Environmental Product Declarations

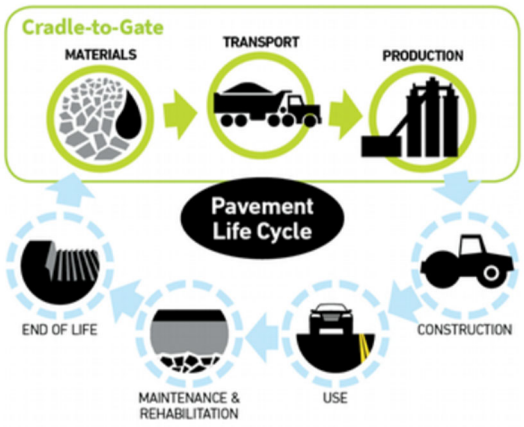
The Oregon Department of Transportation (ODOT) maintains databases on many components of highway construction and maintenance (e.g., project design, contractor bids, costs, road condition, material specifications, etc.). ODOT does not currently track emissions or climate impacts from installed materials. Environmental Product Declarations (EPDs) are a rapidly emerging platform being used by the construction industry to convey vendor, plant, and product-specific climate impacts from material production. Public agencies and private customers are beginning to use EPDs as a tool to measure the carbon footprint of constructing building and infrastructure projects. Furthermore, EPDs can be factored into product selection to comply with emission reduction targets. By requiring and tracking EPDs, ODOT could better understand the climate impacts of product selection while still optimizing the use phase for smoothness and durability. The agency could go even further and require contractors to install materials that are below a set emission threshold, which would move certain materials toward lower carbon alternatives on a prescribed schedule.

Best Practice

Description of Alternative Practice(s)

EPDs are produced by material vendors, commonly with consultant assistance and/or dedicated software packages (e.g., National Asphalt Pavement Association's Emerald Eco Label program) to measure climate impacts, along with other environmental impacts to air and water resources. EPDs focus on "upstream" impacts for material production, often referred to as "cradle to gate," and are highlighted in Figure 1. These include impacts associated with raw materials extraction; transport of raw materials to the plant; and plant energy use and emissions. EPD measurements typically stop at the plant gate. Other factors are needed to measure emissions from the full lifecycle of a product (such as material transport from plant to jobsite, construction, use, maintenance, and deconstruction or end of life).

Figure 1



Source: Baker Rock Resources. EPD reports the impacts for Level 2 1/2" dense #JMAC 2016-1 w/RAS, a Superpave design asphalt mixture.

EPD results are presented based on a declared unit:

- Concrete EPDs commonly report climate impacts as kilograms of carbon dioxide equivalent (kg CO_2e) per cubic yard of material.
- Asphalt concrete pavement and steel products are commonly reported per short ton or another weight-based unit of the material.

Several jurisdictions around the U.S. have started a program to develop baseline climate impacts of vendor mixes and are requiring EPDs to be submitted with material delivery. These programs include the City of Portland, OR; Caltrans (California's Buy Clean); Sound Transit (WA), Colorado DOT; Minnesota DOT; Illinois Turnpike Authority; and Port Authority of New York and New Jersey (PANYNJ). Major material vendors in Oregon are concentrated in the Portland Metro area and are already producing

concrete EPDs for the City of Portland.[1] In each program, the agency and main specifier has made an EPD a term of doing business and established baselines that reflect reduction goals and regionally available materials**.** The best practice is to adopt a process that incorporates EPDs but work with *regionally specific baselines* and targets that meet the atmospheric limit reductions that are needed.[2] Regionally-specific baselines are important due to Oregon's diversity of aggregate quality, traffic use and weather conditions that shape the need and type of cements or asphaltic binders.

By establishing a material activity data tracking system that aligns purchased material quantities with the appropriate vendor, plant, and product-specific EPD, an accurate tracking system for climate impacts may be established for mixes delivered to ODOT's performance standards. EPDs may also be used to benchmark climate impacts across vendors for products produced in similar geographic regions that show the range and the mean of the available products on the market.

