Comparison of embodied greenhouse gas emissions data from environmental product declarations and the EPiC database: implications for material selection

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Abstract: Architects and other construction industry professionals are increasingly seeking to reduce the embodied greenhouse gas (GHG) emissions of construction projects. To support this goal, reliable and comprehensive data is needed on material performance. There are various sources of this data currently being used, including Environmental Product Declarations (EPDs), and material life cycle inventory (LCI) databases, such as the Environmental Performance in Construction (EPiC) Database. Many LCI databases rely on manufacturer-specific data (common also with EPDs) but suffer from inherent data gaps. The EPiC Database is unique as it uses macro-economic input-output data, as part of a hybrid approach, to fill the gaps in LCI and EPD data to ensure comprehensive supply chain coverage. Due to this, data can vary considerably between EPDs and the EPiC Database. However, no study has compared these two data sources. The aim of this study was to compare the embodied GHG emissions coefficients provided by EPDs and the EPiC Database and assess the effect on material selection decisions. EPDs for Australian ready-mix concrete products were analysed and compared to hybrid GHG emissions coefficients for equivalent products within EPiC. It was shown that while hybrid coefficients are generally always higher than coefficients from EPDs, the overall trend between products was relatively consistent. On average, EPD coefficients represent 78% of the equivalent hybrid coefficient, ranging from 38 to 115%, highlighting the incompleteness associated with EPD data. The large variability in GHG emissions coefficients between EPD products of similar type means that product specific EPD data may not provide any more guidance to material selection than what the generic EPiC product data provides. EPiC data may provide very useful initial guidance for material selection, while comparison of materials based on EPDs from different manufacturers may be misleading, also questioning the compliance of EPDs with the requirements of the international standard EN 15804.

Keywords: Embodied greenhouse gas emissions; environmental product declaration; EPiC Database; hybrid life cycle assessment.

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1. Introduction

The contribution of construction projects to global environmental issues is well documented and significant. Buildings alone account for around 37% of global greenhouse gas (GHG) emissions and 36% of global energy demand (UNEP, 2021). Historically, efforts to improve the environmental performance of construction projects have focused on increasing the operational efficiency of buildings, through passive design, improvements to the thermal envelope, and integration of energy efficient appliances and systems (Karimpour *et al.*, 2014). While significant reductions in operational-related GHG emissions have been achieved within the built environment, these have been largely offset by an increasing demand for built assets due to a growing global population (GlobalABC *et al.*, 2019, p. 15). This has also further exacerbated the demand for materials, increasing material embodied GHG emissions. Only recently has reducing these embodied GHG emissions become a key priority for the construction industry.

To ensure embodied GHG emissions reductions are being achieved, material selection decisions must rely on robust, comprehensive data on a material's embodied GHG emissions. Historically, in Australia, this data has been difficult to access, limited to a small range of materials, or based on incomplete coverage of the material's supply chain (Crawford *et al.*, 2020). In recent years, data providers have attempted to address some of these issues. Environmental Product Declarations, known as EPDs, have emerged to provide data on the environmental performance of a much broader range of materials and products. Databases containing embodied GHG emissions coefficients for materials are also becoming more accessible and covering a growing variety of materials.

Despite the growing prevalence of embodied GHG emissions data for construction materials, this data continues to suffer from a range of limitations (see Section 2.3). For example, EPD data can be collated based on an approach that results in inconsistent and incomplete coverage of a material's supply chain, thus underestimating the related GHG emissions. Hybrid data (such as that contained within the Environmental Performance in Construction (EPiC) Database (Crawford *et al.*, 2019)) is designed to fill these data gaps but can suffer from a lack of representativeness for specific materials (see Section 2.2). Material specifiers are often confused by the difference in values that different data sources provide, and how and at what point the data can best be used. Considering the discrepancies between existing sources of data and potentially different material selection implications, it is important to understand the extent of difference between the values in commonly used data sources, the reasons for these differences, and the potential effect of relying on a data source over another for material selection decisions.

