Environmental Product Declarations

The importance of climate-based metrics for production and purchasing

ME 590 Independent Study

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Abstract
The rising importance and urgency of climate change have created a need for comparison between products based on their climate impact. While there are various metrics by which to do this, such as global warming potential (GWP), and methodologies for how to quantify those metrics through lifecycle assessments (LCAs), environmental product declarations (EPDs) fulfill an important niche in making the calculated impacts of products directly comparable. EPDs are based on LCA data, with additional requirements determined based on the specific products they describe. There are a variety of incentives that have been put in place to encourage the use of EPDs, including EPD requirements for municipal construction projects. Several tools have been created to ease the adoption of EPDs through lowering costs and simplifying the creation process. As with all things, EPDs have some shortcomings, but they are manageable, and to help address those issues and build upon their strengths, various additional resources should be provided including better organization of EPD information, more municipal and state EPD requirements or bid incentives, and subsidies for companies taking on the additional cost of EPD creation.

There has been some movement recently in the low embodied carbon concrete space in the Ann Arbor area through a task force made up of a series of local companies in construction and construction-adjacent areas, including the Global CO_2 Initiative. This task force has designed and implemented a slag cement-based concrete mix with a significant GWP reduction. Further research into the possibility of an EPD for this locally created mix is currently underway with the hopes that adoption in the South East Michigan area, along with the potential future creation of local EPD incentives, could help spread the practice further.

Introduction
Over the past few years, as the climate has risen to the forefront of minds, both on an individual and international level, it's become apparent that better tools are necessary to evaluate the climate impact of products. Consumers across all industries have always needed to make choices based on a variety of factors, including cost, lifespan, timing, appearance, etc., and each of these has metrics for judging them. Cost can be measured in a local currency, lifespan in the number of useful years a product has, timing in terms of estimated delivery/construction times, etc. With the increasing public awareness of the climate and the urgency with which its anthropogenic influence needs to be addressed [1], a similar, straightforward, comparable metric is needed for climate impact.

Global Warming Potential
Global warming potential (GWP) often reported in carbon dioxide equivalence (CO_2eq) is a common metric for this. It takes into account the warming potentials of the various emissions released by a product to provide a single number for its climate impact by scaling everything to the GWP of CO_2. There are various time spans on which this can be measured, although 20 and 100 years are the most common. While this is a fairly effective strategy, there are still many questions to be addressed, such as which emissions should be counted and how these numbers can be made intercomparable in an unbiased way.

Life Cycle Assessments

Lifecycle assessments (LCAs) were created to address these concerns. An LCA is a deep dive into a specific process where all of the emissions are accounted for, for a given scope. Common scopes include cradle-to-grave, where all emissions from the first steps of raw or recycled material extraction and usage to the end-of-life processes are included; cradle-to-gate, where an appropriate stopping point is identified and emissions aren't counted past that point; and gate-to-grave, where an appropriate starting point is identified and emissions aren't counted before that point. Each of these has its own perfectly valid use. For example, in the transportation sector, a fuel supplier may only perform a cradle-to-gate analysis since they can't account for the method by which their fuel is used (e.g. gas mileage, type of vehicle). This method is most commonly used to find the embodied emissions of a product (those created during the production stages, but not the use or end-of-life stages). Similarly, a vehicle manufacturer may perform a gate-to-grave analysis as they can't account for the method by which the fuel is produced (e.g. energy used to extract oil). Cradle-to-grave analyses are appropriate for companies that can account for the full use of their product, from its beginning stages to its end-of-life.

