

Chapter 15

The Role of Public Sector Buyers: Influencing Systemic Change in the Construction Sector



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Abstract Construction machinery is essential to all construction projects and is also a significant contributor to both air pollution and greenhouse gas (GHG) emissions. The Non-Road Mobile Machinery Market (NRMM), otherwise known as the construction machinery market, largely operates using diesel fuel nowadays which has significant negative environmental impacts. It is critical that governmental leaders push suppliers to innovate and implement sustainable solutions in the construction sector. Green Public Procurement (GPP) and Innovation Orientated Public Procurement (IOPP) have emerged as potentially powerful instruments to drive green innovation by providing ‘lead markets’ for new technologies. City municipalities, regions, nations, and supranational government structures such as the European Union (EU) are starting to use public purchasing to achieve cleaner construction and Zero Emission Construction Sites (ZEMCONs). Early Market Dialogues (EMD) prior to the release of procurement documents can be an effective tool for achieving innovative solutions and for creating positive buyer and supplier collaboration. This case illustrates how the CapSEM Model and toolbox can operate from a top-down approach, initiating collaborative approaches amongst multiple actors, across multiple CapSEM Levels.

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15.1 Introduction

A Zero Emission Construction Site (ZEMCON) is one where construction activities are carried out exclusively with zero-emission construction machinery or equipment, and all transport of goods and people to and from the site use zero emission vehicles (Bellona 2019). There is great potential for reducing greenhouse gas (GHG) emissions, air pollution and noise pollution from construction sites by switching to zero emission alternatives such as electricity, hydrogen, or non-fossil fuels (World Green Building Council (WGBC) 2019). Non-road mobile machinery (NRMM) is defined as “any mobile machine, transportable equipment, or vehicle with or without bodywork or wheels, not intended for the transport of passengers or goods on roads...” (European Regulation (EU) 2016/1628 – NRMM).

15.2 The Construction Sector: Negative Environmental Impacts and Challenges

The global construction sector is responsible for nearly 40% of energy and process related emissions and 23% of the world’s GHG emissions across the construction supply chain (Huang et.al. 2018). Furthermore, 5.5% of these GHG emissions are created by the combustion of fossil fuel powering machinery and equipment on construction sites (Huang et.al. 2018). Continuing business as usual in the construction sector which relies on carbon-intensive machinery and materials, threatens to put the world on a fast track towards a global temperature rise of 3 °C or more (UN Environment Programme 2019). It is therefore, critical for the construction industry to accelerate the speed of decarbonisation to achieve the Paris Agreement and the UN Sustainable Development Goals.

While the European Commission has regulated NRMMs since 1997, GHG emissions have not been included (European Regulation (EU) 2016/1628 – NRMM). Presently, regulations only address carbon monoxide (CO), total hydrocarbons (HC), nitrogen oxides (NO_x) and particulate matter (PM), ignoring the impact of CO₂ emissions. Regulatory change is needed at the systems level (CapSEM Level 4).

There are also several barriers to achieving a ZEMCON. This includes (but is not limited to), high initial investment costs for fossil-free machinery, adequate electricity infrastructure availability at construction sites, and lack of technical knowledge on both the supply and demand side of the construction market (Bellona 2019). With that said, the opportunity for substantial climate gains by cities when switching to fossil-free and zero emission technologies far outweighs the costs.

15.2.1 Opportunities: Functional Buyer-Supplier Ecosystem for Green Public Procurement

The European Commission (2008:4) defines GPP activity as: “A process in which public entities want to procure goods, services, and labor with a reduced environmental footprint throughout the life cycle compared to those goods, services, and labor with the same primary function as they would otherwise purchase”. Typically, GPP will include environmental requirements and criteria, and this is what differentiates it from traditional procurement (Cheng et al. 2018; European Commission 2016; Igarashi et al. 2015; Varnäs et al. 2009). When utilising GPP, public actors can improve their environmental performance in low-/ zero-emission solutions for construction sites, while encouraging their suppliers to also improve (Varnäs et al. 2009).

Municipalities own a significant proportion of infrastructure and building projects and can leveraging their public sector purchasing power using GPP. An innovative public procurement process will necessitate a higher degree of collaboration between suppliers and customers than traditional procurement (Edquist and Zabala-Iturriagoitia 2012). Transitioning from traditional construction machinery to fossil-free or zero-emission solutions requires a collaborative approach amongst actors across CapSEM Levels. Establishing a functional buyer-supplier Ecosystem for Zero Emission Construction Sites (EZEMCON) can help the mobilization of the market towards delivering a ZEMCON. Such an ecosystem includes actors at every CapSEM Level.