Therefore, the aim of this study was to compare the embodied greenhouse gas emissions coefficients provided by EPDs and the EPiC Database and assess the effect on material selection decisions.

2. Environmental data for materials

2.1. Key drivers

Understanding the implications of the use of different construction materials on the environment is of increasing importance and interest, globally. This is particularly pertinent in the context of climate change and the critical urgency to reduce global greenhouse gas emissions (IPCC, 2018). Construction materials are produced as part of a series of stages that involve harvesting or extracting raw materials from the earth, processing these raw materials, and transforming the processed raw materials into construction materials through various manufacturing processes. For most materials, each of these stages relies on the use of fossil fuels as an energy input. The resultant GHG emissions from the production and use of this energy is attributed to each unit of material that is produced, and commonly known as a material's embodied GHG emissions. For some materials, such as concrete and timber, additional GHG emissions that are not related to the use of fossil fuels are also released due to the harvesting or manufacturing processes. These also form part of the embodied GHG emissions of these materials. In addition, indirect processes, such as insurance, advertising, food production and others, also contribute to embodied GHG emissions of construction materials.

The embodied GHG emissions of materials have been acknowledged and studied for many decades (Azari and Abbasabadi, 2018). However, the construction industry has only recently considered it a serious issue to be addressed. The World Green Building Council has established targets for reducing the embodied GHG emissions of buildings – by 40% by 2030 and 100% by 2050 (Adams *et al.*, 2019). Australia's 2021 National Standard of Competency for Architects (NSCA) requires architects to 'demonstrate an understanding of whole life carbon implications of procurement methods, materials, components and construction systems' (PC10) and 'be able to assess embodied carbon implications of materials, components, construction systems and supply chains (including transport) to achieve net zero whole life carbon when developing design concepts' (PC35) (AACA, 2021). To support this strengthened focus on embodied GHG emissions, numerous countries have implemented policies to reduce these emissions, as outlined in part by Skillington *et al.* (2022), which will likely become more prevalent in the future.

To support these ambitious targets and mandates, decision-makers will require detailed embodied GHG emissions data for a broad range of construction materials and products. Robust, comprehensive, comparable, transparent data will help support decisions around material and product selection, leading to reductions in embodied GHG emissions. The next section discusses the various sources of this data and some of the pros and cons associated with their use.

2.2. Source of environmental data

Embodied GHG emissions data for construction materials and products can be sourced directly from the organisations involved in the various mining, processing, and manufacturing stages of a material. While this data, known as process data, is considered to be more specific (Suh *et al.*, 2004), collecting it on a project-by-project basis can be time-consuming and costly. As this data rarely changes from project to project, it can be collated less regularly and reused across projects. This data is often collected and reported in the development of LCI databases or EPDs.

Process data sources

The most comprehensive source of process data for Australian produced materials is the Australian Life Cycle Inventory Database (AusLCI) (ALCAS, 2019). Information on the quantity of various greenhouse gases associated with the different stages of a material's production are provided, which when combined and converted to carbon dioxide equivalent, provide a total embodied GHG emissions coefficient for a material in kg CO_2e/unit. The data is highly disaggregated and transparent, so it is possible to identify emissions hotspots across the material supply chain. To improve accessibility to environmental data, databases of process-based coefficients have been produced (e.g., Lawson (1996)). These coefficients are easily multiplied by the quantity of specific materials within a construction project to provide an estimation of its total environmental flows.

EPDs are usually produced by life cycle assessment consultants on behalf of product manufacturers. EPDs disclose a range of environmental data associated with a product, often including embodied GHG emissions. The published EPD is less transparent and detailed than traditional LCI data. It generally cannot be used to identify emissions hotspots, other than specific life cycle stages. EPDs for construction products are generally produced in accordance with EN 15804 (CEN, 2019). The two main sources for EPDs of Australian products is EPD Australasia (EPD Australasia, 2022) and Global GreenTag (GGTI, 2022).

