Public Procurement of Zero-Emission Construction Sites

Lessons learned from the Big Buyers Initiative working group

The Big Buyers Initiative is a European Commission Initiative for promoting collaboration between big public buyers in implementing strategic public procurement. Public procurement can be a key tool in driving the development of innovative goods and services on the European market. By working together and pooling their purchasing power, cities, central purchasing bodies, and other major public procurers can maximise their market impact.

The Zero-Emission Construction Sites working group has benefited from close collaboration with the Bellona Foundation and the EIT Climate-KIC project e-ZEMCONs.

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1. Introduction

The Big Buyers Initiative working group on Zero-Emission Construction Sites

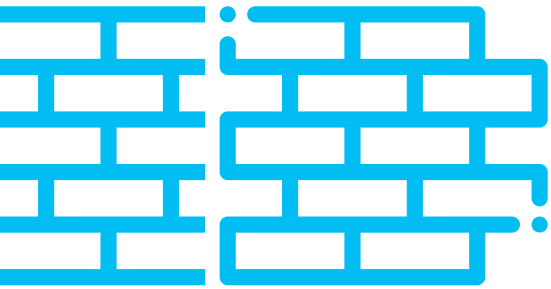
Through the Big Buyers Initiative, a working group on Zero-Emission Construction Sites brings together the cities of **Amsterdam**, **Brussels**, **Budapest**, **Copenhagen**, **Helsinki**, **Lisbon**, **Oslo**, **Trondheim** and **Vienna** to promote zero-emission construction sites, focussing on alternatives to traditionally diesel-driven non-road mobile machinery (NRMM) used to carry out construction works (such as diggers, excavators, wheel loaders, etc.). These cities work together to develop and pilot innovative sustainable procurement approaches in order to reduce the environmental impact of construction activities and encourage market innovation. The group began collaborating in April 2019, and herein shares key takeaways from a year and a half of capacity building, market dialogues, and learning-by-doing through pilot procurements with fossil- and emission-free components. Although they share a common ambition for a low carbon future, the participating cities are in different stages of the transition to clean construction works - a diversity that reflects European urban context and strengthens the exchange among them.

The city of **Oslo** was the first in the world to launch a zero-emission construction site, using all electric machinery to complete street renovation works at Olav Vs Gate [video]. In 2020, fully fossil-free construction sites debuted in **Copenhagen** [video], **Helsinki** and **Trondheim**. **Amsterdam**, **Brussels**, **Budapest** and **Vienna** are in the process of identifying suitable pilot sites to have their first fossil- and/or emission-free construction sites. Zero-emission solutions are already available on the European market, but greater demand is needed to accelerate innovation, especially for heavy machines. Large public buyers have the power to drive the market for sustainable solutions as early adopters, which present a benefit to the wider construction sector, to local environmental quality and to their own citizens' health.

Putting construction emissions in context

Conventional construction works are important sources of pollution both locally and globally. The construction industry contributes 23% of the world's CO_2 emissions across its entire supply chain, and approximately 5.5% of these emissions come directly from activities on construction sites—predominantly through the combustion of fossil fuels to power machinery and equipment.[1] As the energy efficiency of building use has been ambitiously tackled over the past decade, the focus increasingly shifts to embodied carbon: the emissions footprint of material extraction, production, transport and construction works.

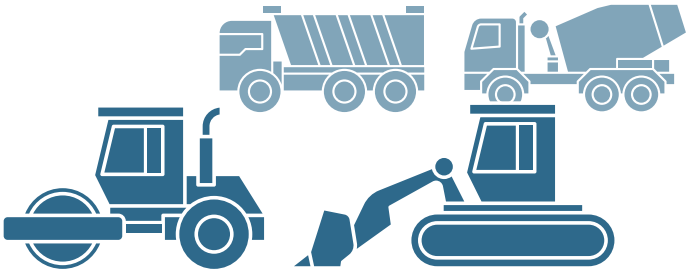
Currently there is no overarching policy at EU level that addresses greenhouse gas emissions from non-road mobile machinery and equipment, as it is not included in the Clean Vehicles Directive. Policies that touch upon construction machinery specifically do not do so sufficiently to address the climate and human health challenge. As it stands today, the EU's Non-Road Mobile Machinery Regulation only addresses carbon monoxide (CO), total hydrocarbons (HC), oxides of nitrogen (NO_X) and particulate matter (PM), thereby ignoring the CO_2 impact. Without a clear regulatory mandate at the EU level, suppliers await a clear signal from big buyers to demonstrate reliable demand for zero-emission NRMM solutions.