- Level 4: the public buyers and governmental leaders
- Level 3: the construction companies and developers
- Level 2: subcontractors and equipment suppliers
- Level 1: the construction site itself

15.2.2 Framework for Innovation Oriented Public Procurement (IOPP)

As indicated already, public procurement is “a powerful tool for spending public money in an efficient, sustainable and strategic manner” (European Commission 2017). It is seen as a strategic policy instrument to (1) enable investment in the real economy, (2) stimulate demand to increase competitiveness based on innovation and digitalization, (3) support the transition to a resource-efficient, energy-efficient and circular economy, and (4) foster sustainable economic development and more equal, inclusive societies (European Commission 2017).

As Lember et al. (2014) highlight, innovation and public procurement may be related to each other in different ways. Public procurement can be understood as a tool to stimulate innovation by targeting a new product or service, or it also refers to

activities that aims to induce innovation possibilities by creating innovation-conducive environments to stimulate learning, e.g., pre-commercial procurement (Lember et al. 2014). In this case, we adopt the definition of Innovation Orientated Public Procurement (IOPP) by Lember et al. (2014) that includes both above-mentioned approaches, which emphasize that the public sector uses its purchasing power to act as an early adopter of innovative solutions that do not exist in the market or are not yet available on a large scale commercial basis.

15.2.3 Innovation-Oriented Public Procurement: Framework and Dialogue

There are four different policy modes in which innovation-oriented public procurement (IOPP) can be applied; each IOPP mode has distinct goals and means, institutional and policy-capacity requirements and, consequently, distinctive challenges (Lember et al. 2014).

The most influential mode of IOPP *is to use it as a technology procurement policy*. By applying its monopolistic power, public procurement can guide the technology development and innovation by indirect mild policy intervention or frequent strong intervention to create and diffuse new technology. The development of new technological solutions can also have innovation and economic spill-over effects to other industries. IOPP can also be used *as R & D policy* when it targets radical innovation with high-level R & D work to meet specific public demand. In EU, this is mostly implemented with pre-commercial public procurement. Utilising IOPP *as a generic innovation policy* has been gaining a lot of attention since 2000s. It focuses on creating an innovation-friendly public procurement culture to support innovation. Many procurement practices and tools have been developed and adopted, such as applying performance/environmental specifications, competitive dialogue, and market dialogue. The last mode of IOPP is to apply it as *“no policy” policy*. This mode is often chosen unconsciously because the public authorities are not aware of the alternatives. It can also be chosen because some governments assume the public funds should be spent in the safest way, and that innovation is linked with high risk.

Table 16.1 illustrates how different IOPP models can be adopted in the CapSEM Model to facilitate Ecosystem for Zero Emission Construction Sites (EZEMCONs). At CapSEM Level 4, IOPP can be used by cross-national networks, national, and cities by adopting a technology procurement policy to drive technological innovation. IOPP can also operate as a generic innovation policy that uses dialogue to align expectations and strengthen mutual insights between the public buyers and suppliers, at CapSEM Levels 3 and 4, respectively. At CapSEM level 3, IOPP can be applied generically to align emission targets (national or city level) and procurement specifications for a specific construction project.

15.2.4 Early Market Dialogue for Innovation-Oriented Public Procurement

Early Market Dialogue (EMD) is a tool for achieving innovative procurement as described above, and it refers to the range of activities through which a procuring entity or public buyer at CapSEM Level 4 engages with potential suppliers at Level 3, before procurement documents are released. The national program for Innovative procurement in Norway (Innovative anskaffelser 2020), identifies that EMD is an important way of enhancing market's knowledge and it should be mutually beneficial. Public buyers can use dialogue prior to procurement to increase predictability for the construction machinery market. This can give market actors the confidence to invest in more sustainable products and construction methods, to bring solutions to scale. Dialogue process can stimulate market interest among, and competition between potential suppliers which will improve the outcomes of a subsequent competitive procurement process (Watt 2018). In Table 15.1, typical dialogue participants engaging in innovation-oriented public procurement (IOPP) for a ZEMCON have been identified.

15.3 Implementation at Global, Regional, National, and City Levels

This section illustrates key projects at the global, regional, national, and city level respectively which aim to create an Ecosystem for Zero Emission Construction Sites (EZEMCONs) for cleaner construction practices.