Real World Examples

- ***Port of New York and New Jersey*** **(PANYNJ)** initiated EPD requirements and is developing a baseline for standardized mixes in use for roadways, runways, highways, structures, and buildings.
- ***Buy Clean Colorado,*** signed into law in 2021, became the first EPD mandate in the nation requiring EPDs for asphalt mixtures. The Colorado Department of Transportation (CDOT) now requires contractors to submit EPDs for road, highway, or bridge projects that are advertised, starting July 1, 2022. CDOT will use EPDs to develop GHG emissions reduction policy that will take effect in 2025.
- ***Buy Clean California***, signed into law in 2017, includes EPD reporting for seven major building materials: steel rebar, structural steel, flat glass, and mineral wool board insulation, concrete, asphalt, and aggregate.[3]
- ***Buy Clean and Buy Fair Washington Project,*** a partnership between the University of Washington's Carbon Leadership Forum and the Washington State Department of Commerce, received funding from the state legislature to collect data on certain projects (i.e., EPDs, quantities, other product-specific data) with the goal of reducing GHGs and identifying low-carbon materials.
- Other states considering similar legislation include Oregon[4] and Minnesota. ***BlueGreen Alliance***[5] is supporting these efforts by uniting labor unions and environmental organizations.

[1] Oregon Department of Environmental Quality has worked with a variety of industry partners to establish and promote a system of voluntary greenhouse gas reporting, specifically for material production through EPDs.
[2] Appropriate emission reduction targets are aligned with the scientific consensus of not increasing global temperatures beyond 1.5 degrees C, which means emission reductions of 50% by 2030 and 100% by 2050.
[3] For details on Buy Clean California visit https://dot.ca.gov/programs/engineering-services/environmental-product-declarations
[4] HB 2688 was introduced in the 2021 Oregon legislative session but did not receive a formal vote. The bill would have required ODOT to track EPDs from contractors installing cement concrete, asphalt, and steel. More details can be found here: https://olis.oregonlegislature.gov/liz/2021R1/Downloads/MeasureDocument/HB2688/Introduced
[5] For details on BlueGreen Alliance's Buy Clean work visit https://www.bluegreenalliance.org/work-issue/buy-clean/

- ***City of Portland, Oregon's Low Carbon Concrete Initiative***[6] began requiring EPDs for all Portland Cement Concrete in January 2020 to inform where climate impact thresholds should be set for public purchases of concrete. Carbon limits per strength class of concrete are expected to be published in 2022.

  High-level process steps used by City of Portland EPD program for concrete include:
  - Phase 1: Environmental Product Declaration (EPD) Requirements
  - Phase 2: Data Collection, including Lower Carbon Concrete Pilot Projects
  - Phase 3: Establishing Global-Warming Potential (GWP) Thresholds

Current Conditions & GHG Inventory Results

Note: this paper focuses on the production phase of construction materials and does not include the use phase of the pavement, where smoothness and durability (life-cycle optimization) are a top priority.

Current Conditions

ODOT purchases large quantities of construction materials including asphalt concrete pavement, concrete and cement products, and steel products that have climate change impacts. Upstream production of construction materials is outside the agency's direct control. However, ODOT has the ability to adjust material performance standards and project-level or regionally-specific outcomes. For example, ODOT has historically specified use of recycled materials (e.g., up to 30% reclaimed asphalt pavement (RAP)) and the allowance of substitute cementing materials (SCM), which now occurs in 85% of all concrete mixes used in ODOT projects. These policies demonstrate ODOT's leadership on lower material production impacts.

Furthermore, while ODOT tracks material activity data by type and between construction and maintenance programs, the agency does not track emission factors alongside specific, project-level material purchases. Two pieces of information are required to track climate impacts of material production:

1. ***Activity Data:*** Common reporting units include weight (e.g., short tons), volume (e.g., cubic yards), or in some cases, dollars spent. Ideally, the activity data collected will align with commonly-agreed-upon, published emission factor reporting units.
2. ***Emissions Factors (GHGs / activity unit):*** For construction materials, the current best data source are vendors who provide EPDs. Ideally, the emissions factor used to account for production impacts will be vendor and product specific. However, this information may not be available or may not align with available activity data, necessitating the use of industry average proxies.