1 Bellona Foundation - Zero Emission Construction Status Report 2019

2. Zero-Emission Construction Machinery: State of the Art in the European Market

There is potential for a positive business case for operators already today when looking at total cost of ownership. This is driven by the significantly higher energy efficiency of electric vehicles, a lower lifetime maintenance cost, and continuously decreasing battery prices.[2] Potential barriers to overcome include the lack of at-scale charging technologies and a limited track record and product availability. Electric machines are set to be most appropriate in urban settings where emission and noise regulations require cleaner work sites, and where electricity is readily accessible on-site.



Machine availability

Small electric machines are currently widely available in most of the EU. Machinery up to 2.5 tonnes evolved faster because its power requirements (e.g. batteries, charging infrastructure) do not suppose technical innovation beyond the existing market for electric vehicles. These smaller machines have been in use for years in works such as indoor or underground renovations, in which noise, vibration and exhaust emissions are especially undesirable.

Biofuel (fossil-free fuel from bio-based sources) alternatives for large machines are available too, and can show up to 90% carbon emission reduction compared to diesel-driven machines, depending on carbon absorption of the biofuel feedstock.[3] As biofuels can be used in conventional machinery (no retrofit necessary), the only additional cost is for the fuel itself. According to experience in market dialogues by the working group, fossil-free NRMM may be an attainable intermediate solution for contractors in regions where emission-free machinery is still unavailable. For example, the city of Helsinki found that use of biodiesel could be a minimum requirement for machinery in public construction works already in 2020, while emission-free machines could only be incentivised as an award criteria for the time being.

Large electric machines are not yet widely available anywhere in the world, but a growing number of machine manufacturers are beginning to innovate under mounting pressure from public procurers and large private contractors. A number of large emission-free machines are in circulation in the Nordic countries as of 2020, though not enough to keep up with regional demand. Below is an indicative list of existing large electric NRMM:

- The ZERON line from NASTA includes the 17.5-ton ZE85 battery-powered electric excavator in use on Oslo's Olav Vs Gate pilot site. It features full charging in under an hour and can operate in battery or cable mode.
- PON, a Norway-based dealer of Caterpillar construction equipment, unveiled a fully electric 25-ton excavator model in 2018. Each battery charge provides 5-7 hours of operation, with the same power performance as the original diesel version.
- Large NRMM manufacturers/suppliers working to electrify their fleets include Suncar HK/ NASTA, Caterpillar/ PON-Cat, Wacker Neuson, Liebherr, CASE, Hitachi CM and Volvo CE.

The working group members have no direct experience with hydrogen technologies yet, but consider this a further area for emission-free market development. For further information on the availability of state-of-the-art construction machines, see the Bellona Foundation's Emission-free NRMM Database.

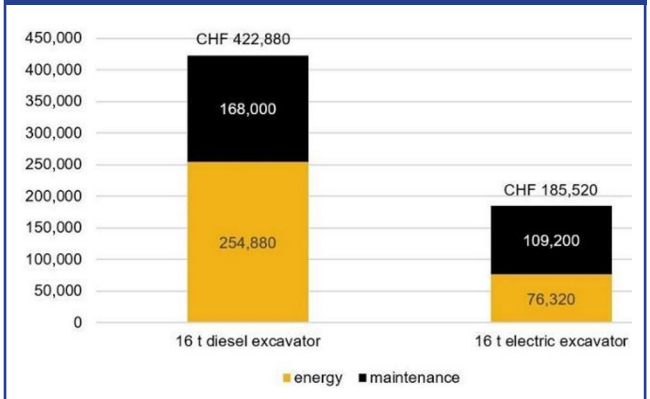
2 www.klimaoslo.no/wp-content/uploads/sites/88/2019/06/Perspectives-on-zero-emission-construction.pdf
3 www.biofuel-express.com/en/hvo

Machine performance and lifecycle cost

Emission-free machines using electric motors are more expensive upfront compared with conventional options, but manufacturers say that fuel savings, reduced maintenance, lower repair costs, and, in some instances, added productivity, may offset that initial investment.[4] Electric engines are around 2.5 times more efficient than combustion engines, which results in significant savings on fuel. Electric NRMMs also have fewer moving parts, allowing for significantly reduced servicing and maintenance costs. As a result, electric machines are expected to have 1.5 times the lifetime of diesel alternatives.[5,6] Initial results from **Oslo's** Olav Vs Gate pilot show that the technical performance of the large electric machines used is equivalent to that of diesel counterparts. Moreover, workers on the job site showed satisfaction in operating the innovative equipment.[7]

