural barriers, Nordic governments are beginning to act. In Sweden, a 2025 government inquiry proposed a more unified permitting system, expanded use of permit amendments (“ändringstillstånd”), and clearer criteria for when full reassessment is necessary. Similar discussions are ongoing in Denmark and Finland. Norway’s mineral strategy also commits to reducing permitting timelines by improving technical systems, enhancing coordination across sectors, and implementing more streamlined parallel processes. It includes a “one-stop shop” model via the Norwegian Directorate of Mining and Bergmesteren for Svalbard[155] to facilitate permitting for strategic minerals. The strategy also prioritises projects with minimal environmental impact and promotes reuse of excess materials. Improvements in municipal land-use planning are intended to support both establishment and closure of operations without undermining national environmental and climate goals. These national reforms align with broader EU efforts to accelerate permitting for projects essential to the green transition, including revisions to the EIA and IED directives.

As the Nordic countries enter a new era of infrastructure, housing, and energy investment, modernising permitting systems will be critical.

153 Miljøstyrelsen, (2025). ’Fællesområdetilladelser’. Available at: https://mst.dk/erhverv/groen-produktion-og-affald/raastofindvinding/raastofindvinding-paa-havet/indvindingstilladelser/faellesomraadetilladelser

154 Personal communication, Dansk Infrastruktur

155 Norges mineralstrategi, 2023

Upholding high environmental standards need not entail bureaucratic rigidity. With more transparent, consistent, and future-ready systems, the region can reverse the decline in operational quarries—and secure the raw materials essential for a sustainable future.

6.2 Material Supply Preparedness: A strategic challenge for the Nordic built environment

In recent years, the vulnerability of material supply chains has become increasingly evident—especially for basic yet essential materials such as aggregates. As demand grows for housing, infrastructure, and climate adaptation, secure access to sand, gravel, and crushed rock is emerging as a strategic priority.

Throughout the Nordic region, aggregate supply is still largely managed at the local or regional level. While this reflects the site-specific nature of extraction, it also limits strategic coordination with national land-use planning, infrastructure investment, and climate targets. As a result, the system is poorly equipped to anticipate long-term needs or address spatial imbalances. In many areas, establishing new extraction sites is becoming increasingly difficult due to competing land uses, environmental restrictions, and political resistance—particularly near urban growth centers.

At the same time, the number of operational quarries continues to decline. This drives up transport distances, costs, and emissions—placing additional pressure on already strained infrastructure networks. The absence of a coordinated response has made these challenges more acute, turning aggregate availability into a silent but growing constraint on sustainable development.

Despite their foundational role in construction and climate resilience, aggregates are rarely addressed through coherent national strategies. Recent policy efforts have largely focused on rare or high-value critical raw materials, overlooking the crucial importance of bulk construction resources in building sustainable societies. This gap is becoming more problematic as regional shortages intensify, permitting timelines lengthen, and land-use conflicts increase.

To address this, the Nordic countries need coordinated national strategies that treat aggregates as a core component of material supply preparedness. These strategies should aim to ensure long-term access to high-quality resources, reduce permitting and transport vulnerabilities, and promote more climate-efficient and circular material flows. They must also clarify the role of aggregate supply in meeting climate targets—recognising that even with growing recycling efforts, primary raw materials will remain essential for decades.

A national approach would also support smarter spatial planning—enabling extraction in locations where it is most needed, while minimising environmental impacts and reducing social conflict. Without such coordination, material supply risks becoming a hidden bottleneck in the green transition, undermining resilience and competitiveness in the construction sector.

By recognising this risk and elevating aggregate supply to a strategic policy issue, Nordic governments can instead strengthen the foundations of sustainable development—ensuring that essential materials are available where and when they are needed, and that their use contributes to both environmental and economic goals.

6.3 Regional imbalances in aggregate Access

As construction and infrastructure needs intensify across the Nordic countries, so too does the strain on local aggregate supply systems. While aggregates are used and transported within specific geographies, the current approach to managing supply remains fragmented and largely reactive. Most planning takes place at the local level, where extraction activities frequently conflict with other land uses such as housing, recreation, environmental protection, or agriculture.

This localised and short-term focus has led to growing spatial imbalances. Urban regions typically consume the most aggregates but often lack nearby extraction sites due to past depletion, land-use conflicts, or environmental restrictions. As local quarries close, aggregates must be transported longer distances—raising emissions, inflating construction costs, and increasing pressure on already stressed transport infrastructure. In addition, local resistance to new or expanded quarries—often due to concerns about noise, dust, landscape impact, or competition for land—further complicates efforts to meet demand. This local opposition is a growing explanatory factor behind regional supply bottlenecks and highlights the need for stronger, more proactive planning frameworks.

