openIMPACT
Project Overview

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Prepared by: Vaclav Hasik & Mikaela DeRousseau, Building Transparency

1 Problem Statement

Tool developers, designers, owners, and others in the building industry need access to embodied carbon values for generic construction materials representative of the typical North American market. Most intended users are not LCA experts. The primary users will want access to model results and need enough information/citations to interpret and communicate them appropriately but will not need/want to dig into the nuances of underlying LCA modeling. The users also want data with broadly predefined performance and geographical criteria most relevant for the early design modeling, instead of providing access to all product-specific EPD data.

2 Goal

The goal of the openIMPACT project is to create a set of LCA impact results for construction materials based on high-quality, transparent, and peer-reviewed LCA models, and that can be used broadly by open-source tools.

2.1 General requirements

- Free to use
- Transferable via open API
- Provides ranges of GWP results (20th percentile, 80th percentile, average/mean)
- Provides parameterized data for user-based assumptions
- Is transparent, well-documented and updatable (see Transparency for more information)

2.2 Transparency

- List foreground input/output inventory for each data point (e.g. X kg of cement, Y kg of aggregate, Z kWh of electricity, etc.); however, there may be some level of aggregation to protect confidential data.
- Provide info on the sources of background data to the point of specific unit process name and database name and version for the inventory entries (e.g., ecoinvent 3.5, hot-rolled steel, production | Cutoff, U - GLO).
- Provide a link/reference to the background data documentation if available.
- Provide documentation of our modeling approach and decisions.

2.3 Deliverables

- Table of impacts (spreadsheet)
- LCA models (OpenLCA database files in JSON-LD format, uploaded to FLCAC[1] or GitHub)
- Documentation reports (Word or Google Doc with references and appendices)

[1] Federal LCA Commons, https://www.lcacommons.gov/

2.4 How this work can be used

The contributions made in this project can be utilized in several ways, which are summarized below.

1. Resultant environmental impact data and uncertainty ranges can be used in building LCA tools where North American industry estimates are needed.
2. The parameterized models can be used to compare how environmental impact results change when parameters are set to different values.
3. More broadly, the Monte Carlo methodology developed in this project can be expanded to many material and product types to better understand their environmental impact ranges in certain regional markets.

3 Scope

- Material/product scope:
  - Phase 1: Concrete, Steel
  - Phase 2: Wood, Asphalt
  - List of materials is expected to grow over time, as openIMPACT project grows
- Life cycle stages:
  - Included in initial scope:
    - A1, A2, A3 - extraction and manufacturing by product
    - A4/C2 - transportation modes, distances, and load capacities
    - A5 - construction by building type, equipment use, etc.
    - B1 - Use (e.g., carbonation of concrete)
    - B4 - Replacement
    - C3, C4 - end-of-life disposal and waste processing
  - Excluded from initial scope:
    - B2, B3 - not relevant to initial material categories unless addressed on a whole-building level along with probabilistic structural design assessment
    - B5 - relevant only on a whole-building assessment level
    - B6, B7 - operational aspects best addressed on a whole-building level
    - C1 - demolition is best addressed on a whole-building level
    - D - informational module only, not focus of this work
  - Scope for other material categories in future updates may be different and will be specified
- Impact categories:
  - Because the geographic focus is North America, the primary impact assessment method will be the most updated version of TRACI (currently TRACI 2.1) to ensure comparability. Note that TRACI 2.1 uses an older version of the IPCC GWP factors than some newer PCRs which require IPCC AR5.
  - Ranges / distributions are modeled primarily for GWP results.

Product			Construction		Use					End-of-life				Beyond
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	D
Raw material supply	Transport	Manufacturing	Transport	Construction and installation	Use	Maintenance	Repair	Replacement	Refurbishment	Demolition and deconstruction	Transport	Waste processing	Disposal	Credit for Reuse, Recycling and Recovery Potential

Figure 1. Life cycle stages based on EN 15978 (excludes B6 operational energy use and B7 operational water use).

4 Work plan

The following is a list of main steps for this project also outlining major milestones. Steps 3-7 are iterative.

1. Requirements & project scoping
2. Working groups & category scoping
3. Data collection & research
4. Modeling
5. Report / documentation
6. Results
7. Review & validation
8. Publishing

4.1 Data collection and research

- Identify existing LCA models that can be used as a starting point
- Identify the relationship between performance characteristics of materials and their composition
- Collect additional data on processes, emissions, market shares, and trade
- Identify standards (ISO, EN, ASTM, etc.) and rules (PCR, IPCC, etc.) for calculating impacts in each product category and for addressing methodological decisions (on biogenic carbon, carbonation, allocation, etc.)

5 Guiding principles

5.1 Transparent in data and methodology

- Uncertainty disclosure
- 'Legible' by a variety of users and purposes
    - Back this up with educational materials
- Disclose sources and methodologies in background and foreground data
    - There may need to be some limits when using proprietary databases, but the use of specific unit processes needs to be disclosed to allow for reproduction and deeper analysis by users
    - Capture the context of models, so that it's clear how they can be reused
- Where feasible, develop parametrized life cycle information models that will ensure consistent use of product system models and map unit processes to appropriate background data sets, while empowering users within the scope of their application to manipulate foreground parameters
- Modeling choices conform to relevant standards (e.g., ISO 21930, ISO 14040, ISO 14044, PCRs)

5.2 Reasonable initial scope

- Create a 'minimum viable product' that can serve as a template and platform
- Make good use of existing work including:
    - Ecoinvent
    - US LCA Commons: https://github.com/USEPA/Federal-LCA-Commons-Elementary-Flow-List
    - NREL electricity baselines: https://github.com/USEPA/ElectricityLCI, see also pdf
    - GreenDelta, e.g. http://www.openlca.org/download/
    - Athena
- Covers high-carbon materials used in North American construction, and the high-carbon parts of the supply chain
- Global Warming Potential mandatory (primary focus)
- Ozone depletion, acidification, eutrophication, and photochemical smog supported
    - Included if already in upstream data (or otherwise easy to get)
    - Structure to support tracking additional impact categories

5.3 Interoperability & harmonization

- Ensure / improve interoperability
- Use common semantics and language
- Ensure compatibility in the integration of data both vertically and horizontally

5.4 Extensible

- Can be extended for additional materials and categories
- Can be extended for use worldwide
- Can be extended for additional impact categories