INDUSTRIAL DEEP DECARBONISATION
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THE SCALE AND IMPACT OF GREEN PUBLIC PROCUREMENT OF STEEL AND CEMENT IN CANADA, GERMANY, THE UK, AND THE US

Ali Hasanbeigi, PhD
Adam Sibal, PhDc

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Executive summary

The decarbonization of heavy industries, particularly steel and cement, is critical to achieving global climate goals, as these two industries are responsible for approximately 18% of global CO_2 emissions. Governments have the opportunity to leverage their substantial purchasing power, especially in public procurement, to accelerate the shift toward low-carbon materials. This report, developed with support from UNIDO and the Industrial Deep Decarbonization Initiative (IDDI), assesses the scale of public procurement and the CO_2 emissions impact of pledge levels for Green Public Procurement (GPP) to the IDDI in four countries—Canada, Germany, the UK, and the US—on the decarbonization of the steel and cement industries (See Table 1 for description of each IDDI GPP pledge level).

Canada

Canada is producing 12.1 million tonnes (Mt) of steel and 15 Mt of cement annually. Public procurement accounts for 25% of steel and 26% of cement demand, representing a significant portion of the Canadian market. Under the IDDI GPP Pledge framework, adopting low-emission procurement policies could drastically reduce emissions. Under IDDI Level 3, public steel procurement emissions could decrease from 4.5 Mt CO_2/year in 2022 to 0.8 Mt/year CO_2 by 2050 (81% reduction), and cement procurement emissions could drop to 0.3 Mt CO_2 by 2050 (85% reduction). Achieving GPP Pledge Level 4—which requires near-zero emissions materials—will result in even lower emissions in 2050. This necessitates significant investment in technologies like hydrogen-based direct reduced iron (H2-DRI) steelmaking and CCUS for cement.

Germany

Germany, Europe's largest steel producer and a major cement consumer, presents a different scenario. Public procurement in Germany accounts for a smaller share—5% for steel and 23% for cement—due to a high private sector demand and relatively low public infrastructure investment. By adhering to GPP Pledge Level 3, the country could reduce public steel procurement emissions from 2.3 Mt CO_2 in 2022 to 0.4 Mt CO_2 by 2050 (83% reduction). Similarly, cement procurement emissions could drop from 3.8 Mt CO_2 in 2022 to 0.6 Mt CO_2 by 2050 (84% reduction). The GPP Pledge Level 4 would bring both industries closer to zero emissions by mid-century, although challenges related to technology deployment remain significant.

United Kingdom

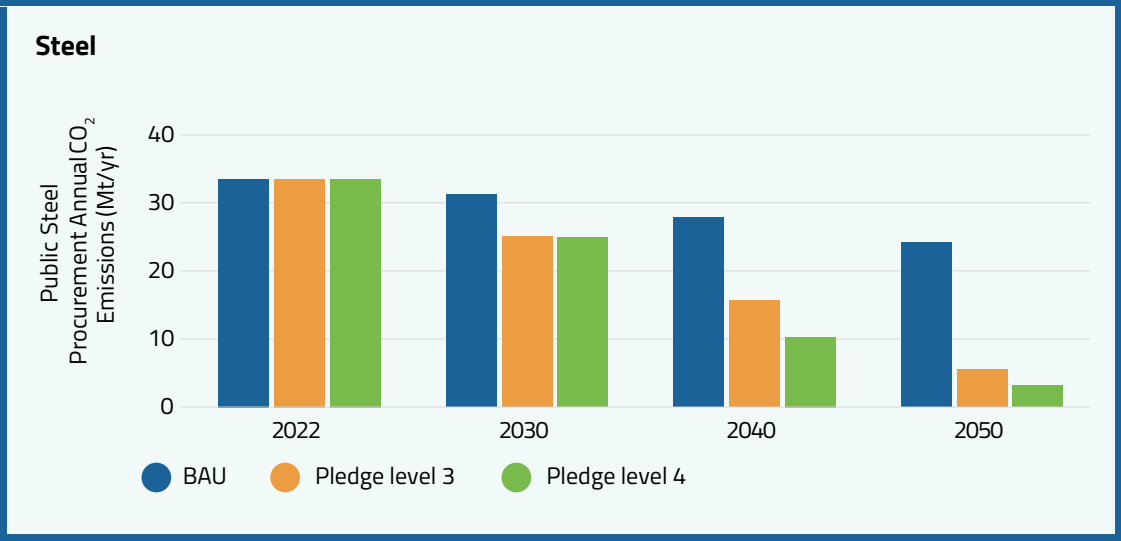
The UK is a smaller producer, with 6 Mt of steel and 8.4 Mt of cement produced annually. Public procurement covers 9% of steel and 24% of cement demand. Implementing GPP Pledge Level 3 policies could reduce emissions from public steel procurement from 1.3 Mt CO_2 in 2022 to 0.2 Mt CO_2/year by 2050 (83% reduction), while emissions from cement procurement could fall from 1.9 Mt CO_2 to 0.3 Mt CO_2/year by 2050 (84% reduction). The GPP Pledge Level 4 would bring the emissions even lower, but similar to other countries, technological and market constraints need to be addressed.

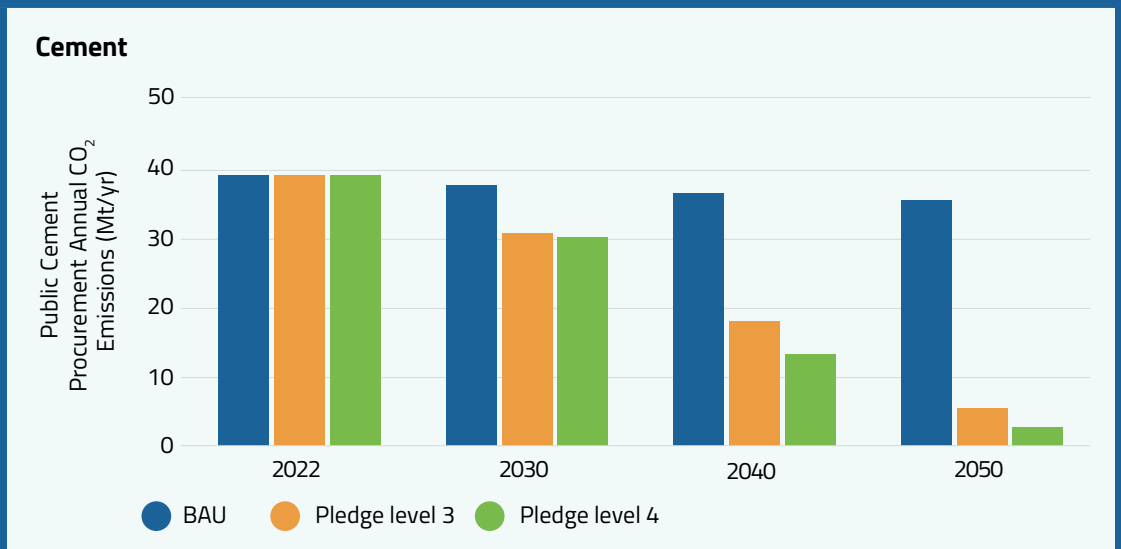
United States

The US is one of the largest steel and cement markets globally, and produced 80.5 Mt of steel and 93 Mt of cement in 2022. Public procurement represents 24% of steel demand and 35% of cement demand, making it a significant driver of decarbonization efforts. By adopting GPP Pledge Level 3, the US could lower public steel procurement emissions from 25 Mt CO_2 in 2022 to 4.7 Mt CO_2 by 2050 (81% reduction). Cement procurement emissions could also decrease from 30.6 Mt CO_2 in 2022 to 4.6 Mt CO_2 by 2050. Under GPP Pledge Level 4, both steel and cement could reach near-zero emissions by 2050 (85% reduction), but the transition will require accelerated investments in deep decarbonization technologies such as H2-DRI steelmaking and CCUS.

The combined CO_2 emissions impact in four countries studied associated with the BAU, and IDDI GPP Pledge Levels 3 and 4 scenarios for steel and cement are shown in Figure ES1. Implementing GPP Pledge Level 3 policies in these four countries could reduce emissions from public steel procurement from 33 Mt CO_2 in 2022 to 6 Mt CO_2/year by 2050 (81% reduction), while emissions from cement procurement could fall from 39 Mt CO_2 to 6 Mt CO_2/year by 2050 (85% reduction). The GPP Pledge Level 4 would bring the emissions to near zero.

Figure ES1. Combined annual CO_2 emissions related to public procurement of steel and cement under BAU and IDDI GPP Pledge Levels 3 and 4 in the four countries studied





Recommendations

1. **Set Clear Procurement Targets**: Governments should adopt clear, ambitious targets for low-carbon steel and cement procurement, aligning them with IDDI GPP pledges. These targets should reflect national circumstances while pushing the envelope toward decarbonization.
2. **Invest in Low-Carbon Technologies**: Meeting GPP Pledge Level 4 commitments will require substantial investment in technologies such as hydrogen-based steelmaking and CCUS for cement. Governments should allocate funds to incentivize the deployment of these technologies.
3. **Develop Transparent Tracking Systems**: Governments need to establish systems to track the embodied carbon in steel and cement used in public projects. Accurate, transparent tracking will ensure that procurement policies are having the desired effect on emissions.
4. **Collaboration Across Sectors**: Public-private partnerships will be essential to drive innovation and achieve economies of scale for low-carbon materials. Governments should foster collaboration between industries, policymakers, and technology developers to expedite the transition.
5. **Promote Consistency Across International Standards**: Given the international nature of the steel and cement markets, countries should work together to promote consistency across standards and certifications for low-carbon materials, making it easier for producers to meet global demand.

Through targeted action in procurement, technology investment, and collaboration, these four countries can lead the way in reducing industrial emissions and meeting global climate targets. By embracing the IDDI GPP pledges and committing to long-term strategies, governments can unlock significant CO_2 reductions while driving the market for low-carbon steel and cement.

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1. Introduction

The production of steel and cement are among the largest contributors to global CO_2 emissions, responsible for around 18% of global emissions—11% from steel and 7% from cement (Hasanbeigi & Sibal, 2023a,b). According to the International Energy Agency (IEA), both sectors are currently off track to meet the targets of the Paris Climate Agreement, which aims to limit global temperature rise to 1.5°C (International Energy Agency, 2023). To meet global climate goals, it is essential that carbon emissions from steel, cement, and concrete production are reduced by over 90% by 2050 (IDDI, 2023a).

Governments are major consumers of these carbon-intensive materials for large-scale infrastructure projects such as roads, railways, buildings, and public transport services. Public procurement in OECD countries accounts for an average of 12% of GDP, and in many developing countries, this figure can reach up to 30%. As a result, the adoption of Green Public Procurement (GPP) policies that prioritize low-carbon steel and cement could have a substantial impact on global emissions reductions. By leveraging their significant purchasing power, governments can drive markets towards more sustainable practices, minimizing the environmental impact of their procurement decisions and promoting social and environmental benefits (Hasanbeigi et al., 2019).

In response to the need for such action, the United Nations Industrial Development Organization (UNIDO) and the Clean Energy Ministerial launched the Industrial Deep Decarbonization Initiative (IDDI) in 2021. This initiative aims to stimulate demand for low-carbon industrial materials, particularly steel and cement, by collaborating with governments and the private sector to standardize carbon assessments, set procurement targets, and incentivize investment in low-carbon technologies. A key focus of the IDDI is on the critical role that public procurement can play in promoting decarbonized materials, with goals to establish standards, guidelines, and data systems to support this transition (UNIDO, 2024).

At the 28th United Nations Climate Change Conference (COP28), the governments of Canada, Germany, the United Kingdom, and the United States—all members of the IDDI—committed to setting ambitious, time-bound goals for the procurement of low-emission steel, cement, and concrete. These nations also pledged to establish emission reduction targets for entire project life cycles, aiming for net-zero emissions in public buildings and infrastructure. These commitments are part of the IDDI's Green Public Procurement Pledge (Table 1), which seeks to promote the production and use of low and near-zero emission materials (IDDI, 2023a).

In this report, we assess the potential CO_2 emissions reduction that Canada, Germany, the UK, and the US could achieve at different IDDI GPP Pledge Levels, as outlined in Table 1. To conduct this analysis, we first estimate the scale of public procurement in each country using publicly available data. We then analyzed the CO_2 intensity of domestically produced and imported steel and cement for each country to calculate the embodied carbon in steel and cement used in both public and private procurement. Using this information, we quantify the emissions reductions that could be realized under each IDDI GPP Pledge Level for Canada, Germany, the US and the UK. The report concludes with key findings, recommendations for government policies, and suggestions for improving data collection methods in each country to better support future decarbonization efforts.

Table 1. IDDI Pledge Levels and definitions (IDDI, 2024b)

Pledge Level	Commitment
Level 1	Starting no later than 2025, require disclosure of the embodied carbon in cement/concrete and steel procured for public construction projects.
Level 2	In addition to Level 1, starting no later than 2030, conduct whole project life cycle assessments for all public construction projects, and, by 2050, achieve net zero emissions in all public construction projects.
Level 3	In addition to Levels 1 and 2, starting no later than 2030, require procurement of low emission cement/concrete and steel in public construction projects, applying the highest ambition possible under national circumstances.
Level 4	In addition to Levels 1, 2, and 3, starting in 2030, require procurement of a share of cement and/or crude steel from near zero emission material production for signature projects.

2. Canada

2.1 The scale of Canada's government procurement of steel and cement/concrete

Canada is the world's 17th largest producer of crude steel, with annual production of around 12.1 million tonnes (Mt) in 2022. Canada consumes slightly more steel than it produces, with the total demand for finished steel products in 2022 at 13.5 Mt (World Steel Association, 2023). Canada is also a significant producer of cement, producing 15 Mt in 2022, with an estimated consumption of 13 Mt in 2020. Canada is a also significant exporter of cement to the US (Cement Association of Canada, 2023). Heavy industry, including the production of steel and cement, accounted for nearly 78 Mt of GHG emissions, or about 11% of the nation's total 708 Mt of GHG emissions in 2022. Of these emissions, the production of steel and cement accounted for 13 Mt (1.8%) and 11 Mt (1.5%) respectively (Environment and Climate Change Canada, 2024).

The Canadian government is the largest asset owner and public procurer in Canada (IDDI, 2023b). Previous analysis has shown that the Canadian public sector (i.e. federal, provincial, territorial, municipal, and aboriginal governments) procured 32% and 29% of Canada's cement/concrete and steel demand respectively in 2018 (Hasanbeigi et al., 2022). In recognition of the impact its procurement could have on reducing GHG emissions, the Canadian government joined IDDI in 2021 (Clean Energy Ministerial, 2021). Since then, the government has already introduced several measures regarding the GPP Pledge. Canada's Greening Government Strategy for the government's property and fleet operations has committed to reducing absolute Scope 1 and Scope 2 GHG emissions by 40% by 2025 and by at least 90% below 2005 levels by 2050. On this emissions reduction pathway, the government will aspire to reduce emissions by an additional 10% every 5 years starting in 2025.

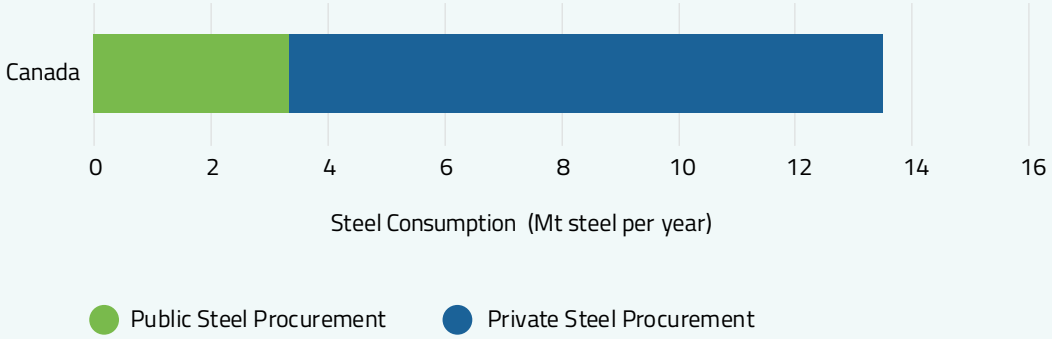
For materials like steel and concrete, this pledge incorporates the disclosure of embodied carbon in structural materials through environmental product declarations (EPDs), reducing the embodied carbon of structural materials by 30% starting in 2025, and conducting LCAs for entire assets by 2025 (Hasanbeigi & Sibal, 2023a). Additionally, through programs like the Net Zero Accelerator and Innovative Solutions Canada, the government supports long-term decarbonization of steel and cement sectors, which are projected to cut 8 million tonnes (Mt) of CO_2 emissions by 2030 (IDDI, 2023b).

This analysis provides updated estimates on the scale of Canada's public procurement of steel and cement/concrete based on the most recent Canadian Input-Output (I.O.) tables, covering the year 2020 (Statistics Canada, 2024). The I.O. tables released by Canada are detailed cataloging public and private spending across the Canadian economy. Within this dataset, the spending on various steel and cement/concrete products is detailed under construction spending on various infrastructure products (transportation engineering construction, electrical power engineering structures, residential and non-residential structures, etc.). Of these construction types, Canada's I.O. tables also provide details on the portion of the construction spending attributed to structures such as educational buildings, hospitals, and defense services (government-funded in Canada) and provide specific spending by the federal, provincial/territorial, local, and aboriginal governments. The process followed for specifically abstracting this updated information from the 2020 Canadian I.O. tables was first published by Hasanbeigi et al. in 2022, which used the most updated I.O. tables at the time for 2018 (Hasanbeigi et al., 2022).

2.1.1. Steel procurement in Canada

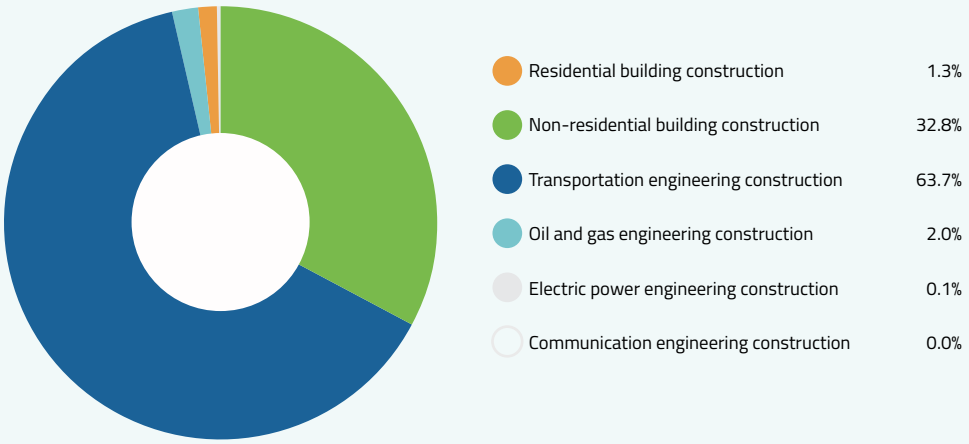
Analysis of Canada's 2020 I.O. tables indicates that the share of public procurement of steel fell slightly from 29% in 2018 to 25% in 2020, although it still accounted for approximately CAD 1.4 billion of total steel procurement in Canada. Assuming that the share of public procurement remained constant during 2020-2022, we estimate that in 2022 the Canadian public procurement totaled approximately 3.4 Mt of finished steel products, as reflected in Figure 2. Canada's private sector procured the remaining 10.1 Mt of Canada's total 13.5 Mt steel demand in 2022.

Figure 2. Canada's public and private procurement of steel in 2022
(This study is based on Statistics Canada, 2024 and worldsteel 2023)



Further analysis of public procurement of steel in Canada based on the I.O. table data indicates that nearly two-thirds (64%) go towards transportation construction projects. One-third of Canada's public steel procurement is used in non-residential construction (hospitals, schools, etc.), while very small portions go towards oil and gas production (2%), residential building construction (1.3%), and even smaller amounts for electrical power and communication construction, as shown in Figure 3.

Figure 3. Canadian public procurement of steel by major construction sector
(Our analysis based on Statistics Canada 2024)



Canada produced 12.1 Mt of steel in 2022, while the annual steel demand was 13.5 Mt. With Canada importing 9.4 Mt of steel in the same year, it is a net importer of steel (World Steel Association, 2023). Around 46% of Canada's steel production is via Electric Arc Furnace (EAF). The average CO_2 intensity of steelmaking in Canada in 2022 is estimated at 1,076 kg CO_2 per tonne of crude steel, based on the intensity values provided by Hasanbeigi (2022) and the share of EAF steelmaking.