Despite their essential role aggregates have not been comprehensively addressed through national or regional supply strategies. While national frameworks set overarching priorities, they rarely translate into regional action plans that reflect actual supply and demand dynamics. Without such plans, the system is poorly equipped to anticipate future needs, reduce spatial mismatches, or respond to market shocks.

To address these challenges, national strategies must be complemented by robust, forward-looking regional material supply plans. These plans play a critical role in identifying available resources, anticipating future needs, and aligning extraction activities with broader land-use and climate goals. They can also support the siting of new quarries or the expansion of existing ones by providing clear, evidence-based rationales—reducing resistance and enabling more timely and predictable permitting processes.

Regional disparities across the Nordics illustrate the urgency of this approach. In Denmark, gravel pits in the Capital Region and Region Zealand are projected to be depleted by 2033 and 2038, respectively, pushing reliance toward more distant sources with higher environmental and economic costs[156]. A coordinated national strategy is needed to address these disparities.

Similarly, in Sweden, the Mälardalen region, including Stockholm, faces a looming supply issue as quarries deplete within 20 years. The region's rapid population growth will increase demand, resulting in longer transport distances and higher costs, highlighting the need for coordinated resource management.

In Finland, regional disparities, such as those in Uusimaa, are also growing. As local reserves deplete, aggregates are being transported from farther distances, raising transport costs and emphasizing the need for a more coordinated strategy. Many Finnish regions, especially ones with higher population density, have already created regional material plans with varying degree of detail. For example, sufficient aggregate reserves are noted in county plans for many regions.[157]

The Norwegian counties are required to develop regional plans for land use and infrastructure. However, there are no clear guidelines on whether these plans should address mineral and material extraction strategies. Regional differences in both supply and demand have led some counties to incorporate material extraction, recycling, or expansion plans, while others have not. This disparity has resulted in counties with significant aggregate production, such as Rogaland, having clear strategies in place, while others lack comprehensive plans. These regional variations highlight the need for more consistent approaches to managing material resources. The Norwegian Mineral Strategy emphasizes "the importance of clarifying expectations for county municipalities" work with mineral management and waste disposal, particularly in their role as regional planning authorities and advisors. This will be crucial in ensuring that the material supply is managed sustainably across the country, addressing local resource availability and demand more effectively.

Beyond identifying new resources, regional material supply plans can help integrate material flows into comprehensive spatial planning—ensuring aggregate supply is embedded in broader decisions about housing, transport, and infrastructure. These plans also offer opportunities to reduce transport distances, support recycling initiatives, and align extraction with community expectations and environmental considerations.

156 Dansk Industri, (2025). 'Grønne anlæg af infrastruktur'.
Available at: gronnere-anlag-af-infrastruktur-2025_web.pdf

157 Pirkanmaa, (n.d.). Available at: https://maakuntakaava2040.pirkanmaa.fi/sites/default/files/Kiviaineshuolto_kaavoituksessa.pdf

Ultimately, the importance of regional material supply plans in the Nordics cannot be overstated. Each country must recognise their critical role in securing access to the aggregates needed for infrastructure, housing, energy, and other construction projects. By promoting responsible land-use, resource efficiency, and long-term environmental protection, these plans can support sustainable development, reduce environmental impacts, and help meet both current and future demand.

6.4 Reducing emissions from extraction and transport

The quarrying and transport of aggregates remain some of the most carbon-intensive components of the construction. In the Nordic region, aggregate operations often involve diesel-powered machinery, significant transport distances, and energy-intensive crushing activities. As investments in infrastructure and housing increase to meet climate and societal objectives, it becomes increasingly important to consider how material supply systems might evolve to minimise associated emissions.

The need to reduce emissions from extraction and transport is becoming increasingly urgent. While climate efforts often focus on the operational emissions of buildings and infrastructure, the carbon impact of material sourcing is gaining overdue recognition. Quarrying activities and the movement of heavy materials over long distances significantly contribute to the sector's footprint—and these emissions will only increase without targeted efforts to modernise supply chains. Decarbonising quarry operations is therefore not just an environmental imperative, but a strategic priority for meeting climate targets across the region.

Encouragingly, some progress is already underway. Within quarry sites, production processes are being refined to lower fuel use and improve energy efficiency. This includes more efficient material handling during internal transport, storage, and loading, as well as investments in fossil-free transport solutions and digital tools—such as visualisation and simulation software—that streamline operations and reduce unnecessary handling.