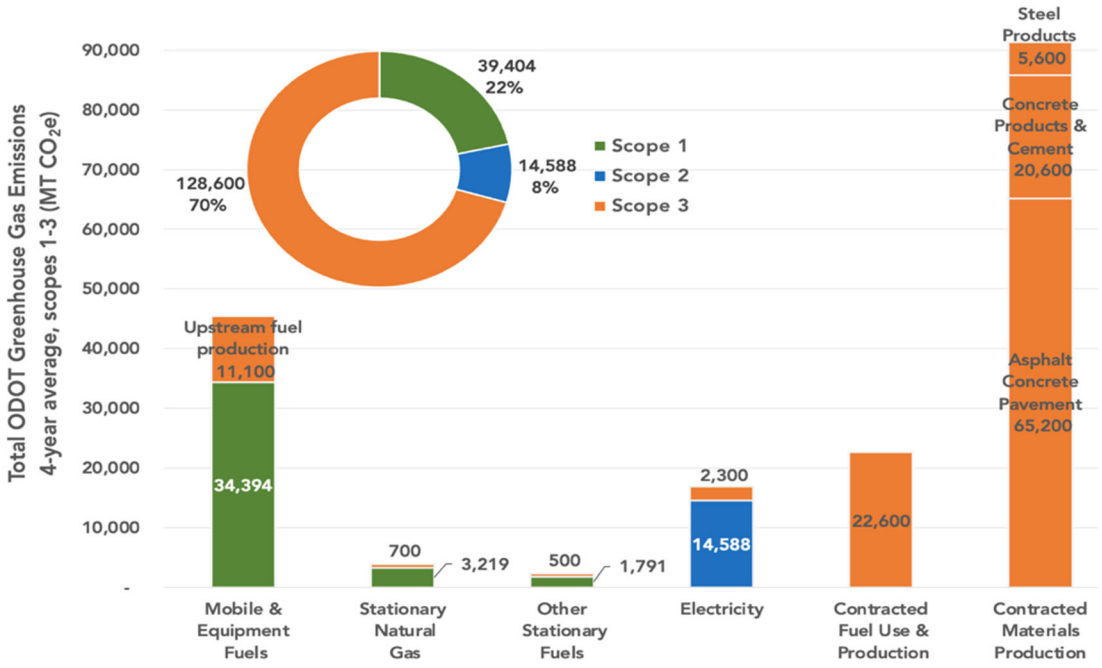
ODOT tracks asphalt concrete pavement used in construction by weight and mix type which aligns well with EPDs. For the many concrete products used by ODOT, material weight or volume data by product are unavailable in a consistent form which does not align with EPDs. However, the agency does track information that lends itself to looking up EPDs for specific purchases of concrete products. Specifically, ODOT tracks information about vendor, mix number, and use of SCMs at the project level for specific bid items. Details about the data and process to calculate GHG emissions form concrete and steel are described in the GHG Inventory report Appendix A.

[6] For details on Portland's program design and pilot project results visit https://www.portland.gov/omf/brfs/procurement/sustainable-procurement-program/sp-initiatives

GHG Inventory Results

Contracted material production and use represents a significant source (estimated to be 70%) of ODOT's annual emissions. The materials included in ODOT's GHG inventory represent large known quantities and have publicly available EPDs. The figure below provides details of the emissions totals for three materials categories: 1) asphalt concrete pavement, 2) concrete products & cement, and 3) steel products. See the GHG inventory report for more details.