Other data sources

Other types and sources of embodied GHG emissions data are also available. These have typically been developed to address truncation issues that exist with process data, where many smaller goods, and services-based processes are excluded due to the complexity of the supply chain (Lenzen and Dey, 2000; Majeau-Bettez *et al.*, 2011). Input-output data, based on macro-economic transactions between sectors, is available within the IELab (Wiedmann, 2017) and can be used to provide a top-down and more comprehensive assessment of a material's embodied GHG emissions, yet with reduced reliability and relevance to specific products (Lenzen, 2000). Hybrid data combines process and input-output data, maximising the use of process data, where available, and filling any remaining data gaps with input-output data. The earliest database of hybrid environmental flow coefficients (embodied energy and carbon) for Australia was produced by Tucker *et al.* (1996, Appendix C). Since then, further hybrid databases have been published, including that of Treloar and Crawford (2003), Crawford and Treloar (2010), Crawford (2018), and Wiedmann *et al.* (2019). The most recent hybrid data is contained in the EPiC Database (Crawford *et al.*, 2019). The EPiC Database is a database of hybrid coefficients for construction materials, compiled using a combination of Australian and international process data and Australian input-output data. It covers flows of energy, water and GHG emissions for over 280 common construction materials. Further details can be found in Crawford *et al.* (2022).

2.3. Previous studies

Multiple studies have compared the embodied GHG emissions of construction materials based on their data source (e.g. Martínez-Rocamora *et al.* (2016), Emami *et al.* (2019)). In their comparison of ecoinvent 3.1 with the GaBi database Martínez-Rocamora *et al.* (2016) found significant discrepancies for materials such as aluminium (the ecoinvent embodied GHG emissions coefficient being more than 10 times that of GaBi). At the same time, the authors found similar figures for the embodied GHG emissions coefficient of concrete (0.112 kg CO_2e/kg for ecoinvent and 0.118 kg CO_2/kg for GaBi). This demonstrates potentially significant variations in the embodied GHG emissions coefficient for the same material between established databases. When comparing the GaBi and ecoinvent databases as applied to buildings in Finland, Emami *et al.* (2019) identified relatively small differences when it comes to GHG emissions at the building level (-16% to +13%). This observation holds true when comparing at the construction assembly level, except for 'frame and roof structure' which varied by more than 30%. As such, using different databases to quantify the embodied GHG emissions of construction projects might lead to variable emissions intensities for given materials. Depending on the number of different materials within a project, these differences can either balance each other out or accumulate to result in marked differences in total embodied GHG emissions.

Similarly, other studies have compared generic data contained within databases to those of EPDs (inter alia Lasvaux *et al.* (2015), Häfliger *et al.* (2017), and Emami *et al.* (2019)). Lasvaux *et al.* (2015) collected data from 266 EPDs across 28 material categories and compared the embodied GHG emissions coefficients with ecoinvent 2.1 (as well as other indicators). They found significant variations between EPDs and ecoinvent data for specific materials, e.g., fibreglass insulation +40% or cellulose fibre -65%, on average. This variability is also highlighted by Emami *et al.* (2019) who found that embodied GHG emissions for the same material can vary by a factor of more than 100 when using different EPDs. Variations between EPDs can be due to different energy mixes, recycled content, and modelling assumptions. Häfliger *et al.* (2017) also observe a potentially significant difference between embodied GHG emissions of particular material groups when obtained from EPDs, as compared to ecoinvent.

These studies demonstrate the significant variations of embodied GHG emissions coefficients for the same product when using different EPDs, or different databases. This can be due to a range of factors, including geographic coverage, data age, modelling assumptions, and system boundary coverage. Yet, to date there are no studies comparing EPDs with hybrid embodied GHG emissions coefficients. Given that hybrid life cycle inventory approaches have comprehensive system boundaries, it is anticipated that the difference between EPDs and hybrid coefficients will be even more significant than with the process databases compared previously.

3. Research approach

This section describes the approach used to compare EPD and hybrid embodied GHG emissions coefficients. The number of materials available for comparison is quite large considering that over 280 material variations exist in the EPiC Database and the Australasian EPD database contains 129 EPDs, with 116 of these construction-related products. These EPDs also contain a varying number of material variations for each producer. Given the potential large number of comparisons possible, the scope of this initial study is focused only on ready-mix concrete produced in Australia. While a broader comparison across materials contained within the EPiC Database may be conducted in the future, this initial focus on concrete is supported by the significant contribution of concrete to global GHG emissions (with cement alone accounting for 7% of global CO_2 emissions (IEA, 2018)).

