HB21-1303

Legislative Council Staff

Nonpartisan Services for Colorado's Legislature

Final Greenhouse Gas Emissions Report

Drafting Number:	LLS 21-0322	**Date:**	August 23, 2021
Prime Sponsors:	Rep. Bernett; McLachlan Sen. Hansen	**Analyst:**	Christina Van Winkle | 303-866-6289 Christina.VanWinkle@state.co.us
BILL TOPIC:	**GLOBAL WARMING POTENTIAL FOR PUB PROJECT MATERIALS**		
Primary Sectors Impacted:	☒ Electric Power ☒ Transportation ☒ Industrial Processes ☐ Waste Management ☐ Agriculture		☐ Natural Gas and Oil Systems ☒ Residential / Commercial / Industrial Fuel Use ☐ Coal Mining and Abandoned Mines ☐ Land Use / Land Use Change / Forestry ☐ Other
Net Change:	☐ Increase	☒ Decrease	☒ Indeterminate ☐ Minimal
Report Status:	This report reflects the enacted bill.		

Emissions Summary

This bill will result in greenhouse gas (GHG) emissions reductions by an indeterminate amount beginning in 2024 by setting limits on the global warming potential on materials used in public projects. The exact quantity of the GHG emissions reduction is unknown because there is no established emissions baseline for eligible materials used in public projects, and because emissions reductions will depend on the policies established by the Office of the State Architect (OSA) and the Department of Transportation (CDOT) and the nature of projects undertaken in future years.

Key Provisions

This bill requires the OSA within the Department of Personnel and Administration and CDOT to establish policies related to the global warming potential of certain building materials used in public projects. These policies must establish limits on the maximum global warming potential of eligible materials and strive to achieve continuous GHG emissions reductions over time.

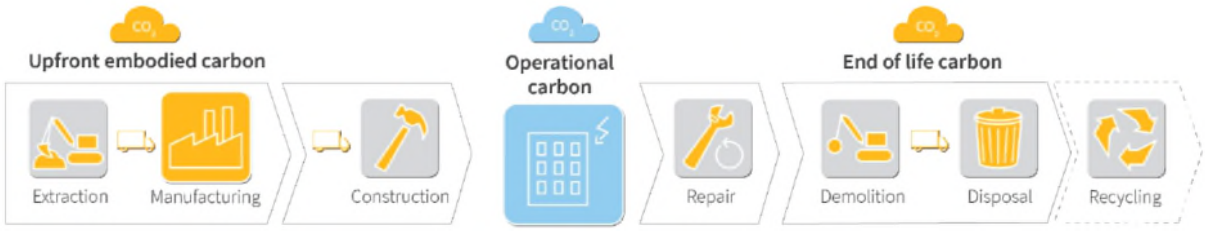
Beginning in 2024, public projects using eligible materials will be required to adhere to the maximum acceptable global warming potential limits established in policy. Eligible materials in pubic capital construction projects include asphalt, cement, concrete, glass, post-tension steel, reinforcing steel, structural steel, and wood structural elements. Eligible materials in public road, highway, and bridge projects include asphalt and asphalt mixtures, cement, concrete, and steel. These limits may be reduced in future years to align with industry conditions and ensure continuous GHG emissions reductions. Designers bidding on projects must submit environmental product declarations that comply with the GHG emissions limits established in policy.

Background

The production of construction materials for buildings and other infrastructure causes GHG emissions. These emissions arise from the extraction, processing, transportation, installation, use, and disposal of materials such as concrete, cement, asphalt, steel, and wood products used to construct buildings, bridges, roads, and other infrastructure (see Figure 1).[1]

Embodied carbon. The GHG emissions embodied in these construction materials account for combustion-related and process-related emissions. Combustion-related emissions result from the use of fossil fuels for heat and power during extraction, processing, and transportation. Process-related emissions result from manufacturing products such as cement and steel. Cement production, for example, releases carbon dioxide during the calcination of limestone during clinker production. The Portland Cement Association estimates that Colorado produces 2.6 million metric tons of cement per year.[2] The Colorado GHG Inventory Report estimates the process-related GHG emissions from cement manufacturing to be 0.8 million metric tons of carbon dioxide equivalent in 2019, or 0.6% of total statewide emissions.[3] The GHG emissions associated with these building materials is referred to as embodied carbon.

Figure 1
Embodied carbon of building materials



Source: Carbon Leadership Forum

Embodied carbon is calculated through a life cycle assessment, which tracks emissions throughout these stages. These emissions are then reported using a metric that quantifies the GHG emissions per unit of material (e.g., kilograms of carbon dioxide equivalent per metric ton of material). This metric is often referred to as the global warming potential of the material and reported in its Environmental Product Declaration.