While these assessments are very useful and the variability makes it possible to analyze parts of processes for which the full process analyses are unachievable, it makes comparison between products more difficult. The exact scope definition and potential gate location can dramatically influence the final climate impact result. Similarly, the breadth of the scope is important. In the case of a vehicle manufacturer, there are many adjacent processes that could be considered. For example, should the emissions from the construction of the roads be included in an LCA of a car? The emissions from a steel plant's creation? If so, how should that be quantified? The percent share of road deterioration from cars could perhaps be calculated, but the analyses would likely be incredibly involved and dependent on location, road type, and many other factors. The same question can be asked in reverse, should a concrete company be responsible for the emissions from cars that use the roads they created? All of these factors compromise the comparability of different LCA results and necessitate some additional metric by which to compare products.

EPDs, PCRs, and Related Standards

Environmental Product Declarations (EPDs) were created to make LCA data comparable. EPDs can be thought of as a climate nutrition label for a given product. They provide the global warming potential as well as several other metrics, such as ozone depletion, acidification, and smog creation, for a given product based on an LCA that is in line with a variety of standards and the associated product category rule (PCR).

PCRs are the rules by which an EPD is made. They're specific to each product type and determine the EPD's scope and breadth as well as a variety of other things including the format and the specific measurements which must be included. These rules are generally developed by those in the industry with assistance from program operators, a company with expertise in the relevant area, and in ISO standards such as ASTM International or NSF International. An example of the hierarchy of standards for an EPD is shown below for a ready-mix concrete company.

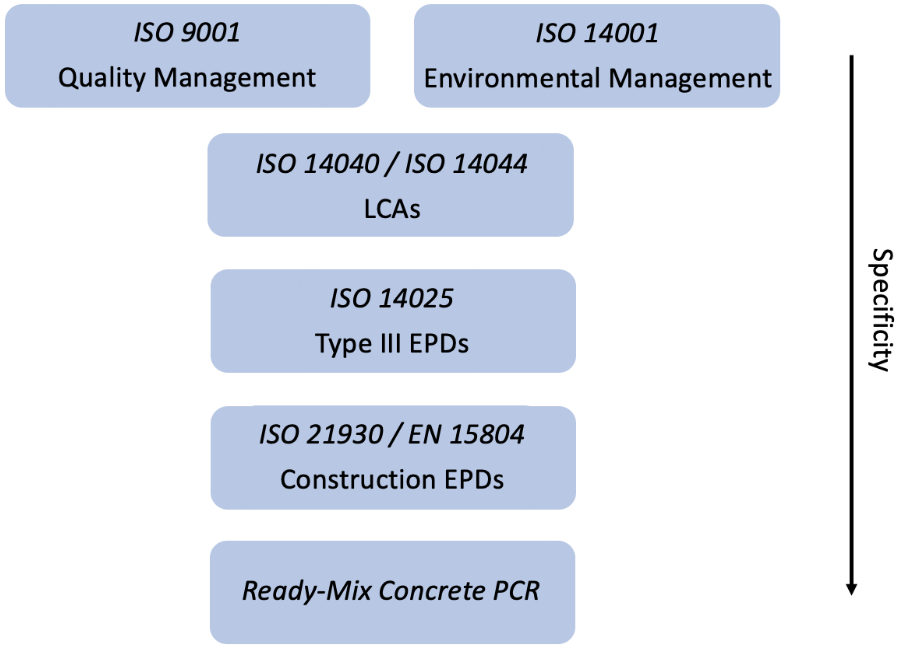

Fig. 1: The hierarchy of standards relating to a ready-mix concrete EPD. First, the quality and environmental management standards must be followed (ISO 9001 / 14001). Then the life cycle assessment of a product must be done according to the ISO 14040 / 14044 standards. Then the EPD itself must be created in line with 14025 standards, and construction EPDs must additionally follow ISO 21930 and EN 15804. Finally, the EPD must be created in accordance with the PCR developed for ready-mix concrete. Each subsequent standard creates an LCA/EPD combination more tailored to a given product and minimizes any ambiguity to ensure comparability within that sector. [2]

It's important to note that these standards are not legally binding documents, and thus the PCRs include the practice of third-party verification, where a company hires a program operator to perform a check of their LCA data upon which the EPD is created to ensure it follows the appropriate PCRs. Third-party verification is proof that an EPD is accurate and can be 1:1 compared with other verified EPDs within the same PCR.