3.1. Data

EPiC Database hybrid coefficients

The current EPiC Database contains 15 concrete mix variations. This includes General Purpose (GP) concrete for five strength grades – 20, 25, 32, 40, and 50 MPa. It also includes mix designs using 30% fly ash (FA) as a cement replacement for each strength grade and 30% ground granulated blast furnace slag (GGBFS) as a cement replacement for each strength grade. In addition to these, and as part of this research, hybrid coefficients for an additional 57 concrete mixes were calculated, as per the process outlined in Crawford *et al.* (2022). This involved creating additional concrete mixes for strength grades of 65, 80 and 100 MPa, based on a standard GP blend, 30% fly ash as a cement replacement, and 30% GGBFS as a cement replacement for each strength grade. In addition, coefficients were calculated for higher proportions of fly ash and GGBFS replacement (i.e., 40%, 50% and 60%) for each strength grade. The concrete mix variations considered in this study are summarised in Table 1. The embodied GHG emissions coefficients are provided as a single figure (in kg CO_2-e/m^3).

As the Path Exchange approach used to compile the hybrid coefficients provides a systemically complete coverage of the concrete product system boundary, this data covers the emissions associated with the production of each concrete mix across its entire supply chain. This is a unique feature of the use of input-output data and contrasts with the process data used to compile the EPDs, as described below.

Table 15: Hybrid concrete data summary.

Data source	No. of products	Grades (MPa)	Variations	System boundary
EPiC Database[1]	72	20, 25, 32, 40, 50, 65, 80, 100	GP; Fly ash SCM: 30%, 40%, 50%, 60%; GGBFS SCM: 30%, 40%, 50%, 60%	A1-A3[2] complete coverage

[1] Crawford et al. (2019), [2] as per CEN (2019); SCM = supplementary cementitious material

Environmental Product Declarations

Concrete mix EPD data was sourced from the Australasian EPD database, located at epd-australasia.com. Available products were filtered within the 'Building and construction products' category to include only 'Concrete and concrete elements'. Of the 44 EPDs available, only EPDs including 'pre-mix' or 'ready-mix' concrete produced in Australia were selected, excluding precast, masonry, reinforcement, and non-Australian products. This resulted in 16 individual EPDs across 6 manufacturers (Table 2). These EPDs contained multiple products, often replicated across each state. Products with no equivalent EPiC product were excluded (e.g., fly ash/GGBFS blends), as were products where the mix could not be reliably identified. Some regional or project-specific variations were also excluded. Further detail on the specific products included in the analysis, including their embodied GHG emissions coefficient, geographical scope, international standard compliance, life cycle stage coverage, and the equivalent EPiC product is provided in Crawford and Stephan (2022). While most EPDs cover only stages A1-A3 (as per CEN (2019)), only the GHG emissions associated with these stages of the concrete mixes were included, to ensure a consistent basis for comparison with the hybrid data. GHG emissions data was extracted from each EPD for the equivalent grades of concrete covered by the EPiC Database (see Table 1). These values are typically categorised under the Global Warming Potential (GWP) impact category, in kg CO_2-e/m^3 of concrete. These values were then collated and grouped according to the strength grade (i.e., 20 to 100 MPa) and mix design (i.e., GP, FA, GGBFS).

Table 2: Environmental product declaration concrete data summary.

Data source	EPDs	Companies	Products
EPD Australasia[1]	16	6	374 (GP: 117, FA: 117, GGBFS: 140)

[1] EPD Australasia (2022)

3.2. The effect of data source on material selection

This section describes the approach used to assess the implications of using EPD or hybrid data on material selection decisions. This is achieved by comparing EPD and hybrid coefficients for the same product as well as across products. The analysis assumes that the aim of material selection is to reduce the embodied GHG emissions associated with the use of concrete. The rank of EPiC products from high to low GHG emissions was compared to the general trend in GHG emissions for EPD products across the concrete variations. Also, as there are multiple EPD coefficients for similar products, GHG emissions coefficients were compared between concrete product variations for identical strength grades to determine whether the choice to use EPD and hybrid data, and the source of EPD data used, changes the preferred concrete product for minimising GHG emissions.

