Defining Carbon

Global Warming Potential and Resilient Flooring

Introduction

Understanding carbon and global warming potential is a key topic in design, specification, and construction of building projects. There are many terms associated with reducing the carbon footprint of a building down to the specification of individual low embodied carbon products. The terminology can easily be misunderstood if everyone is not following the same definitions. This is a primer for terminology that is used to address climate change, carbon emissions, and the reduction of global warming potential.

Terms to Know

The following terms are used in relation to carbon emissions, global warming potential, and embodied carbon as related to the design and operation of buildings and specification of products. Additional "Deep Dive" information is provided as needed in this document to help the user better understand the application of the terms, resources, and tools that are available for use by specifiers and manufacturers.

Carbon Footprint: a measure of the total amount of greenhouse gases generated and emitted by our actions, including agricultural activities, transportation, manufacturing activities, building construction, and building usage.[1]

Deep Dive

- *Greenhouse gas emissions (GHG) include more than carbon dioxide (CO_2) but GHG is often used interchangeably with carbon emissions in relation to climate change.*
- *The full footprint of an organization encompasses a wide range of emissions sources from direct use of fuels to indirect impacts such as employee travel or emissions from other organizations up and down the supply chain.*[2]
- *The Greenhouse Gas Protocol (GHG Protocol) has available A Corporate Accounting and Reporting Standard and divides emissions into three categories or scopes:*
  - *Scope 1 Emissions: direct emissions resulting from activities within an organization's control.*
  - *Scope 2 Emissions: indirect emissions from energy purchased from a third party and consumed by an organization.*
  - *Scope 3 Emissions: all other emissions resulting from an organizational and employees' activities and their supply chain organizations' activities.*[3]

[1] University of Michigan: Center for Sustainable Systems. Carbon Footprint Fact Sheet: https://css.umich.edu/sites/default/files/2022-09/Carbon%20Footprint_CSS09-05.pdf. Accessed 12/14/2023.
[2] Carbon Trust: *Carbon footprinting – An introduction for organisations [sic]. Available at* https://semspub.epa.gov/work/09/1142510.pdf. Accessed 12/15/2023.
[3] Sustain Life. Accessed 12/15/2023.

Greenhouse Gas Emissions (GHG Emissions): gases that trap heat in the atmosphere. These include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (HFCs, PFCs, SF_6, and NF_3). CO_2 is the largest contributor to GHG emission (approximately 80%), and that is why carbon dioxide and greenhouse gas emissions terminology is sometimes used interchangeably.[4] GHG emissions other than CO_2 make up approximately 20% of GHG emissions.[5]

Deep Dive

- *Carbon dioxide enters the atmosphere through burning fossil fuels, solid waste, trees and other biological materials, and as a result of certain chemical reactions (e.g., cement production). CO_2 is removed from the atmosphere when it is absorbed by plants as part of the biological carbon cycle – this is called sequestered carbon.*
- *Methane is emitted during the production and transport of coal, natural gas, and oil. CH_4 is emitted from livestock and other agricultural practices, land use, and the decay of organic waste in municipal solid waste landfills.*
- *Nitrous oxide is emitted during agricultural, land use, and industrial activities, including combustion of fossil fuels and solid waste and treatment of wastewater.*
- *Fluorinated gases, including hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride are synthetic greenhouse gases emitted from a variant of household, commercial, and industrial applications and processes.*[6]

Embodied Carbon: CO_2 emissions from manufacturing, transportation, installation, maintenance, and disposal of building materials.[7] Embodied carbon is typically accounted for in the design and construction phases of a building project before it becomes operational.