There are three main types of EPD of varying levels of difficulty to create. The first is used when there is no PCR developed for a given industry and thus describes an EPD that follows the rules set out for all EPDs based on ISO 14044 (rules for LCAs). The second is a generic, industry-wide EPD which must be in line with PCRs (including third-party verification), but uses industry-wide data for the LCA upon which the EPD is built. The third is the most rigorous and must follow all the relevant PCRs using product-specific information [3]. This type of EPD is also referred to as a type III environmental label (often also called a type III EPD), although types I and II describe ecolabels (ISO 14024) and self-declaration of environmental improvement (ISO 14021), neither of which are EPDs [4].

A type III EPD provides the most information about a specific product and is most useful in making comparisons between products, and will be the focus of the rest of this paper.

EPD Incentives

The process to create these detailed EPDs is very complex, and while some organizations such as the International EPD® System provide supporting documentation and other resources to help make it more transparent, the information is largely difficult to find and difficult to understand. Additionally, in most places, this process is completely optional and can be fairly expensive. There is still, however, sound rationale for companies to create EPDs including market forces and various types of external pressure.

As with many green products in the US economy, EPDs are pursued partially due to consumer desire to be environmentally friendly. Many companies believe that advertising the positive environmental impact of their products will gain them a larger market share or higher revenues due to customer willingness to pay a green premium, and EPDs are one, albeit fairly involved, way of doing this. One concrete example of this is LEED credits. These credits are given out to buildings in which certain sustainability measures have been implemented, and at certain milestones of credits, various certification levels are achieved (certified, silver, gold, and platinum). In California, these certifications, on average, raise the value of homes by 8% [5]. Creating a building using lower than average GWP numbers sourced from the products' EPDs is one way to gain such credits, which shows fairly direct financial benefit from EPDs.

In a similar vein, some municipalities and states have exerted their fairly large influence in certain industries (especially construction) to further incentivize this practice. This often takes the form of a municipal requirement or financial incentive. For example, Portland, OR, implemented an EPD requirement through their Low Carbon Concrete Initiative. This initiative took place in three stages: 1) a full-fledged product-specific, third-party verified EPD requirement for concrete in city construction projects, 2) a pilot program where low embodied carbon concretes were tested in the field, and 3) a GWP-maximum based on the information collected during the pilot program with which the EPDs would be used to confirm compliance [6]. In New York, a bill was recently introduced that, instead of outright requiring EPDs, creates a bidding discount for companies based on the GWP of their product compared to a baseline, which must be confirmed with an EPD [7]. Each of these methods can be extremely effective in encouraging EPD usage using only the large buying power of the government.

As the impacts of climate change become more visible and severe and climate rises to the forefront of people's minds, all of these incentives will likely continue to expand and make EPDs more and more popular among producers as they become more and more financially beneficial.

EPD Tools

In addition to the general financial benefits of green products and more specific incentives and requirements, there are also a series of tools that help to make the EPD process more approachable.

Environmental Impact Creation Tools

The simplest version of these tools helps create a simplistic environmental impact report based on industry average data. These tools will not help generate a type III EPD, but they can be very useful for quickly obtaining rough climate impact numbers, especially for internal use. These are often simply spreadsheets of varying complexity based on the level of detail involved in the model. The ZGF Tool is one example of this for concrete and consists of a spreadsheet where mix designs can be inputted and based on the region in which the product is created, the associated emissions are automatically populated with that region's industry average values. Another example is the Slag Cement LCA Calculator, which follows a similar design but was designed specifically for slag cement-based concrete.