In addition to carbon, emission-free machinery avoids other local air pollutants (e.g. NO_X, SO_X, PM) also emitted by conventional NRMM. Further, electric machines have proven to be significantly less noisy, which contributes to a healthier and more pleasant working environment for construction workers and all in the vicinity of the site. Zero-emission solutions are estimated to produce up to five times less noise than conventional construction machinery.[8] On one **Copenhagen** civil works site, the quiet electric machines led to the city's Noise Department permitting longer hours worked, which decreased the project timeline by 50% overall and resulted in savings that compensated the 20% higher initial investment for emission-free equipment.

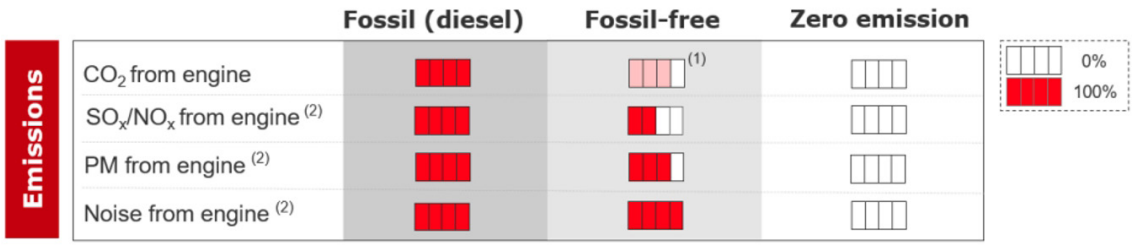
Comparison Operating Costs / Life Cycle



Initial investment for zero-emission machinery ranges from 20% to 3 times higher than a comparable diesel machine. However, electric machines have 40-70% lower operating costs. From a total cost of ownership (TCO) perspective, these savings nearly always compensate for the higher initial investment.

Source: Suncar HK

Perspectives on Zero-emission Construction



(1) CO_2 from engine is almost as high for bio as for regular diesel, but CO_2 absorption from biofuel feedstock reduces the total emissions and can be, depending on the sustainability of the biofuel, considered to be climate-neutral.

(2) The continuing strengthening of diesel emissions standards have reduced emissions of SOx, NOx and PM over time, and with the latest and strictest emissions standards in Europe these emissions have to be substantially reduced.

Source: Oslo Climate Agency, 2019

4 www.constructionequipment.com/charge-ahead-electric-machines
5 www.klimaoslo.no/wp-content/uploads/sites/88/2019/06/Perspectives-on-zero-emission-construction.pdf
6 www.suncar-hk.com/en/electric-excavators/advantages
7 www.sintefbok.no/book/index/1252/nullutslippsgravemaskin_laeringsutbytte_fra_elektrifisering_av_anleggsmaskiner
8 https://network.bellona.org/content/uploads/sites/3/2018/06/ZEC-Report-1.pdf

3. Key takeaways from the Big Buyers Initiative working group

Laying the groundwork

Political will

Considering the multi-stakeholder approach required to implement an innovative construction project and the initial investment for emission-free NRMM solutions, experience shows securing political will for ambitious climate action is imperative. **Oslo** and **Copenhagen** consider unwavering political support and dedicated funding for pilots as key to their progress so far. The working group has elaborated a Factsheet for Policymakers highlighting the key arguments for a transition to zero-emission construction sites, which may be used to this end.

Early market dialogues

Market engagement and building partnerships with key stakeholders has proven to greatly strengthen the effectiveness of the contracting authority's ambition. Dialogue with market actors should be used to set the appropriate level of ambition. Through contact with suppliers and contractors, public procurers can gain market intelligence on what is possible now, what is on the innovation horizon, and what kind of cost and management impacts their planned procurement approach could provoke. The eZEMCONs project, with inputs from the Big Buyers working group, has published comprehensive Early Market Dialogue Guidance for Innovative Procurements of NRMM to support public actors in designing and carrying out result-driven interactions with suppliers.

