How much does Green Public Procurement (GPP) cost in practice?

An Economic Assessment for Climate-Neutrality in Public Purchasing

Executive Summary

Green Public Procurement (GPP) has recently stepped into the spotlight at EU and member state level due to its powerful potential for decarbonizing the construction industry and for accelerating the green industrial transition in several other sectors at very little cost. In essence, GPP can help create green lead markets for climate technologies that generate large numbers of jobs and prosperity, while leveraging private investments. Our research finds that climate neutral GPP is highly cost-effective: achieving net zero is estimated to increase the public bill by only 3-6%. Even in the carbon heavy construction sector the total project cost would increase by only 5-7%.

Let's look at some concrete case studies: The Hochmoselbrücke in Rhineland-Palatinate, Germany's second highest bridge, cost around €175 million. Even with a conservative calculation (based on a high green premium, i.e., the price difference between a clean product and a conventional one that emits more CO_{2eq}) the overall cost increase would be about only 5% if the federal government had opted for green cement and steel in the construction (ca. 2.5% in the optimistic scenario). The case of the European School in Munich demonstrates an even smaller difference with about €1.5 million (2%) under a conservative assumption and just €1 million (1%) in the optimistic scenario.

Another case study in the transportation sector shows similar effects; the purchase of electric firetrucks or police cars currently features higher investment costs – however, due to significant fuel savings, the upfront costs can be recouped within five years, making the e-firetruck and the e-police car cheaper over their 20-year-lifetime in comparison with traditional models.

To lower these values even more, decreasing the green premium is crucial. GPP itself and other green lead market frameworks can be highly valuable as they decrease costs by catalyzing climate innovation. Also, entry barriers for startups need to be lowered to spur competition within public tenders. Lastly, a rapid implementation of GPP (with a clear focus on CO_{2eq}) across all levels of government is necessary. Lawmakers and authorities should in addition consider suitable communication strategies and practice guidelines to support the implementation.

1. Introduction

Green Public Procurement (GPP) is a key measure to stimulate the market demand for carbon neutral products and thus to accelerate the transition to a net zero economy. It can support an early scale-up of climate technologies and de-risk private investments into such solutions. The policy paper *"Green Public Procurement – Stimulating climate-neutral demand for a competitive EU net zero economy: A case study of Germany"*[1] by the Tech for Net Zero Alliance highlights the strong relevance of GPP as an effective instrument within the race to net zero.

In Germany, public procurement corresponds to roughly 13 percent of its GDP, a sum of contracts worth around €500 billion[2] awarded by federal government, state authorities as well as municipalities. It does not only contribute to a significant share of public budget but also greenhouse gas emissions, given that many contracts are awarded in carbon heavy sectors such as construction and transportation. For example, carbon emissions from the construction and use of buildings are responsible for more than 30% of all emissions in Germany. On a global level, public procurement of goods and services contributes to about 15% of greenhouse gas emissions. Consequently, "greening" public procurement becomes increasingly relevant to cutting emissions.

Since the definition of GPP varies and may consider different elements of ecological sustainability, the following analyses focus on greenhouse gas emissions as the main purchasing criteria within GPP frameworks. The overarching idea is that public authorities that put the reduction of CO_{2eq} on top of their agenda when implementing GPP frameworks will make the greatest contribution to reaching climate targets.

However, climate policy is only one – despite being a crucial – aspect of public agencies' considerations when it comes to awarding public projects and purchasing goods and services. Still, the sole monetary factor of purchasing price is usually decisive as public budgets are both under fiscal pressure and public attention. The purpose of this report is to examine the economic aspects of climate-neutral public procurement to evaluate the monetary difference in comparison with traditional procurement.

[1] German Energy Agency (ed.) (dena, 2023) "Tech for Net Zero Alliance: Green Public Procurement: Climate-neutral procurement by federal, state and local authorities". URL: https://techfornetzero.org/wp-content/uploads/2023/03/Tech-for-Net-Zero-2023-Green-Public-Procurement-Policy-Paper.pdf

[2] Fischer, A., Küper, M., Green Public Procurement. Potenziale einer nachhaltigen Beschaffung (2021).

2. Literature Review

Given the importance of GPP in reducing greenhouse gas emissions, there is a growing body of research on the additional costs that governments incur when they opt for green procurement. An analysis by the World Economic Forum (WEF)[3] estimates that about 40% of all public procurement-related emissions can be avoided at a cost of less than $15/ ton of CO_{2eq}, while another 35% can be reduced at a cost between $15-$100/ton of CO_{2eq}. Although procurement costs for governments will increase, achieving net zero emissions is estimated to increase the bill by only 3-6%. Looking more closely at construction and transportation, abatement costs in construction are at the low end of the industries studied, while transportation is at the high end.