Nine countries accounted for 88% of the steel Canada imported in 2022 (Figure 4). Using the amount of steel imported from each country and the rest of the world, along with the CO_2 intensity of steel produced in each country from Hasanbeigi (2022), we estimated the weighted average CO_2 intensity of the steel imported by Canada in 2022 to be 1,460 kg CO_2 per tonne of crude steel.

Using the CO_2 intensity of steel produced in Canada and the weighted average CO_2 intensity of steel imported by Canada in 2022, we calculated the weighted average CO_2 intensity of steel used in Canada in 2022 (1,337 kg CO_2 per tonne of crude steel). This calculation was based on the amount of imported steel and domestically produced steel used in Canada. This weighted average is utilized to estimate the emissions associated with steel procurement in Canada.

Figure 4. Canada import of steel mill products in 2022
(US Department of Commerce 2023a)

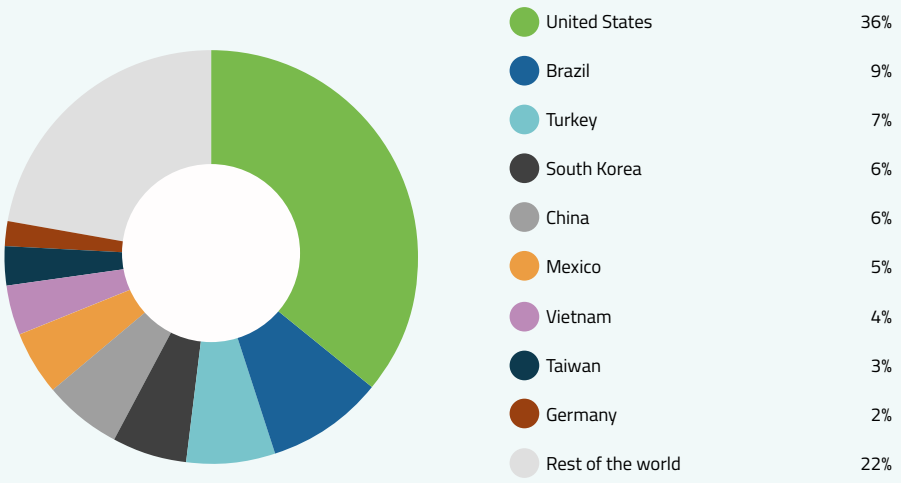
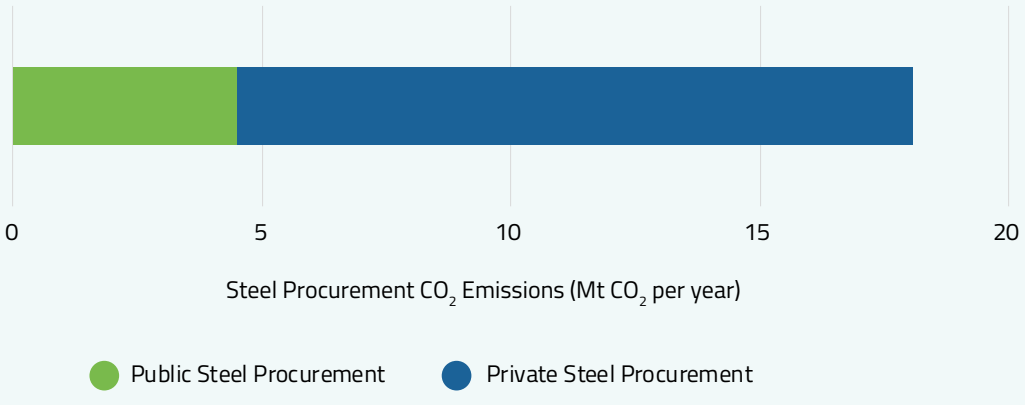


Figure 5 illustrates the annual CO_2 emissions associated with total steel demand in Canada totaling approximately 18 Mt CO_2/yr in 2022 where public procurement of steel is responsible for 4.5 Mt CO_2/yr with private sector steel procurement responsible for the other 13.5 Mt CO_2/yr.

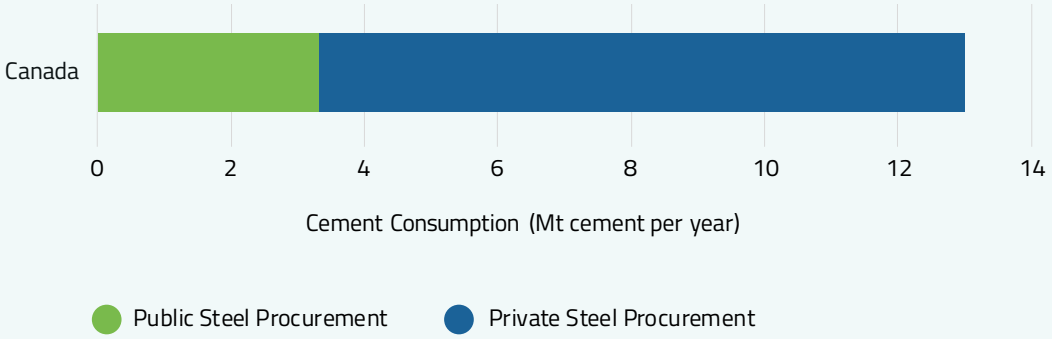
Figure 5. Annual CO_2 emissions from public and private procurement of steel in Canada in 2022



2.1.2. Cement and concrete procurement in Canada

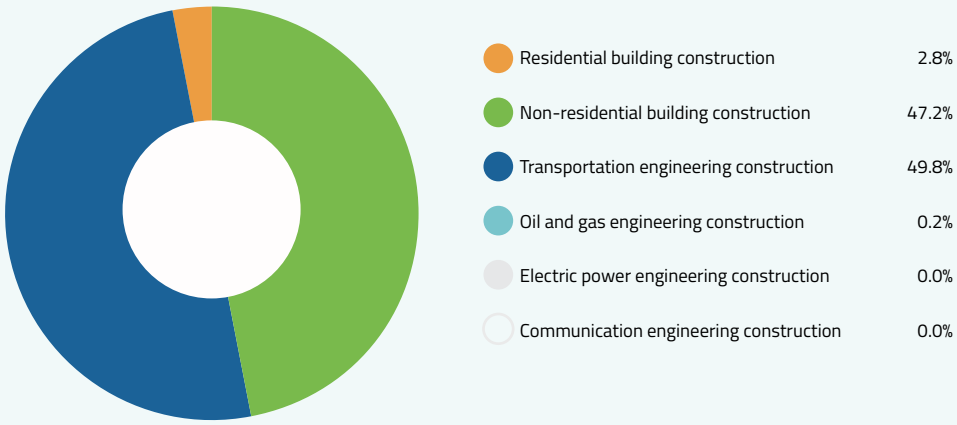
Our analysis of Canada's 2020 I.O. tables shows that public procurement of cement/concrete accounted for 26% of total cement consumption in Canada in 2020. Given the total cement demand of 13 Mt in Canada in 2022, as shown in Figure 6, we estimate that publicly-funded procurement of cement was about 3.3 Mt, while the private sector procured 9.7 Mt in 2022.

Figure 6. Canadian public and private procurement of cement in 2022
(Our analysis based on Statistics Canada, 2024)



The cement/concrete procurement by the Canadian public sector is primarily utilized in the transport (50%) infrastructure and non-residential building (47%) sectors. A small portion (2.8%) of cement/concrete procurement can be attributed to residential building construction funded by the Canadian public sector as shown in Figure 7.

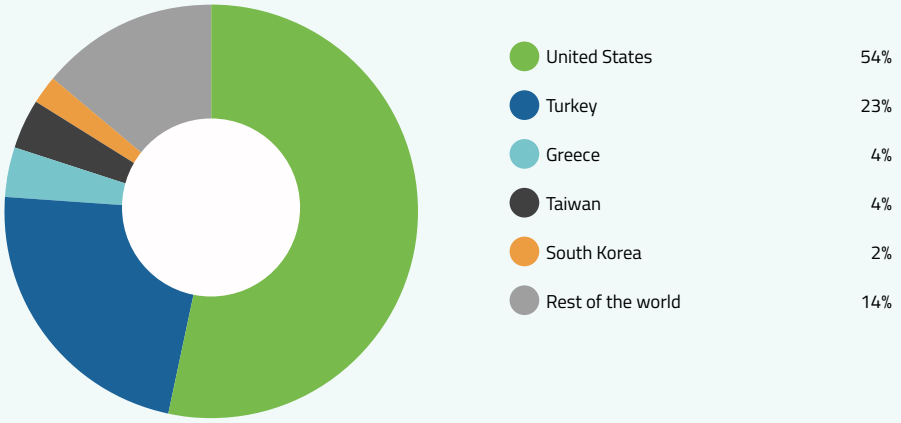
Figure 7. Canadian public sector procurement of cement by major construction sector
(Our analysis based on Statistics Canada, 2024)



Canada produced 15 Mt of cement in 2022, while the annual cement demand in Canada was 13 Mt that year. Canada imported 1.9 Mt of cement and 0.2 Mt of clinker in 2022 (Indexbox, 2024; USGS, 2024a). The CO_2 intensity of Canada's cement production is 667 kg CO_2/t of cement (Global Cement and Concrete Association, 2022).

Six countries accounted for 86% of Canada's cement imports in 2022 with the top two countries (the US and Turkey accounting for 77% of imports (Figure 8). Using the amount of cement imported from each country and the CO_2 intensity of cement produced in each country from Hasanbeigi and Springer (2019), we estimated the weighted average CO_2 intensity of cement that Canada imported in 2022 (699 kg CO_2/t cement).

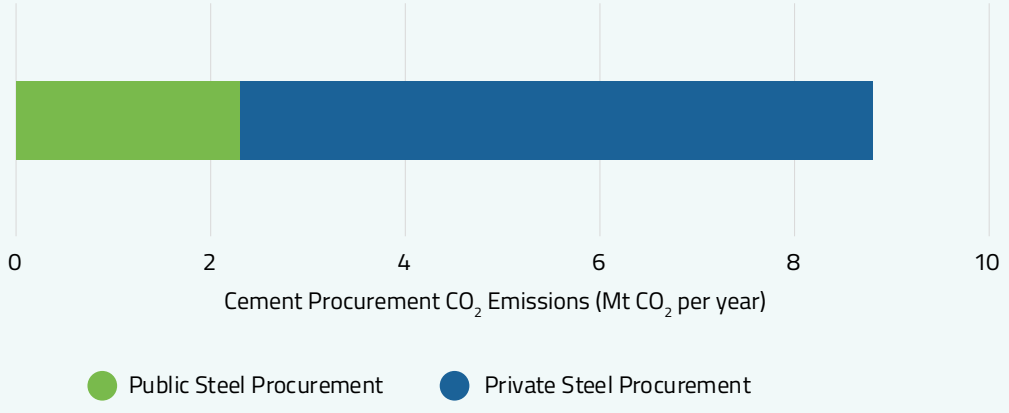
Figure 8. Canada cement import in 2022 (OEC, 2024b)



Using the CO_2 intensity of cement produced in Canada and the weighted average CO_2 intensity of cement imported in 2022, along with the amounts of imported and domestically produced cement used in Canada, we calculated the weighted average CO_2 intensity of cement used in Canada in 2022 to be 672 kg CO_2 per tonne of cement. This figure was utilized to estimate the emissions associated with cement procurement in Canada.

In total, it is estimated that cement use in Canada is responsible for approximately 8.7 Mt of CO_2 emissions per year, of which 2.3 Mt can be attributed to public cement consumption and 6.4 Mt to private cement consumption, as shown in Figure 9.

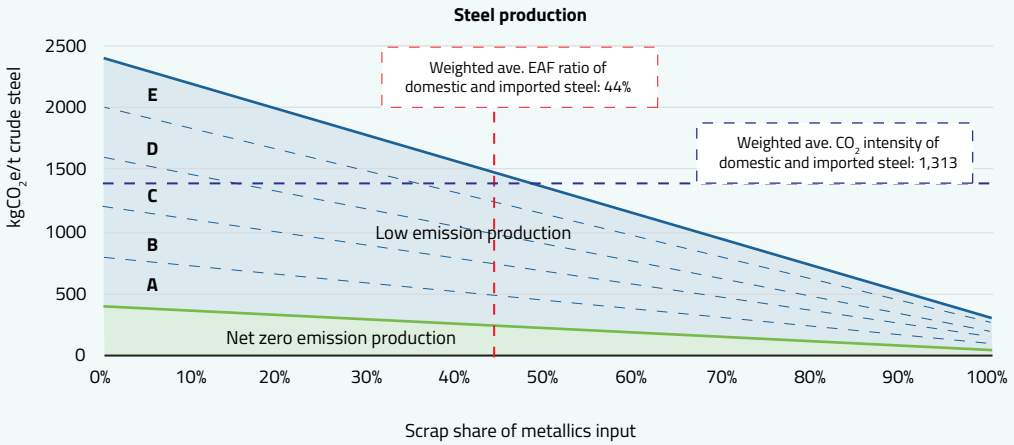
Figure 9. Annual CO_2 emissions from public and private procurement of cement in Canada in 2022



2.2 The impact of Canada's emissions pledge levels to the Industrial Deep Decarbonization Initiative

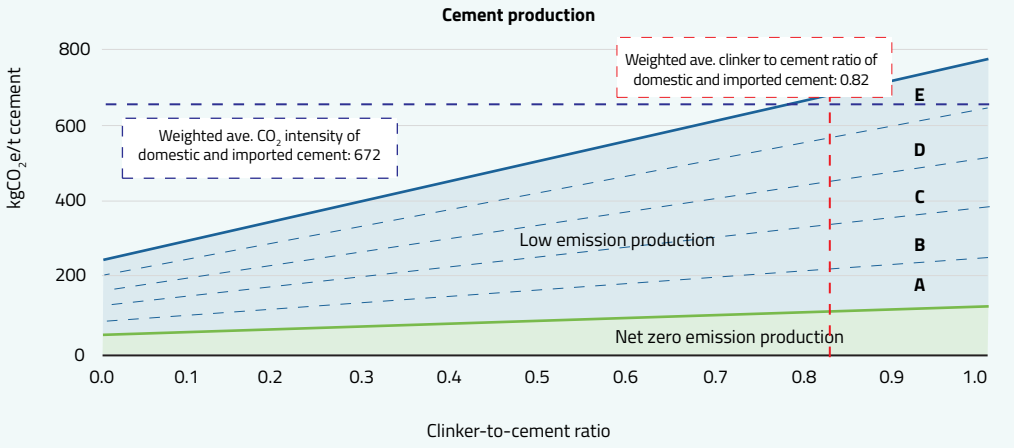
The IDDI employs the IEA's definitions for "near zero production" and "low emission" cement and steel from their report "Achieving Net Zero Heavy Industry Sectors in G7 Members" as a robust starting point (UNIDO, 2023) for the GPP Pledge. Given the weighted average emission intensity and share of scrap, the steel used in Canada is already considered low emissions steel under band E as shown in Figure 10 while the cement CO_2 intensity falls just on the upper bound of band E as shown in Figure 11.

Figure 10. Weighted Average CO_2 intensity of domestic and imported steel in Canada compared to the IEA low emissions **steel** definitions adopted by the IDDI



Adapted from IEA (2022)

Figure 11. Weighted average CO_2 intensity of domestic and imported cement in Canada compared to the IEA low emissions **cement** definitions adopted by the IDDI



Adapted from IEA (2022)

Given that the IDDI has different pledge levels, it is important to quantify the impact each of these Pledge levels may have. The following general assumptions are presented for each Pledge level in Canada in Table 1, specific to the publicly procured steel and cement in Canada. It should be noted that no country has yet made a Pledge to Level 4 under the GPP Pledge. Additionally, the availability of a sufficient amount of near-zero steel and cement to meet the Level 4 Pledge is a constraint that needs to be addressed by the industry. See Appendix section for more explanation of impact assessment method.

It should be noted that in the majority of cases, the government or its contractors do not purchase cement and instead purchase concrete (mainly ready-mix concrete) which is the final product used in construction projects. The values shown in this study include the cement used in concrete that is used in construction projects.

Based on the assumption shown in Table 2, we calculated the CO_2 intensity of publicly procured steel and cement in Canada under the BAU, and GPP Pledge Levels 3 and 4 (Figures 12-13).

Table 2. Modeling assumptions for IDDI GPP Pledge levels 1-4 in Canada

Pledge Level	Pledge Wording	CO_2 Intensity Assumption for Cement	CO_2 Intensity Assumption for Steel
Level 1	Starting no later than 2025, require disclosure of the embodied carbon in cement/ concrete and steel procured for public construction projects.	Business as usual (BAU) with 10% CO_2 intensity reduction during 2022-2050	Business as usual (BAU) with 26% CO_2 intensity reduction during 2022-2050
Level 2 **(not explicitly modeled)**	In addition to Level 1, Starting no later than 2030, conduct whole project life cycle assessments for all public construction projects, and, by 2050, achieve net zero emissions in all public construction projects.	Level 2 Pledge was not explicitly modeled in this analysis.	Level 2 Pledge was not explicitly modeled in this analysis.
Level 3	In addition to Levels 1 and 2, Starting no later than 2030, require procurement of low emission cement/concrete and steel in public construction projects, applying the highest ambition possible under national circumstances.	CO_2 intensity decreases to the upper bound of band D by 2030, the upper bound of band B by 2040, and a higher bond of near zero band by 2050	CO_2 intensity decreases to the lower bound of band D by 2030, the lower bound of band B by 2040, and a higher bond of near zero band by 2050
Level 4	In addition to Levels 1, 2, and 3, Starting in 2030, require procurement of a share of cement and/or crude steel from near zero emission material production for signature projects.	Level 3 pledge is met plus the following share of near zero cement in total public procurement in Level 4 ▪ 1% near-zero cement by 2030 ▪ 25% near-zero cement by 2040 ▪ 100% near-zero cement by 2050	Level 3 pledge is met plus the following share of near zero cement in total public procurement in Level 4 ▪ 1% near-zero steel by 2030 ▪ 30% near-zero steel by 2040 ▪ 100% near-zero steel by 2050

Figure 12. CO_2 intensity of publicly procured **steel** in the BAU, and GPP Pledge Levels 3 and 4 in Canada

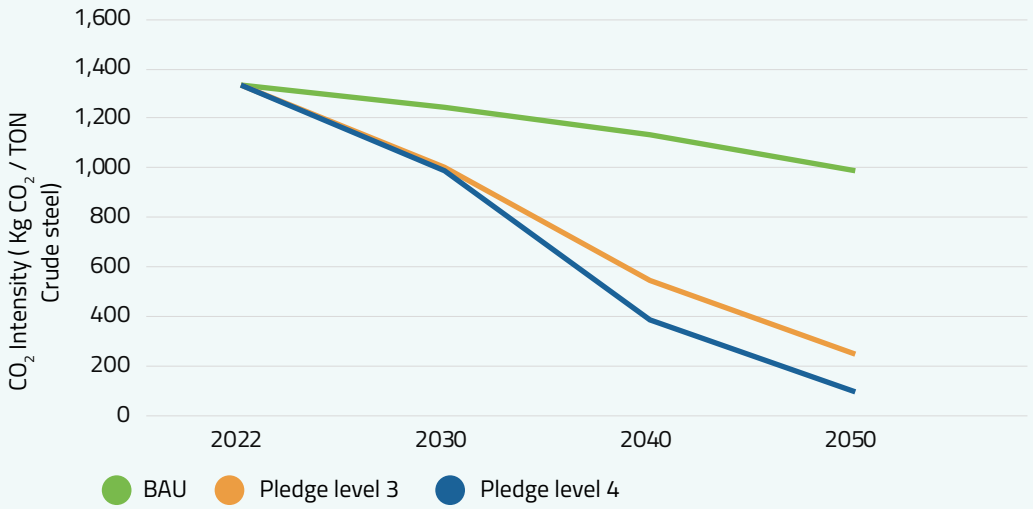
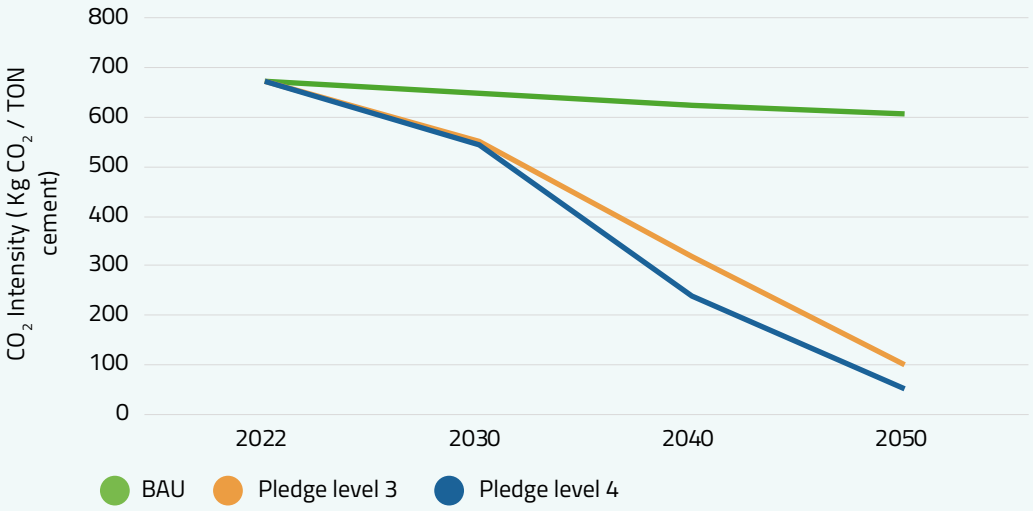


Figure 13. CO_2 intensity of publicly procured **cement** in the BAU, and GPP Pledge Levels 3 and 4 in Canada



The results of the GPP Pledge level analysis and the resulting CO_2 emissions impact associated with the BAU, and GPP Pledge Levels 3 and 4 scenarios for steel and cement are shown in Figures 14 - 15 respectively.

