Oslo

Climate Agency

Barriers and key success factors for zero emission construction in Oslo

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1. Introduction

In 2015, the City of Oslo set an ambitious climate target: to reduce direct greenhouse gas (GHG) emissions by 95 percent by 2030. Achieving this goal requires addressing all sources of direct emissions. In 2023, emissions from non-road mobile machinery (NRMM) were about 125,000 tons CO2, accounting for almost14 % of the city's total GHG emissions.[1] A significant share of these emissions comes from the operation of construction machinery. According to Oslo's Climate Strategy, all construction sites should zero-emission by 2030.[2]

Figure 1. Oslo's climate goals

To support a broader transition to zero emissions across the entire construction and building sector by 2030, municipal entities must lead the way. Since 2019, when companies compete for public works, the city has awarded suppliers that can provide zero-emission construction services. At the same time, in 2019, the city stated that all public works commissioned by the city should be zero-emission by January 1st, 2025.

The shift has been swift. In 2024, roughly 85 percent of work at municipal construction sites in Oslo was carried out with zero emissions machinery (see Figure 1).

[1] Utslipp av klimagasser i Norges kommuner og fylker - miljodirektoratet.no
[2] City of Oslo. 2020. https://www.klimaoslo.no/rapport/climate-strategy-for-oslo-towards-2030/

The next step involves also private real estate developers making use of electric construction machinery. The shift from fossil fuel to electricity as the main energy source for construction increases the demand for electric power and increase grid-load.

This report, prepared as part of the City of Oslo's Net Zero Cities project "Power Up a Renewable Society" (PURE), aims to summarize Oslo's progress toward achieving zero-emission construction sites. Previous reports have extensively documented barriers and key measures in transitioning to electric machinery. Instead of repeating these points, this report summarizes key findings and offers an updated assessment of the most impactful barriers and key success factors in Oslo.