EPD Creation Tools

EPD creation tools aren't much more complex than environmental impact creation tools. They use a spreadsheet or the equivalent to find the relevant numbers, but they must include everything required in the relevant PCR. The largest difference between this category and the former one is that specific operational data is required. In the case of concrete, the PCR specifies twelve months, so a producer interested in creating an EPD must base their climate impact numbers off of the last twelve months of their specific emissions, resource consumption, etc. This data would include a fairly exhaustive list of things to ensure the final environmental numbers are accurate. Examples include gas usage, fleet fuel, type of materials purchased, distance of materials traveled, waste generation, particulate matter emitted, etc. [2] This information would then be inserted into the tool, thereby allowing each company to accurately account for their unique environmental impact while using a non-specific framework (the tool). This non-specific framework can be pre-verified by a program operator, which means only the operational data must be confirmed on a producer-by-producer basis.

There are three main tools in the US that fit these criteria for concrete: the Climate Earth Tool, Athena's Impact Estimator for Buildings, and the Global Cement and Concrete Association (GCCA) tool, the last of which is slightly different from the first two. There are also three main program operators in the US that work with concrete: the National Ready Mixed Concrete Association (NRMCA), ASTM International, and NSF International, the last of which works in a slightly different way to the first two as well. The rest of the tool-based EPD procedure, along with the differences between these, are discussed further below.

All three of the main tools require the same EPD components, as those have been standardized by the PCR, however, the GCCA tool deviates in how it collects and reports these. Climate Earth and Athena assign LCA consultants to the producer interested in creating an EPD to assist with what operational information needs to be collected, and how to go about doing that. Where information is missing, for example, for an upstream product that doesn't have an associated EPD, industry average data is used. They then take that information and send it to a program operator for verification. Upon verification, the operational data is implemented into the tool and this individualized tool is shared with the producer. Importantly, this tool generates a final EPD from the information, and upon being individualized, requires no additional third-party verification as everything about the tool has already been verified. This producer can then continue to create as many EPDs as they want for as long as the certification period of the verification lasts (as defined in the PCR).

The GCCA tool, however, doesn't create the individualized model, but rather is designed for the producer to create it themselves. While this leads to lower initial costs since a consultant isn't necessary, the burden of finding and implementing the operational data must be shouldered by the producer, and each new series of EPDs the producer creates must be newly verified to ensure that operational data upon which the model is built continues to be accurate. The GCCA tool also does not output EPDs specifically, but rather just provides the relevant environmental information, which must then be formatted into an EPD by the producer. These differences lead to the Climate Earth and Athena tools being largely favored by companies planning on producing many EPDs, as the verification costs aren't repeated with every new set, and the EPD is outputted by the tool directly, not requiring additional formatting steps [8].

Among the main program operators, only NRMCA and ASTM International will pre-verify these tools. NSF International is, therefore, generally only used as a program operator for small projects as the creation of an LCA for each new product and individual verification of each new LCA, is very costly.

While these tools make creating EPDs much faster and more economical, especially when many different products are involved, they are not strictly necessary. It is always possible to perform an individual LCA for a product, create an EPD based on its results, and have a program operator individually certify its accuracy.

EPD Reporting Tools

There are also tools that have been created to assist with reporting EPDs. An EPD is not that useful by itself, but it provides important information for comparison between products. For these comparisons to occur with any amount of frequency, related EPDs must all be easily accessible, preferably in the same spot with available software that can show how a given product stacks up against the others. This can be useful for the producer as they attempt to compete with other companies to lower their footprint (in a similar way to lowering costs) and for the purchaser, as they decide on which product to buy. The Embodied Carbon in Construction Calculator (EC3) is one such tool for the construction industry. EC3 accepts all third-party verified EPDs (it currently has over 40,000) and lists them for free. It creates aggregate data from all the listed EPDs and allows a purchaser to compare a product's performance to the average, other specific products' performances, and other metrics, all while selecting for other product features such as strength, aesthetics, location, etc. An entire building project can be created within this tool, tracking the embodied carbon of each stage along the way. EC3, and others like it, can be very powerful in helping a customer truly understand the carbon impact of their decisions while giving them the tools to minimize it.