Figure 14. Annual CO_2 emissions related to Canada's public **steel** procurement under BAU and IDDI GPP Pledge Levels 3 and 4

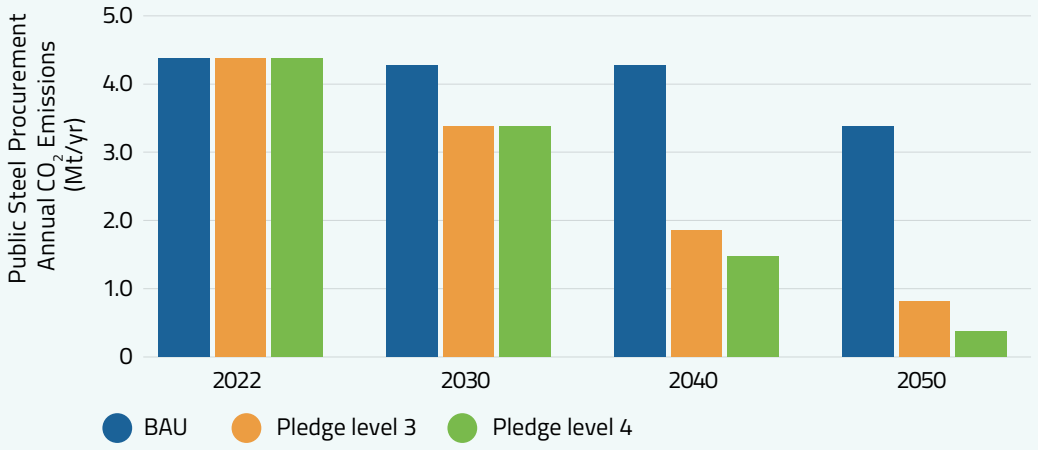
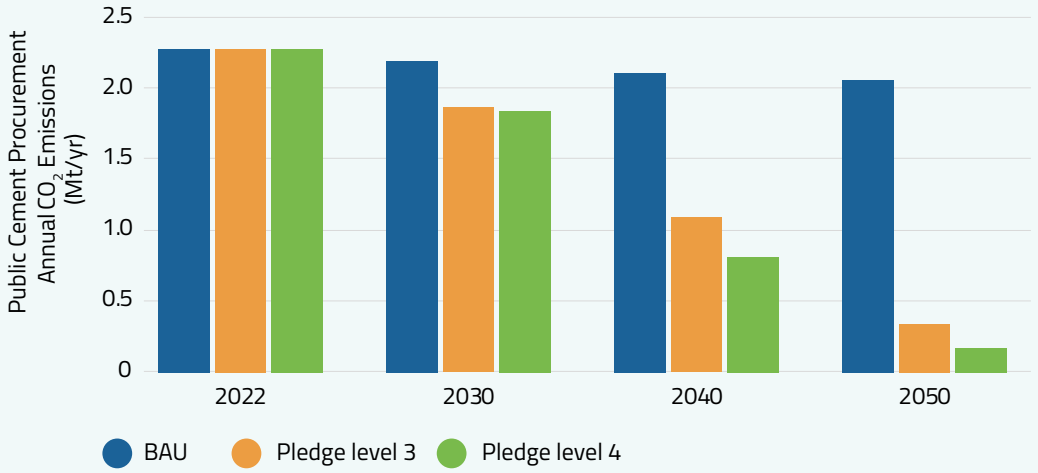


Figure 15. Annual CO_2 emissions related to Canada's public **cement** procurement under BAU and IDDI GPP Pledge Levels 3 and 4



The results show a larger impact on emission reduction is seen through the GPP of steel. Through 2030, a commitment to GPP Pledge Level 3 or 4 does not demonstrate a significant difference from each other. However, by 2040, commitments to GPP Pledge Levels 3 and 4 both result in a substantial reduction in CO_2 emissions. The annual CO_2 emissions associated with public procurement of steel would drop from 4.5 Mt CO_2/year in 2022 to 0.8 Mt CO_2/year in 2050 under the GPP Level 3 Pledge (81% reduction) and would further drop to 0.3 Mt CO_2/year by 2050 under the GPP Pledge Level 4 (93% reduction) (Figure 14). For cement procurement, the annual CO_2 emissions associated with public procurement of cement would decrease from 2.3 Mt CO_2/year in 2022 to 0.3 Mt CO_2/year by 2050 under the GPP Level 3 Pledge (85% reduction) and would drop to 0.2 Mt CO_2/year by 2050 under the GPP Level 4 Pledge (93% reduction) (Figure 15).

The indirect CO_2 emissions reduction could be substantially higher due to the impact that the green public procurement of steel and cement would have on transforming the entire market, including the steel and cement used in non-public construction.

3. Germany

3.1 The scale of Germany's government procurement of steel and cement/concrete

Germany is the world's 7th largest producer of crude steel and the largest in the EU producing 36.8 Mt of crude steel in 2022 (USGS, 2024b). In the same year, Germany also consumed 31.6 Mt of finished steel products. Of the countries assessed in the study, Germany is the only net exporter of steel (World Steel Association, 2023). Germany is also a major producer and consumer of cement. Germany produced 33 Mt of cement in 2022 (USGS, 2024a). This corresponded to annual emissions of over 19 Mt CO_2/year.

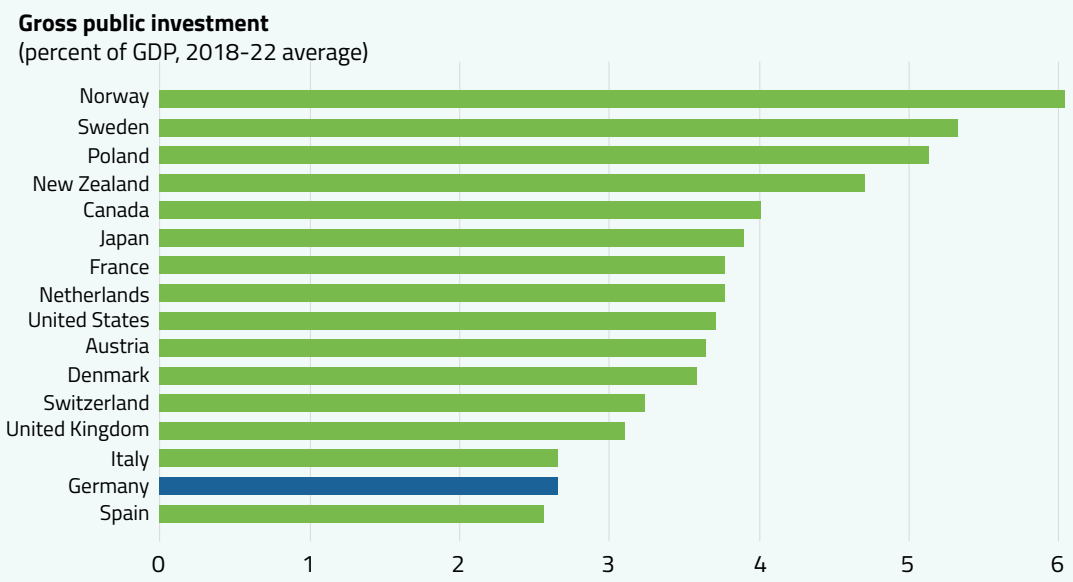
Industrial emissions in Germany accounted for approximately 21% of total national greenhouse gas emissions in 2022, with the steel and cement sectors being significant contributors due to their energy-intensive processes. Industrial emissions in Germany fell to their lowest in 2022 and 2023 (164 Mt in 2022 and 144 Mt of CO_2 in 2023) due to the COVID-19 pandemic and energy crisis (Agora Energiewende, 2024).

Since the 1990s, Germany's public infrastructure investment has declined and barely offset depreciation. In recent years, Germany's public investment in infrastructure has been proportionally less than most other Organization for Economic Co-operations and Development (OECD) member nations at around 2.8% of GDP between 2018-2022 as shown in Figure 16. For comparison, countries like France and the United Kingdom have public infrastructure investments of approximately 3.4% and 3.3% of GDP, respectively (Fletcher et al., 2024).

As a result, public investment in construction in Germany has remained lower than the other nations assessed in this study at around 14% of all construction sector spending between 2019 and 2023 (Gornig & Pagenhardt, 2024). A key reason for the low public investment in infrastructure has been linked to limited municipal planning capacity, where most of the projects are being realized (Fletcher et. Al, 2024).

This is an untapped potential for the realization of green investments in construction and infrastructure and thus, supporting the transition to a decarbonized heavy industry especially steel and cement in Germany. Recognizing this potential, the German government enacted the Federal Climate Change Act in 2019, which acknowledges green public procurement as an element in achieving its climate neutrality goals by 2045. In 2021, Germany joined the IDDI and pledged to further develop standards to increase demand for low-emission materials. This effort includes setting minimum requirements for green steel and cement starting in 2024, supported by rising CO_2 prices and funding programs aimed at decarbonizing heavy industries (IDDI, 2023b).

Figure 16. Gross public investment in infrastructure as a percent of GDP among OECD member nations between 2018 and 2022 (Fletcher et al., 2024)

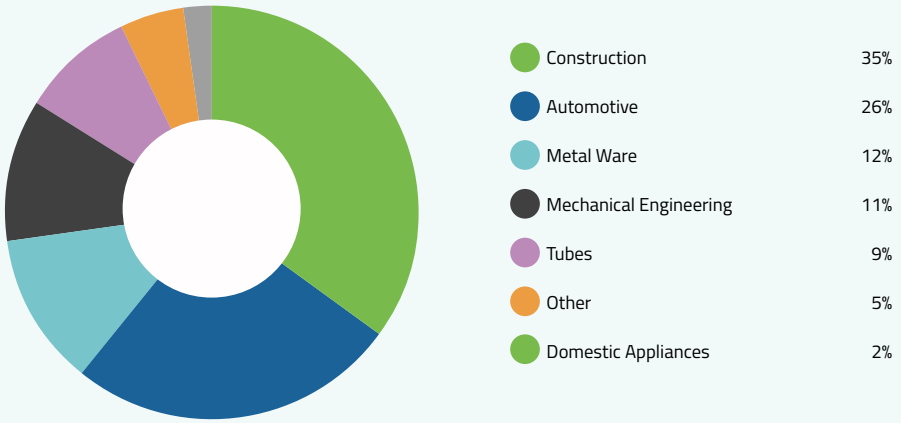


Analysis of Germany's most recent Input-Output (I.O.) tables, published in 2021 and covering economy-wide expenditure in 2019, reveals significantly less detailed information than any of the other I.O. tables assessed in this study (US, UK, and Canada) (Statistisches Bundesamt, 2021). Germany's I.O. tables contain 84 rows of information and 86 columns compared to the over 400 by 400 matrix available in the US, for example. In Germany's I.O. tables, there is information provided on the total and sectoral use of iron and steel; however, there is no clear way to attribute its consumption to government spending on infrastructure. Cement and concrete spending is not explicitly included in the I.O. tables, and it is unclear where the spending on these materials may be embedded. Therefore, the scale of procurement analysis in this study for Germany relies on other data reported by the government and third-party data.

3.1.1. Steel procurement in Germany

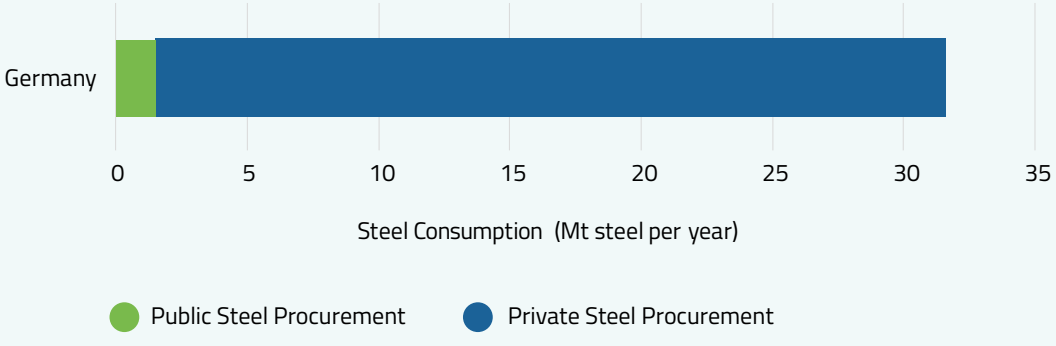
To estimate the quantity of steel procurement by the German government, data from Gornig & Pagenhardt (2023) is utilized. It showed that in 2019, construction sector spending in Germany accounted for €420.4 billion, of which public construction, including infrastructure, made up approximately 14% at €57.5 billion. To further assess the amount of steel utilized in the construction industry, third-party data was utilized, indicating that 35% of the steel used in Germany goes towards the construction sector, as shown in Figure 17, which is well below the 49% average globally. Germany's large automotive sector consumes a significant amount of Germany's steel demand at 26%.

Figure 17. Steel end use in Germany in 2017
(Koasidis et al., 2020)



Given that infrastructure projects are included in construction spending, we calculate the public sector's steel consumption. Multiplying the total construction spending share (14%) by the share of steel used in construction (35%), we estimate that the public consumption of steel in Germany is approximately 5% of the total steel consumption in 2019 as indicated in Figure 18. According to the 2019 German I.O. tables, in which the total use of iron and steel in Germany totaled €19.1 billion, it is estimated that government procurement of steel amounted to approximately €914 million in 2019. Assuming this 5% public procurement of steel holds for 2022, we estimate that public procurement of steel in Germany amounted to 1.6 Mt in 2022, while private procurement of steel accounted for 30 Mt in 2022, as indicated in Figure 18.

Figure 18. Germany public and private procurement of steel in 2022



The percentage of public steel procurement in Germany (5%) is significantly lower than in the other countries assessed in the study. This can be attributed to the substantial role of the private sector in steel consumption, particularly in industries like automotive and machinery. Additionally, the low public investment in infrastructure contributes to this figure. Other recent studies have estimated the same level of public procurement of steel in Germany with similar justifications, further validating our estimate (Wyns et al., 2024).

Germany produced 36.8 Mt of steel in 2022, while the annual steel demand was 31.6 Mt. Also, Germany imported 21 Mt of steel in the same year (World Steel Association, 2023). Although Germany is a net exporter of steel in terms of value, it imports certain steel grades and semi-finished products that contribute to its total steel consumption. Around 29% of Germany's steel production is via Electric Arc Furnace (EAF). The average CO_2 intensity of steelmaking in Germany in 2022 is estimated at 1,419 kg CO_2 per tonne of crude steel, based on the intensity values provided by Hasanbeigi (2022) and the share of EAF steelmaking.

Nine countries accounted for 73% of the steel Germany imported in 2022 (Figure 19). Using the amount of steel imported from each country and the rest of the world, along with the CO_2 intensity of steel produced in each country from Hasanbeigi (2022), we estimated the weighted average CO_2 intensity of the steel imported by Germany in 2022 to be 1,488 kg CO_2 per tonne of crude steel.

Using the CO_2 intensity of steel produced in Germany and the weighted average CO_2 intensity of steel imported by Germany in 2022, we calculated the weighted average CO_2 intensity of steel used in Germany in 2022 (1,470 kg CO_2 per tonne of crude steel). This calculation was based on the amount of imported steel and domestically produced steel used in Germany. This weighted average is utilized to estimate the emissions associated with steel procurement in Germany.

Figure 19. Germany imports of steel in 2022
(OEC, 2024d)

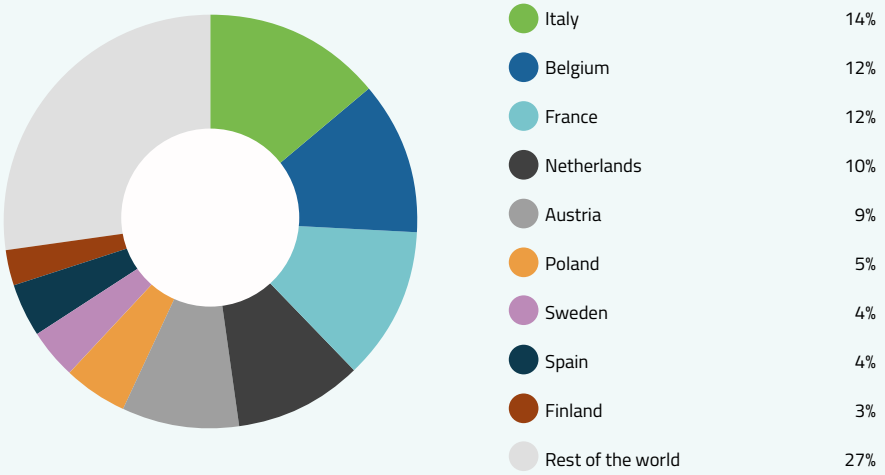
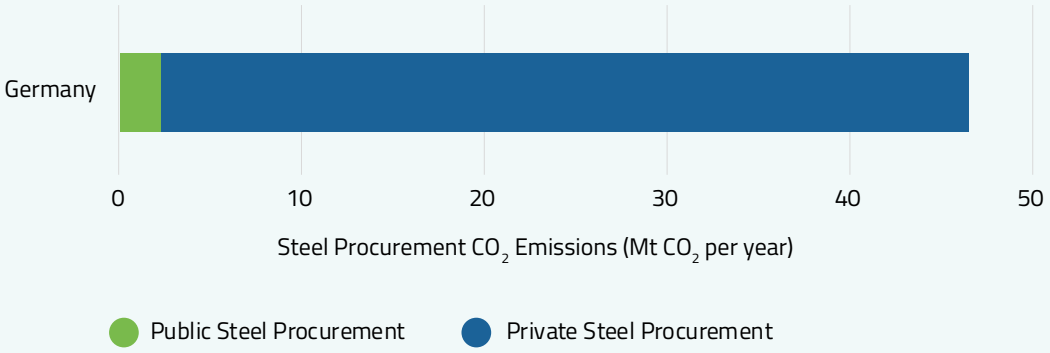


Figure 20 illustrates the annual CO_2 emissions associated with total steel demand in Germany totaling approximately 46.5 Mt CO_2/year in 2022 where public procurement of steel is responsible only for 2.3 Mt CO_2/year with private sector steel procurement responsible for the other 44.2 Mt CO_2/year.