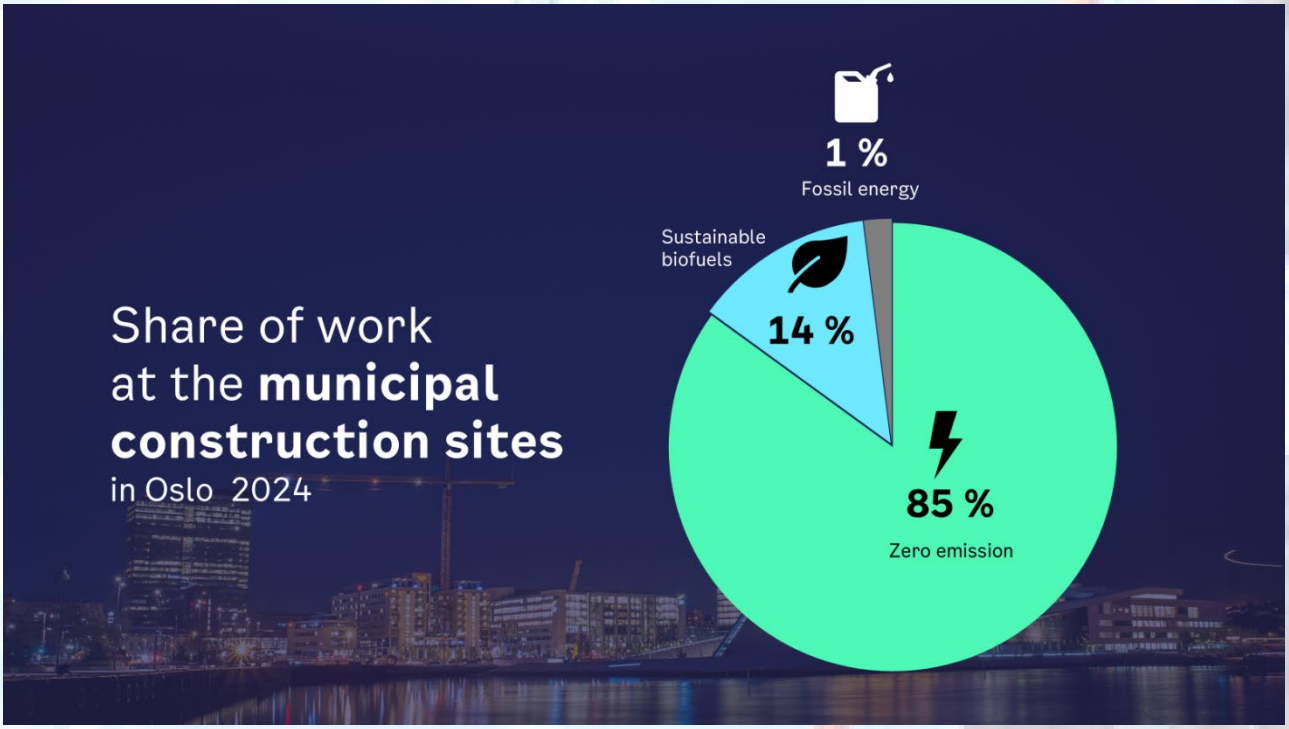

Figure 2. Work done at Oslo's municipal construction sites in 2024 distributed on energy source.

2. Definitions

Construction site/project: Refers to the construction of buildings, infrastructure, or facilities. For the purposes of this report, activities at a construction site are limited to those occurring within the construction fence, focusing on construction machinery and other energy use on-site. See Figure 2 for further details on system boundaries for construction activities.[3]

Zero-emission construction sites: Defined as sites that have no on-site tailpipe emissions and do not use fossil fuels. This definition pertains only to direct GHG emissions and excludes Scope 2 and Scope 3 emissions. Zero-emission construction machinery comprises battery-electric machines and cable-electric machines. While the term could also include fuel cell hydrogen machines, such equipment has not yet been deployed in Oslo.

Fossil-free construction sites: These are sites where no fossil fuels are used. They may still produce tailpipe emissions from sustainable biofuels alongside zero-emission energy sources. Fossil free construction has been a minimum requirement for all municipal construction works in Oslo since 2017.