Electrification is a key driver of decarbonisation. Many large rock quarries with continuous, year-round crushing activities have already electrified their crushing equipment—particularly where high-voltage grid connections are accessible and sufficiently robust[158]. Further electrification is feasible in similar contexts. However, smaller quarries with infrequent crushing operations have been slower to transition, largely due to the limited cost-effectiveness of electrification under current market conditions. Nonetheless, emerging technologies are expected to reduce capital costs and improve scalability, opening the door for broader electrification even in smaller or more remote operations.

158 Sveriges bergmaterialindustri, (n.d.). 'Branschens prioriterade åtgärder'. Available at: https://sverigesbergmaterialindustri.se/branschens-klimatomstallning/branschens-prioriterade-atgarder/

In addition, emissions from external transport to and from quarry sites can be significantly reduced by transitioning to electric or alternative-fuel vehicles. Equally important is the potential to reduce overall transport demand through smart spatial planning, including the co-location of quarries and terminals close to end-use markets.

Reducing emissions from extraction and transport is a critical step toward decarbonising the construction sector in the Nordic region. While progress is underway—through electrification, operational efficiency, and smarter logistics—further action is needed to scale these solutions across all types of quarry operations. By modernising supply chains, embracing emerging technologies, and integrating spatial planning, the region can significantly reduce the carbon footprint of aggregate supply. Achieving this transition is not only essential for meeting climate goals, but also for building a more resilient and future-proof material system.

6.5 Reducing the climate impact of aggregates through smarter supply and circular strategies

As urban centres grow and infrastructure expands, the Nordic construction sector faces a dual challenge: reducing emissions while ensuring a stable material supply. Aggregates are central to this equation. Yet the current system for sourcing, transporting, and reusing these materials is poorly equipped to deliver climate results at scale.

The climate footprint of construction aggregates is primarily driven by transportation, not extraction. As construction projects expand and nearby quarries close, the average transport distance for aggregates is increasing —raising emissions and placing further strain on regional infrastructure. For example, in Stockholm County, around one in four heavy-duty transport vehicles is carrying aggregates, contributing significantly to traffic congestion and greenhouse gas emissions.

Environmental Product Declarations (EPDs) estimate emissions from aggregates at roughly 3.1–3.5 kg CO_2e per tonne, with little difference between primary and secondary materials when transportation is included[159]. This underlines a key insight: the climate performance of aggregates depends less on the type of material and more on how and where it is sourced and moved. To reduce emissions, Nordic countries need to take a more strategic approach to material supply. This includes locating quarries closer to urban growth areas, developing urban terminals for aggregate distribution, and integrating material logistics into regional planning. Without such measures,

159 Fossilfritt Sverige, (2024). 'Färdplan för bergmaterialindustrin'. Available at: https://fossilfrittsverige.se/wp-content/uploads/2020/09/Bergmaterialindustrin_fardplan_uppgraderad_2024.pdf

longer transport distances will continue to erode the climate gains of other efforts in the construction sector.

At the same time, increasing the reuse and recycling of aggregates remains critical. While recycled materials may not always show lower emissions per tonne, they reduce pressure on natural resources and can help minimise overall transport needs when reused locally. Policy should support improved sorting, standards, and procurement practices that create stronger and more predictable demand for recycled aggregates[160].

However, the full potential of recycling is limited by several systemic barriers. Across the Nordic region, fragmented responsibilities, unclear mandates, and weak logistical coordination often prevent effective material reuse. For example, in Sweden, no single actor is typically responsible for managing circular material flows, and in Denmark, misalignment between regional and national stakeholders complicates system-wide coordination.

Economic and market barriers also persist. The cost of recycling—including storage, transport, and quality testing—is often higher than sourcing primary materials, and supportive business models and procurement structures are lacking. In Norway, short project timelines and limited financial incentives discourage investment in long-term circular solutions. Meanwhile, in Finland, physical constraints such as lack of intermediate storage and long transport distances reduce feasibility.

Rigid procurement practices further hamper progress[161]. Standardized contracts across Sweden often default to linear solutions, while Denmark struggles with insufficient data to justify reused materials in tenders. Across all countries, data and knowledge gaps around material availability, contamination, and technical standards prevent effective reuse.