Figure 20. Annual CO_2 emissions from public and private procurement of steel in Germany in 2022

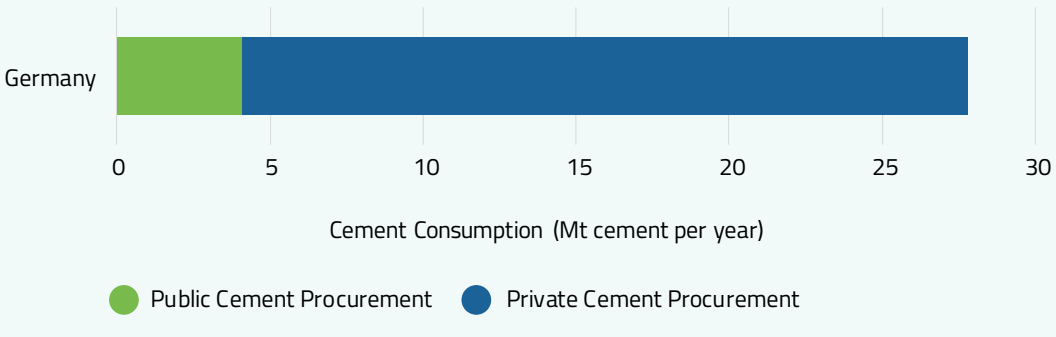


3.1.2. Cement and concrete procurement in Germany

Because the data in the German I.O. tables are not disaggregated enough to be used for the estimation of public procurement of cement and concrete, we relied on other publicly available sources. A recent report by Wyns et al. shows that the share of cement used in government funded construction projects accounts for 23% of total cement demand in Germany. This share was also confirmed in another report (WWF, 2019). With an annual cement consumption of 28 Mt, we estimate that public cement consumption accounted for 6.4 Mt while private sector cement consumption totaled 21.6 Mt in 2022 as shown in Figure 21.

Germany needs to implement significantly improved construction contract tracking mechanisms and provide more detailed separate breakouts in the I.O. tables for cement and concrete consumption and its construction sectors to provide more refined government procurement estimates.

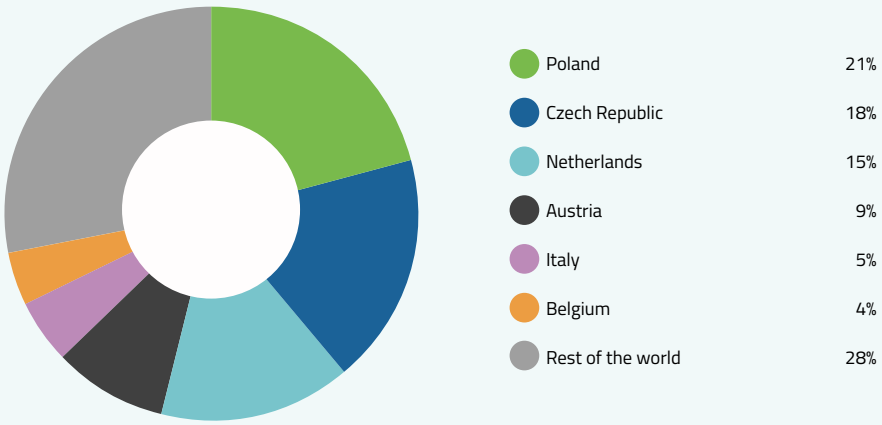
Figure 21. Germany public and private procurement of cement in 2022



Germany produced 33 Mt of cement in 2022, while the annual cement demand was 28 Mt that year. Germany imported 1 Mt of cement (Global Cement, 2023). The CO_2 intensity of cement production in Germany is 581 kg CO_2 per tonne of cement (Global Cement and Concrete Association, 2022).

Six countries accounted for 72% of Germany's cement imports in 2022, with the top three countries (Poland, Czech Republic, and the Netherlands) accounting for 55% of imports (Figure 22). The total cement import by Germany is relatively small (1 Mt), accounting for around 3% of its cement consumption. Using the amount of cement imported from each country and the CO_2 intensity of cement produced in each country from Hasanbeigi and Springer (2019) and GCCA (2022), we estimated the weighted average CO_2 intensity of cement imported by Germany in 2022 to be 625 kg CO_2 per tonne of cement.

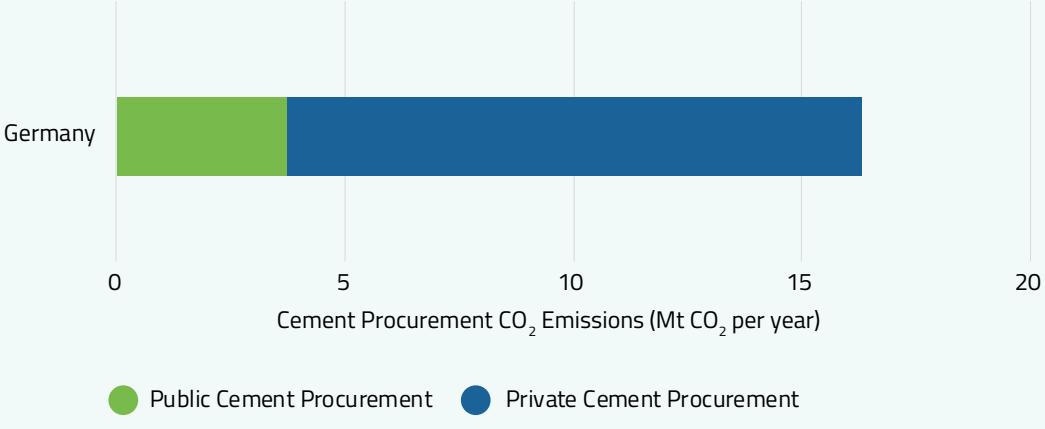
Figure 22. Germany's cement imports in 2022
(OEC, 2024a)



Using the CO_2 intensity of cement produced in Germany and the weighted average CO_2 intensity of cement imported in 2022, along with the amounts of imported and domestically produced cement used in Germany, we calculated the weighted average CO_2 intensity of cement used in Germany in 2022 to be 583 kg CO_2 per tonne of cement. This figure was utilized to estimate the emissions associated with cement procurement in Germany.

In total, it is estimated that cement use in Germany is responsible for approximately 16.3 Mt of CO_2 emissions per year, of which 3.8 Mt CO_2/year can be attributed to public cement consumption and 12.5 Mt CO_2/year to private cement consumption, as shown in Figure 23.

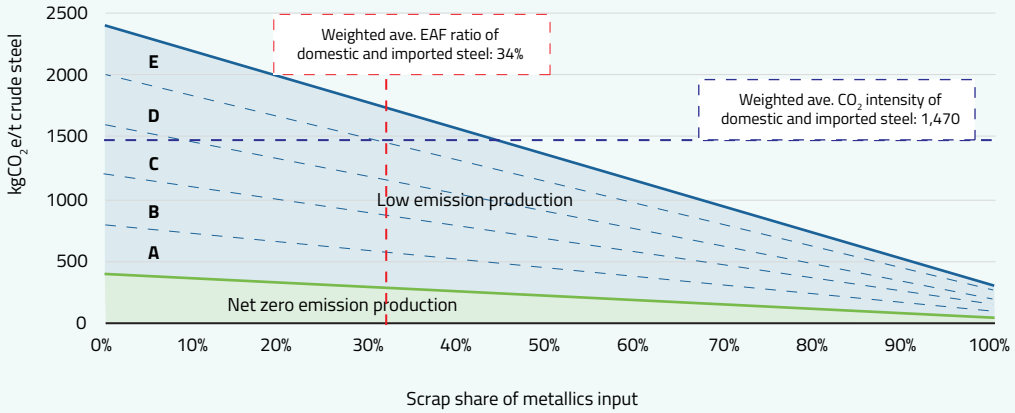
Figure 23. Annual CO_2 emissions from public and private procurement of cement in Germany in 2022



3.2 The impact of Germany's emissions pledge levels to the Industrial Deep Decarbonization Initiative

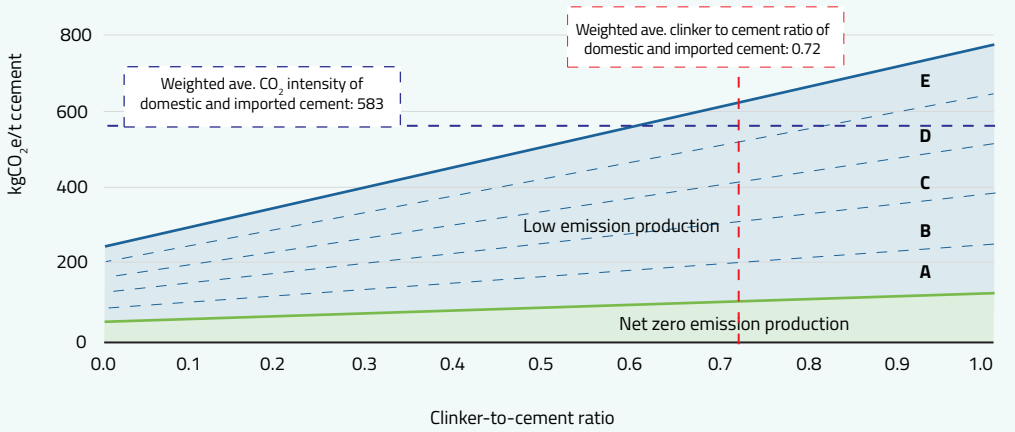
The IDDI employs the IEA's definitions for "near zero production" and "low emission" cement and steel from their report "Achieving Net Zero Heavy Industry Sectors in G7 Members" as a robust starting point (UNIDO, 2023). Currently, the emissions intensities for Germany's steel and cement industry place them within Band E (Figure 24, Figure 25).

Figure 24. Weighted average CO_2 intensity of domestic and imported steel in Germany compared to the IEA low emissions **steel** definitions adopted by the IDDI



Adapted from IEA (2022)

Figure 25. Weighted average CO_2 intensity of domestic and imported cement in Germany compared to the IEA low emissions **cement** definitions adopted by the IDDI



Adapted from IEA (2022)

Given that GPP pledges to IDDI have different levels, it is important to quantify what impact each of these pledge levels may have. The following general assumptions are presented for each pledge level in Germany in Table 3 specific to the steel and cement[1] procured by Germany's government. It should be noted that no country has yet made a Pledge to Level 4 under IDDI. Additionally, the availability of sufficient volumes of near-zero steel and cement to meet the Level 4 Pledge is a constraint that needs to be addressed by the industry. See Appendix section for more explanation of impact assessment method.

Table 3. Modeling assumptions for IDDI GPP Pledge levels 1-4 in Germany

Pledge Level	Pledge Wording	CO_2 Intensity Assumption for Cement	CO_2 Intensity Assumption for Steel
Level 1	Starting no later than 2025, require disclosure of the embodied carbon in cement/ concrete and steel procured for public construction projects.	Business as usual (BAU) with 9% CO_2 intensity reduction during 2022-2050	Business as usual (BAU) with 27% CO_2 intensity reduction during 2022-2050
Level 2 **(not explicitly modeled)**	In addition to Level 1, Starting no later than 2030, conduct whole project life cycle assessments for all public construction projects, and, by 2050, achieve net zero emissions in all public construction projects.	Level 2 Pledge was not explicitly modeled in this analysis.	Level 2 Pledge was not explicitly modeled in this analysis.
Level 3	In addition to Levels 1 and 2, Starting no later than 2030, require procurement of low emission cement/concrete and steel in public construction projects, applying the highest ambition possible under national circumstances.	CO_2 intensity decreases to the upper bound of band D by 2030, the upper bound of band B by 2040, and a higher bond of near zero band by 2050	CO_2 intensity decreases to the lower bound of band D by 2030, the lower bound of band C by 2040, and a higher bond of near zero band by 2050
Level 4	In addition to Levels 1, 2, and 3, Starting in 2030, require procurement of a share of cement and/or crude steel from near zero emission material production for signature projects.	Level 3 Pledge is met plus the following share of near zero cement in total public procurement in Level 4 ▪ 1% near-zero cement by 2030 ▪ 25% near-zero cement by 2040 ▪ 100% near-zero cement by 2050	Level 3 Pledge is met plus the following share of near zero cement in total public procurement in Level 4 ▪ 1% near-zero steel by 2030 ▪ 30% near-zero steel by 2040 ▪ 100% near-zero steel by 2050

1 It should be noted that in the majority of cases, the government or its contractors do not purchase cement and instead purchase concrete (mainly ready-mix concrete) which is the final product used in construction projects. The values shown in this study include the cement used in concrete that is used in construction projects.

Based on the assumption shown in Table 3, we calculated the CO_2 intensity of publicly procured steel and cement in Germany under the BAU, and GPP Pledge Levels 3 and 4 (Figures 26-27).

Figure 26. CO_2 intensity of publicly procured **steel** in the BAU, and IDDI GPP Pledge Levels 3 and 4 in Germany

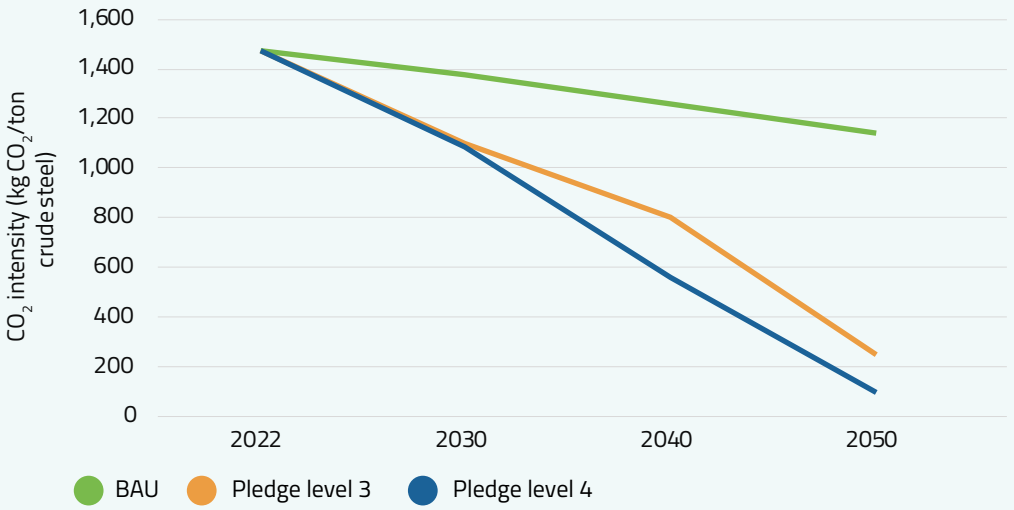
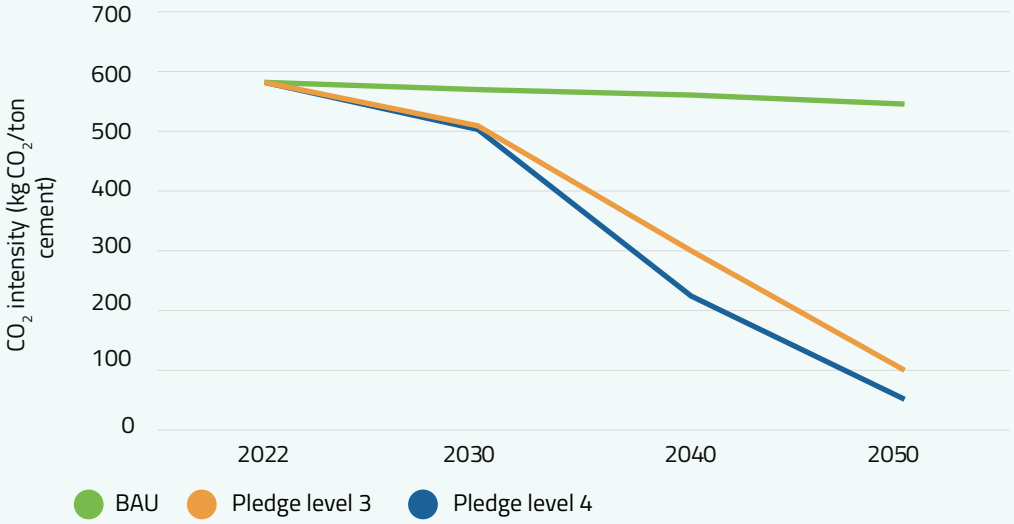


Figure 27. CO_2 intensity of publicly procured **cement** in the BAU, and IDDI GPP Pledge Levels 3 and 4 in Germany



The results of the GPP Pledge level analysis and the resulting CO_2 emissions impact associated with the BAU, and GPP Pledge Levels 3 and 4 scenarios for steel and cement are shown in Figures 28 - 29 respectively.

Figure 28. Annual CO_2 emissions related to Germany's public **steel** procurement under BAU and IDDI GPP Pledge Levels 3 and 4

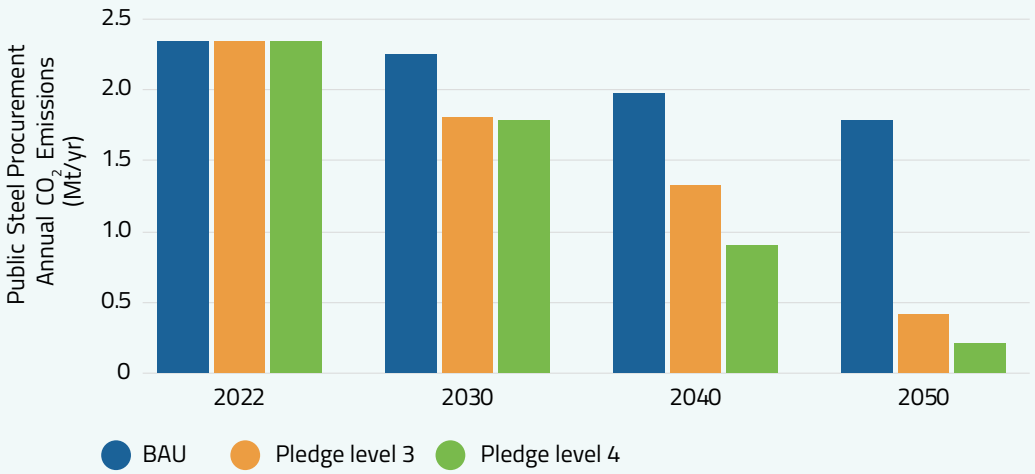


Figure 29. Annual CO_2 emissions related to Germany's public **cement** procurement under BAU and IDDI GPP Pledge Levels 3 and 4

Through 2030, a commitment to GPP Pledge Level 3 or 4 does not show a significant difference between each other. However, by 2040, commitments to GPP Pledge Levels 3 and 4 both result in a substantial reduction in CO_2 emissions.

The annual CO_2 emissions associated with German government procurement of steel would drop from 2.3 Mt CO_2/year in 2022 to 0.4 Mt CO_2/year in 2050 under a GPP Pledge Level 3 (83% reduction), and would further drop to 0.2 Mt CO_2/year by 2050 under a GPP Level 4 Pledge (93% reduction) (Figure 14). For cement procurement, the annual CO_2 emissions associated with government procurement of cement would decrease from 3.8 Mt CO_2/year in 2022 to 0.6 Mt CO_2/year by 2050 under a GPP Level 3 Pledge (83% reduction) and would drop to 0.3 Mt CO_2/year by 2050 under an GPP Level 4 Pledge (91% reduction) (Figure 14).

The indirect CO_2 emissions reduction could be substantially higher due to the impact that green public procurement of steel and cement would have on transforming the entire market, including the steel and cement used in non-public construction.