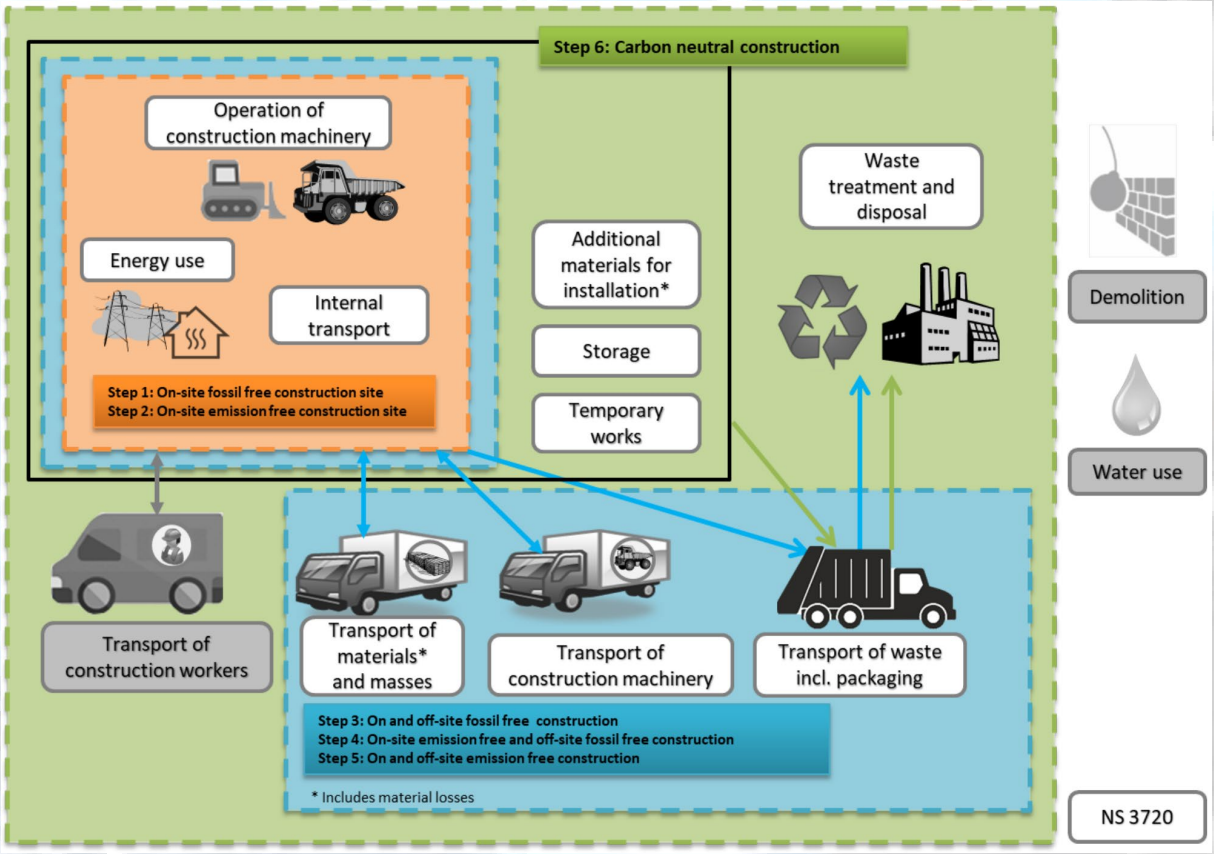

Figure 3: Diagram showing the system boundary for all construction activities.

[3] SINTEF. 2021. https://www.klimaoslo.no/rapport/survey-emission-free-building-and-construction-sites/

3. History of zero emission construction in Oslo

In 2017, the City of Oslo introduced a requirement for all construction projects on municipal sites to be fossil-free. This meant that contractors bidding for municipal projects were required to replace fossil fuels with biofuels in their on-site machinery as a minimum standard. This set a clear expectation that fossil fuels were no longer acceptable in city-managed projects.

Also in 2017, Oslo adopted a more ambitious procurement strategy, aiming to accelerate the transition to zero-emission construction. The strategy stipulated that all municipal projects should prioritize zero-emission technologies, such as electric or hydrogen-powered machinery.

In 2019, Oslo's procurement strategy was operationalized through the introduction of standardized tender award criteria.[4] To incentivize electrification, the criteria included a weighting system that rewarded contractors who could offer zero-emission machinery and solutions, such as electric or hydrogen-powered equipment. This framework implies, when all else is equal regarding price and quality between competing bidders, the company who offers the highest share of electric construction equipment wins the contract.

Figure 4: History of fossil free and zero emission construction sites in Oslo

[4] City of Oslo. 2019. Climate-and-environmental-requirements-for-the-City-of-Oslos-construction-sites.pdf

