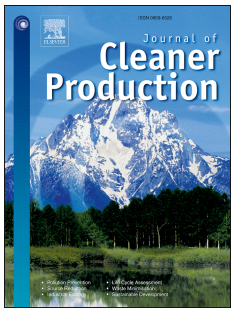
Accepted Manuscript



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PII: S0959-6526(17)30566-8

DOI: 10.1016/j.jclepro.2017.03.122

Reference: JCLP 9249

To appear in: *Journal of Cleaner Production*

Received Date: 6 December 2016

Revised Date: 22 February 2017

Accepted Date: 18 March 2017

Please cite this article as: Teh SH, Wiedmann T, Castel A, de Burgh J, Hybrid life cycle assessment of greenhouse gas emissions from cement, concrete and geopolymer concrete in Australia, *Journal of Cleaner Production* (2017), doi: 10.1016/j.jclepro.2017.03.122.

Submission to: [Journal of Cleaner Production]
Category: [Original article]
Word count: 12628 (total), 8467 (main text only)

Hybrid Life Cycle Assessment of Greenhouse Gas Emissions from Cement, Concrete and Geopolymer Concrete in Australia

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Abstract

Concrete is the second most used material after water and the production of cement is responsible for 5-8% of global carbon dioxide emissions. The development of low-carbon concretes is pursued worldwide to help the construction industry make its contribution to decarbonising the built environment and achieving carbon reduction targets agreed under the Paris Climate Agreement. However, there is uncertainty around the actual amount of greenhouse gas emissions that can be avoided by employing alternative types of concrete. This study quantifies the carbon footprint intensities of Australian cement and concrete production, including ordinary Portland cement, standard ordinary Portland cement concrete, blended cement-based concrete and geopolymer concrete production. For the first time, an input-output based hybrid life-cycle assessment method is used for these products. The main goal of this paper is therefore to make a methodological comparison between process-based and hybrid life cycle assessment using the Australian cement and concrete production as a case study. A comparison with published results from process-based life-cycle inventories as well as a decomposition of results into product categories is provided. The hybrid life cycle assessment resulted in higher greenhouse gas emissions for ordinary Portland cement and all types of concrete due to the methodology incorporating an economy-wide system boundary, which includes the emissions from upstream processes. For geopolymer concrete in particular, the results are also dependent on the method applied for allocating greenhouse gas emissions from fly ash and slag. The findings from this study are likely to inform the development of strategies and policies aimed at greenhouse gas reduction in the cement and concrete industries.