Deep Dive

*Embodied carbon is determined by completing a **product life cycle assessment** and documented in **environmental product declarations** (EPDs). The impact indicator for embodied carbon is **global warming potential** (GWP) and measured by weight of emissions in kilograms of carbon dioxide equivalents (kg of CO_2 eq).*

- *Industry wide EPDs are based on averaged data originating from various manufacturers of the same type of category of product, e.g., heterogeneous sheet vinyl flooring, solid vinyl tile, etc.*
- *Product specific environmental product declarations are based on data for a particular product made by a specific manufacturer, e.g., product "B" made by brand "A".*

Building Transparency Resources provides various types of detailed reports and

[4] US Environmental Protection Agency (EPA): https://www.epa.gov/ghgemissions/overview-greenhouse-gases. Accessed 12/14/2023.
[5] US Environmental Protection Agency (EPA): https://www.epa.gov/ghgemissions/overview-greenhouse-gases. Accessed 12/14/2023.
[6] US Environmental Protection Agency (EPA): https://www.epa.gov/ghgemissions/overview-greenhouse-gases. Accessed 12/14/2023.
[7] Carbon Leadership Forum: https://carbonleadershipforum.org/embodied-carbon-101/. Accessed 12/14/2023.

information on embodied carbon and its relation to climate change. RFCI participated in the pilot program in the development of the criteria for the resilient flooring product category for Building Transparency's Embodied Carbon Construction Calculator (EC3).

- *Registration for accessing EC3 is free and allows open access to product specific EPDs global warming potential values and EC3 global warming potential values. The EC3 GWP values are based on the EPD GWP values for minimally cradle to gate (life cycle stages A1 – A3)* ***plus applied uncertainty metrics to determine the EC3 value****.*
- *The goal of the EC3 tool is to allow the product specifier to quickly compare the GWP values between products to inform product selections. It is important to note that products should be selected based on multiple attributes versus only GWP value.*
- *Embodied carbon should be evaluated in the context of the application and additional attributes required for a product specification, such as desired product service life, durability and product maintenance requirements, and aesthetics.*

Operational Carbon: CO_2 emissions due to building energy consumption once a building is operational and occupied.[8]

Deep Dive
Most organizations have been tracking energy consumption data for many years, not only as a sustainability measure but also to better understand related energy costs incurred on a monthly and annual basis. When a new or renovated building project is being designed, discussing not only first costs, but on-going operational costs by developing a life cycle cost analysis (LCCA), provides the opportunity for the operator/organization to evaluate higher first costs for energy efficient equipment, the use of on-site renewable energy sources, and other strategies that may demonstrate a lower on-going operational energy consumption, lower costs over time, and significant reduction in carbon emissions.[9]

Biogenic Carbon: CO_2 emissions directly resulting from the combustion, decomposition, or processing of biologically based materials other than fossil fuels, peat, and mineral sources of carbon through combustion, digestion, fermentation, or decomposition processes.[10]

Deep Dive
Typically, biogenic CO_2 refers to carbon in wood, paper, grass trimmings, and other biofuels that were originally removed from the atmosphere by photosynthesis and would eventually cycle back to the atmosphere as carbon dioxide due to degradation

[8] Cove Tool: Embodied Carbon versus Operational Carbon: https://cove.tools/blog/embodied-carbon-vs-operational-carbon. Accessed 12/15/2023.
[9] Cove Tool: Embodied Carbon versus Operational Carbon: https://cove.tools/blog/embodied-carbon-vs-operational-carbon. Accessed 12/15/2023.
[10] US Environmental Protection Agency (EPA): Accounting Framework for Biogenic CO_2 Emissions from Stationary Sources: https://www.epa.gov/sites/default/files/2016-08/documents/biogenic-co2-accounting-framework-report-sept-2011.pdf. Accessed 12/15/2023.

processes. In following the GHG Protocol standard, the biogenic emissions footprint, also measured in kg of CO_2 eq, can be used to offset the embodied carbon for a product, which is typically found in the wood flooring industry. It is recommended to separately disclose the biogenic emissions for full transparency in reporting and declarations.