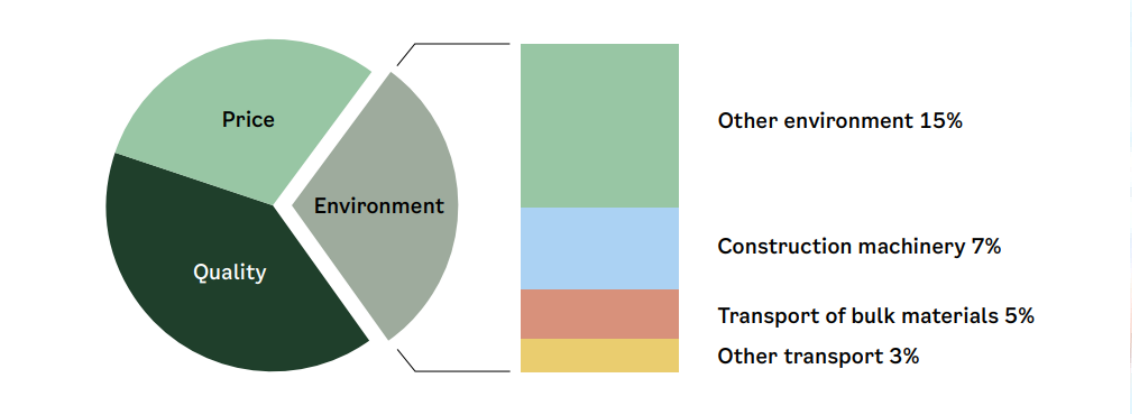

Figure 5: How tender award criteria is used to promote environmental performance in construction projects commissioned by the city of Oslo. Municipal agencies are instructed to use at least half of the environmental award criteria on electrification of construction machinery and transport services, but are provided flexibility to give priority to other environmental aspects of projects such as the use of circular or low-emission materials.

Additionally, the criteria clearly outlined the city's long-term goal, emphasizing its commitment to achieving fully zero-emission construction sites in all municipal projects from January 1, 2025. This approach provided a clear roadmap for the construction industry, combining immediate actions with a definitive timeline for transitioning to zero-emission technologies, thereby driving innovation and investment across the sector.

In 2020, Oslo adopted a new climate strategy. The climate strategy extended the zero-emission ambition to encompass all construction sites, public and private, by 2030.[5]

That same year, Oslo introduced new requirement in urban zoning regulation obliging construction sites to be fossil free from 2021. This marked the beginning of Oslo's decarbonization efforts for non-municipal projects.

The introduction of the new requirement in zoning plans revealed a legally uncertain landscape. While the municipality has concluded that the approach is lawful, this conclusion was soon challenged by the National Government, which argued that such provisions might fall outside the municipality's legal authority (Ministry of Municipal Affairs and Modernization, 2021). The ensuing debate highlighted disagreements over the municipality's authority to enforce climate-related regulations in zoning plans. These conflicting interpretations point to a critical issue: the Planning and Building Act has significant shortcomings when it comes to facilitating for cities to require zero-emission solutions to be adopted by private real-estate developers. Despite this uncertainty, the city still deems regulatory tools such as urban planning provisions as essential for achieving key local climate goals and ensuring predictability and fair competition for all developers operating in Oslo.

Oslo's new municipal master plan, expected to be adopted in 2025, includes proposed planning requirements that zero-emission construction sites, whether public or private, should be the norm by 2030. These requirements are currently under review by the city government, considering public consultation input from Autumn 2023 and the legal viability of specific climate requirements.

[5] City of Oslo. 2020. https://www.klimaoslo.no/rapport/climate-strategy-for-oslo-towards-2030/

In April 2025, a new regulation was adopted at the national level, based on the Pollution Control Act rather than the Planning and Building Act. Under this new legal basis, municipalities can now choose to mandate the use of zero-emission solutions and biogas on construction sites. It is up to each municipality to develop and adopt local climate requirements, which must be enacted as a municipal regulation.

Municipalities are expected to adapt the requirements to local conditions and circumstances. This means they can, for example, decide whether the rules should apply only to certain areas or types of projects within the municipality, or only to projects above a certain size. Each municipality also determines the share of energy use that must be zero-emission, and whether the requirements should be phased in gradually.

