



April 2021

RE: Reproducibility and alignment project of LCA models and EPD impacts results

In accordance with the [NSF Concrete Product Category Rule \(PCR\), February 2019](#), Section 11 “Verification and Validity of an EPD,” and Subsection B pertaining to aligning a product specific EPD to an industry average EPD, NRMCA collaborated with the Athena Sustainable Materials Institute (Athena) and Climate Earth to demonstrate variability and provide transparency on calculated environmental impact results that stem from background data and modelling software.

The criteria as defined in the PCR is as follows:

- In order to evaluate the consistency of results between product specific EPDs and industry average EPDs either:
 - The same LCA modeling software and version and background data shall be used to create the EPD, or
 - The LCA modeling software and version shall test representative samples of the regionally specific industry average benchmark data and include in the EPD a report of the maximum percent difference for environmental impact categories: global warming potential, acidification potential, ozone depletion potential and smog creation potential.

Reproducibility:

To learn the reproducibility of environmental impact results as reporting through EPDs for ready mix concrete products, NRMCA retained Athena and Climate Earth to participate in an LCA model reproducibility project.

Upon completion of the research project [A Cradle-to-Gate Life Cycle Assessment of Ready-Mixed Concrete Manufactured by NRMCA Members – Version 3, dated February 2020](#), Athena facilitated an effort to replicate their study results with other researchers.

Athena collaborated with Climate Earth on background data decisions, the publication of additional transparency of background data and assumptions to align Climate Earth’s models to NRMCA’s LCA report compiled by Athena. The collaboration included:

- **Improved LCA Transparency**

Athena developed the LCA model and made efforts for additional detail to the descriptions of the modeling decisions and calculated parameters. First and foremost, Athena only used data that other parties could access (i.e. no proprietary Athena data). These data included published EPDs for materials like cement and admixtures. In cases that these background data were adjusted and/or supplemented with additional results not in the original EPDs, Athena published the complete list of indicators in an Appendix of the LCA report.



Additionally, Athena published calculated parameters for each of the representative regions so that this modeling could be more easily replicated. Adding this additional reporting, while not required by the PCR, improved the reproducibility of the study.

- **Model Alignment**

Athena coordinated with Climate Earth the best approach to aligning model results and agreed that Climate Earth would attempt to replicate results for a particular strength class (2500 PSI) in a given region (Eastern). Ongoing correspondence discussed modeling variances and differences between the two sets of results.

At the conclusion of the alignment discussions and refinement of the Climate Earth model, Climate Earth presented their findings as to the remaining differences between the models. The result of the collaboration identified relative variances between NRMCA Eastern regional benchmark results developed by Athena and then calculated by Climate Earth. See Appendix A for results. The primary difference was the selection of “diesel boiler” instead of “diesel equipment” for the facility energy use which caused minor differences in several impact categories; and therefore, the outstanding discrepancies were negligible in terms their influence on benchmarking and could thus be ignored.

Application of the project findings:

Where ready-mixed concrete producers are aligning their EPD results to an industry average EPD, and demonstrating an optimized option of a concrete mix design, NRMCA, as well as users of EPDs, can be confident, that through this alignment project, Athena and Climate Earth EPDs can produce consistent results between product specific EPDs and industry average EPDs.

Conclusion

The exercise described in this document was found to be of significant value for LCA practitioners such as Athena and Climate Earth – and most importantly to the NRMCA in terms of the overall confidence of all parties in the quality of the environmental impact results. The conclusion of the results alignment was that the results were all adequately aligned and that both Athena and Climate Earth could be confident that the EPDs produced by the two parties are consistent.

NRMCA recommends that other LCA practitioners conduct a similar study to determine their consistent and reproducible impacts to those found in the *Cradle-to-Gate Life Cycle Assessment of Ready-Mixed Concrete Manufactured by NRMCA Members – Version 3, dated February 2020*. This effort would demonstrate if underlying models and data sources produce similar results and provide the most value to NRMCA members seeking their own EPDs through Athena or others; and, wanting to align environmental indicator results to optimize mix designs for lower environmental impact.

Disclaimer: The aforementioned project and subsequent claims by Athena and Climate Earth, and their ready-mixed concrete clients, regarding alignment of company-specific EPDs with industry average or regional benchmark impact results is only valid where the data sources are the same as cited within this project. If different data sources are selected, then additional alignment studies must be completed.



Appendix A: Summary of Reproducibility Results

Results of alignment for the NRMCA Eastern Region Benchmark.

Impact category	ABB	Athena	Climate Earth	Unit	Results		Difference
		Method Used	Method Used		Athena	Climate Earth	
Global warming	GWP	TRACI 2.1 V1.02	TRACI 2.1 v 1.04	kg CO2 eq	202.80	201.02	-0.88%
Ozone depletion	ODP	TRACI 2.1 V1.02	TRACI 2.1 v 1.04	kg CFC-11 eq	6.18E-06	5.98E-06	-3.28%
Eutrophication	EP	TRACI 2.1 V1.02	TRACI 2.1 v 1.04	kg N eq	0.29	0.2799	-2.79%
Acidification	AP	TRACI 2.1 V1.02	TRACI 2.1 v 1.04	kg SO2 eq	0.74	0.7245	-2.17%
Smog	SFP	TRACI 2.1 V1.02	TRACI 2.1 v 1.04	kg O3 eq	15.20	14.959	-1.57%