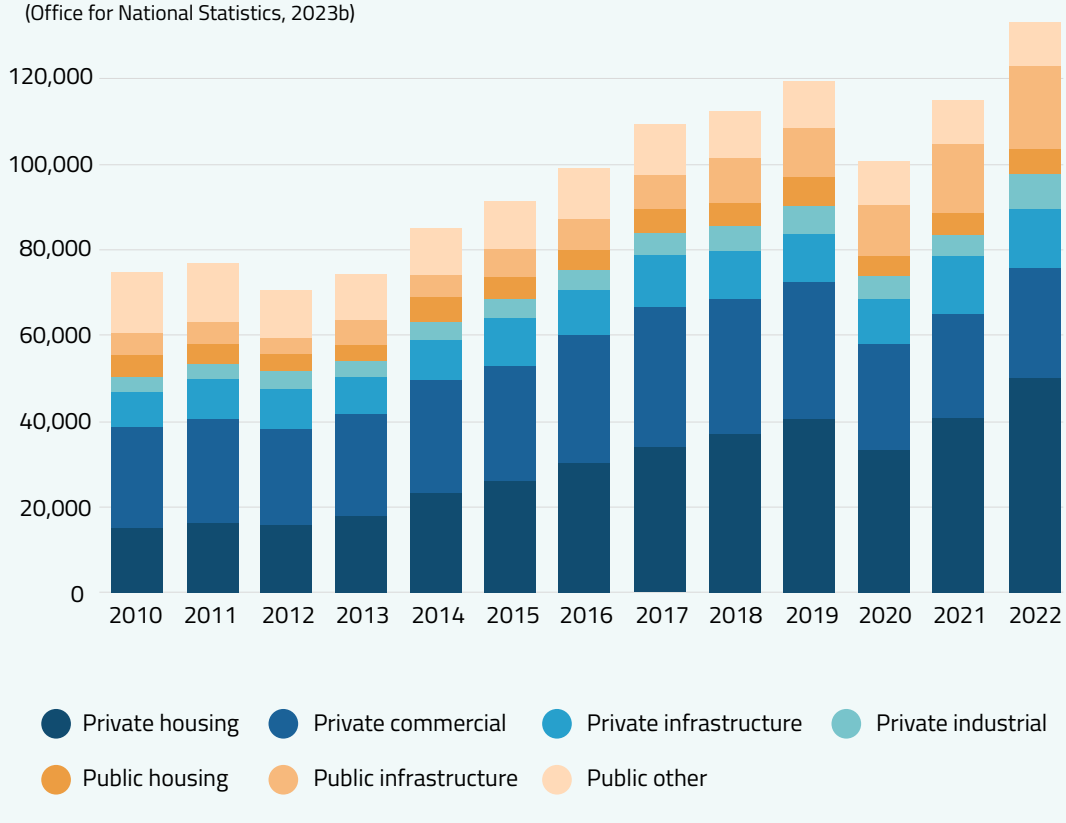
4.United Kingdom

4.1 The scale of the UK's government procurement of steel and cement/concrete

The United Kingdom (UK) is one of the world's largest producers and consumers of both steel and cement/concrete products. In 2022 the UK was the 28th largest steel producer in the world with 6 million tonnes (Mt) of crude steel production and consumption of 9.2 (Mt) of finished steel products (World Steel Association, 2023). The UK is also a large consumer of cement and concrete consuming more than 90 Mt of concrete per year, of which 95% is domestically produced (mpa UK Concrete, 2020). In the UK, the industrial sector was responsible for approximately 14% of the country's GHG emissions in 2022 just shy of 60 Mt CO_2. The CO_2 process emissions from the cement sector have been and continue to be responsible for the majority of these emissions while the share of emissions from fuel combustion in the industry sector has been steadily declining since 1990 (UK Department for Energy Security and Net Zero, 2024).

In the UK, the construction sector is the primary consumer of steel and cement/concrete and has been growing year-over-year with the exception of the COVID-19 pandemic. The Great Britain public projects fund approximately 27% of their domestic construction sector as demonstrated in Figure 30.

Figure 30. Types of construction work, current prices, non-seasonally adjusted, Great Britain, 2010 to 2022
(Office for National Statistics, 2023b)

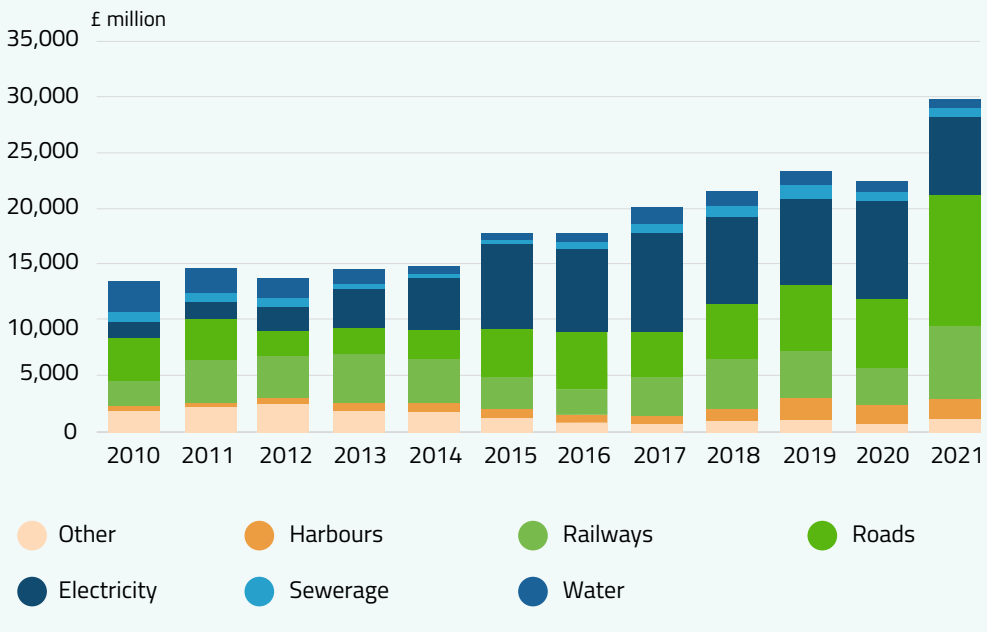


The UK government has recognized the significant role its procurement of construction materials could play in reducing emissions in the industrial sector and is a co-leader of the IDDI in collaboration with national governments, works to standardize carbon assessments, establish ambitious public and private sector procurement targets, incentivize investment into low-carbon product development and design industry guidelines (IDDI, 2024a).

The UK Government has prioritized green public procurement as part of its National Procurement Policy Statement and held consultations throughout 2023 to define standards for green steel and cement. In alignment with the Industrial Decarbonisation Strategy and Net Zero Strategy, public procurement is being used to drive emissions reductions in construction projects. Since 2022, Whole Life Cycle carbon assessments and reporting have been required across major public projects to help achieve net zero carbon by 2050. The UK's Climate Change Act commits to a 100% reduction of greenhouse gas emissions by 2050, supported by the Construction Playbook and Net Zero Estate Playbook, which guide government organizations in decarbonization planning. Additionally, the UK requires the use of the BREEAM standards for major construction projects to promote low-carbon materials. To decarbonize the steel and cement sectors, the government is investing through initiatives like the £1 Billion Net Zero Innovation Portfolio, £500 million Industrial Energy Transformation Fund, and the £210 million Industrial Decarbonisation Challenge. Furthermore, the UK is advancing Carbon Capture, Utilisation, and Storage (CCUS), aiming to deploy at least two CCUS clusters by the mid-2020s (IDDI, 2024b).

However, challenges exist for countries to fully quantify the impact the levels of Pledge to the IDDI may have due to a lack of available data specific to the procurement of steel and cement/concrete. This is no exception in the UK where the scale of government procurement has not previously been quantified for cement/concrete. However, Government procurement of steel products for major government-funded projects (excluding those conducted in Scotland, Whales, and Northern Ireland) has been tracked since 2019 and reported yearly by the UK Department of Business and Trade's Steel Public Procurement reports (UK Department of Business & Trade, 2024). However, these reports do not cover all steel procurement. The UK also tracks and reports total spending for government-funded infrastructure projects grouped into major infrastructure project categories shown in Figure 31 (Office for National Statistics, 2023a) and total construction sector spending (Figure 30) (Office for National Statistics, 2023).

Figure 31. UK government investment in infrastructure projects from 2010 to 2021
(Office for National Statistics, 2023a)



The UK Input-Output table published for the year 2020 contains approximately 110 rows with less detail than its US counterpart, however, there is still useful information on the procurement of steel and cement/concrete (i.e., total country level use of steel and cement/concrete by value) that can be discussed in detail below.

An in-depth analysis of the UK I.O. tables shows a limited allocation of goods and services used by the government. For example, there is zero input of steel and cement/concrete into the output column for government consumption. However, steel and cement/concrete are not often directly procured by governments, and are instead procured through government-funded contracts for infrastructure construction projects. Analysis of the UK's IO tables identified that nearly all of the cement and concrete use that is also lumped together with lime, and plaster (86% by value) is categorized for use in a single generalized "Construction" output column, presenting a challenge for then determining what share of that cement and concrete is being procured by the government. Additional analysis of the I.O. tables was undertaken for the allocation of the steel, cement/concrete, and construction inputs into the various infrastructure projects (transport, buildings, etc.) that was inconclusive (Office for National Statistics, 2024).

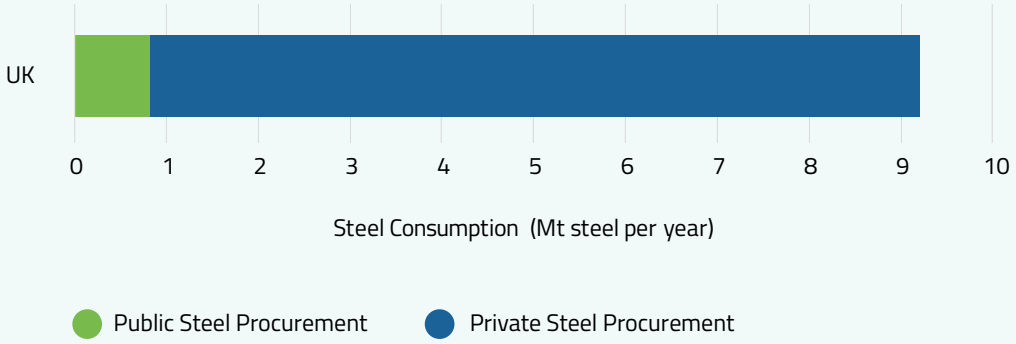
4.1.1 Steel procurement in the UK

Due to the lack of sufficient data to estimate the scale of government procurement of steel from the I.O. tables as well as existing, but incomplete steel procurement data found in the UK's Steel Public Procurement reports, data for 2021 from the UK's Steel Public Procurement was utilized in combination with I.O table data from the same year to determine the government share of steel procurement in the UK (UK Department of Business & Trade, 2023). The data from the fiscal year 2021/2022 report also coincides with most recently available UK I.O. tables with data available through 2021 to allow us to have a baseline of comparison for the analysis.

In the UK's steel procurement report it was indicated that in 2021, the government procured approximately £603 million in steel products totaling a weight of 0.3 Mt. With the UK's total steel demand of 11.0 Mt in 2021 (World Steel Association, 2023), this would equate to 2.7% of the steel procurement as public, significantly below other nations in the region (Wyns et al., 2024). Since the UK's steel procurement report does not cover all of the UK steel procurement, (excludes infrastructure projects managed by Wales, Scotland, and Northern Ireland) to estimate the share of publicly procured steel, the total procurement monetary value (£603 million) was divided by the total UK steel spend from I.O. tables in the same year of £7.08 billion, to arrive at an estimated 9% of steel procurement by value, significantly more in line with regional public procurement levels.

Based on the share of publicly funded steel procurement to total procurement of steel in the UK with total demand for steel of 9.4 Mt in 2022, it is estimated that the total public procurement was around 0.85 Mt of steel while private procurement of steel is estimated to be 8.55 Mt in 2021 (Figure 32).

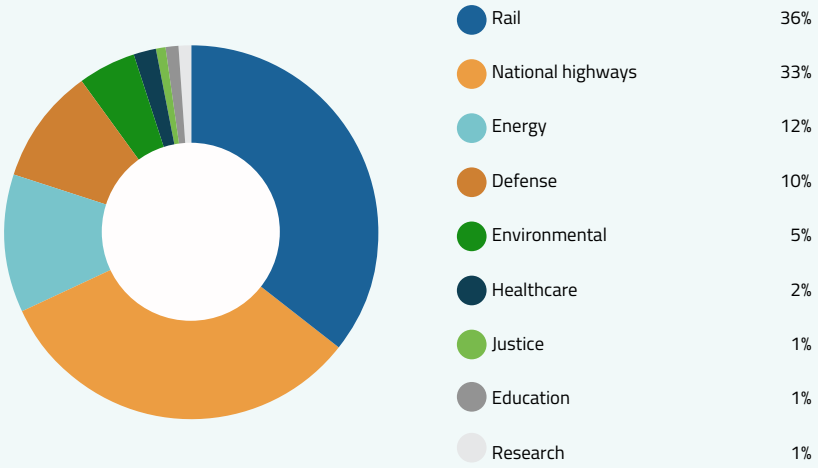
Figure 32. UK public and private procurement of steel in Mt in 2022



Further analysis of the distribution of publicly funded steel procurement in the UK in 2021 indicated that transport infrastructure projects (rail and roadways) were responsible for more than two-thirds of the public consumption of steel as shown in Figure 33 by construction project type. Approximately 12% of the UK's public steel procurement went towards energy projects within the purview of the UK's Nuclear Decommissioning Authority, while 10% of the public procurement of steel was undertaken by the Ministry of Defense. Smaller portions of this steel procurement were attributed to healthcare, education, justice, research, and environmental infrastructure.

Figure 33. UK public procurement of steel by major construction sector in 2021

Adapted from UK Steel Public Procurement 2023 Report data (UK Department of Business & Trade, 2023)



The UK produced 6 Mt of steel in 2022 and the annual steel demand in the UK was 9.4 Mt in that year. The UK imported 5.2 Mt of steel in 2022 as well making it a net importer of steel (World Steel Association, 2023). Only 19% of the UK steel production is via EAF. Based on the average CO_2 intensity of BF-BOF and EAF steelmaking and considering grid emissions factor in the UK, we estimated the CO_2 intensity of 1,608 kg CO_2/t crude steel produced in the UK.

Nine countries accounted for 67% of steel the UK imported in 2022 (Figure 34). Using the amount of steel imported from each country and the rest of the world and the CO_2 intensity of steel produced in each country from Hasanbeigi (2022), we estimated the weighted average CO_2 intensity of steel that the UK imported in 2022 (1,398 kg CO_2/t crude steel).

Having the CO_2 intensity of steel produced in the UK and the weighted average CO_2 intensity of steel that the UK imported in 2022, and using the amount of imported steel and the domestically produced steel used in the UK, we calculated the weighted average CO_2 intensity of steel that was used in the UK in 2022 (1,409 kg CO_2/t crude steel). This is utilized to estimate the emissions associated with steel procurement in the UK.

Figure 34. UK import of steel mill products in 2022 (US Department of Commerce 2023b)

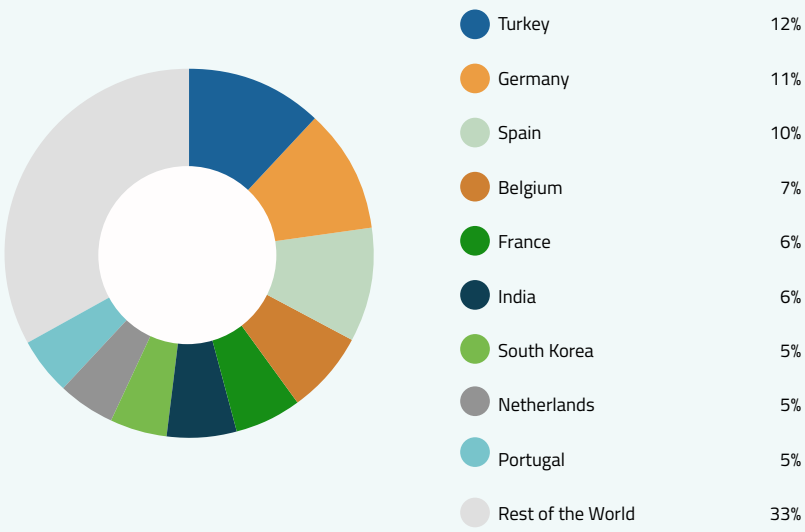
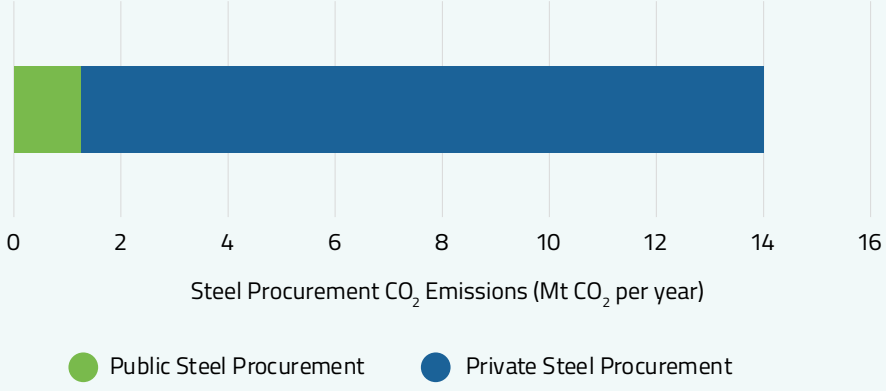


Figure 35 illustrates the annual CO_2 emissions associated with total steel demand in the UK totaling approximately 14 Mt CO_2/year where public procurement of steel is responsible for 1.3 Mt CO_2/year with private sector steel procurement responsible for the other 12.7 Mt CO_2/yr.

Figure 35. UK public and private CO_2 emissions from procurement of steel in 2022



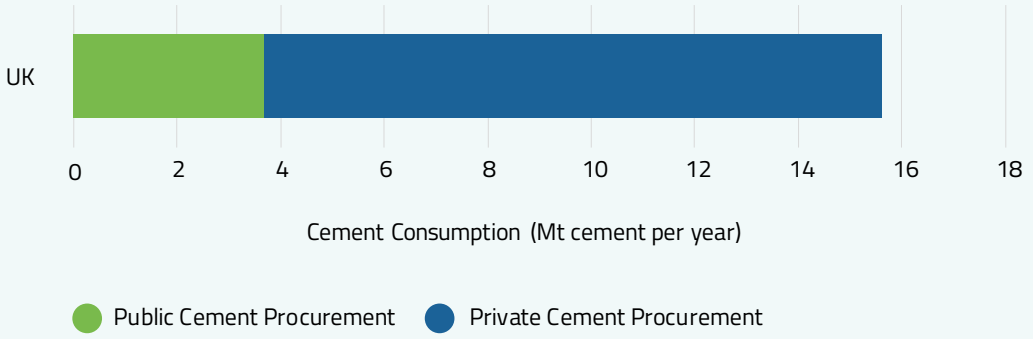
4.1.2 Cement and concrete procurement in the UK

To estimate the UK government procurement of cement and concrete, the total construction sector use of cement/concrete was adjusted to account for the inclusion in the I.O. tables of lime and plaster (Imbabi et al., 2012). Knowing that the UK government funds approximately 27% of the construction sector from Figure 30, this value was multiplied by the total construction sector spend in the I.O. tables to approximate the government spending portion. A ratio of government spending on construction for public infrastructure compared to all infrastructure construction was utilized in which approximately 25% of construction in the US is government-funded (US Census Bureau, 2024) compared to 27% in the UK (Figure 30).

Previous analysis of the US construction sector indicated that approximately 3.4% of all government-funded infrastructure project funding was allocated to the procurement of cement and concrete (Hasanbeigi and Khutal 2021). This value was scaled to 3.7% for the UK based on the public construction spending ratio between the US and the UK. The scaled cement/concrete spending ratio was multiplied by the estimated UK government spending on construction determined from the I.O. tables and was then divided by the adjusted total use of cement and concrete value from the IO tables.

The analysis indicated that the UK government procured approximately 24% of the nation's cement and concrete use worth £1.7 billion. In 2021, the UK's total cement consumption was 15.6 million tonnes (Mt) of cement (Bide et al., 2023), implying that the government procured approximately 3.7 Mt of cement in 2021 while the private sector consumed 11.9 Mt (Figure 36).

Figure 36. UK public and private procurement of cement in 2021

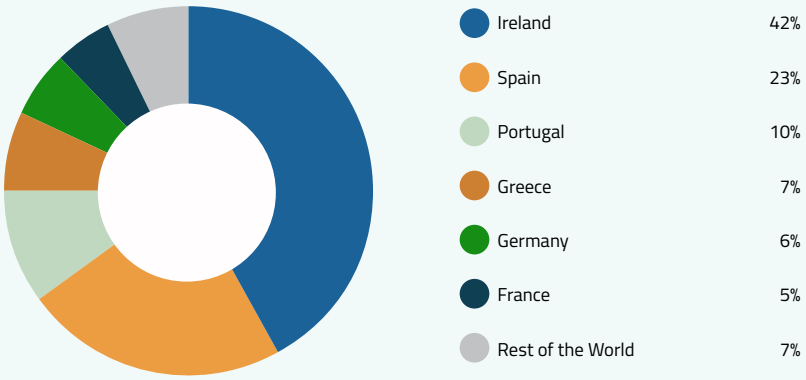


Without the availability of more granular data from the I.O. tables or other publicly available data sources, estimating directly what infrastructure project types the cement can be allocated to cannot be determined. However, based on the UK's significant investment in roadways and rail infrastructure projects in 2021, it is likely that the majority of the public procurement of cement could be attributed to these transport infrastructure investments.

The UK produced 8.4 Mt of cement in 2022, while the annual cement demand in the UK was 12 Mt that year. The UK imported 3.3 Mt of cement and 0.6 Mt of clinker, making it a net importer of cement (Global Cement 2024; Statista 2024). The CO_2 intensity of UK cement production is 641 kg CO_2/t of cement (Global Cement and Concrete Association, 2022).