By addressing these systemic, logistical, and regulatory barriers, and by integrating smarter transport strategies with targeted measures for circularity, policymakers can significantly lower the climate impact of construction aggregates. Coordinated infrastructure development, improved procurement design, and national leadership on data and logistics are essential steps toward making recycling a viable and climate-effective part of the Nordic construction ecosystem.

6.6 Recycled aggregates: A demand-side challenge

Despite growing attention to circularity, the use of recycled aggregates in the Nordic construction sector remains limited. One of the main reasons is a persistent demand-side gap. While supply capacity is growing and technical standards are improving, uptake remains limited because recycled materials struggle to gain traction in the market.

160 Ibid.

161 Stakeholder interviews.

A key barrier is how construction projects are procured, particularly by the public sector. Governments are among the largest buyers of infrastructure and housing, yet procurement processes often fail to accommodate or encourage the use of recycled aggregates. Conventional materials are still the default—favoured by outdated technical specifications, rigid material requirements, and a general reluctance to take on perceived risks. Even when recycled materials meet the same performance standards, they are frequently excluded from tenders or overlooked during evaluation. This creates uncertainty for producers, weakens incentives to invest in recycling capacity, and reinforces reliance on primary raw materials. The result is a system that favours the familiar—even when more sustainable alternatives are available.

Introducing clearer incentives or requirements for the use of recycled aggregates in public procurement could play a transformative role. This could take the form of bonus points in tender evaluations, or lifecycle-based performance criteria that favor lower-carbon material choices. One promising approach is to structure procurement around functional requirements —defining the desired performance or outcome, rather than prescribing specific materials or technologies. This gives contractors the flexibility to propose innovative, lower-emission solutions that meet the same standards.

Such an approach has already shown positive results in Norway, where function-based procurement has allowed for the use of recycled materials in road construction, based on their performance rather than their origin. For example, in Norway's National Transport Plan (NTP), there is an increasing emphasis on sustainable materials, including recycled aggregates, for infrastructure projects. The Norwegian Public Roads Administration (Statens vegvesen) has been actively working on integrating circular economy principles into road construction, and performance-based specifications have enabled contractors to incorporate recycled aggregates without being restricted by rigid material specifications. Similarly, the growing application of Environmental Product Declarations (EPDs) is helping standardise how environmental impacts are assessed across material types, enabling more informed and climate-aligned procurement decisions.

However, the broader challenge remains: until procurement norms shift more decisively, the market for recycled aggregates will continue to struggle. Without stronger and more consistent demand signals—especially from the public sector—the transition to circular material use will remain slower and more fragmented than needed.

6.7 Improving material use through early-stage collaboration

One of the most overlooked drivers of aggregate demand is inefficient material use. Too often, construction projects consume more resources than necessary—not because of technical limitations, but because decisions that influence material volumes are made too late in the process. When planning, design, and procurement are disconnected or rushed, opportunities for optimisation are lost, leading to excess use of aggregates and other materials. A key barrier is the traditional, sequential approach to construction planning, where stakeholders—such as clients, consultants, contractors, and subcontractors—enter the process at different stages. This fragmented process reduces opportunities to align on project goals, explore efficient solutions, or address sustainability targets in a coordinated way. As a result, material efficiency is frequently an afterthought rather than a guiding principle. By contrast, early-stage collaboration enables more strategic and resource-conscious construction. When all key actors are involved from the beginning —architects, engineers, sustainability experts, and contractors—it becomes possible to evaluate design choices, standardisation options, and logistics in parallel. This integrated approach facilitates smarter decisions that reduce material volumes, enable reuse, and improve cost-efficiency across the project lifecycle.

Early collaboration also supports innovation and risk management. With shared input and broader expertise available early on, project teams can more easily identify potential pitfalls and implement solutions that minimise waste and improve environmental performance. Importantly, it also strengthens the collective capacity of the team, increasing both the quality and sustainability of outcomes.

In short, embedding early-stage collaboration into project planning processes is essential for reducing the overuse of construction materials—including aggregates. It lays the foundation for more coherent, circular, and cost-effective construction practices—helping to lower demand, ease supply pressures, and support broader sustainability goals in the built environment.

“The trend of declining number of quarries in the Nordics run the risk of endangering our societal development. It’s evident that political action is required to enable new extraction, increasing recycled materials, and improving material efficiency in order to secure the crucial supply of aggregates.”

Hakim Belarbi, Head of Public Affairs NCC

7. Policy recommendations

1. **Establish national strategies for aggregate supply preparedness**
   Nordic governments should develop national strategies to ensure long-term access to material used for building and maintenance in both crises' situations and under normal circumstances. The supply of aggregates is vital to the Nordic countries' ability to handle preparedness and the growth of the Nordic countries and should therefore be considered an essential building material.