Figure 2



Scope 1: *Direct GHGs from equipment and facilities owned or operated by ODOT.*
Scope 2: *Indirect GHGs from electricity purchased for equipment and facilities owned or operated by ODOT.*
Scope 3: *All other indirect emissions sources that result from ODOT's activities but are owned or controlled by ODOT contractors and other downstream material vendors (e.g., asphalt and concrete plants and concrete and cement manufacturers).*

Market Study

Availability and Access

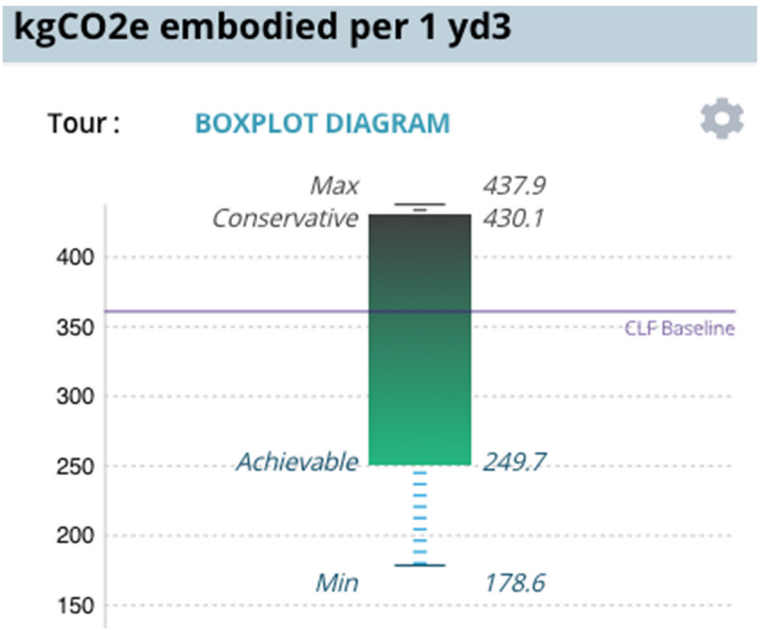
EPDs are public documents that provide consumers with information about the climate impact of the product they are buying. The National Ready Mix Concrete Association produces industry average EPDs of its membership on its website.[7] Specific vendors – like CRH and CalPortland – post EPDs for their mix designs from specific plants. And recently, Building Transparency, a 501c(3) nonprofit, released an international database of available EPDs for a variety of materials.[8] The database, known as EC3, allows the user to look up EPDs based on geographic location, vendor, and specific mix properties and qualities to allow for rapid review of available mixes that fit project need. Currently, most EPDs are available for ready-mix and other related cement and concrete products (about 1,400 ready-mix EPDs are publicly available for Oregon). Other materials do not have

[7] https://www.nrmca.org/association-resources/sustainability/disclosing-environmental-impacts/
[8] https://www.buildingtransparency.org/

the same breadth and depth of EPD resources. For example, there are currently 17 EPDs for asphalt concrete pavement available from Oregon producers. There are only two available for steel products – for rebar only – in the Oregon marketplace.

Figure 3, to the right, is an image taken from EC3 and illustrates the average GHG impact of Oregon concrete mixes with a compressive strength of 4000 psi, as an example. The tool can be customized to isolate concrete specifications of interest, including compressive strength curing time, exposure class, slump, and more. It is designed to provide a range of emissions from known mixed designs (maximum and minimum) as well as an "achievable" mark (20% of EPDs reach this value).

Figure 3



EPD service providers and software packages are readily available in the marketplace. Athena Institute[9] and Climate Earth[10] are two well-known vendors in this space. These vendors aid with data collection and provide verification, impact calculations, and preparation of standard EPD reporting. Any material vendor may engage with such a firm for assistance in developing an EPD for a production plant. The services do come at a cost, which may be a bigger financial challenge for smaller "mom and pop" material contractors to provide the same EPD information as larger companies with greater resources and staff expertise.

On average, preparation of EPDs for a new plant takes approximately one to six months of calendar time from the beginning of data collection through reporting of results. The amount of time required depends on a company's existing data systems and staff expertise and availability to collect and organize the necessary data. Once the initial set up is complete, an automated EPD system can produce an EPD efficiently (15 minutes to four hours, depending on the number of changes).