4. Results

This section presents the results of the comparison between EPD and hybrid embodied GHG coefficients for a range of concrete mixes used in Australia. Of the 72 concrete mix products available in EPiC, only 45 of these were able to be matched with concrete mixes covered by current Australian EPDs. The products in EPiC for which no equivalent EPD data was available included all mixes with 60% fly ash or GGBFS, as well as 100 MPa concrete with either fly ash or GGBFS. For the 45 concrete mixes in EPiC, in most cases there were multiple comparable products identified across the 16 relevant EPDs.

Figures 1 to 3 show the hybrid coefficient for each of the 45 concrete mixes in comparison to identified equivalent products from Australian EPDs. This comparison has been separated into standard GP mixes (Figure 1), mixes with fly ash as a SCM (Figure 2), and mixes with GGBFS as a SCM (Figure 3).

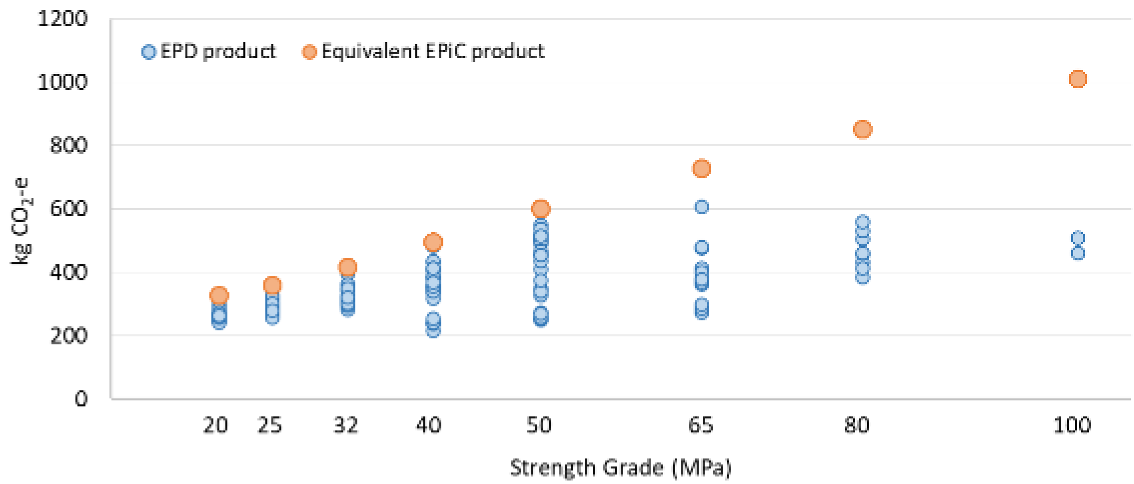

Figure 28: Comparison of EPD and hybrid embodied GHG emissions coefficients for standard GP concrete.

Figure 1 shows a relatively linear relationship between embodied GHG emission coefficients in EPiC and concrete grade. There is a similar relationship for the EPD coefficients, although not as pronounced. Hybrid coefficients are higher than all equivalent EPD coefficients, with EPD coefficients ranging from 38 to 97% of the hybrid coefficient. While there are fewer EPD coefficients published for 65 to 100 MPa concrete, the largest difference between EPD and hybrid coefficients can be seen for these products. The large spread of coefficients across EPDs mean that a higher-grade concrete may be preferred for reducing emissions, depending on the EPD products being compared. For example, the GHG emission coefficients for several 65 MPa GP concrete products are lower than most of the coefficients for lower grade concrete products, which is counter-intuitive considering the higher cement content.