Nine countries accounted for 97% of the UK's cement imports in 2022 with the top three countries (Ireland, Spain, and Portugal) accounting for 75% of imports (Figure 37). Using the amount of cement imported from each country and the CO_2 intensity of cement produced in each country from Hasanbeigi and Springer (2019), we estimated the weighted average CO_2 intensity of cement that the UK imported in 2022 (649 kg CO_2/t cement).

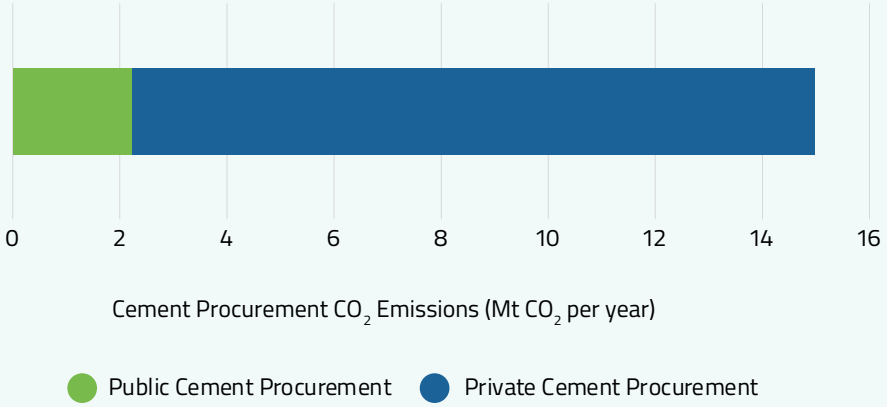
Figure 37. UK cement import in 2022 (OEC, 2024c)



Having the CO_2 intensity of cement produced in the UK and the weighted average CO_2 intensity of cement imported in 2022, and using the amounts of imported and domestically produced cement used in the UK, we calculated the weighted average CO_2 intensity of cement used in the UK in 2022 (643 kg CO_2/t cement). This was utilized to estimate the emissions associated with cement procurement in the UK.

In total, it is estimated that cement use in the UK is responsible for approximately 9.9 Mt of CO_2 emissions per year of which 2.4 Mt can be attributed to public cement consumption and 7.5 Mt to private cement consumption as shown in Figure 38.

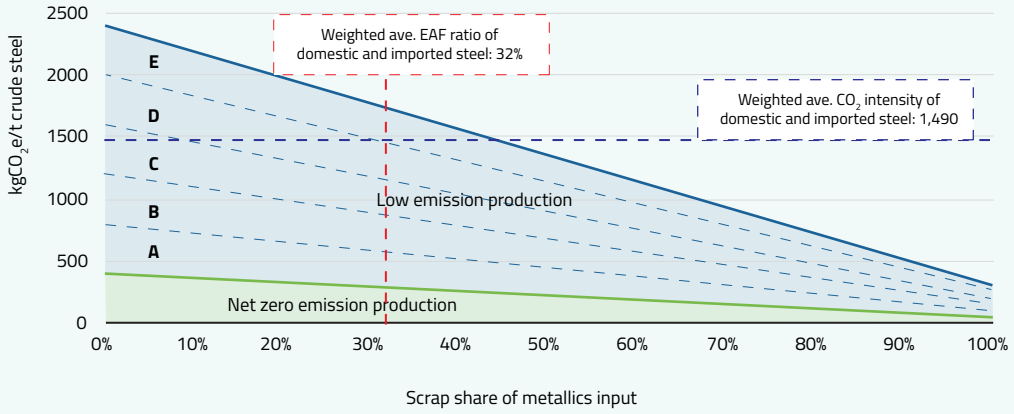
Figure 38. UK public and private CO_2 emissions from procurement of cement in 2022



4.2 The impact of UK's emissions pledge levels to the Industrial Deep Decarbonization Initiative

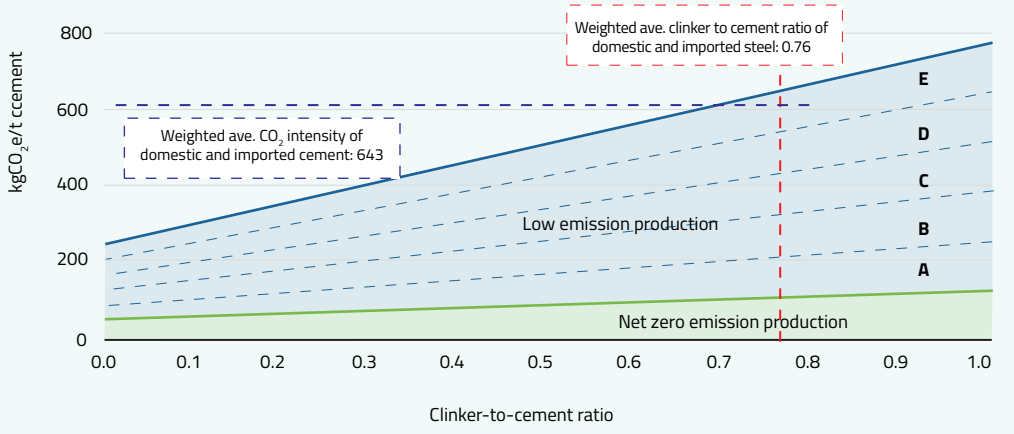
The IDDI employs the IEA's definitions for "near zero production" and "low emission" cement and steel from their report "Achieving Net Zero Heavy Industry Sectors in G7 Members" as a robust starting point (UNIDO 2023). Today, the emission intensity and share of scrap used for the UK steel industry are already considered low emissions steel under band E as shown in Figure 39 while UK cement falls just above the low emissions cement definition as shown in Figure 40.

Figure 39. Weighted average CO_2 intensity of domestic and imported steel in the UK compared to the IEA low emissions steel definitions adopted by the IDDI



Adapted from IEA (2022)

Figure 40. Weighted average CO_2 intensity of domestic and imported cement in the UK compared to the IEA low emissions cement definitions adopted by the IDDI



Adapted from IEA (2022)

Given that the IDDI has different Pledge levels, it is important to quantify what impact each of these Pledge levels may have. The following general assumptions are presented for each Pledge level in the UK in Table 4 specific to the steel and cement[2] procured by the UK government. It should be noted that no country has yet made a Pledge to Level 4 under IDDI. Also, the availability of a sufficient amount of near-zero steel and cement to meet the Level 4 Pledge is a constraint that needs to be met by the industry. See Appendix section for more explanation of impact assessment method.

Table 4. Modeling assumptions for IDDI GPP Pledge levels 1-4 in the UK

Pledge Level	Pledge Wording	CO_2 Intensity Assumption for Cement	CO_2 Intensity Assumption for Steel
Level 1	Starting no later than 2025, require disclosure of the embodied carbon in cement/ concrete and steel procured for public construction projects.	Business as usual (BAU) with 9% CO_2 intensity reduction during 2022-2050	Business as usual (BAU) with 25% CO_2 intensity reduction during 2022-2050
Level 2 **(not explicitly modeled)**	Starting no later than 2030, conduct whole project life cycle assessments for all public construction projects, and, by 2050, achieve net zero emissions in all public construction projects.	Level 2 Pledge was not explicitly modeled in this analysis.	Level 2 Pledge was not explicitly modeled in this analysis.
Level 3	Starting no later than 2030, require procurement of low emission cement/concrete and steel in public construction projects, applying the highest ambition possible under national circumstances.	CO_2 intensity decreases to the upper bound of band D by 2030, the upper bound of band B by 2040, and a higher bond of near zero band by 2050	CO_2 intensity decreases to the upper bound of band C by 2030, the upper bound of band B by 2040, and a higher bond of near zero band by 2050
Level 4	Starting in 2030, require procurement of a share of cement and/or crude steel from near zero emission material production for signature projects.	Level 3 pledge is met plus the following share of near zero cement in total public procurement in Level 4 ▪ 1% near-zero cement by 2030 ▪ 25% near-zero cement by 2040 ▪ 100% near-zero cement by 2050	Level 3 pledge is met plus the following share of near zero cement in total public procurement in Level 4 ▪ 1% near-zero steel by 2030 ▪ 30% near-zero steel by 2040 ▪ 100% near-zero steel by 2050

2 It should be noted that in the majority of cases, the government or its contractors do not purchase cement and instead purchase concrete (mainly ready-mix concrete) which is the final product used in construction projects. The values shown in this study include the cement used in concrete that is used in construction projects.

Based on the assumption shown in Table 4, we calculated the CO_2 intensity of publicly procured steel and cement in the UK under the BAU, and IDDI GPP Pledge Levels 3 and 4 (Figures 41-42).

Figure 41. CO_2 intensity of publicly procured **steel** in the BAU, and IDDI GPP Pledge Levels 3 and 4 in the UK

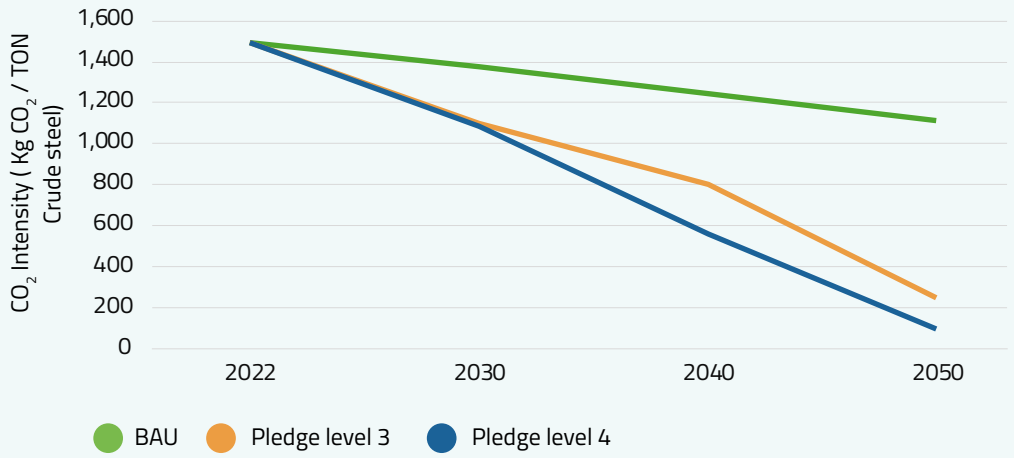
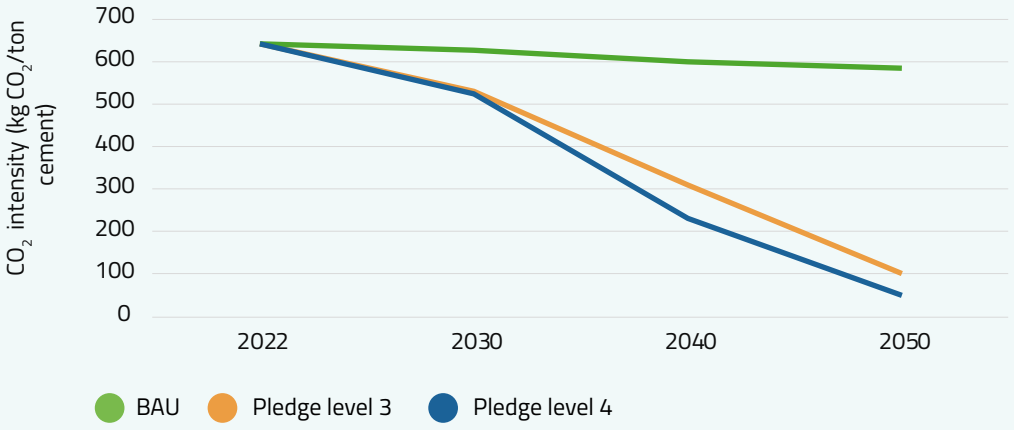


Figure 42. CO_2 intensity of publicly procured **cement** in the BAU, and IDDI GPP Pledge Levels 3 and 4 in the UK



In all scenarios, we assumed that the percentage of government procurement of steel (9%) and cement (24%) remains constant over the study period. The results of the IDDI GPP Pledge level analysis and the resulting CO_2 emissions impact associated with the BAU, and IDDI GPP Pledge Levels 3 and 4 scenarios for steel and cement are shown in Figures 43 - 44 respectively.

Figure 43. Annual CO_2 emissions related to UK public **steel** procurement under BAU and IDDI GPP Pledge Levels 3 and 4

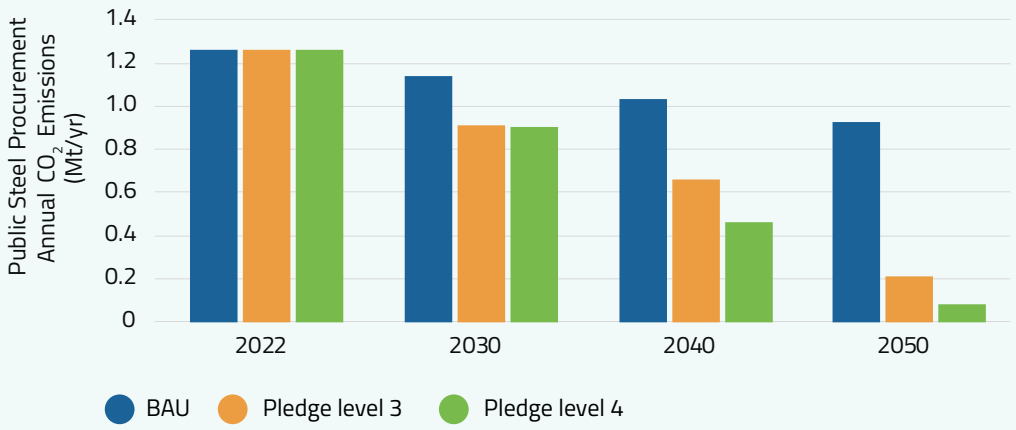
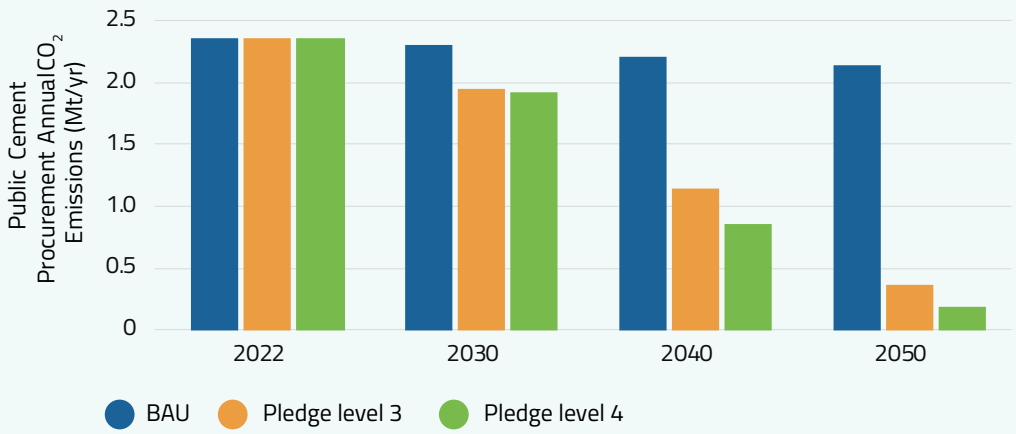


Figure 44. Annual CO_2 emissions related to UK public **cement** procurement under BAU and IDDI GPP Pledge Levels 3 and 4



As consumption of cement in the UK is already one of the largest sources of CO_2 emissions from the industrial sector, and due to the significant scale of cement procurement by the government relative to steel, the greatest impact on emission reduction is seen by the GPP of cement. Through 2030, commitments to GPP Pledge level 3 or 4 do not demonstrate a significant difference from each other. However, by 2040, commitments to GPP Pledge levels 3 and 4 both result in a substantial reduction in CO_2 emissions.

The annual CO_2 emissions associated with UK government procurement of steel would drop from 1.3 Mt CO_2/year in 2022 to 0.2 Mt CO_2/year in 2050 under GPP Pledge Level 3 (84% reduction) and would further drop to 0.1 Mt CO_2/year in 2050 under GPP Pledge Level 4 Pledge (93% reduction) (Figure 43).

For the cement procurement, the annual CO_2 emissions associated with UK government procurement of cement would decrease from 2.4 Mt CO_2/year in 2022 to 0.4 Mt CO_2/year by 2050 under the GPP Pledge Level 3 (83% reduction) and would drop to 0.2 Mt CO_2/year by 2050 under the GPP Pledge Level 4 (92% reduction) (Figure 44).

The indirect CO_2 emissions reduction could be substantially higher because of the impact that the green public procurement of steel and cement would have to transfer the entire market including the steel and cement used in non-public construction.

5. United States

5.1 The scale of US government procurement of steel and cement/ concrete

The United States (US) is the world's third largest consumer of steel, behind China and India, demanding 94.5 Mt of finished steel products in 2022. The US is also the world's fourth largest producer of crude steel producing 80.5 Mt in the same year (World Steel Association, 2023). The US is also the 4th largest producer of cement globally with approximately 93 Mt produced in 2022 and consumed an estimated 120 Mt (USGS, 2024a). The US industrial sector was responsible for 30% of the US energy-related CO_2 emissions of which the production of steel accounted for 7% and cement accounted for 3% of total industrial CO_2 emissions (US DOE 2022).

The US Federal government is the largest direct purchaser in the world, spending $700 billion annually. In the US, public procurement accounted for 12% of the GDP and 18% of the nation's emissions can be attributed to public construction projects in 2012. The US government has recognized the important role that its procurement of these products can have in encouraging the adoption of low-carbon production methods. Under the Biden-Harris administration, the US announced its Federal Buy Clean Initiative in September of 2022. The initiative prioritizes the purchase of key low-carbon construction materials by the US Federal Government for use in public infrastructure, from buildings to roads to dams. It is estimated that the Buy Clean Initiative could directly reduce 1-5 million tonnes of CO_2 emissions from the cement industry alone with the potential to reach up to 39 million tonnes of CO_2 emissions reduction in indirect impacts as US concrete manufacturing companies decarbonize to meet federal government project demands (Hasanbeigi & Sibal, 2023a)

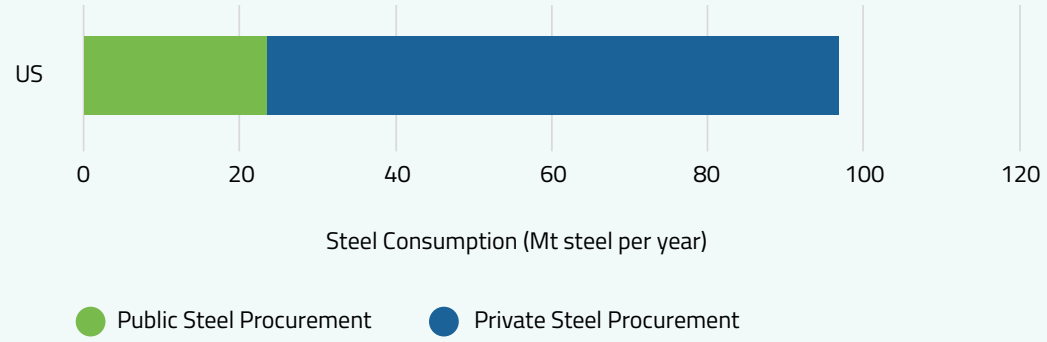
As directed by the Inflation Reduction Act (IRA) and in accordance with the Federal Buy Clean Initiative, the US Environmental Protection Agency (EPA) is setting numerical targets for the CO_2 intensity of steel, cement/concrete, asphalt, and glass that meet more stringent CO_2 intensity thresholds to receive funding from the 2022 IRA (Office of the Federal Chief Sustainability Officer, 2023).

This analysis provides updated estimates on the scale of US government procurement of steel and cement/concrete based on recently released (2024) detailed US 402 Industries I.O. tables covering the year 2017 input-output data adjusted to 2022 (US BEA, 2024). Publication of the US 402 Industries I.O. tables has historically been published every five years with a 7-year lag time due in part to the high level of detail within the reports. The I.O. tables released by the US Bureau of Economic Analysis (BEA) are among the most detailed in the world, containing more than 400 lines of inputs and outputs cataloging public and private spending across the US economy. Within this dataset both the spending on manufacturing of steel and cement/ concrete products is detailed along with construction spending on various infrastructure products (transport structures, educational structures, residential and non-residential structures, etc) of which steel and cement/concrete procurement constitute significant proportions of this spend. The US I.O. tables additionally provide data on the spend by the private sector, as well as by federal, state, and local governments. The process followed for specifically abstracting this updated information from the 2017 US tables was first published by Hasabeigi and Khutal in 2021 which used the most updated I.O. tables at the time for 2012 (Hasanbeigi & Khutal, 2021).