Figure 6: History of fossil free and zero emission construction sites in Oslo, part 2

4. Barriers and success factors in Oslo

The barriers to transitioning to zero-emission construction sites span across the political, technological and economic sectors. This report categorizes them as follows:

- lack of political direction and stability,
- technological limitations,
- energy supply constraints,
- economic considerations,
- market readiness and supply chain constraints

The city has commissioned numerous reports, including an impact assessment of zero emission building processes in Oslo[6]. Additional insights regarding energy supply constraints are provided by Sweco in a mapping of power consumption and limitations of power connections at construction sites in Norway. [7] Hafslund Rådgivning have developed to Guidelines for emission free construction and building sites[8] and conducted a study for the City of Oslo estimating future electricity and charging infrastructure needs in the sector towards 2030.[9]

This section summarizes and evaluates the impact of these barriers in Oslo, highlighting the city's specific success factors in overcoming each challenge.

4.1 Lack of political direction and stability

The construction industry requires predictability to invest in zero-emission equipment. Unclear or unstable political signals regarding the transition to zero-emission fuels pose a significant barrier to effective transition. However, in Oslo, successive city government have consistently delivered clear and ambitious messages about the City's seriousness and commitment to zero emissions construction. Oslo's 2020 Climate Strategy was adopted by a large majority in the City Council, and its ambitions have remained stable across successive city governments.

Barrier in Oslo: No
Success factor in Oslo: Ambitious climate targets adopted by a large majority in the City Council, with a clear and consistent focus on zero-emission construction sites from 2019 to 2025.

[6] SINTEF. 2022. https://www.klimaoslo.no/rapport/impact-assessment-of-zero-emission-building-processes-in-oslo/
[7] Sweco. 2024. https://www.klimaoslo.no/rapport/current-power-demand-at-construction-sites/
[8] Two guidelines for Zero Emission Construction Sites
9 Hafslund Rådgivning. 2022. https://www.klimaoslo.no/rapport/elektrifisering-av-tungtransport-og-bygg-og-anleggsektoren-i-oslo/

4.2 Technological Limitations

The limited availability of zero-emission construction machinery, particularly for affordable heavy-duty applications such as excavators. and wheel- loaders, is a significant challenge. When Oslo began transitioning to zero-emission construction, electric alternatives for many types of equipment was simply not available. The first fully zero-emission construction site in Oslo, a pilot project to refurbish Olav Vs gate in 2019, provided valuable insights by mapping the availability, and potential for electric machines and equipment. The pilot demonstrated the feasibility of zero-emission construction sites and laid the groundwork for further advancements. Since then, electric construction machinery has been tested across more than 220 projects and tasks in Oslo.

Early engagement with contractors, original equipment manufacturers (OEMs), and industry associations has been a critical in addressing this barrier. Despite progress, technological limitations remain a significant challenge to achieving full zero-emission construction.

Barrier in Oslo: Yes, significant.
Success factor in Oslo: Early-stage market dialogue, standardized green-procurement requirements and pilot projects demonstrating feasibility.

4.3 Energy supply constraints

Zero-emission construction sites require considerably more electricity than conventional sites. Limitations in grid capacity and lengthy application processes for grid connections can be significant barriers. Finding alternate solutions to grid connection such as batteries or hydrogen to supply clean electricity on-site can be important, as is understanding peak demand and grid constraints.

In Oslo, ensuring adequate electrical infrastructure, such as charging facilities and grid capacity enhancements, has been a resource-intensive process. While there have been instances where grid power was insufficient or connections were delayed, these issues have not constituted a major barrier to zero-emission construction sites in Oslo. For example, the use of battery containers has provided a practical solution in several projects.

Oslo has also explored how the transition to zero-emission construction sites might affect the power grid on a larger scale. Hafslund Rådgivning's analysis in 2022 concluded that the increase in power demand from zero-emission construction sites could exceed the expected growth in demand under the distribution system operator's (DSO's) baseline scenario (see figure below).