Based on hybrid data, Figure 2 shows a decrease in embodied GHG emissions as a result of an increase in the proportion of fly ash used. Cement replacement with fly ash at 30% results in a GHG emissions reduction of 22 to 25% compared to standard GP concrete, a reduction of 31 to 33% for 40% cement replacement, and 38 to 42% for 50% cement replacement. Other than one case where the EPD coefficient is higher than the hybrid coefficient (as the EPD product with 20% fly ash is assumed to be equivalent to the 30% fly ash EPiC product), hybrid coefficients are up to 64% higher than equivalent EPD coefficients.

Based on hybrid data, Figure 3 shows a decrease in embodied GHG emissions as a result of an increase in the proportion of GGBFS used. Cement replacement with GGBFS at 30% results in a GHG emissions reduction of 18 to 21% compared to standard GP concrete, a reduction of 25 to 28% for 40% cement replacement and 32 to 35% reduction with 50% cement replacement. Other than five cases where the EPD coefficient is higher than the hybrid coefficient, hybrid coefficients are up to 67% higher than equivalent EPD coefficients.

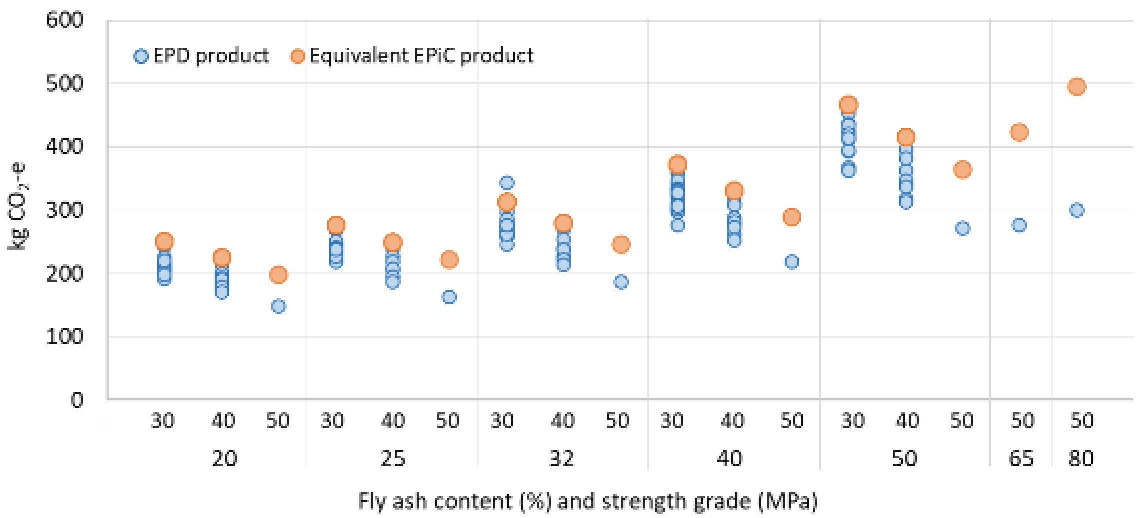

Figure 2: Comparison of EPD and hybrid embodied GHG emissions coefficients for concrete mixes with fly ash.