Environmental Product Declarations. Environmental indicators, including global warming potential, are reported on Environmental Product Declarations, which are third-party verified, voluntary documents that adhere to product category rules that present transparent information about the environmental impacts of the product. The various stages and material inputs considered in a life cycle assessment may not represent the impacts associated with the full life cycle of a construction material. Rather, they typically only includes emissions from the production stages

[1] Current building codes primarily address operating energy while a building is in use, and do not address the upfront energy consumed during production of the building materials. Project developers seeking LEED certification receive credits for disclosing environmental information on building materials, which is driving manufacturers to conduct life cycle assessments.
[2] Portland Cement Association (PCA). Colorado Cement Industry. Available at: https://www.cement.org/docs/default-source/ga-pdfs/cement-industry-by-state-2015/colorado.pdf?sfvrsn=2&sfvrsn=2
[3] Colorado 2021 Greenhouse Gas Inventory Update Including Projections to 2050. Colorado Department of Public Health and Environment. January 2021.

(reflected by the upfront embodied carbon Figure 1 above). Emissions associated with the transportation, use, and end-of-life are typically excluded from these emissions assessments.

Baseline emissions from select building materials. The Carbon Leadership Forum has developed baseline GHG emissions for select building materials by aggregating Environmental Product Declarations from public databases. These baseline emissions are reported in three figures representing a conservative baseline ("high"), a typical estimate ("median"), and an achievable estimate ("low"). The baseline represents the 80th percentile value of the category. The typical estimate represents the industry-average Environmental Product Declaration, where available, developed by industry associations. The achievable estimate represents an achievable target, where at least 20 percent of products are better than this value.

Table 1
Baseline Global Warming Potential for Select Construction Materials

		kg CO_2e per declared unit			
Category	Declared Unit	Achievable (Low)	Average (Median)	Conservative (High)	% savings from Average to Achievable
Concrete					
RMC[1] 0-2500 psi	m^3	190	266	340	29%
RMC 2501-3000 psi	m^3	210	291	380	28%
RMC 3001 -4000 psi	m^3	260	343	470	24%
RMC 4001-5000 psi	m^3	320	406	580	21%
RMC 5001-6000 psi	m^3	330	429	610	23%
RMC 6001-8000 psi	m^3	380	498	710	24%
RMC >8000 psi	m^3	411	535	710	23%
Slurry - Flowable Fill	m^3	90	170	230	47%
Steel					
Rebar	kg	0.8	0.98	1.7	18%
Plate Steel	kg	1	1.47	3	32%
Structural Steel - hollow sections	kg	1.5	2.39	3	37%
Structural Steel - hot-rolled sections	kg	0.8	1.16	1.7	31%
Cold Formed Steel	kg	1.5	2.28	3	34%
Prefabricated Assemblies	kg	0.7	1.38	2.5	49%
Wood and Composites					
Dimension Lumber	m^3	50	63	100	21%
Sheathing Panels - plywood & OSB	m^3	200	230	400	13%
Mass Timber	m^3	104	137	200	24%
Bulk Materials					
Flat Glass	kg	1.2	1.4	2.3	14%

[1] RMC = ready mix concrete
Source: LCS calculations, adapted from the Carbon Leadership Forum Baseline Report

A comparison of the 'typical' global warming potential to the 'achievable' global warming potential reflects the potential GHG emissions savings for various building materials. As shown, transitioning from a 'typical' ready mix concrete to an 'achievable' ready mix concrete may result in GHG emissions savings of 21 to 29 percent per cubic meter. The global warming potential of ready mix concrete is influenced by a number of factors, including the electricity resource mix used to operate machinery, the distance traveled between resource extraction and processing plants, and the clinker-to-cement ratio in the cement mixes. For example, mixes with higher recycled byproducts from other industries, such as fly ash, reduce the quantity of clinker in cement and generally result in lower global warming potential. Other potential GHG emissions savings are reflected in the table above for steel, wood, and glass materials.

Less information is known about the global warming potential for asphalt, as few manufacturers have produced environmental product declarations.[4] Efforts are underway in the asphalt industry to reduce temperatures for asphalt mixtures through warm-mix technologies, which reduces the energy needed and associated GHG emissions with mixture production. In addition, the use of recycled materials in asphalt mixtures, primarily reclaimed asphalt pavement and shingles, conserves raw materials (e.g. asphalt, binder, and aggregates) and reduces landfill waste. According to one industry study, the use of warm-mix asphalt technology can reduce GHG emissions by between 300 and 1,200 metric tons of carbon dioxide equivalent per million tons of warm-mix asphalt produced, compared to hot-mix asphalt.[5] This same study estimated that the use of reclaimed asphalt pavement can reduce GHG emissions by approximately 26,000 metric tons of carbon dioxide equivalent per million tons of reclaimed asphalt pavement produced.

Emissions Assessment

House Bill 21-1303 requires OSA and CDOT (state agencies) to develop policies that track and limit greenhouse gas emissions of eligible materials used in public projects. Currently, there is no tracking of emissions and no requirement that manufacturers conduct life cycle assessments to estimate the global warming potential associated with their materials. This bill is expected to reduce GHG emissions primarily by limiting the maximum acceptable global warming potential for eligible materials used in public projects, as described below. It may also contribute to improved data collection on the impact of building materials, which could indirectly reduce GHG emissions in the future.