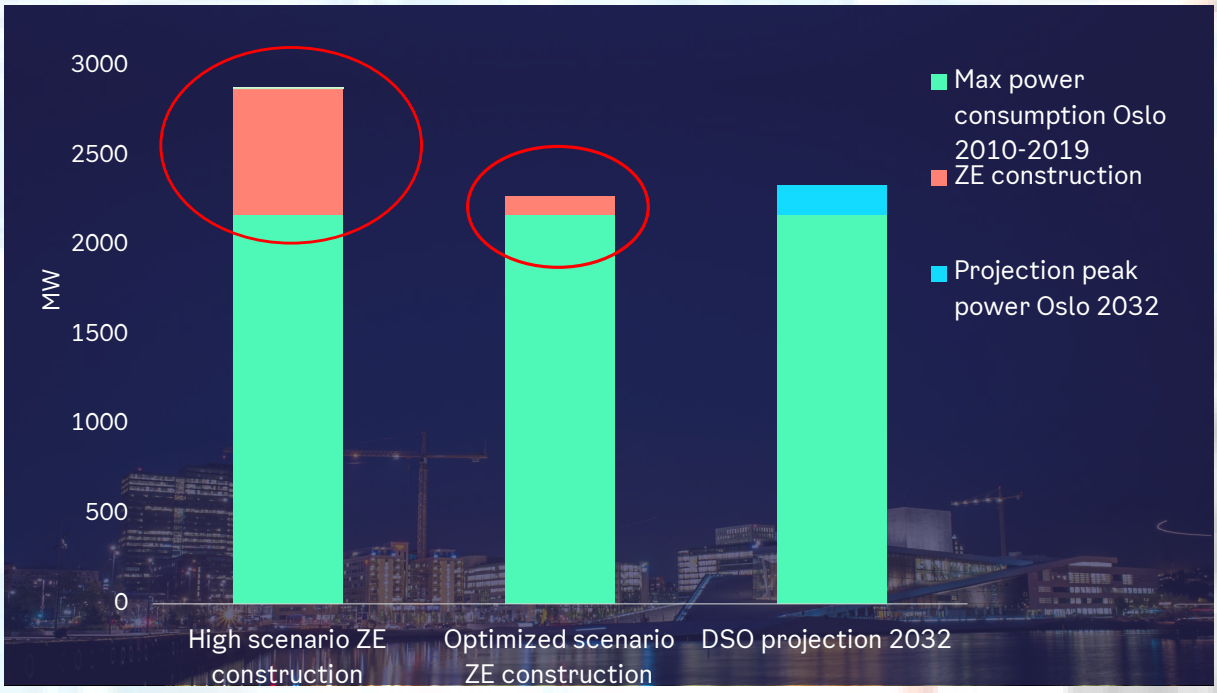

Figure 7: Potential increase in peak power demand from Zero emission construction[9]. Note that the red squares are placed on the top of the peak power in the rest of the grid, meaning this is a worst case situation. The peak power from the construction sites will probably not be simultaneously with the peak power demand for the rest of the grid. The City of Oslo regard the Optimized scenario (in the middle) as a more likely scenario than the High scenario (left).

However, Oslo considers the optimized scenario—a 120 MW increase in demand—the most likely. However, Hafslund's Rådgivning's scenario illustrates a worst-case situation, and empirical data from Sweco suggest that peak power demand from construction sites is lower than previously expected. Additionally, solutions such as load management, larger batteries in machinery, and the smart use of batteries on-site may help reduce peak demand.

Effective dialogue and established routines for ordering grid connections between builders (the municipality), contractors, and the DSO (Elvia) have been critical success factors in overcoming energy supply constraints. The guidelines from Hafslund Rådgivning aim to further streamline grid connection processes for contractors.[10]

Barrier in Oslo: Yes, but not major.
Success factor in Oslo: Established routines and shared industry experience for grid connection requests, alongside effective dialogue with stakeholders.