Carbon Neutral: A person, organization, or country is "carbon neutral" if they balance the carbon dioxide released into the atmosphere with the amount of carbon dioxide removed from the atmosphere through natural means (e.g., planting of trees) or technological means. Carbon neutral is also referred to as net zero carbon emissions or net zero carbon, because overall no carbon dioxide is added to the atmosphere.[11]

Deep Dive
In evaluating a manufactured product and related embodied carbon, a product is considered "carbon neutral" if the manufacturing process CO_2 emissions are balanced or removed from the atmosphere during the manufacturing process. For an organization to achieve carbon neutrality, the following steps are recommended by Climate Impact Partners:

- *Step 1: Define: understand exactly what should be covered in an organizations carbon footprint.*
- *Step 2: Measure: calculate emissions accurately and conservatively.*
- *Step 3: Target: set goals to reduce the defined carbon footprint and offset all remaining emissions.*
- *Step 4: Reduce: deliver internal reductions and offset all remaining emissions through financing verified emission reductions and removals.*
- *Step 5: Communicate: demonstrate your climate action and engage all stakeholders.*

Carbon Offset: investing in carbon emission reductions that are outside of the manufacturing process and operations of an organization.[12]

Deep Dive
A "carbon offset" seeks to balance the carbon emission resulting from product manufacturing processes and organizational activities by essentially offsetting the emissions to reach a lower carbon emission overall and in some cases reach carbon neutrality There are various types of offsets including: 1) supporting forestry and conservation because plants and trees absorb carbon dioxide, 2) purchase of renewable energy as it is not fossil fuel based, 3) community-based projects that reduce the types and amounts of fuels used while typically improving human health at the same time, and 4) waste to energy projects that avoid mining and utilizing fossil fuels.[13]

[11] UK Natural History Museum: https://www.nhm.ac.uk/discover/quick-questions/what-do-carbon-neutral-and-net-zero-mean.html. Accessed 12/15/2023.
[12] United Nations: *A Beginner's Guide to Climate Change*: https://unfccc.int/blog/a-beginner-s-guide-to-climate-neutrality. Accessed 12/15/2023.
[13] EIC: Examples of Carbon Offset Projects: https://www.eic.co.uk/4-types-of-carbon-offset-projects/. Accessed

Carbon Negative: used to describe a product or organization that removes more greenhouse gases from the atmosphere than it adds. The sum of its carbon emission is less than zero, making it carbon negative.[14]

Deep Dive

"Carbon negative" refers to actions that are actively engaged in combating climate change and introducing the idea that organizations can achieve CO_2 negative. Per the Certified Carbon Negative organization, the following steps are an approach to achieving negative carbon emissions.

Firstly, conduct a Life Cycle Assessment (including all stages of a product's life – cradle to grave) to calculate the total carbon emissions produced by a product. This information would be found in an Environmental Product Declaration. If completing on a manufacturing level, an assessment would have to include measuring all carbon emissions resulting from operations, producing, and distributing products.

> *Cork is an example of an ingredient available to be used in various types of resilient flooring that is inherently carbon negative, because it represents 70 times its own weight in sequestered carbon from the atmosphere per the Certified Carbon Negative organization. Depending on the portion of cork used, the sequestered carbon could be enough to offset the entire product, including material sourcing, production, and distribution. Therefore, beginning with the product level for evaluation would be the first place to start, as a manufacturer may produce several different types of products and can not assume that the entire plant would be carbon negative overall without completing an entire evaluation of all manufacturing and operations.*

Secondly, there are two approaches that could be taken to reach CO_2 negative emissions (again using cork as an example ingredient):

1) *Change initial impact by incorporating or increasing use of cork as an ingredient. For example, foams or plastics with higher CO_2 emissions could be replaced with cork composites.*
2) *Carbon offsets for a specific product or for an entire operation can be used to achieve carbon neutral – but then if an organization increased purchase and participation in carbon offset activities, a product and/or an organization could be carbon negative by choice.*

Conclusion

For more information on RFCI sustainability initiatives, see the RFCI Sustainability Center for certifications and declarations available for the resilient floor covering industry.

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[14] Certified Carbon Negative: https://co2neg.com/why-negative. Accessed 1/11/2024.