15.3.1 Global Action and Joint Initiatives by Cities: Members of ICLEI and C40

C40 Cities Climate Leadership Group is a network of mayors of nearly 100 world-leading cities collaborating to deliver the urgent action needed to confront the climate crisis. ICLEI Local Governments for Sustainability is a global network of more than 2500 local and regional governments committed to sustainable urban development. These two organizations work very closely for the development of ZEMCONs and adaptation of NRMM to fossil free. In October 2019, at the C40 Mayors' Summit in Copenhagen, a common political declaration known as the 'C40's Clean Construction Declaration', was made. There were three targets, including the reduction of embodied emissions from new builds, from infrastructure, and procuring using zero emission construction machinery from 2025. Specifically, the declaration demands zero emission construction machinery by the signature cities (Budapest, Los Angeles, Mexico City, Oslo, San Francisco) projects from 2025, and zero emission construction sites city-wide by 2030, where available.

Table 15.1 Application of IOPP modes for ZEMCON in the CapSEM Model

CapSEM level	IOPP level	Dominant IOPP policy approach (Lember et al. 2014)	Typical dialogue participants	Example project actors in IOPP for ZEMCONs
Level 4	Cross-national, network of large cities	IOPP as technology policy – Driving the development of electrical NRMM	Large, global NRMM manufacturers, facilitating third parties (EU), network of large buyers (cities)	C40 mayors' commitment to actions for clean construction; ICLEI and EUROCITIES, big buyers initiative (BBI), Scandinavian green public procurement Alliance (SGPPA) on NRMMs
	National driven by large cities	IOPP as generic innovation policy, technology policy or R & D policy – Using dialogue to align expectations and strengthen mutual insights	Large city, additional (smaller) cities, national third party, construction firms, other regional ecosystem members	Finnish green deal with a commitment on emission free construction sites
	City level	IOPP as generic innovation policy – Aligning local ecosystem members, both internally and externally for a range of projects or more in general	Individual city, internal stakeholders, local construction firms, national third party, regional ecosystem members, e.g. electricity providers	Oslo, Copenhagen, Helsinki, Trondheim, Budapest and Amsterdam, among others.
Level 3	Project level	IOPP as generic policy – Aligning emission targets and procurement specifications for a specific construction project	Individual city, primarily procurement and EM advisors, local supply network (construction firms, subcontractors)	Omsorgsbygg, Volvo, Caterpillar, and Hitachi construction machinery, among others.

This is an example of a top-down approach from governmental leaders at CapSEM Level 4 which in turn places pressure on lower levels.

15.3.2 *Regional Action: Scandinavian Green Public Procurement Alliance (SGPPA) and Big Buyers Initiative (BBI)*

The Scandinavian Green Public Procurement Alliance project (SGPPA 2020) operating between 2016 and 2019 is an example of cross border joint procurement partnership between the City of Copenhagen, Oslo, and Stockholm, and was funded by

the Carbon Neutral Cities Alliance. A key outcome of the alliance was the establishment of a Dynamic Purchasing System (DPS) which facilitated the possibility for the cities of Oslo and Copenhagen to purchase machines in the future that are not available currently.¹ DPS is an innovative procuring procedure that typically spans several years and operates in this case to signal to the businesses on Level 3 of the CapSEM Model, the growing demand for emission free machines. The City of Oslo and Copenhagen continue to collaborate and operate the cross-border DPS of NRMMS via a web-based platform managed by Merzell.

The Big Buyers Initiative (BBI) is a European Commission programme for encouraging collaboration between big public buyers (cities at CapSEM Level 4) and the construction market (at CapSEM Level 3). The initial project was conducted between 2018 and 2020, with a second phase between 2021 and 2022 based on its success. One of the three established working groups focuses on ZEMCONs with city members from Europe, including Amsterdam, Brussels, Budapest, Copenhagen, Helsinki, Lisbon, Oslo, Trondheim, and Vienna. The multi-city collaboration brought about innovative partnerships and increased political will to transition to cleaner construction machinery through using EMD. Such regional projects allow engaged cities to test procurement procedures such as DPS and environmental award criteria in a coordinated and targeted manner across public construction projects, with mutual learnings.

15.3.3 National Action: Finland Targeting Emissions in the Construction Sector

In Finland, the national government is placing top-down pressure on its cities through legislation drafted which obligates local governments to draw up climate plans for low-carbon procurement in a bid to move closer to fossil free construction sites (HENRY project 2020). The Finnish government has anchored this top-down initiative to the EU Green Deal agreement for sustainable procurement (2022).

15.3.4 City Action: Oslo Leads Climate Action for Clean Construction Sites

The city of Oslo took a lead role in setting ambitious demands on potential suppliers and infrastructure providers well before large electric construction machines were commercially available (DNV GL 2019). Fossil-free (biofuels) construction sites have been the minimum requirement for public projects by Oslo municipality since

¹ Due to legal and administrative differences between the countries it was not possible for the City of Stockholm to join the final procurement process.