Innovation partnerships

To implement an emission-free pilot, multiple key stakeholders are needed: various departments of local government (e.g. climate/ sustainability, procurement, construction permitting), utility companies that provide on-site power, construction contractors (and potentially subcontractors), and project managers. Public authorities can incentivise innovation by establishing platforms for public-private exchange in the form of innovation partnerships, by which cities can ensure their sustainability targets are in focus, while giving suppliers flexibility to seek creative solutions.

- Trust partnership in **Amsterdam**: The city of Amsterdam seeks to stimulate and partner with innovative market actors by building long-term contracts based on trust. In a city-wide programme for infrastructure tenders - such as for pavement and asphalt in 2019, or bridges and quay walls in 2020 - this model is strategically used on very large projects so that suppliers invest securely in innovation, such as emission-free equipment.

- Dynamic purchasing system in **Copenhagen**: Through the Scandinavian Green Public Procurement Alliance, the cities of Copenhagen and Oslo forged a **joint cross-border procurement of innovation** by establishing a Dynamic Purchasing System for emission-free NRMMs - similar to a framework contract in that it serves a need city-wide and lasts several years. By pooling their purchasing power, the cities expected lower-priced bids. After qualification, suppliers can enter the system and then continue developing their offer with innovative technology over time. Tenders are made individually based on need and available solutions.

Selecting a pilot site

To maximise the impact and support the success of a zero-emission construction site pilot, the following important considerations should be taken into account when choosing a site:

Visibility

To gain recognition and citizen acceptance of the special project - thus paving a way to standardise the approach - ideally the pilot site will be in a strategic, visible place. Likewise, posters on the site fence can indicate the status as a zero-emission pilot. Examples from the working group include pedestrianisation and greening of a central road near the town hall and renovation of public space to include mobility infrastructure.

Power supply

If the machinery is to be electric, securing a sustainable and stable power-supply on-site is paramount. As soon as initial planning can indicate potential power demand, coordination with electricity providers should begin. It is imperative to bear in mind that without a clean electricity mix, cost and carbon savings from use of zero-emission machinery may be compromised.

- One key finding from Norway is that available grid capacity is highly dependent on location. One way of reducing the need for upgrading the grid, and thereby the connection cost, is to reduce the total power demand (i.e. MW), which can be done by the use of batteries or the use of hydrogen instead or in combination with electricity.

Scale of works

As with any pilot initiative, it is important to set oneself up for success by undertaking an appropriately scaled challenge. Overly complex or large construction projects may not be suitable for a first attempt at a zero-emission site. If a city wants a fully zero-emission site (as opposed to a site with a mix of conventional, fossil-free and/ or emission-free machines), availability of the adequate machinery should be considered when choosing the type and scale of works.

Procurement procedure

Minimum requirements

If market engagement indicates sufficient maturity (e.g. that competition is not infringed upon, as multiple suppliers are able to meet a demand), use of fossil- or emission-free machines can be stipulated in the call for tenders as a minimum requirement. For technologies already widely available, such as small electric NRMM (≤2.5 tonnes), this can be required without issue. Another aspect is heating and drying (e.g. of concrete foundations), which can also be specified as a zero-emission requirement. Phrasing of the requirements should be oriented around the desired outcome (e.g. no fossil fuels) and avoid being too prescriptive by specifying a certain solution. In order to avoid overburdening small and medium enterprises (SMEs), often ambitious minimum requirements are applied only for large or complex construction projects over a certain value threshold. In lower value projects apt for smaller contractors, such requirements can be used as aspirational award criteria until the market develops further.

Award criteria

If market maturity does not allow for requiring, for example, all emission-free NRMM on a construction project, an award criterion could reward the ratio of emission-free machines on the site. Weighting of the award criteria should be enough to affect offers, and should be considered carefully for potential trade-offs with other strategic goals - including social and economic aspects. As technology develops further over the coming years, and in line with contracting authorities overall carbon reduction targets, these criteria can incrementally become minimum requirements.

Further options

The key to tackling systemic change at the cutting edge is often thinking outside the box. Many public procurers are getting creative when it comes to strategic procurements of sustainable innovation. Depending on the local

market maturity and applicable regulation, contracting authorities can consider a variety of incentives to promote the use of emission-free NRMMs.