Cost

Consultant companies, like the aforementioned Athena Institute and Climate Earth, charge a set-up fee to develop software for a material vendor and then a subscription fee for the vendor to update EPDs or create new EPDs for a given plant. These fees range from $500 to $15,000 depending on the plant, materials and services requested. On the more involved end of services, one EPD developer quoted $15,000 to produce 30 EPDs from 4 plants (approximately $500 per mix). There are economies of scale in this work: per plant costs for EPD services is reduced as more plants are included in the project. Additional costs for vendors to develop EPDs include staff time, estimated to be one full-time employee for three months during initial data collection and production of an initial set of EPDs. No specific staff training costs were reported by vendors, but they did report

[9] http://www.athenasmi.org/
[10] https://www.climateearth.com/

a learning curve and the skills required can be self-taught. Costs for consultant services and dedicated staff time may be challenging for smaller vendors. Financial and technical support services may be available from Oregon Department of Environmental Quality.[11]

It is unclear if fees borne by material vendors to develop an EPD would be passed along to the customer. Nonetheless, an EPD for a specific material is typically valid for five years and can be used repeatedly (i.e., initial costs to develop EPDs for a production plant will be amortized across many projects). Project interviews indicated it is unlikely ODOT would see an increase in material costs simply because of a requirement to provide an EPD.

Within ODOT's operations, staff time would be required to review and manage submitted EPDs. Program development, including setting baselines and climate goals, will take time and consideration to ensure alignment with existing data management. Investment in EPD-specific software may be necessary to adequately track EPDs and tie them to specific projects. However, this depends on the goals of the agency; simply tracking global warming potential - a single data point in an EPD - would be very informative for ODOT. A more robust program could require the assistance of a consultant or academic support.

Making the Transition

The following text summarizes concerns and suggestions from the project advisory group and individual stakeholder interviews regarding an EPD program at ODOT.

- An emphasis needs to be placed on optimizing the lifecycle and smoothness of pavement. While EPDs are an important and useful tool to understand climate impacts, pavement lifecycle and efficiency factors like smoothness are not captured in a typical EPD. Smoothness reduces friction from tires rolling on the pavement which reduces fuel consumption from vehicles on the system. Durability of the pavement means less energy and materials are put into the pavement as the same materials sit in place for a longer period of time, thus reducing the need for more materials.
- ODOT should only require submittal of EPDs after contract award to ensure the performance specifications are met. This is heavily preferred over an open competition model in which a contractor is selected based, in part, on the lowest embodied emissions from their bid. It also allows for the entire industry to make the transition together and does not pick winners, which will most likely be the larger firms that can make the capital investments before the smaller independent and portable operations can. This is the route that CalTrans appears to be moving toward (establishing regional baselines and then mandating new thresholds for embodied GHGs).
- A declared set of emission thresholds need to be declared early on and need to reflect a schedule that allows the industry to plan for and execute a successful transition to utilizing EPDs to meet climate goals.
- Pilot and/or demonstration projects are encouraged to begin a project to develop understanding and build confidence with EPDs.
- Special considerations should be made for smaller-scale vendors that may not have the financial or staff resources to produce EPDs.

[11] For details visit ODEQ's website https://www.oregon.gov/deq/mm/production/Pages/Concrete.aspx.

- Where possible, reduce the number of mix specifications being requested by ODOT in order to simplify reporting within an EPD program. PANYNJ, for example, uses only 20 mixes total for all applications (airport runways, bridges, roadways, and structures).
- Trade organizations like the National Asphalt Pavement Association[12] or the National Ready Mix Concrete Association[13] provide technical support to their members.
- At least four regions are suggested for designing an EPD program for ODOT: Coast, Valley, High Mountains and East Side. EPD requirements or climate impact thresholds informed by EPDs should also be specific to fixed plants (located in major metro areas) compared to mobile plants (used in more rural areas). The reason being there will be a large difference in the fuel types used for the production, in addition to available materials. For fixed plants, the heat source is typically natural gas, while portable plants are likely to use residual fuel oil (RFO).
- The Carbon Leadership Forum's Embodied Carbon Policy Toolkit[14] offers a wide variety of background information and factsheets on measurement of climate impacts for material production and disclosure; basics of Buy Clean Policies; and details related to development and implementation. It is recommended to reference this toolkit and consult the organization's staff if ODOT moves forward with creating an EPD program.