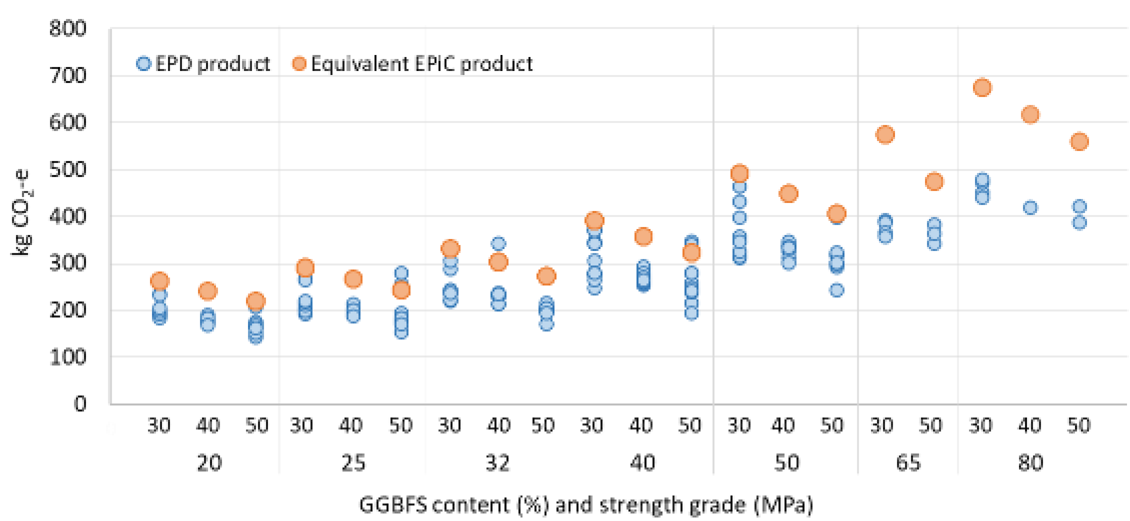

Figure 3: Comparison of EPD and hybrid embodied GHG emissions coefficients for concrete mixes with GGBFS.

While the variation in EPD coefficients is wide across all product types, there is also a clear downward trend in GHG emissions with an increase in SCM use. Hybrid data shows a greater reduction in GHG emissions for fly ash replacement, whereas EPD data tends to show a slightly greater reduction for GGBFS replacement. This may be due to how the GHG emissions of these two products are allocated. Interestingly, EPD data shows that many of the products with higher SCM content often have a higher GHG emissions coefficient than products with a lower SCM content, and as such, selecting a product with higher SCM content may not necessarily be a clear choice for minimising GHG emissions.

5. Discussion

This section discusses the results of the study as well as the broader implications of the choice of data on material selection decisions. The comparison of EPD and EPiC embodied GHG emissions data for a broad range of concrete products shows considerable variability between data sources as well as across EPD coefficients for similar products. Some of the key reasons for variability in GHG emissions data includes the source of base data used to quantify GHG emissions, system boundary completeness, different manufacturing processes and efficiencies, allocation of GHG emissions for specific raw materials such as GGBFS and fly ash, emissions intensity of regional fuel sources, and fuel mix of production processes.

The embodied GHG emissions coefficients contained within EPiC for concrete products are based on Australian and international process data as well as Australian input-output data to fill any process data gaps. The average coverage of the concrete supply chain by process data is 83%, ranging from 72 to 90%, which is high compared to the average of 43% for all products contained within the EPiC Database. This means that input-output data, including the cost variable used to translate from a financial to physical functional unit, has limited influence on the embodied GHG emissions coefficients. While the process data can be traced back to individual producers, the breadth of producers used to compile the generic process data used in the hybrid coefficients is much more limited than is available across the range of producer specific EPDs. However, despite claims that manufacturer specific EPDs are more reliable than generic process data contained in databases such as AusLCI or ecoinvent, this study has identified that all concrete EPDs analysed rely heavily on generic process data from such sources. None of the EPDs analysed rely solely on primary process data meaning that their reliability may be compromised, and for the supply chain activities covered by this generic data, is no more reliable than the data used within EPiC. EN 15804 requires that only 'processes the producer of the specific product has influence over' must be calculated using specific (i.e., non-generic) data. In a supply chain as complex as that of concrete, this can be a very limited range of processes, meaning that generic data can easily represent a large majority of the data used within an EPD. In addition, EN 15804 allows for processes to be excluded completely if their total amounts to no more than 5% of the energy usage and mass of the product. However, as this study shows, EPD coefficients are on average 22% below those of the equivalent hybrid coefficients, meaning that more than 5% of processes are excluded. On average, EPD coefficients are 78% of the equivalent hybrid coefficient, ranging from 38% to 115%, and 57% of them are more than 20% lower, with only 9 (0.02%) higher. This highlights the incompleteness associated with EPD coefficients.