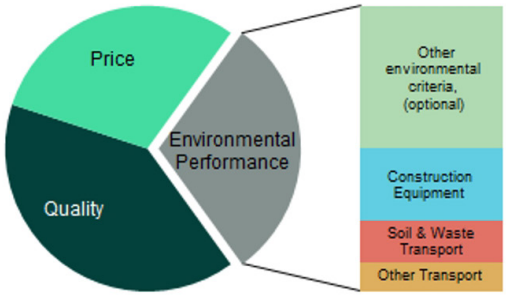
- Regulatory framework in Vienna Vienna's legislative initiatives are concentrated on the following topics for easing the pre-commercial development of emission-free equipment:
  - fast-lane for electric construction transportation,
  - directive for electric NRMM for indoor use (e.g. in refurbishments), and
  - exception for night ban for electric-HV transportation to the site (exists for noiseless vehicles, but construction activities are forbidden).
- Building a municipal NRMM e-Fleet in Copenhagen The city of Copenhagen has its own construction machines for maintenance and servicing of public space, which it has begun to transition from diesel to fossil-free, and aspires to be emission-free by 2025. On some municipal projects, the works are tendered on the condition that they be performed using the city's own environmentally-friendly machinery. This shifts the burden of investment in innovative solutions from construction contractors, but reduces site emissions the same.

Zoom in on PILOT PROCUREMENTS

OSLO

Since 2017, the city of Oslo has used fossil-free construction machinery on-site as a minimum requirement for public projects. Oslo's first fully zero-emission site was the Olav Vs Gate pilot, to redevelop the streetscape with greening, pedestrianisation and EV-charging infrastructure in central Oslo near the town hall. Further contracts for public works and building projects (including a youth centre, nursing home and Kindergarten) build upon this model, which has become the city's standard approach for public construction procurements: environmental criteria are always weighted at least 20-30% - specifically, the construction machinery emissions criterion's suggested weighting is 7% [see breakdown of the environmental criteria in the figure below]. The municipality has published a full explanation of Climate and environmental requirements for the City of Oslo's construction sites.

- **Minimum requirement:**
  - Fossil-free (bio-fuels) construction
  - Zero-emission heating (district heating / electric)
- **Companies compete on environmental performance**
  - Standard requirements for construction work commissioned by the City of Oslo
  - Emphasis on zero-emission construction equipment



Key takeaway:
Using tender award criteria in a coordinated and targeted manner across public construction projects is sending a strong signal to the market, driving innovation and low carbon transformation. The market response has been impressive, with several local machine retailers stepping up to provide tailor-made heavy duty electric equipment currently not available from the large global construction equipment suppliers. Going forward, Oslo will engage with both industry and government stakeholders at national and EU-level to facilitate further innovation and transition to a zero-emission construction industry.

Zoom in on PILOT PROCUREMENTS

COPENHAGEN

For civil works in public space, Copenhagen planned to undertake 5 pilots in 2020. These procurements use a minimum requirement for electric NRMM below 2.5 tonnes, and above 2.5 tonnes electric or sustainable biofuel. On one pilot to convert parking spaces for cyclists and pedestrians, suppliers were asked for a bid with a price for use of (a) conventional fossil diesel machinery and (b) with use of biofuel and/or electric machinery. Three entrepreneurs were contacted and invited to tender. The additional cost in their offers including fossil-/ emission-free equipment varied from €33 000-66 000. The lowest bid was accepted, and the project was carried out with small electric and large biodiesel NRMM.

Key takeaway:
As the market looks now, it is difficult to find large electric machines but we can find biofuel solutions for all sizes. We stand at the start of a market where all of us who ask for this in tenders for construction and civil works projects help to drive development by creating demand. Large electric machines must be in real production for it to be possible to procure at an acceptable price.