2.1 Construction

Steel and cement are two important components of most construction projects, and both fall into the category of hard-to-decarbonize materials contributing 7% (Iron and steel) and 5% to global CO_{2eq} emissions respectively[4]. Alternatives to the emission-intensive conventional production processes are still several years away from large-scale deployment. In the case of steel, the use of Direct Reduced Iron (DRI) in an Electric Arc Furnace (EAF). As there are different emissions sources for cement – the basic chemical reaction and process heating – there is also a wider range of decarbonization pathways such as utilizing non-carbonate calcium sources as a replacement for limestone, electrification of the heating process, or carbon capture utilization and storage.

In this paper the application of Carbon Capture and Storage (CCS) is used to estimate the green premium as it can cover emissions from both major sources. Several studies have estimated the green premium of low emission steel and cement, for steel the green premium is $120-$215 (15 to 30%) per ton produced, while the range for cement is $95-$175 (75 to 140%)[5] per ton using CCS. However, for cement there are also promising trials generating pure streams of CO_2 reducing the costs for CCS and thereby

[3] World Economic Forum in collaboration with Boston Consulting Group and Mission Possible, Green Public Procurement: Catalysing the Net-Zero Economy (January 2022). URL: https://www3.weforum.org/docs/WEF_Green_Public_Procurement_2022.pdf

[4] Azevedo, M., Moore, A., van den Heuvel, C., & van Hoey, M., Capturing the green-premium value from sustainable materials (2022). URL: https://www.mckinsey.com/industries/metals-and-mining/our-insights/capturing-the-green-premium-value-from-sustainable-materials#/

[5] Breakthrough Energy, Where to innovate first: The Green Premium. URL: https://breakthroughenergy.org/our-approach/the-green-premium/

the green premium to around $40[6]. Using a construction project as an example the WEF[7] calculated that if the cost of steel and cement increased by 50%, the cost of a building would increase by 5-7%. This is due to the fact that material costs are only responsible for a small share of overall project costs, so the impact on the end-consumer turns out to be minor. Similarly, Mission Possible[8] calculated the extra cost to consumers from using green cement for a house and from using green steel in a car and found this to be around 3% for the former and 1% for the latter.

Using Germany as an example, a study by the *Institut für Deutsche Wirtschaft*[9] examined the additional costs to the public sector of procuring green steel. The paper assumed a share of green hydrogen in the DRI-process and a quota for this type of green steel in public projects. The study found that steelmaking using DRI with 10% green hydrogen and a quota of 5% green steel for all construction projects in 2025 would result in an additional cost to the public sector of €18 million, while avoiding more than 150,000 tons of CO_2. Given a 30% quota for green steel procured and a 50% share of hydrogen in 2030, the extra cost rises to €112 million for 1,2 million tons of CO_2 avoided. The extra cost for green steel used in the example ranged between €150-€200 (40 to 50%) per ton of steel and abatement cost in the two scenarios were 108 €/tCO2 (2025) and 97 €/tCO2 (2030) respectively.

Looking at cement, close to 29 million tons were used in Germany in 2021[10], the public sector being responsible for about 23% of this [11]. Applying a green premium of €100 per ton, Germany will face additional costs of about €670 million per year. Given Germany's cement footprint of 0.600 tCO_2/ per ton of cement[12] abatement costs sum up to €165 per ton of CO_2. It should be noted that most estimates for abatement costs are lower ($110-$130) as they also include cheaper forms of CO_2 reduction than CCS.

[6] IEA, ETP Clean Energy Technology Guide (2022). https://www.iea.org/data-and-statistics/data-tools/etp-clean-energy-technology-guide?selectedSector=Cement+and+concrete
[7] World Economic Forum in collaboration with Boston Consulting Group, Scaling Low-Carbon Design and Construction with Concrete: Enabling the Path to Net-Zero for Buildings and Infrastructure (March 2023). URL: https://www3.weforum.org/docs/WEF_Scaling_Low_Carbon_Design_and_Construction_with_Concrete_2023.pdf
[8] Mission possible, Reaching net-zero carbon emissions from harder-to-abate sectors by mid-century (November 2018). URL: https://www.energy-transitions.org/wpcontent/uploads/2020/08/ETC_MissionPossible_FullReport.pdf
[9] Fischer, A., Küper, M., Green Public Procurement. Potenziale einer nachhaltigen Beschaffung (2021).
[10] Verein Deutscher Zementwerke, Hrsg. Zementindustrie im Überblick 2022/2023 (2022).
[11] WWF, Klimaschutz in der Beton und Zementindustrie Hintergrund und Handlungsoptionen (2019).
[12] Verein Deutscher Zementwerke, Hrsg. Dekarbonisierung von Zement und Beton – Minderungspfade und Handlungsstrategien (2020).