The study identified that EPD GHG emissions coefficients for identical products may differ between states/manufacturing plants, even for the same manufacturer, which corroborates the findings of Lasvaux *et al.* (2015), Häfliger *et al.* (2017), and Emami *et al.* (2019). This shows that when using EPD data to select a concrete product with the lowest possible GHG emissions, the decision may not be as intuitive as previously thought. Although there appears to be a general correlation between increased proportions of fly ash and GGBFS and total GHG emissions reduction, there are instances where an increase in SCM content increases the GHG emissions, even for the same manufacturer. Some of these products can even have higher GHG emissions than equivalent strength grade GP concrete products. Where EPD coefficients for some products are substantially lower than equivalent products from other EPDs/manufacturers, this is more than likely due to exclusion of supply chain processes and associated emissions or use of different generic data sources, rather than substantially better performance. However, further research is needed to analyse specific EPDs and manufacturer's production processes and supply chains.

The study shows that while the trend in emissions between product types is generally consistent regardless of whether EPD or hybrid data is used, material specifiers typically consider a more limited range of specific products than considered here. This may mean that trends identified here may not be evident across a smaller selection of EPDs and as such may lead to different choices. Importantly, where an absolute value for the environmental performance of a material or project is required, the use of EPD coefficients will most often result in an underestimation of the total GHG emissions.

5.1. Limitations

While this study considers a substantial proportion of the ready-mix concrete products available in Australia, it only compares the performance of products covered within existing EPDs published through EPD Australasia. Other EPDs may be available, as well as many other ready-mix products where an EPD has not yet been published or may be published in the future. While EPDs have a 5-year validity period, there are new EPDs being published regularly. This means that production improvements that reduce GHG emissions may be more rapidly represented in EPD data than in the EPiC Database, which is less regularly updated. Some assumptions needed to correlate products within EPDs with EPiC Database products may also vary the findings, albeit slightly. Comparisons of other products, especially where process data accounts for a smaller proportion of the hybrid coefficient, is also needed as this will provide a more reliable comparison between the two data sources.

6. Conclusion

The aim of this study was to compare the embodied GHG emissions coefficients provided by EPDs and the EPiC Database and assess the effect on material selection decisions. EPDs for ready-mix concrete products available in Australia were analysed and compared to hybrid GHG emissions coefficients for equivalent products within EPiC. It was shown that while hybrid coefficients are generally always higher than coefficients from EPDs, the overall trend between products was relatively consistent – higher emissions for higher strength grades, and lower emissions for higher cement replacement rates.

Despite this, the study also found considerable variability in EPD coefficients for comparable products – ranging from 38 to 115% of the hybrid coefficient. This may be due to different manufacturing processes and efficiencies but is also likely to be a result of variability in the data source and supply chain coverage of EPD data. While Australia, like other developed economies, has seen the rapid expansion in the availability and use of EPDs in recent years, the considerable variability in the coefficients provided, even between equivalent products, suggests that we should not put blind faith in their use. EPD data may not provide any more guidance to material selection than what EPiC provides and may in fact increase confusion among material specifiers that are not familiar with the reasons for variations between EPD coefficients. This study highlights that by comparing data from EPDs for concrete with the comprehensive coefficients provided within the EPiC Database, showing the 22% average data truncation, these EPDs may not comply with the requirements of the international standard EN 15804.

The large variability in GHG emissions coefficients between EPD products of similar type means that product selection may be problematic and may not always lead to an intuitive choice. Further in-depth analysis of EPD data is needed to determine the reasons for such high variability in coefficients. This will help support product specifiers and improve emissions reductions in the construction sector. It appears that EPiC data may provide very useful initial guidance for material selection. It is highly likely that EPD data currently available may be misleading given the variation in system boundary coverage, data source and quality, making comparison between EPDs from different manufacturers unreliable.

Further research is needed to consider a broader range of materials and the influence of data source on the environmental benefits of the choice of construction materials and products. With a rapidly growing reliance on EPDs, an assessment of their reliability for material selection decision-making is critical, including an in-depth analysis of the comparison between international standard requirements for EPDs (as per EN 15804), the claims made in published EPDs regarding supply chain coverage and other aspects, and the degree to which EPDs comply with these.

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