Limit global warming potential. Establishing maximum acceptable global warming potentials for construction materials, and adjusting these limits downward to reflect industry conditions, will result in a reduction of GHG emissions over time. As industry conditions improve, state agencies may adjust the maximum acceptable global warming potential in line with these industry improvements, further reducing GHG emissions.

---

[4] As referenced above, project developers seeking LEED certification receive credits for submitting environmental product declarations. Less information is known about pavement materials, such as asphalt. The Federal Highway Administration and state departments of transportation are encouraging the standardization of life-cycle assessment methodologies for pavement materials, which may increase the available data on asphalt global warming potential in the future.

[5] National Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage. 2019. Available at: https://urldefense.com/v3/__https://member.asphaltpavement.org/Shop/Product-Catalog/Product-Details?productid=*7b9BC71D4C-2307-EA11-A812-000D3A4DBC41*7d__;JSU!!PUG2raq7KiCZwBk!MaxyVerbTR2ZVw3FEBol2VJ6EAF3MQOcc1cVI3hgcAtbhSpxBmdrgKHNabrdwxbA3w8v4XJ0EDk$.

Potential emissions savings. Over the past 10 years, Colorado has spent around $54 billion in public construction projects. Spending has generally trended upwards, increasing over 10 percent between 2010 and 2019.

Table 2
Annual Value of Colorado State and Local Construction Put in Place
(millions)

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$4,821	$3,838	$4,698	$6,056	$5,404	$4,717	$5,323	$7,190	$6,807	$5,377

Source: U.S. Census Bureau Construction Spending[6]

The extent to which House Bill 21-1303 will result in GHG emissions reductions will largely be driven by future decisions at state agencies, future investments in public projects, and industry conditions for these eligible materials. If spending on public projects continues along this upward trend, the potential for GHG emissions savings will increase.

According to the baseline emissions data compiled by the Carbon Leadership Forum, the average emissions savings from transitioning from industry-average to achievable global warming potentials may result in a 13 to 49 percent reduction in GHG emissions per unit for certain eligible materials. As technologies advance and alternative energy sources enable reductions in combustion-related and process-related emissions to manufacture these materials, the maximum achievable GHG emissions reductions will improve. As this occurs, industry conditions may lead state agencies to revise their global warming potential limits downward, achieving greater GHG emissions reductions over time.

Improved data collection. While the bill does not place a direct requirement on manufacturers, construction companies and designers that bid on public projects will be required to use materials for which environmental product declarations are available unless exempted a waiver. To the extent this spurs demand in the industry for manufacturers to conduct life cycle assessments and produce environmental product declarations, the energy consumption and environmental impacts of materials will become better known. This verifiable and transparent information will allow for the comparison of the environmental performance of materials, and will inform policy-making and decision-making both at the government and manufacturer level. Materials manufacturers will be able to better identify areas for efficiency improvements, which may increase competition to reduce the environmental footprint of construction materials.

Increased competition may spur innovation and deployment of low-carbon technologies. Current efforts to reduce GHG emissions from cement, for example, are already underway, including carbon capture technologies and alternative binding materials to reduce the clinker-to-cement ratio. Although this bill only requires public projects to adhere to these requirements, a better informed industry may spur economy-wide demand for construction materials with lower GHG emissions.

[6] U.S. Census Bureau. Annual Value of Construction Put in Place 2009 – 2020. Available at: https://www.census.gov/construction/c30/historical_data.html.

Limitations. As stated above, environmental product declarations typically only account for the GHG emissions associated with the production of the construction materials, and exclude emissions associated with transportation, operational use, and end-of-life. If state agencies choose to include transportation-related emissions in their established policies, as authorized by the bill, further emissions reductions may be possible.

As environmental product declarations are voluntary, it is not known what proportion of materials manufacturers are represented by industry averages. In addition, there is limited information on the global warming potential for asphalt used in transportation projects. Therefore, the potential scope of GHG emissions savings from this material is unknown. According to the U.S. Census Bureau, construction spending for highways and roads accounts for around 30 percent of public construction spending. This bill may increase information on the environmental impacts of asphalt and asphalt mixtures, currently lacking in publically available databases on environmental product declarations.

Also, the bill authorizes the agencies to waive the requirements of meeting maximum acceptable global warming potential requirements if eligible materials are not reasonably priced or available at the time of design or construction. It is not known the availability of eligible materials that meet the requirements of this bill, as producing environmental product declarations is currently voluntary.

Data Sources and Agencies Contacted

Colorado Department of Public Health and Environment
Colorado Department of Transportation
U.S. Census Bureau
Carbon Leadership Forum
National Ready Mix Concrete Association
National Asphalt Pavement Association