2017 (DNV GL Rapport 2018). The city has now set requirements that all suppliers must use emission-free construction machinery by 2025 (Klimakur 2030, 2020/2022). To achieve this, the municipality utilises allocation criteria that rewards suppliers who can deliver emission-free and biogas-powered solutions. Additionally, the municipality requires that all vehicles used for the transport of masses and waste must be fossil-free and that heating and drying of the construction site must be emission-free. 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 (Moore 2020). The application of IOPP and EMD for innovative GPP and applying significant weight on environmental award criterion for construction contract has underpinned success.

15.4 Discussion

Historically the CapSEM Model works according to a bottom-up approach (Fet and Knudson 2021), starting with improvements in production activities and their environmental impacts at Level 1, the production processes, and at Level 2, the products, and their value chains. Transition to higher levels then happens with implementation and improvements in management systems and sustainability monitoring at the organizational Level 3, and at the larger systems Level 4 with a diversity of actors. The CapSEM Model focuses on environmental aspects, and in the case of ZEMCONs, at the highest level, social aspects are incorporated, such as the well-being of construction workers and communities.

For the case presented here, rather than applying lower level CapSEM tools to facilitate moving to higher levels, we are demonstrating a top-down approach using tools available at higher levels such as policy programmes and regulations to bring about systemic change.

15.4.1 *Top-Down Systemic Change and the CapSEM Toolbox*

To achieve a ZEMCON, decision makers, such as construction firms and machinery producers focus influence on Level 2 and 1 to implement Cleaner Production (CP). Starting at the highest CapSEM Level 4, government leaders and public buyers can implement systems-related changes by applying principles of systems engineering (SE) as a ‘process’ (see Chap. 12). In the construction machinery market, it is important to facilitate the integration of different actors’ views, environmental perspectives, business strategies and organization management for improved environmental performance. SE operates by establishing a functional ecosystem for the ZEMCON. Within this EZEMCON, frameworks such as IOPP, and practical tools such as early market dialogue (EMD) and GPP help align expectations and

strengthen common knowledge across Level 3 and 4 of the CapSEM Model. This in turn sets the foundation for sustainable development in a long-term perspective.

Policy programmes for cleaner construction sites and regulations help to set goals for the larger societal system at the city or national level for example. Environmentally weighted criteria in GPP (created at level 4 and together in dialogue with Level 3) can be used to implement changes for more sustainable supply chain management (SCM) down-stream in the construction value chain (Level 2) as well as design for environment (DFE). Leaders and public buyers can instruct their pre-tender customers on Level 3 (such as Volvo or site a developer) to establish, transparent reporting, organizational routines such as implementing environmental management systems (EMS) (ISO 2015) and doing environmental performance evaluations (EPE) (ISO 2021). Adoption at organisational Level (3) of key performance indicators (KPIs) or certification schemes will help govern the construction market production processes and product value chains for NRMMs at the lower levels. Furthermore, at Level 3 the construction firm can influence its' subcontractors and equipment suppliers (Level 2) down the value chain, by requiring that the supplier produce environmental product declarations (EPDs) for the development of NRMMs and its component products. Pressure from the upper levels forces cleaner production (CP) at the construction site itself (Level 1).

15.4.2 Linkages to Lower CapSEM Levels and Tools

A valuable information feedback loop takes place when community leaders at higher CapSEM Levels learn from, and amend, policy and strategies according to knowledge gained about environmental performance at lower CapSEM Levels. Knowledge about individual construction sites' GHG emissions is gained by using input/output (I/O) tools and cleaner production (CP) practice which monitor the environmental impacts during production and manufacturing processes at Level 1. Information gained by using tools such as Life Cycle Analysis (LCA) at Level 2 for a NRMM and its component parts helps organisations such as Hitachi Construction Machinery (at Level 3) and the municipality buyer (at Level 4) make informed decisions. Ultimately the community at Level 4 is held accountable through use of analytical models for measuring the material flows (MFA) on construction sites.

15.5 Concluding Remarks

When public buyers, cities and nations, follow the top-down CapSEM Model approach, they adopt the role of *change maker* in a larger system. Zero-emission solutions are already available on the European market for smaller NRMMs, however greater demand is needed to accelerate innovation, especially for larger heavy machines.

This case illustrates how the CapSEM Model supports a collaborative approach across actors within multiple CapSEM Levels. At community level (Level 4), strong political support and dedicated financing for ZEMCON pilots is required. Early market dialogue (EMD) across Levels 3 and 4 can help knowledge transfer mechanisms and capacity building for ZEMCONS. Leveraging the strategic purchasing power of public authorities and other top-down demand initiatives such as EU-level regulation on carbon emissions from construction machinery can accelerate market innovation and extend uptake of emission-free NRMM solutions. Multi-actor dialogues together with a commitment from both public and private actors to decarbonisation is essential.

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