2.2 Transportation

Transportation accounts for 16% of global CO_{2eq} emissions, with road transport accounting for 12%[13]. Within Germany, 20% of all emissions stem from road vehicles[14]. Public authorities require a considerable number of vehicles making GPP an import tool to implement on the transport sector to help decarbonize it.

Electric vehicles (EV) are the most viable alternative to conventional fossil fuel-powered road vehicles and are readily available especially for passenger vehicles and public buses. Subsidies and federal funding are available to encourage their uptake in the public sector. For public buses, Germany is targeting 65% of all new buses to be emissions free by 2026. Currently, e-buses make up 3.6% of the 35,000 city buses in operation across the country[15]. E-buses can cost up to twice as much as their diesel counterparts, but up to 80% of the additional cost may be covered by the Federal Ministry for the Environment[16]. An e-bus can cost anywhere in the range of €600,000-€700,000, with subsidies covering €250,000 – €350,000 of the added upfront cost. While upfront costs for e-busses may be higher, studies have shown that, with lower maintenance costs and significant fuel savings, battery electric buses have the lowest life-time costs when compared to diesel buses and other alternatives[17]. A study from São Paulo revealed 9% lower lifetime costs from battery electric buses compared to diesel buses[18]. Additionally, E-buses operated in the United Kingdom, with a power mix comparable to Germany's, lead to 77% lower lifetime CO2 emissions compared to diesel buses[19]. These studies further confirm that E-buses are the ideal option both economically and environmentally.

The Berlin Fire Department has taken part in a pilot project with the Austrian Rosenbauer Group, the European market leader in firetrucks, where a hybrid electric fire truck was tested in their department[20].

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[13] Ritchie H., and Roser M., Our World in Data, Emissions by Sector (2020). URL: https://ourworldindata.org/emissions-by-sector#energy-electricity-heat-and-transport-73-2

[14] Abu-Nasr D., Bloomberg UK, Berlin's New Fleet of Electric Buses Can't Come Fast Enough (September 2022). URL: https://www.bloomberg.com/news/articles/2022-09-02/to-combat-carbon-berlin-bets-on-battery-powered-buses

[15] Sustainable Bus, 3,400 zero emission buses to be procured in Germany by 2025, PwC study shows (May 2022). URL: https://www.sustainable-bus.com/news/zero-emission-germany-pwc-e-bus-radar/

[16] Bus2Bus, E-buses: Manufacturers are delivering. URL: https://www.bus2bus.berlin/en/newsroom/e-buses-manufacturers-are-delivering/

[17] Tong, F., Hendrickson C., Biehler A., Jaramillo P., and Seki S. M., Life cycle ownership cost and environmental externality of alternative fuel options for transit buses (2017). URL: https://doi.org/10.1016/j.trd.2017.09.023.

[18] C40 Knowledge, How to shift your bus fleet to zero emission by procuring only electric buses, (November 2020). URL: https://www.c40knowledgehub.org/s/article/How-to-shift-your-bus-fleet-to-zero-emission-by-procuring-only-electric-buses?language=en_US

[19] Simpson R., On a charge - the economics of electric buses (July 2022). URL: https://assets.markallengroup.com//article-images/246924/On%20a%20charge.pdf

[20] Stangl-Kremser C., Electrically powered firefighting and rescue vehicle for the Berlin Fire Department (June 2021). URL: https://www.rosenbauer.com/blog/en/elhf-for-the-berlin-fire-department/

After the successful trial run where 90% of 1,400 deployments were performed electrically, and 10 metric tons of CO2 were saved, Berlin Fire Department purchased five more Rosenbauer RT trucks[21]. The Rosenbauer RT trucks start at a base cost of €820,000 and can increase to €1.1million after customization[22]. The cost of a conventional mid-range pumper fire truck ranges from €500,000 – €900,000[23,24]. The RT line falls within the upper price range of these pumper trucks.

3. Case Studies

The following case studies provide some examples of how GPP would affect the cost of different public infrastructure and mobility projects. While a life-cycle analysis is the standard method to assess GPP, the following cases concentrate on the material component of infrastructure projects. Extra costs from steel and cement are investigated in isolation as the respective green alternatives have very similar material characteristics compared to their fossil alternative. Therefore, the impact on emissions during the usage phase is very limited.

3.1 Construction

The Hochmoselbrücke in Rhineland-Palatinate is Germany's second highest bridge and crosses the valley of the Moselle. The bridge cost around €175 million and some 32,500 tons of steel and 14,000 tons of cement were used during construction[25]. Even with a conservative estimate – using the high end of the green premium above – of $215 (€195) for steel and $175 (€160) for cement the overall cost increase for the building is below 5%. This drops to only about 2.5% in the optimistic scenario ($120 for steel and $95 for cement).