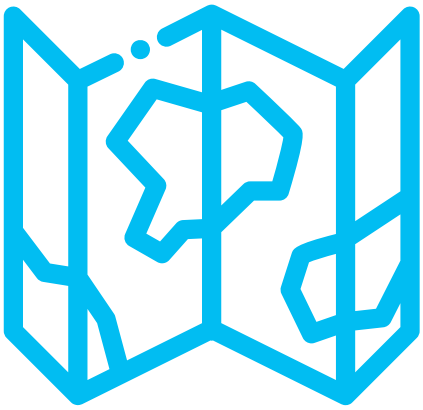
TRONDHEIM

The first fossil-free pilot project in Trondheim was the rehabilitation of the town square, underway from 2017 to 2020. The minimum requirements used ensured fossil-free activity at the construction site, fossil-free transport to and from the construction site and fossil-free delivery of heavy materials. The project also succeeded in using some small electric NRMM and district heating. The estimated additional costs for this approach were €182 325. In addition, the municipality has started a fossil-free rehabilitation of a bike/ pedestrian bridge, with an estimated total cost of €10m. This pilot used a minimum requirement of emission-free for small NRMM, and an award criterion for the ratio of fossil- or emission-free large machines. Environmental aspects were weighted at 10%. Trondheim has plans for two more pilots in the next three years, including the rehabilitation of an urban park in the city centre. This project aims to be the city's first emission-free project within the construction fence, while transport to/ from the site will be fossil-free. The project will begin in summer 2021, and additional costs for the emission-free NRMM is estimated to be €365 000 - a large part of which will be covered by a grant. From the market perspective, the construction contractor that performed the rehabilitation of the town square has ordered two bigger NRMM (excavators of 8 and 23 tonnes) from Cat Next Generation. The market is aware that the municipality will continue strengthening its procurement requirements, therefore some companies are investing in NRMM to strengthen their competition advantage.

Key takeaway:
Pilot projects give the municipality a lot of experience that will be used in future projects, and we observe that the market is increasingly turning in a more climate- friendly direction. It is important, though, that increased demand at some point leads to a "normal" production line of the NRMM and hence lower costs.

Zoom in on PILOT PROCUREMENTS

HELSINKI



Helsinki's first fossil-free construction sites include a bicycle boulevard in Kulosaari and other civil works in public space. Kulosaaren Boulevard is being converted into a shared street for bicycles and slow motor vehicles. The boulevard conversion, valued at around €3 million, is under construction from July 2020 - February 2021. In this pilot, fossil-free and low-emission criteria were used with the stricter emissions requirement of Euro 6 for the heavy transport equipment and quality criteria for the use of electric machinery. The tenders were evaluated based on the minimum requirements and award criteria, weighted as price 70% and quality 30% (number of electric machines, 5=100p; 0=0p). Market dialogue was used to set the ambition for the procurement, so it was expected that the contractors could meet the minimum requirements. In the bidding phase, it came out that small emission-free options are readily available - in the end, four electric machines were used. A fossil-free site was achievable with no additional cost over the estimate. In addition to Kulosaari, three other fossil-free and low-emission civil works pilots are underway and the decision has been made that in the future all infrastructure construction tenders will use low-emission criteria.

Helsinki's low-emission construction site minimum requirements:

- The tenderer shall have an environmental management system certification
- The machinery must meet the requirements of Stage IV emission standards, at the minimum
- The heavy transport equipment must meet the emissions requirements of Euro 5 emission standards
- The machinery and heavy vehicles must either be electric or run on non-fossil fuels. Acceptable non-fossil fuels include bio gas, hydrogen, ethanol (e.g. ED95) and renewable HVO diesel or motor oil in accordance with the EN 19540 standard
- The electricity used on site must be produced using renewable energy sources and a certificate of the origin of the electricity must be presented
- The heating of the worksite must be implemented with district heating, fossil-free biofuels or electricity from renewable sources
- All the small machinery on site (power ⩽4 kW) must be electric

Key takeaway:
It is important for public buyers to set demands for low emission solutions; contractors agree with the direction towards zero-emission construction but need the client to lead the way. Publishing roadmaps with intermediate goals shows the demand already in advance and helps the market to prepare for the necessary changes ahead.

Managing risk

Role of contracting authority

To meet the zero-emission ambition without overburdening contractors, it may be necessary for the contracting authority to assume some risks or responsibility, such as for power supply and energy costs for the use of electric NRMM. On urban construction sites with public utility grids, this should be feasible.

- Synergies in **Oslo**: In Oslo's Olav Vs Gate, part of the street redevelopment included fast-charging infrastructure for electric taxis. Thanks to early planning and coordination, this EV charging infrastructure could be used to partly power the construction machines.

Contract performance clauses In order to maximise learning from the pilot and ensure compliance of the contractor, the contracting authority should include the relevant contract performance clauses to ensure access to data (e.g. on fuel or power use and operational hours) and access to the construction site for monitoring of machine use and conduct.

Monitoring environmental performance

Monitoring procedure

Currently, the pilots from the working group are collecting the following information:

- operational hours
- electricity consumption, metered at the site
- fuel consumption (in the case of mixed machine types on-site or use of biofuels)
- qualitative feedback from machine operators

Further, municipal project managers reserve the right to drop in on the site to monitor machine performance and observe site working conditions, or do so in regular (e.g. monthly) project management meetings. Monitoring systems for pilots are still being developed and adapted as learnings emerge, though all contracting authorities concur that careful evaluation of initial projects is key to better understand and optimise emission-free sites going forward.