[10] Two guidelines for Zero Emission Construction Sites

4.4 Economic Considerations

The high initial costs of purchasing and/or retrofitting electric machinery can pose financial challenges. Electric equipment typically requires greater upfront investment compared to diesel-powered alternatives. Furthermore, preparing necessary temporary electricity supply involves upfront planning resources and in many cases increased investment costs where grid capacity is limited. Some of these upfront costs will be returned with savings from more efficient energy use and reduced maintenance. The net-cost of electrification of construction services is uncertain and varies a lot between projects. Different studies indicates that in this very early stage of transition there is an additional cost in the order of 0,5% - 4% of overall project cost, depending on several factors. As a client, we observe that in some contracts the bid with the lowest price also has the highest share of electrified equipment. In other contracts the most electrified supplier also has the highest price. To reduce financial risks, it is important to provide:

- a high level of foresight and predictability,
- to engage actively with the market,
- to allow sufficient time for companies to adapt to new environmental requirements
- and to secure attractiveness and competition among companies bidding for public works

The clear emissions reduction goal and willingness of the City Government to use green public procurement to drive innovation and market transformation has been critical. When shifting from diesel to electric construction, the financial risks involved are complex and significant, highly dependent on market conditions. These risks need to be dealt with. But in the longer run, similar to developments in the car industry, there could be significant net economic gains to be harvested.[11]

SINTEF has projected that electric machines could become cost-competitive with diesel alternatives in many applications by 2030 due to lower operational costs.[12] But the capacity to perform zero emission construction works is still a unique local feature of the regional market in Norway and the Netherlands. Much of the equipment is still available in limited numbers, often costly, retrofit machinery. To improve competitiveness, there needs to be a swift scale up of production volumes and assortment, like the recent developments in the car industry.

Barrier in Oslo: Yes, but not major.
Success factor in Oslo: Strategic use of purchasing power and political willingness to pay additional costs during the transition period.
National success factor: The national support scheme for zero-emission construction machinery has also played an important role.

4.5 Market Readiness and Supply Chain Constraints

The nascent stage of the zero-emission construction market has resulted in supply chain challenges, including limited production capacity and long lead times for procuring electric

[11] Total Cost of Ownership Will Fuel the EV Construction Industry | IDTechEx Research Article
[12] SINTEF. 2022. https://www.klimaoslo.no/rapport/impact-assessment-of-zero-emission-building-processes-in-oslo/

construction machinery. Additionally, some zero-emission machines are being available in other parts of Europe, but are not yet readily available in much of Norway. The need for increased and suitable provisionary energy supply needs to be addressed and is a prerequisite for a wider introduction of electric machinery, in a similar way that you need charging infrastructure to use your electric on-road vehicle.

Despite these constraints, Oslo has been successful in its effort to electrify public construction works. There has been risks involved, and initial uncertainty whether electric equipment could do the job. But five years and more than 200 projects into this transition, we have proven that zero emission construction is a viable alternative, with limited impact on progress and overall project cost. The companies performing the works have failed and learned along the way, reporting about a more quiet, clean and safe on-site working environment.

Barrier in Oslo: Yes, but not major.
Success factor in Oslo: Strong purchasing power and consistent communication to the market.

4.6 National support scheme of zero emission construction

Norway maintained a national support scheme for electric construction machinery through the State-owned national enterprise Enova, for several years, which played a pivotal role in facilitating the transition to zero-emission equipment. Initially, the support scheme provided broad financial support covering a wide range of relevant electric construction machines. However, in recent years, the scope of the scheme has been narrowed to include only specific categories of construction machinery.

In addition to these changes, the scheme has shifted from a rights-based subsidy model to a competition-based model. This means that funding is no longer guaranteed for all eligible applicants; instead, projects must compete based on criteria such as cost-effectiveness with only the highest-ranked proposals receiving subsidies. This shift has increased uncertainty for the construction industry and could partly explain a decline in sales of electric machinery in 2024 compared to 2023, both in total numbers and market share.

While the recent modifications of the national support scheme administered by Enova is identified as a barrier, it is important to underline the scheme's historical significance. Enova has been a key success factor in accelerating the zero-emission transition in Norway's construction sector. Ensuring that the scheme continues to provide effective and predictable support will be crucial for sustaining progress toward zero-emission construction.