Practice Alternative(s): Mitigation & Cost Scaling

Life Cycle Considerations

- Embodied emissions should not be optimized at the expense of smoothness (reduced friction on vehicle wheels) or durability/longevity of the wearing surface (reduced need for maintenance materials over time) unless a complete lifecycle analysis is performed and proves otherwise.
- EPDs only capture a small set of the material lifecycle. Other impacts such as transportation to the job site, construction, maintenance and end of life steps are not included.
- Concrete has the potential to sequester significant quantities of carbon over its lifecycle and those benefits are not currently counted in EPDs. Cursory research for this project found there are a wide variety of estimates in private market claims and the academic literature. Additional research is required to better inform the scale of the carbonation benefit and how best to apply that benefit within ODOT's GHG Inventory.

GHG Impacts

EPDs do not mitigate GHG emissions on their own. EPDs are a tool - emission reductions are seen through their application. For example, material vendors may find inefficiencies in their operations by way of an EPD. Some experts believe simply requiring EPDs lead to emission reductions because of this awareness. That said, an EPD can have the greatest GHG impact when used to show compliance with an emission performance standard (i.e., an installed product must be below a previously-set carbon threshold).

[12] For details on NAPA's Emerald Eco-Label EPD program visit https://www.asphaltpavement.org/programs/napa-programs/emerald-eco-label
[13] For details on NRMCA EDP program visit https://www.nrmca.org/association-resources/sustainability/epd-program/
[14] For details on The Carbon Leadership Forums toolkit visit https://carbonleadershipforum.org/clf-policy-toolkit/

Recommendations

Develop and pilot a "Buy Clean" policy as soon as possible:

Program development

- Require and track EPDs on a specific projects or in certain regions (Portland-area vendors are more likely to have EPDs in response to the City of Portland's EPD requirement).
- Research past projects (within one to two years) to match mix data with EPDs available on the market (using the EC_3 tool). Develop an understanding of the status quo (i.e., range of emissions from current and recently completed projects).
- Define material reporting categories and set a predictable and adequate timeline for EPD reporting from contractors / material producers.
- Include accommodations for smaller businesses and provide access to financial incentives and technical support.
- Design and implement new internal material tracking systems that align with EPD reporting units (AASHTOWare[15] is one example). The system at a minimum should be capable of tracking material quantities (weights or volumes depending on the EPD and material type) at the bid-item level; retaining a copy of the EPD; and the global warming potential value taken from the EPD. This system set up will allow for simple annual reporting of material quantities, average global warming potential by material type, and total annual GHGs.
- Learn from the Carbon Leadership Forum. Follow the progress of Colorado's recently passed Buy Clean legislation and specifically how they develop the EPD tracking system for asphalt concrete pavement

Implementation

- Run pilot projects to experiment with low-carbon applications. This can happen concurrently - during program development - and does not need to wait for any policies. Reference the City of Portland's "Low Carbon Concrete Sidewalk Pilot" project.[16]
- Review the EPDs over time to see where there are common hotspots and work with material vendors to mitigate where possible (e.g., moisture management, cement alternatives, renewable fuels).
- Require EPDs for projects, starting small and become more inclusive as availability of EPDs increases.
- Set emission limits by region, material type, and/or specific to a project.
- Lower emission limits over time at appropriate levels, sensitive to market and available technologies, as well as the need for climate action (i.e., net-zero emissions by 2050).

[15] For details visit https://www.aashtoware.org
[16] https://www.portland.gov/sites/default/files/2020/concretecasestudy_copsidewalks_final.pdf