Calculating carbon footprints

So far, carbon impacts of the presented pilots have been calculated using a top-down approach using baseline values for diesel consumption of conventional NRMM to calculate equivalent avoided CO_2e. The carbon intensity of the electricity powering the machines will greatly affect the overall environmental impact. Though not put in practice by any working group participants, an alternative, bottom-up approach would be to monitor on-site air quality and/ or sum each machine's emissions. This may be problematic as several other uncontrollable and non-attributable factors also influence local air quality - such as nearby traffic and weather conditions. Further, localised emissions calculations would implicate additional human resources and monitoring equipment.

4. Remaining challenges to overcome

The launch of the first zero-emission construction site in the world is certainly exciting - but it marks only the beginning of the transition to clean construction. To transition from pilots to emission-free as standard practice on European construction sites, the following barriers must be addressed:

- The principal obstacle to the take-off of zero-emission construction sites is the currently very limited availability of large electric NRMM and yet unknown potential of hydrogen. This causes high prices for equipment and more risk in planning and project management.
- Market actors depend upon predictable demand in order to invest in green innovation. To address this, procurers can link their purchasing strategy to a construction emission transition timeline, in line with the relevant climate action and carbon targets.
- Sustainability of power supply is key for a good business case. Power supply must be a priority and well-considered before selection of a pilot site. Research shows that in the case of coal-powered electricity, emissions resulting from electrified machinery would be even higher than conventional diesel equipment.
- Charging infrastructure requires cross-sectoral collaboration, and may compete as a priority with other renewable electricity system upgrades (e.g. district energy and stable residential supply). This may be increasingly less of a problem as EV charging infrastructure becomes more extensive, and renewable solutions decentralise supply.
- Capacity building of the construction workforce is needed for contractors to operate new machines - for example, for planning on-site logistics with consideration of charging cables and timetables.
- There is a need for an optimised on-site data collection methodology and benchmarking framework to evaluate the performance and success of such sites. Though there are limited LCA studies on certain machine models, the proof of business case is not fully developed yet, and therefore conclusive documentation of pilot cases is crucial.

5. Outlook for Zero-Emission Construction

Zero-emissions construction sites may have seemed unattainable just a few years ago, but the market is moving very fast to make the necessary innovations. The transition is gathering speed, with daring cities doubling down on demands for clean and carbon-free construction. Knowledge exchange platforms such as the Big Buyers Initiative build capacity of public procurers to strategically leverage their purchasing power for innovation and sustainability. Nonetheless, construction is an infamously conservative sector, and the change in market supply relies on a stable and sizable demand.

The cities of the Zero-Emission Construction Sites working group call on other contracting authorities to commit to action on reducing emissions and cleaning up construction sites, as only with aggregated and committed demand can the necessary market innovation be accelerated. As described above, multi-level governance to support this transition will necessitate strong political support and dedicated financing to get pilots off the ground and thereafter normalise the approach across an organisation. To pave the way for others to follow suit, knowledge transfer mechanisms and capacity building can leverage the strategic purchasing power of public authorities. Finally, EU-level regulation on carbon emissions from construction machinery would undoubtedly accelerate market innovation and extend uptake of emission-free NRMM solutions.

Get in touch!

For more information on the Big Buyers Initiative, visit:

https://sustainable-procurement.org/big-buyers-initiative

For further inquiries, contact Kaitlyn Dietz, ICLEI Europe - kaitlyn.dietz@iclei.org

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Further resources

Factsheets with key arguments for zero-emission construction targeting (1) Policymakers, (2) Market actors and (3) Citizens can be found on the Big Buyers Initiative website: https://sustainable-procurement.org/big-buyers-initiative

Emission-free NRMM Database - Bellona Foundation

Climate and environmental requirements for the City of Oslo's construction sites - City of Oslo

Perspectives on Zero-emission Construction - Climate Agency, City of Oslo

Reports on the status of zero-emission construction in Europe - Bellona Foundation

Scandinavian Green Public Procurement Alliance on Non-road Mobile Machinery: Lessons Learned Report - SGPPA

Early Market Dialogue Guidance for Innovative Procurements of Non-Road Mobile Machinery (NRMMs)
- E-ZEMCONs: NTNU, Climate-KIC