5. New Legal Basis for Local Climate Requirements

On April 3, 2025, the Ministry of Climate and Environment adopted a new regulation to limit emissions from construction sites (FOR-2025-04-03-594). The regulation grants municipalities the authority to require the use of zero-emission solutions and biogas on construction sites. It is authorized under Section 9 of the Pollution Control Act.

In November 2024, the City of Oslo submitted a consultation response to the draft regulation, requesting the broadest possible legal authority and calling for a swift implementation. Oslo

emphasized the need for clear market signals to accelerate the transition to zero-emission construction sites. The adopted provision gives the municipality broad discretion, in line with Oslo's input, to mandate zero-emission solutions and biogas use on all construction sites within the city limits.

The next step is for the municipality to draft a local regulation requiring zero-emission solutions and biogas on construction sites in Oslo, based on Section 9 of the Pollution Control Act and the national regulation adopted on April 3, 2025.

It is likely that the proposed local regulation will be based on the requirement suggested in the draft of the municipal master plan's land-use section, which was subject to public consultation in 2023. At the same time, adjustments will be necessary in light of the fact that the new regulation does not authorize the mandatory use of biofuels during a transition phase, as was originally proposed in the master plan draft.

The regulation may apply to all construction sites within Oslo's municipal boundaries, regardless of the project owner, and is expected to establish a gradual phase-in toward fully zero-emission operations by 2030. Exceptions must be allowed in line with national guidelines, where requirements are not technically feasible or would result in disproportionately high costs.

6. Conclusion

Oslo has taken a leading role in the transition to zero-emission construction, backed by ambitious climate targets, consistent political leadership, and a strategic use of procurement power. From early fossil-free requirements in 2016 to the upcoming zero-emission mandate for all municipal sites in 2025, the city has steadily raised expectations and enabled market development.

This report identifies five key barriers to zero-emission construction—political instability, technological limitations, energy supply constraints, economic considerations, and supply chain challenges—and assesses their relevance in the Oslo context. While several remain relevant, none are considered insurmountable. Oslo's success factors include strong political signals, early pilot projects, established grid coordination routines, willingness to absorb transitional costs, and a clear and consistent market message.

At the same time, Oslo's experience underscores the importance of national frameworks that support local climate action. Legal uncertainty under the Planning and Building Act, and recent changes to the national support scheme for electric machinery, illustrate the need for more enabling national policies to sustain and scale zero-emission construction across Norway.

All public works commissioned by the city will be electrified in 2025, representing roughly a fifth of the annual local market volume of about 6 billion Euro. The Norwegian Public Roads Administration aims for all new road construction to be zero emission from 2027. The Netherlands have adopted a roadmap to electrify infrastructure development by 2035. In China and California, ambitious policies are being designed to promote off-road electrification, recognizing new solutions are now available, with clear benefits for both health and wider sustainability goals. To exploit the full mitigation potential from electrification of construction equipment national level governments and the EU could:

- provide clear goals for emissions reduction from construction towards 2030 and beyond
- stimulate technology development through targeted R&D funding

- incentivise electrification through public infrastructure funding mechanisms and green public procurement
- signalling the development of long-term regulatory measures aimed to decarbonize non-road mobile machinery

A new milestone was reached in April 2025, when the Norwegian government adopted a national regulation under the Pollution Control Act (§ 9), granting municipalities the authority to require zero-emission solutions and biogas on all construction sites. This regulatory development responds directly to Oslo's earlier request for a strong legal basis and sends a clear signal to the market. It provides municipalities across Norway with a powerful new tool to accelerate the transition.

With continued coordination, investment, and policy development at both local and national levels, Oslo is on track to achieve zero-emission construction across all projects by 2030—setting an example for cities in Norway and beyond.

Oslo