The European School in Munich was built in 2018 and offers space for around 1,500 students. The total costs for the building were estimated to be around €78 million and about 2,220 tons of steel and 10,000 tons of cement were deployed. Looking at our conservative scenario the additional costs were about

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[21] Hoey I., Berlin Fire Department orders more electric vehicles from Rosenbauer (December 2022). URL: https://internationalfireandsafetyjournal.com/berlin-fire-department-orders-more-electric-vehicles-from-rosenbauer/

[22] Morris C., Los Angeles Fire Department unveils hybrid fire truck, (May 2022). UURL: https://chargedevs.com/newswire/los-angeles-fire-department-unveils-hybrid-fire-truck/

[23] Howmuchisit, How Much Does a Fire Truck Cost? (2022). URL: https://www.howmuchisit.org/fire-truck-cost/

[24] Firefighter Insider, How Much Do Fire Trucks Cost? Apparatus Types and Prices URL: https://firefighterinsider.com/fire-truck-engine-apparatus-cost/

[25] Süddeutsche Zeitung, Freie Fahrt hoch über der Mosel: Riesen-Brücke eröffnet, (November 2019). URL: https://www.sueddeutsche.de/wirtschaft/verkehr-zeltingen-rachtig-freie-fahrt-hoch-ueber-der-mosel-riesen-bruecke-eroeffnet-dpa.urn-newsml-dpa-com-20090101-191121-99-827212

€1.5 million (2%) while this drops to €1 million (1%) in the optimistic scenario. It can be concluded that in both cases, the use of green steel and cement does not represent a significant cost increase for the overall project while creating a significant positive market signal for green materials.

3.2. Transportation

The following case studies are performed on a mid-sized German town averaging 150,000 inhabitants that requires approximately 20 firetrucks and 50 police cars. Assuming medium pumper firetrucks cost an average €700,000, the Rosenbauer RT line will require an added €120,000, or 17%, upfront cost for the base model. Replacing all 20 firetrucks requires €2.4 million, or €240,000/year at a 2 trucks/year replacement rate. Annual fuel savings from the RT can amount to €24,000/year[26] and emission reduction potential is about 47 tCO2/year per truck compared to conventional diesel operated trucks. The upfront costs can be recouped within 5 years, making the e-firetruck cheaper over its 20-year lifetime.

A common type of police car in Germany is the VW golf which costs approximately €33,000. The fully electric VW hatch ID.3 is currently being used by police in Germany and costs €43,000, which requires an added 30% in upfront costs[27]. Replacing all 50 cars will require an added €500,000, or €50,000/year at a 5 car/year replacement rate. Annual fuel savings from the VW ID.3 can amount to approximately 4.5 tCO2/year and €2000/year. Based on fuel savings alone, the upfront costs of the ID.3 can be recouped within 5 years, however with subsidies that can cover up to 80% of upfront costs and additional maintenance costs savings will reduce the time further.

4. Conclusion

Cost-effective climate-neutral public procurement has a triple bottom-line. First, it reduces the government's direct carbon footprint. Second, increased demand spurs more innovation and competition, thus lowering costs for climate technologies (i.e., reducing the green premium). Third, climate-neutral public procurement can strengthen and prolong countries' hold on companies and innovators who are leading the world in climate tech R&D and commercialization.

Lastly, our analysis shows that the monetary difference between traditional public procurement (focusing on monetary costs as the main decision point) and climate-neutral procurement is much smaller than expected. Even under conservative estimations (with a higher green premium price for climate neutral products), the total cost increase for a typical project is a small percentage point. Given

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[26] Rosenbauer, Every revolution has its leader. URL: https://rosenbaueramerica.com/rosenbauer-revolutionary-technology/

[27] Volkswagen, URL: https://www.volkswagen.fr/fr/configurateur.html/__app/golf.app

the various benefits of adopting climate-neutral public procurement in authorities, especially its role as a catalyst for climate innovation and emission reduction, policymakers should promote a swift implementation within the different levels of government.

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Future Cleantech Architects is a climate innovation think thank that works on closing the remaining innovation gaps to reach net-zero emissions by 2050. To reach this objective, Future Cleantech Architects seeks to accelerate innovation in critical industries – such as cement, aviation or shipping – where sustainable solutions are still in very early stages.

Tech for Net Zero

The Tech for Net Zero Alliance is a network of leading climate tech start-ups, scale-ups and investors in Germany and the DACH region. To accelerate the scale-up of breakthrough climate technologies, the alliance focusses on expanding climate tech finance, stimulating market demand, and adopting an enabling regulatory environment.