EPD Limitations

While EPDs have many benefits, they're not perfect, and their implementation has some drawbacks. The first and most obvious is their cost. For small companies (such as many ready-mix concrete companies), the price of paying for an EPD can be quite steep. Without relying on other tools, a company would need to pay (internally or externally) for the creation of an LCA, verification that the LCA data aligns with the relevant PCR, creation and formatting of an EPD from that data, reporting of the EPD, and renewal of the verification once the certification period has passed (generally five years). This entire process is likely to cost more than $10,000 and would need to be largely repeated for each new product and every five years [8].

The organizations and their associated tools described above have helped in making this more affordable through minimization of the verification costs (specifically, Climate Earth's and Athena's). These verifications are generally in the range of $3,000 and, without a connection to a tool, need to be done for each product. When the tools themselves are verified, they can continue to be used with the knowledge that all outputs have already been verified.

Similarly, for larger companies with multiple plants, there are discounting procedures in place when using these tools. Although the operational data at different plants are different, the overall procedures are similar, making the data acquisition and analysis process much easier at subsequent plants. For one plant, a rough breakdown of costs might be $10,000 for an LCA consultant from the tool's creator and $3,500 for verification from a program operator. At two plants, it might be $16,000 for the LCA consultant and $4,000 for verification for a program operator, in total. These are just estimates, as the costs are product- and industry-dependent, but they provide a rough sense of scale for the creation process. After these costs are paid, the creation of EPDs (generally for 5 years) is essentially free, or fairly cheap, depending on the specific pricing scheme of the tool [8].

Another issue with EPDs stems from the PCR definitions. The benefits of EPDs are dependent on painting an accurate picture of the emissions associated with a given product. Since how PCRs are defined determines what the EPDs include, any mistake in that definition can lead to comparisons between products based on faulty data, which could do more harm than good. Similarly, the format in which EPDs are created is determined entirely from the PCR. Poor PCR definitions can lead to missing identifying information, hard to parse reports, or many other communicative shortcomings, all of which increase the difficulty of comparing EPDs.

Another shortcoming of EPDs is their reliance on upstream EPDs for accuracy. In the example of concrete, the majority of emissions stem from the cement production. When generating an EPD for a concrete mix, if the cement company doesn't have the relevant environmental impact information (ideally in the form of an EPD), the concrete's EPD must use industry average data, thereby decreasing the accuracy of the most important emissions step in the concrete's production. This somewhat compromises the integrity of an EPD by treating all cement companies as equal, when, in reality, that is not the case.

Case Study in Environmental Reporting - Ann Arbor Task Force Mix

Our work in this field began with the creation of the Low Embodied Carbon Concrete Task Force in Ann Arbor. The task force was assembled by AIA Huron Valley, Washtenaw Contractors Association, and the A2 2030 District to promote low embodied carbon concrete in the Washtenaw area. The task force consisted of local stakeholders across the construction landscape, including both a local concrete and a local cement supplier: Doan Companies and St Marys Cement. With the help of these stakeholders and the technical expertise of the Global CO_2 Initiative at the University of Michigan (U-M), several low embodied carbon concrete mixes were created. They primarily relied on mix components that had already been used across the state to ensure they could be implemented quickly, including supplemental cementitious materials (SCMs) such as fly ash and steel slag.

After several months of trying new mixes with different proportions and finding GWP reduction estimates, one particular mix using steel slag became the clear winner, and that mix was used in field-testing in Ann Arbor at the Tri Delta Sorority House for a driveway and for various patches on South Industrial Highway in early July. All test reports since have shown that the mix is performing very well.