5.1.1 Steel procurement in the US

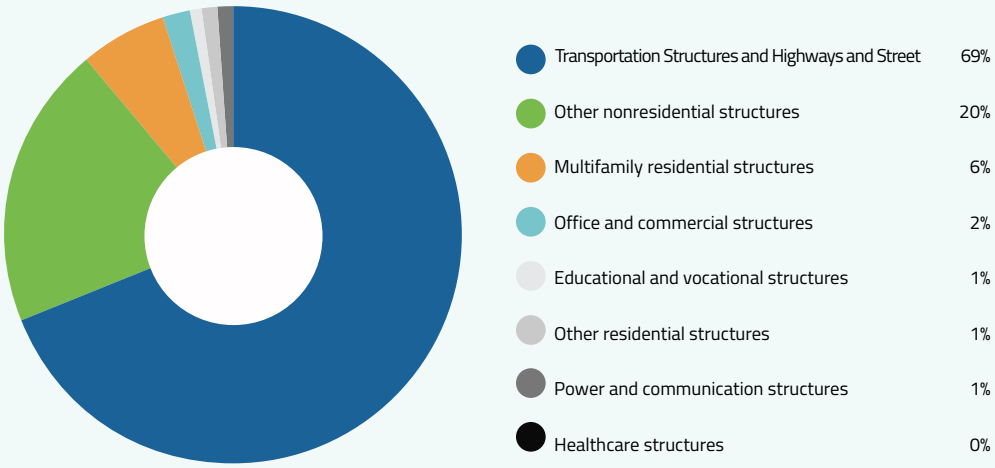
Our analysis based on BEA's 2017 detailed I.O. tables showed that public procurement was responsible for around 24% of US steel procurement in 2017. The apparent US consumption of finished steel products in 2022 was 96.9 Mt (USGS 2024). Assuming the public share of steel procurement remained the same, we estimate public procurement of steel as 23.6 Mt while private procurement of steel accounted for 73.3 Mt in 2022 as shown in Figure 45.

Figure 45. US public and private procurement of steel in 2022
(This analysis is based on US BEA 2024 and USGS 2024)



Based on the reported data in BEA's 2017 detailed I.O. tables, of the US government procurement of steel, the overwhelming majority of steel procurement goes towards the transportation structures, highways, and roads at 68.7%. The remaining steel procurement goes towards government funded structures where in total 7.1% goes towards residential construction and the remaining 24.2% goes towards non-residential construction as shown in Figure 46.

Figure 46. US government procurement of steel by major construction sector
(This analysis is based on US BEA 2024)

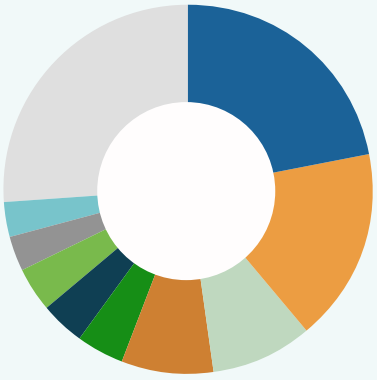


The US produced 80.5 Mt of steel in 2022, while the annual steel demand was 96.9 Mt. The US imported 5.2 Mt of steel in the same year, making it a net importer of steel (USGS 2024a). Approximately 71% of US steel production is via Electric Arc Furnace (EAF). The average CO_2 intensity of steelmaking in the US in 2022 is estimated at 936 kg CO_2 per tonne of crude steel, based on the intensity values provided by Hasanbeigi (2022) and the share of EAF steelmaking. It should be noted that the high share of EAF steel production in the US is quite unusual. In most major steel-producing countries around the world, the share of EAF steel production is much lower because of the limited steel scrap available. Therefore, because of this advantage of having higher EAF steelmaking, the overall CO_2 intensity of the steel industry in the US is among the lowest in the world.

Nine countries accounted for 74% of the steel imported by the US in 2022 (Figure 47). Using the amount of steel imported from each country and the rest of the world, along with the CO_2 intensity of steel produced in each country from Hasanbeigi (2022), we estimated the weighted average CO_2 intensity of steel imported by the US in 2022 to be 1,413 kg CO_2 per tonne of crude steel.

Using the CO_2 intensity of steel produced in the US and the weighted average CO_2 intensity of steel imported in 2022, along with the amount of imported steel and domestically produced steel used in the US, we calculated the weighted average CO_2 intensity of steel used in the US in 2022 to be 1,061 kg CO_2 per tonne of crude steel. This calculation is utilized to estimate the emissions associated with steel procurement in the US.

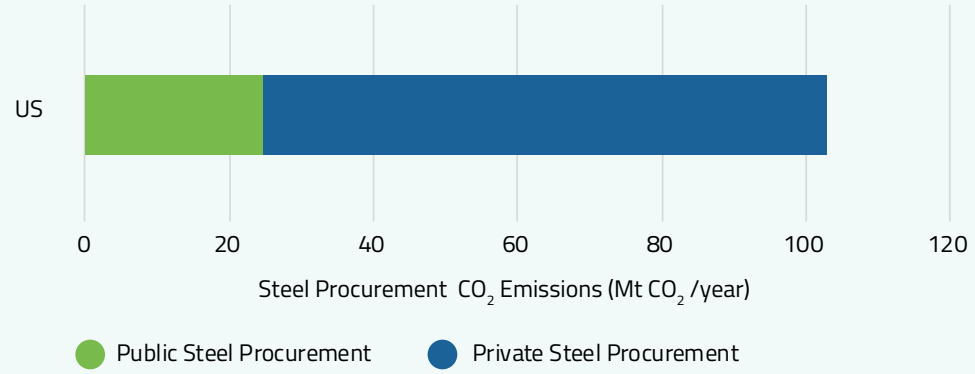
Figure 47. US import of steel mill products in 2022 (USGS, 2024b)



Canada	22%
Mexico	17%
South Korea	9%
Brazil	8%
Japan	4%
Germany	4%
Taiwan	4%
Turkey	3%
Vietnam	3%
Rest of the World	26%

Figure 48 illustrates the annual CO_2 emissions associated with total steel demand in the US totaling approximately 103 Mt CO_2/year where public procurement of steel is responsible for 25 Mt CO_2/year with private sector steel procurement responsible for the other 78 Mt CO_2/year.

Figure 48. Annual CO_2 emissions from public and private procurement of steel in the US in 2022

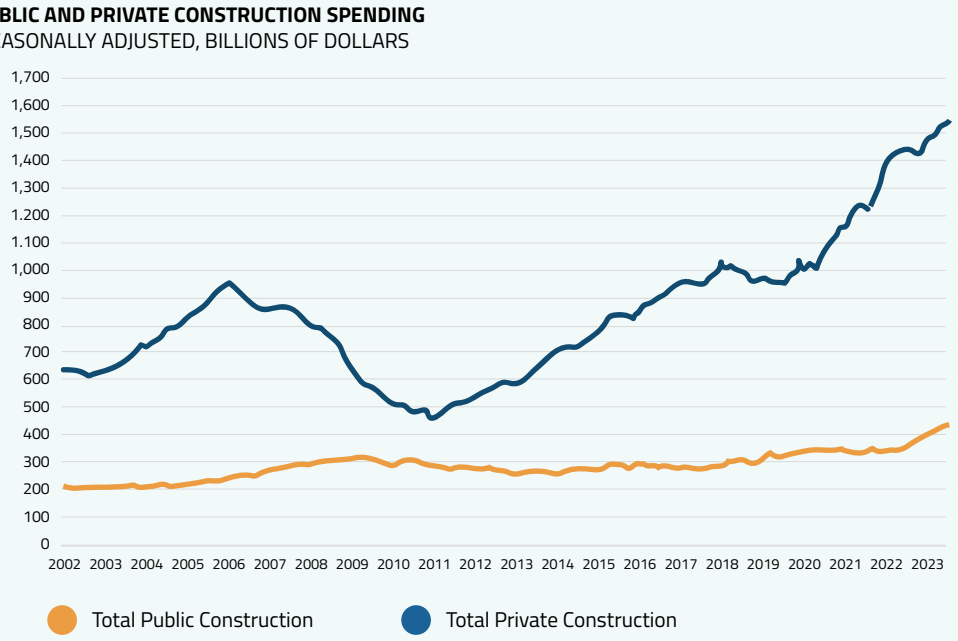


5.1.2. Cement and concrete procurement in the US

The proportion of government's (including federal, state, and local) procurement spending in the total procurement spending on cement and concrete for construction in the US based on BEA's 2017 402 Industries I.O. tables was estimated to be 23% in 2017. This is substantially lower than the 42% estimated by Hasanbeigi & Khutal, 2021 for the share of cement and concrete used in public construction in 2012 based on most BEA's 2012 detailed I.O. tables. A significant shift was observed between the 2012 to 2017 I.O. for the construction sector in that private construction spending grew significantly, while publicly funded construction grew at a slower pace. For example, private spending on non-residential buildings grew by more than 300%, while public construction spending grew by about 50%.

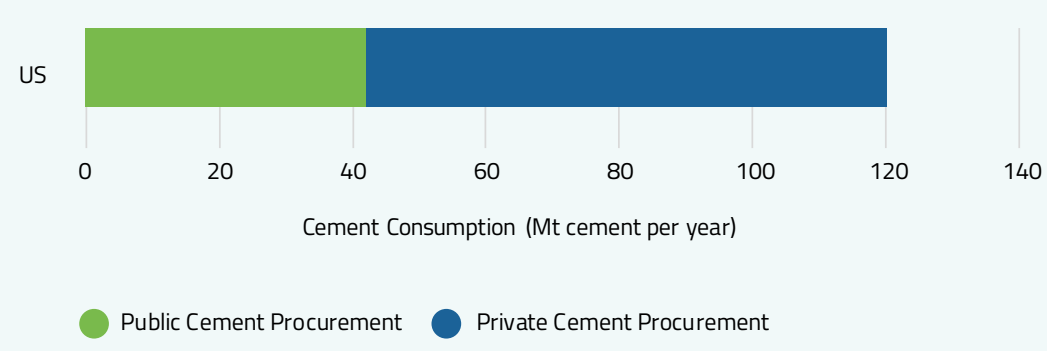
Additionally, private multifamily residential construction grew more than 1000% while public grew 300%. Transport construction (making up about 60% of public cement spending) grew only slightly between 2012 and 2017. One reason why the share of public construction from total cement consumption was higher in 2012 could be explained by changes in the US economy. Between 2011 and 2015 there was significant government spending on infrastructure projects after the 2008 financial crisis to stimulate the economy driven by the real estate market. Therefore the private sector spending and construction was also unusually low during the time after the market recession. An example of such significant changes in construction sector spending can be seen in Figure 49, highlighting that private construction was near its lowest point in many years in 2012, and grew significantly thereafter, while public construction spending grew very little.

Figure 49. Public and private construction spending in the US between 2002 and 2023
(Kingsley, 2023)



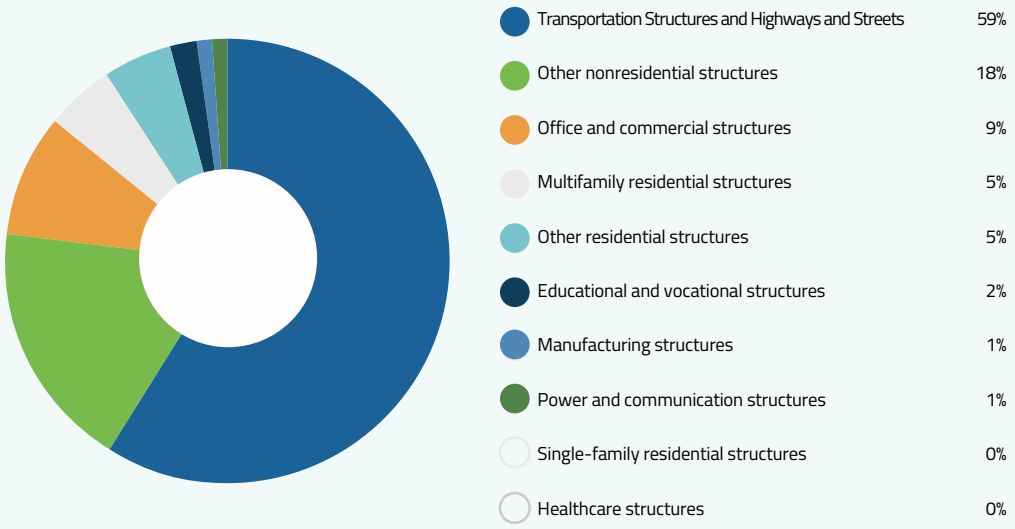
The Portland Cement Association (PCA) (2016) reports that between 2011 and 2015, on average around 46% of cement in the US was used for public construction (Portland Cement Association, 2016). Because of the lack of more recent data on the scale of government procurement for cement, for this analysis, we have decided to use the average of the value we obtained from BEA's 2017 detailed I.O. tables (23%) and the value reported in PCA (2016) (46%). From this, we estimate that around 35% of cement will be used for government-funded construction projects in the US in 2022. The total cement consumption in the US was 120 Mt in 2022. Therefore, the government-funded procurement for cement was about 42 Mt while the private sector procured the remaining 78 Mt in 2022 as shown in Figure 50.

Figure 50. US public and private procurement of cement in 2022
(This analysis is based on US BEA 2024 and USGS 2024)



Based on the reported data in BEA's 2017 detailed I.O. tables, the majority of the government consumption of cement (58.8%) can be attributed to the construction of transport structures, highways, and streets. A significant portion of government consumption of cement goes towards government funded residential structures in the US at 10.6% while the remaining 30.6% goes towards the construction of non-residential structures.

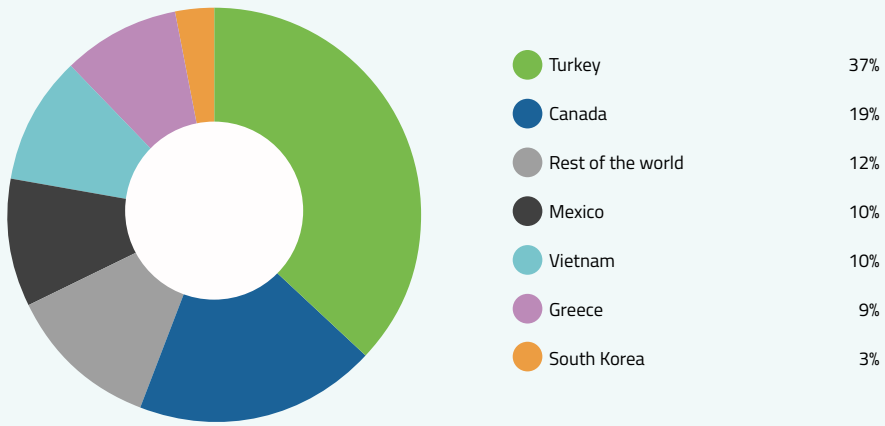
Figure 51. US government procurement of cement by major construction sector
(This analysis is based on US BEA 2024)



The US produced 93 Mt of cement in 2022, while the annual cement demand was 120 Mt that year. The US imported 25 Mt of cement and 1 Mt of clinker, making it a net importer of cement (USGS 2024b). The CO_2 intensity of US cement production is 750 kg CO_2 per tonne of cement (Global Cement and Concrete Association, 2022; US DOE, 2022)

Six countries accounted for 93% of the US's cement imports in 2022, with the top two countries (Turkey and Canada) accounting for 65% of imports (Figure 52). Using the amount of cement imported from each country and the CO_2 intensity of cement produced in each country from Hasanbeigi and Springer (2019) and GCCA (2022), we estimated the weighted average CO_2 intensity of cement imported by the US in 2022 to be 649 kg CO_2 per tonne of cement.

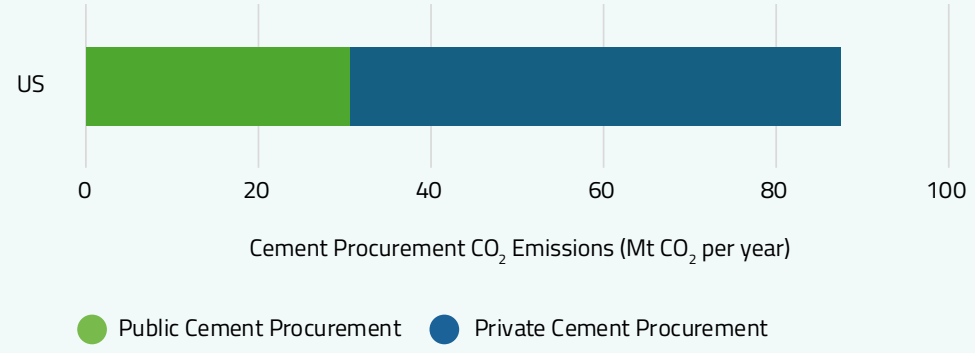
Figure 52. US cement import in 2022 (USGS, 2024a)



Having the CO_2 intensity of cement produced in the US and the weighted average CO_2 intensity of cement imported in 2022, and using the amounts of imported and domestically produced cement used in the US, we calculated the weighted average CO_2 intensity of cement used in the US in 2022 (729 kg CO_2/t cement). This was utilized to estimate the emissions associated with cement procurement in the US

In total, it is estimated that cement use in the US is responsible for approximately 87.5 Mt of CO_2 emissions per year of which 30.6 Mt CO_2 can be attributed to public cement consumption and 56.9 Mt to private cement consumption as shown in Figure 53.

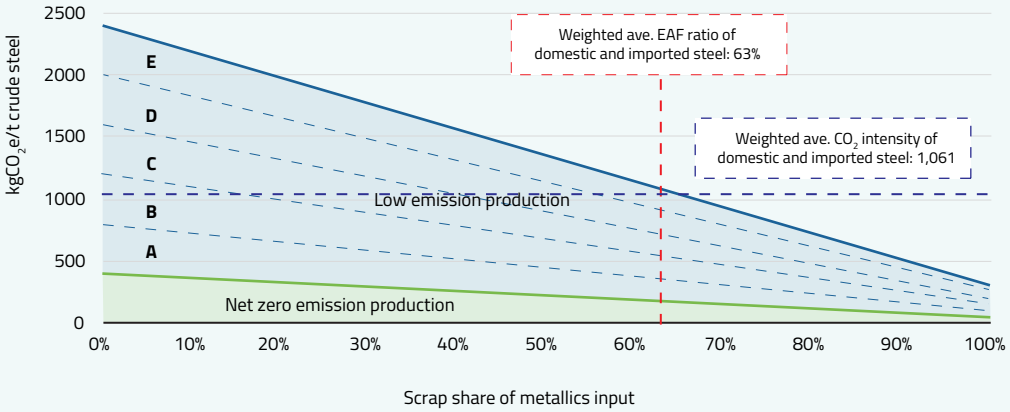
Figure 53. Annual CO_2 emissions from public and private procurement of **cement** in the US in 2022



5.2 The impact of the US's emissions pledge levels to the Industrial Deep Decarbonization Initiative

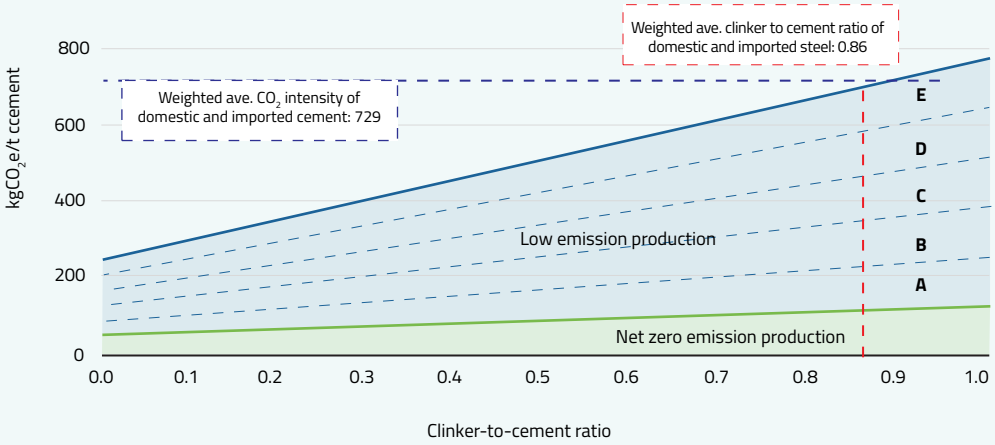
The IDDI employs the IEA's definitions for "near zero production" and "low emission" cement and steel from their report "Achieving Net Zero Heavy Industry Sectors in G7 Members" as a robust starting point (UNIDO 2023). Given the weighted average emission intensity and share of scrap, the steel used in the US is already considered low emissions steel under band E as shown in Figure 54 while the cement used in the US falls just above the low emissions cement (band E) definition as shown in Figure 55.