2. **Strengthen Regional Spatial Planning for Resource Extraction**
   Sweden, Norway and Finland should implement mandatory regional plans that reflect local resource conditions, demand trends, and landuse constraints. Regional plans could also integrate material flows into land-use planning and recycling efforts, improving overall system efficiency and sustainability. Denmark should implement a national plan that coordinates and help reduce regional imbalances, anticipate future needs, and prevent supply bottlenecks that could hinder future development.

3. **Broader scope of permit assessments**
   Environmental EU Directives must take on a broader perspective. An investigation should be made into how to create a broader perspective that enables good trade-offs between conflicting land interests, societal benefits, climate effects and environmental objectives in order maximize the benefit to society.

4. **Strengthening Digital Transparency and Access to Data**
   Develop centralized digital portals where all documents, decisions, and public consultations related to quarry permitting can be easily accessed by stakeholders.

5. **Encourage Cross-Nordic Harmonization**
   Promote knowledge sharing and harmonized procedures for quarry permitting through Nordic Council collaboration to reduce administrative barriers for cross-border companies.

6. **Improved guidance on waste versus product**
   Nordic countries should develop clear national criteria to distinguish between clean, reusable materials and contaminated materials that align with the EU Waste Framework Directive, which allows for "end-of-waste" criteria. Many excavated materials from infrastructure projects are automatically classified as waste, even when they are clean, reusable, and comparable in quality to virgin materials. This leads to valuable materials being unnecessarily sent to landfills leading to more emissions, costs, and environmental degradation.

7. **Use partnering and functional requirements in procurement to optimize material usage**
   To accelerate the circular economy, Nordic governments should promote partnering and functional requirements in public procurement that prioritize performance and carbon outcomes—rather than prescribing specific materials, technologies or construction technical requirements. This approach gives contractors the flexibility and possibility of being innovative to propose lower-emission solutions, thereby boosting materials with a lower climate impact such as recycled aggregates. + standards and eurocodes.

8. **Promote quarries that produce aggregates with a low climate impact**
   Use climate budgets and verifiable Environmental Product Declarations (EPD) to promote projects and aggregates with a lower climate footprint. Through climate budgets, goals are set for the construction project's climate impact and can be used not only to map emissions but also to reduce them. Clearer procurement criteria—such as bonus points, lifecycle-based performance standards, or EPDs can strengthen market signals and drive investment in recycling capacity.

9. **Accelerate decarbonization of the Nordic quarrying sector**
   Nordic governments should support the decarbonization of the quarrying sector by enabling electrification, promoting fossil-free transport and promoting efforts to implement climate investments, such as switching to fossil-free work machines and vehicles. A major transition will require financial support from the Nordic countries. External transport emissions can also be reduced through alternative fuels and by co-locating quarries and terminals near high-demand areas. Smarter spatial planning and strategic siting of extraction activities are essential to lowering emissions, reducing traffic pressure, and improving system efficiency.

Table 01. Investment costs (million SEK/MW) and conversion MWh/MW for different electricity sources[158]

	Million SEK/MW (range)	MWh/MW installed (range)
Hydropower	19	2300
Nuclear	45 (40–55)	7600 (7450–7800)
Offshore wind	25 (25–27)	4700
Onshore wind	11 (10.12.5)	3250 (3200–3300)
Solar	7.5 (7–7.5)	950 (910–970)

Table 02. Investment costs per TWh electricity capacity for different electricity sources

	Hydro-power	Nuclear	Onshore wind	Offshore wind	Solar
Denmark (billion DKK/ TWh)	-	-	2.2	3.5	5.2
Finland (billion EUR/ TWh)	-	0.5	0.3	0.5	0.7
Norway (billion NOK/ TWh)	8.4	-	3.5	5.4	8.1
Sweden (billion SEK/ TWh)	-	5.9	3.4	5.3	7.9

Table 03. Investment costs for new electricity production capacity, per electricity source and in total

	Hydropow-er	Nuclear	Onshore wind	Offshore wind	Solar	Total investment costs
Denmark (billion DKK)	-	-	5	272	178	455
Finland (billion EUR)	-	-	46	22	28	96
Norway (billion NOK)	76	-	48	157	89	370
Sweden (billion SEK)	-	59	203	319	111	692

158 https://energiforsk.se/media/30970/el-fra-n-nya-anla-ggningar-energiforskrapport-2021-714.pdf