So far, we had been relying on the ZGF Tool for GWP reduction estimates, which uses industry average data. While this information is helpful, especially for internal benchmarking like we were using it for, it lacks a lot of the details necessary for comparison with other companies' products. For example, the concrete trucks used by Doan could be significantly more fuel-efficient than the industry average, or the aggregate producers could be located much further away than they are for a standard company. All of these things can have large impacts on the final environmental impact numbers, and thus more accurate, individualized estimates should be used when going beyond internal discussion to public environmental claims, and that requires the creation of a type III EPD.

As we were interested in more public environmental claims, including the creation of a white paper, we began looking into the possibility of creating a type III EPD for this mix. We also wanted to work within the Global CO_2 Initiative's mission statement of furthering carbon utilization, and the side-benefit of the spread of environmental impact reporting schemes in the carbon utilization-rich sector of concrete to South-East Michigan falls well within that mission.

In this specific case, we wanted to keep costs and effort to create an EPD down, so, after consulting with NSF International (who is located just down the street from the U-M), we started looking into the tools developed for EPD production. GCCA's tool was of interest to us, partially because at the moment we were only interested in one set of EPDs, so the repeated costs of verification weren't as important, and partially because it has some additional characteristics that are of special interest to other U-M mixes (such as the ability to include recarbonation in the concrete).

We're currently in contact with Doan about what their available budget is for this and if they have an interest in developing more EPDs moving forward. We're planning to reach out to GCCA, Climate Earth, and Athena to receive more detailed quotes and information on how to move forward with them if this route is financially realistic. As a fallback option, we're planning to use the Slag Cement LCA Calculator, which still uses industry average data, and thus would not meet the requirement for a type III EPD. It, however, was designed for slag cement-based concrete specifically, which, if a full EPD is too costly, makes it a good match for the task force mix which relies heavily on steel slag.

Regardless of which option is pursued, we hope to continue to work in this industry to further promote the adoption of EPDs, including working with our local municipality and state to provide the necessary resources for that to occur. Some of these recommendations are shown in the following section.

Recommendations

It's clear that EPDs are an important part of the solution to climate change. Both producers and purchasers need clear, well-defined metrics upon which to make decisions, and EPDs provide that for a variety of products, many of which are very carbon-intensive, especially within the construction industry. Based on our research, below are a few recommendations for how to better promote the use of EPDs.

First, better instructions and resources for EPD creation are needed. It's difficult to find much of this information in one place, clearly laid out. It took lots of digging to find the relevant standards, the different PCRs for different products, and how the various EPD tools work. A clear home base for EPD information and resources would be very helpful for producers considering creating EPDs or for those who don't know anything about them.

Second, more firm incentives or requirements for EPD usage, especially in the context of government projects, are necessary. Municipalities and states all have a series of incentives or requirements that need to be met to bid on a government job, and, as some have shown (such as through California and Colorado's Buy Clean programs and the Low Carbon Concrete Initiative from Portland, OR), it's possible to include EPDs or even specific maximum climate impacts in those incentives or requirements. When the climate impacts themselves are the focus, EPDs adoption inherently benefits, as it's impossible to mandate climate impact consideration without some method with which to judge the climate impact. Government projects are an ideal place to start because of their large size, especially in the construction space.

Finally, government financial support for EPDs could be very helpful. Many companies in the construction industry run on small profit margins, and having EPDs verified can be quite expensive. Providing financial support to companies interested in creating EPDs for their products may make the process a lot more attractive for voluntary EPD creation and less punitive when paired with EPD requirements.

EPDs will be necessary to optimally transition to a circular, sustainable economy. They provide a foundation upon which consumers can make informed, climate-based decisions on which products to buy and allow producers to compete to lower their negative environmental impact in an efficient manner. There are a variety of incentives that provide a financial reason to pursue EPD creation, including governmental requirements and green premiums, and there are several tools that function to make the creation of EPDs easier and cheaper. The continued development of EPDs should be a priority for the US, at the local level and above, both in terms of mitigating their flaws through the continued improvement of PCRs and financial assistance, and in accelerating their adoption across the country and beyond.

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