Figure 54. Weighted average CO_2 intensity of domestic and imported steel in the US compared to the IEA low emissions **steel** definitions adopted by the IDDI



Adapted from IEA (2022)

Figure 55. Weighted Average CO_2 intensity of domestic and imported cement in the US compared to the IEA low emissions **cement** definitions adopted by the IDDI



Adapted from IEA (2022)

Given that the IDDI has different Pledge levels, it is important to quantify what impact each of these Pledge levels may have. The following general assumptions are presented for each Pledge level in the US in Table 5 specific to the steel and cement[3] procured by the US government. It should be noted that no country has yet made a Pledge to Level 4 under IDDI. Also, the availability of a sufficient amount of near-zero steel and cement to meet the Level 4 Pledge is a constraint that needs to be met by the industry. See Appendix section for more explanation of impact assessment method.

Table 5. Modeling assumptions for IDDI GPP Pledge levels 1-4 in the US

Pledge Level	Pledge Wording	CO_2 Intensity Assumption for Cement	CO_2 Intensity Assumption for Steel
Level 1	Starting no later than 2025, require disclosure of the embodied carbon in cement/ concrete and steel procured for public construction projects.	Business as usual (BAU) with 10% CO_2 intensity reduction during 2022-2050	Business as usual (BAU) with 28% CO_2 intensity reduction during 2022-2050
Level 2 **(not explicitly modeled)**	In addition to Level 1, Starting no later than 2030, conduct whole project life cycle assessments for all public construction projects, and, by 2050, achieve net zero emissions in all public construction projects.	Level 2 Pledge was not explicitly modeled in this analysis.	Level 2 Pledge was not explicitly modeled in this analysis.
Level 3	In addition to Levels 1 and 2, Starting no later than 2030, require procurement of low emission cement/concrete and steel in public construction projects, applying the highest ambition possible under national circumstances.	CO_2 intensity decreases to the upper bound of band D by 2030, the upper bound of band B by 2040, and a higher bond of near zero band by 2050	CO_2 intensity decreases to the upper bound of band D by 2030, the upper bound of band B by 2040, and a higher bond of near zero band by 2050
Level 4	In addition to Levels 1, 2, and 3, Starting in 2030, require procurement of a share of cement and/or crude steel from near zero emission material production for signature projects.	Level 3 pledge is met plus the following share of near zero cement in total public procurement in Level 4 ▪ 1% near-zero cement by 2030 ▪ 25% near-zero cement by 2040 ▪ 100% near-zero cement by 2050	Level 3 pledge is met plus the following share of near zero cement in total public procurement in Level 4 ▪ 1% near-zero steel by 2030 ▪ 30% near-zero steel by 2040 ▪ 100% near-zero steel by 2050

3 It should be noted that in the majority of cases, the government or its contractors do not purchase cement and instead purchase concrete (mainly ready-mix concrete) which is the final product used in construction projects. The values shown in this study include the cement used in concrete that is used in construction projects.

Based on the assumption shown in Table 5, we calculated the CO_2 intensity of publicly procured steel and cement in the US under the BAU, and IDDI GPP Pledge Levels 3 and 4 (Figures 56-57).

Figure 56. CO_2 intensity of publicly procured **steel** in the BAU, and IDDI GPP Pledge Levels 3 and 4 in the US

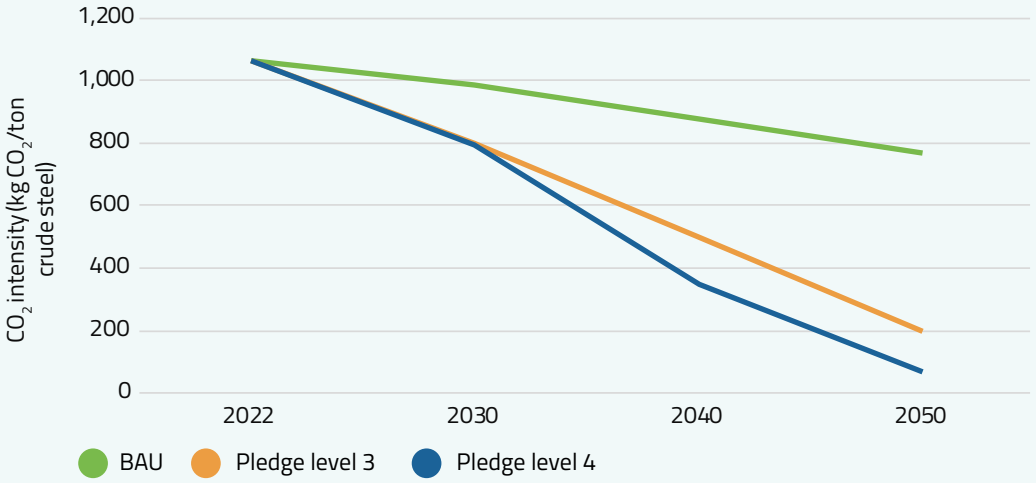
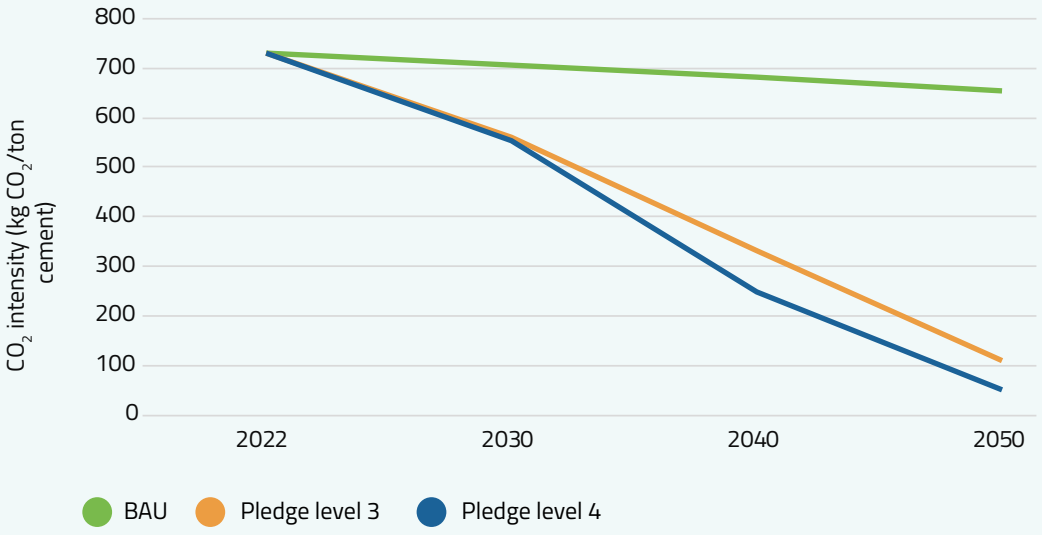


Figure 57. CO_2 intensity of publicly procured **cement** in the BAU, and IDDI GPP Pledge Levels 3 and 4 in the US



Results of the IDDI GPP Pledge level analysis and the resulting CO_2 emissions impact associated with the BAU, and IDDI GPP Pledge Levels 3 and 4 scenarios for steel and cement are shown in Figures 58 - 59 respectively.

Figure 58. Annual CO_2 emissions related to US public **steel** procurement under BAU and IDDI GPP Pledge Levels 3 and 4

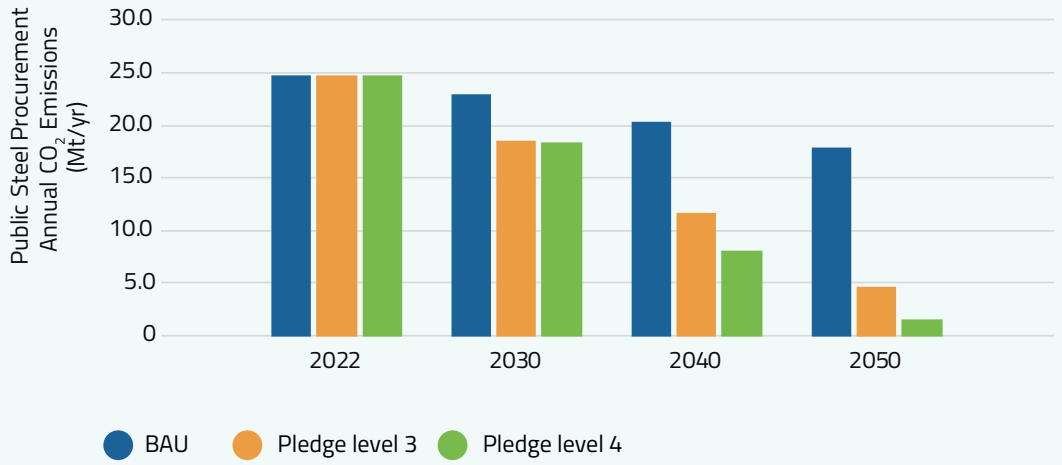
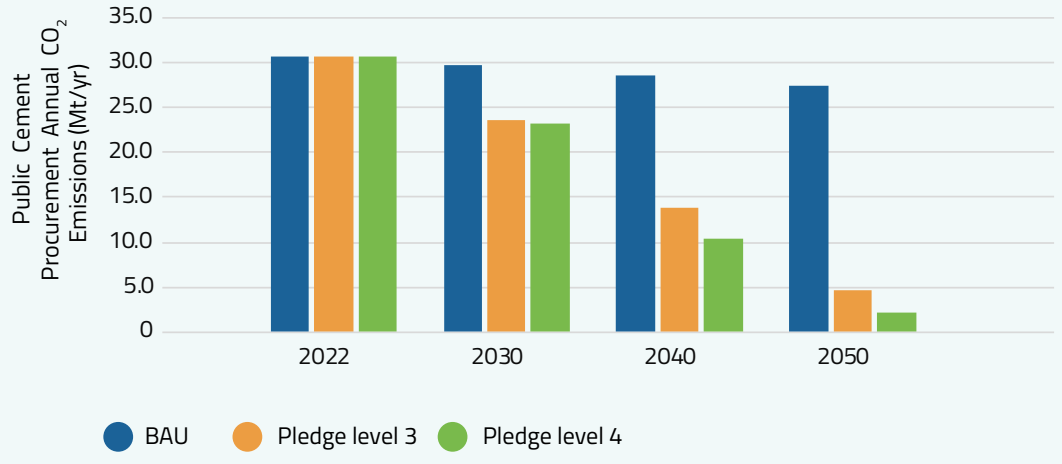


Figure 59. Annual CO_2 emissions related to US public **cement** procurement under BAU and IDDI GPP Pledge Levels 3 and 4



As can be seen from the figures, through 2030, a commitment to GPP Pledge Level 3 or 4 does not show a significant difference between each other. However, by 2040, Pledges to GPP Pledge Levels 3 and 4 both result in a substantial reduction in CO_2 emissions.

The annual CO_2 emissions associated with government procurement of steel would drop from 24.7 Mt CO_2/year in 2022 to 4.7 Mt CO_2/year in 2050 under a GPP Level 3 Pledge (81% reduction), and would further drop to 1.6 Mt CO_2/year by 2050 under an GPP Level 4 Pledge (93% reduction) (Figure 58).

For cement procurement, the annual CO_2 emissions associated with government procurement of cement would decrease from 30.6 Mt CO_2/year in 2022 to 4.6 Mt CO_2/year by 2050 under an GPP Level 3 Pledge (53% reduction) and would drop to 2.1 Mt CO_2/year by 2050 under an GPP Level 4 Pledge (93% reduction) (Figure 59).

The indirect CO_2 emissions reduction could be substantially higher due to the impact that green public procurement of steel and cement would have on transforming the entire market, including the steel and cement used in non-public construction.

6. Conclusions and recommendations

The adoption of GPP policies for low-carbon steel, cement, and concrete is pivotal for driving substantial reductions in CO_2 emissions, particularly within the construction industry. As major consumers of these materials, governments play a critical role in incentivizing the market to shift towards low-carbon alternatives, while also establishing the frameworks necessary for achieving long-term climate goals.

This report examines the role of public procurement in reducing CO_2 emissions from the steel and cement industries in four countries: Canada, Germany, the UK, and the US. In Canada, public procurement constitutes 25% of steel demand and 26% of cement demand, with potential emissions reductions to 0.8 Mt CO_2/year for steel and 0.3 Mt CO_2/year for cement by 2050 under GPP Pledge Level 3. Germany's smaller public procurement share could still lower steel emissions from 2.3 Mt to 0.4 Mt CO_2/year and cement emissions from 3.8 Mt to 0.6 Mt CO_2/year by 2050. The UK, with a smaller steel industry, could reduce steel emissions from 1.3 Mt to 0.2 Mt CO_2/year and cement emissions from 1.9 Mt to 0.3 Mt CO_2/year by 2050 under similar conditions. In the US, public procurement drives 24% of steel and 35% of cement demand, with potential reductions from 25 Mt to 4.7 Mt CO_2/year for steel and from 30.6 Mt to 4.6 Mt CO_2/year for cement by 2050.

Implementing GPP Pledge Level 3 policies in these four countries could reduce emissions from public steel procurement from 33 Mt CO_2 in 2022 to 6 Mt CO_2/year by 2050 (81% reduction), while emissions from cement procurement could fall from 39 Mt CO_2 to 6 Mt CO_2/year by 2050 (85% reduction). The GPP Pledge Level 4 would bring the emissions to near zero.

Achieving IDDI GPP Pledge Levels 3 and 4, presents considerable challenges due to the current state of decarbonization technologies in steel and cement production. Pledge Level 4 calls for near-zero emissions materials by 2030, but technologies like green hydrogen-based steelmaking (H2-DRI), carbon capture, utilization, and storage (CCUS) for the cement industry and alternative low-carbon cement production processes are not yet commercially deployed at the scale needed. Without substantial government support in the deployment of these technologies, meeting the Pledge Level 3 and 4 will be difficult.

Governments must recognize these technological and market constraints and implement policies to incentivize adoption of these near-zero-carbon technologies. Financial support through grants, tax incentives, and public-private partnerships can help accelerate the commercialization and deployment of these critical technologies. Without such measures, Pledge Level 3 and 4 will remain aspirational rather than achievable. The Inflation Reduction Act (IRA) in the US and Germany's Carbon Contracts for Difference (CCfD) are significant steps in the right direction to help the industry sector to decarbonize.

Recommendations

Develop Transparent Tracking Systems: Developing and implementing transparent tracking systems is crucial for monitoring progress in public procurement of steel and cement. Effective tracking systems should not only capture the quantity of materials procured but also assess the carbon intensity of those materials. This requires detailed reporting on the lifecycle emissions of steel and cement used in public projects. Governments should invest in digital tools and platforms to enable tracking and reporting, providing stakeholders with access to verifiable data. A standardized reporting framework across countries can further enhance transparency and comparability, ensuring that all nations can assess their progress toward IDDI goals.

Set Ambitious Procurement Targets: Setting clear and ambitious procurement targets is essential to drive market demand for low-carbon materials. Governments have immense purchasing power and can use it to push both domestic and international producers to reduce their carbon footprints. These targets should align with IDDI GPP Pledge Levels and reflect the urgency of reducing emissions. For example, governments could set intermediate targets for 2030, such as requiring a specific share of publicly procured steel and cement to come from low-emission sources. Achieving these targets would send a strong market signal and encourage industries to adopt green technologies, while also creating a level playing field for international suppliers.

Invest in Low-Carbon Technologies: While procurement policies are a powerful tool, they need to be backed by investments in low-carbon technologies. Governments must allocate funds for research, development, and deployment of technologies such as green H2-DRI steelmaking, CCUS for cement, and alternative low-carbon cement production processes such as limestone calcined clay cement. Without sufficient government intervention, these technologies may not scale quickly enough to meet demand. Policies that incentivize private investment, such as grants, tax credits, and public-private partnerships, can accelerate technological development and deployment. Moreover, governments can work with international organizations to create funding mechanisms that support low-carbon technology projects in developing countries, promoting global decarbonization efforts.

Public-Private Collaboration: Public-private collaboration is essential for achieving meaningful decarbonization across the supply chain. Governments should facilitate partnerships between public procurement agencies, steel and cement producers, technology providers, and international organizations to coordinate decarbonization efforts. Such collaboration could include joint research initiatives, knowledge-sharing platforms, and pilot projects that demonstrate the commercial viability of low-carbon technologies.

Create Incentive Programs for Low-Carbon Materials: Incentive programs can play a crucial role in driving demand for low-carbon materials. Governments should establish incentives for contractors and suppliers that use low-carbon steel and cement in public projects. This could take the form of preferential treatment in bidding processes, tax benefits, or subsidies for companies that meet certain emissions thresholds. This can be implemented under GPP or Buy Clean policies in these countries. Such incentives would encourage more companies to invest in low-carbon technologies and materials.

Promote Consistency Across International Standards: The global nature of steel and cement markets means that international cooperation is essential for decarbonization. Governments should work together to ensure consistency in how emissions are measured and reported across borders. A unified set of standards would make it easier for suppliers to meet procurement requirements in multiple countries, encouraging the production and trade of low-carbon steel and cement. This could be achieved through international agreements, such as those facilitated by initiatives like the IDDI, and organizations like UNIDO or the World Trade Organization. Consistent GHG emissions accounting methodologies and standards would help level the playing field for global producers and reduce the administrative burden on companies working across multiple markets.

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Appendix. Methodology for emissions impact analysis

Given that the IDDI has different pledge levels, it is important to quantify the impact each of these Pledge levels may have. The following general assumptions are presented for each Pledge level in each country in the tables in each impact assessment section, specific to the publicly procured steel and cement in each country. It should be noted that no country has yet made a Pledge to Level 4 under the GPP Pledge. Additionally, the availability of a sufficient amount of near-zero steel and cement to meet the Level 4 Pledge is a constraint that needs to be addressed by the industry.

The CO_2 intensity reductions for different pledge levels under the IDDI GPP Pledge framework are not derived from a single data point but are the result of an analysis and expert judgment based on several steel and cement decarbonization roadmaps developed across different countries. These roadmaps outline the potential pathways for reducing emissions, considering the unique technological, policy, and market conditions in each region. By aligning the trajectory of CO_2 intensity reductions with the GPP pledge levels, we have used a blend of historical data, current trends, and future projections to estimate reasonable CO_2 intensity reduction path.

In terms of approach, the reductions are phased: we aim for more conservative targets by 2030, as this timeframe allows only limited technological and infrastructural shifts. However, as we look toward 2040 and 2050, the roadmap anticipates more aggressive reductions, driven by scaling of new technologies such as hydrogen-based steelmaking, increased use of alternative cementitious materials, and potential adoption of CCUS technology. These projections are tailored to the starting CO_2 intensities in 2022 for each country, meaning the trajectory will differ based on each country's progress and capabilities. The rationale is that, while early reductions are slower due to the time required to implement low-carbon technologies, later reductions can accelerate as these technologies mature and industry-wide adoption increases. The industry roadmaps give us the guiding point to adjust these trajectories based on national circumstances, aligning them with realistic, yet ambitious, targets. All four studied countries have net zero GHG emissions by 2050 targets. Therefore, a substantial reduction in CO_2 intensity will be needed to achieve these national targets as well.

Based on the assumption shown in tables in the main body of the report for each country, we calculated the CO_2 intensity of publicly procured steel and cement in each country under the BAU, and GPP Pledge Levels 3 and 4.

It should be noted that in the majority of cases, the government or its contractors do not purchase cement and instead purchase concrete (mainly ready-mix concrete) which is the final product used in construction projects. The values shown in this study include the cement used in concrete that is used in construction projects.

Table A.1. IDDI GPP Pledge levels 1-4

Pledge Level	Pledge Wording
Level 1	Starting no later than 2025, require disclosure of the embodied carbon in cement/ concrete and steel procured for public construction projects.
Level 2 (not explicitly modeled)	In addition to Level 1, Starting no later than 2030, conduct whole project life cycle assessments for all public construction projects, and, by 2050, achieve net zero emissions in all public construction projects.
Level 3	In addition to Levels 1 and 2, Starting no later than 2030, require procurement of low emission cement/concrete and steel in public construction projects, applying the highest ambition possible under national circumstances.
Level 4	In addition to Levels 1, 2, and 3, Starting in 2030, require procurement of a share of cement and/or crude steel from near zero emission material production for signature projects.

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