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Emission intensity factors for logistics buildings

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updated results as presented at TRB 01/2019 and published in TRR Transportation Research Record

The World Economic Forum estimated almost 10 years ago that logistics (transport, warehouses and terminals) accounts for around 5.5% of the global GHG emissions[i], 13% of which were allocated to 'logistics buildings'. McKinnon recently outlined that still "very little data is available on GHG emissions from the buildings and terminals in which goods are stored, handled and transhipped"[ii]. He further summarizes estimates on the warehouses' contribution to transport emissions: warehouse emissions represent approximately 20% of the transport emissions in the United States[iii], while in the UK these account to presumably 11 or 30%[iv]. For Germany, a share of around 15% was estimated for logistics sites (i.e. warehouses, terminals, and ports).[v]

To overcome this gap on logistics sites' contribution to global GHG emissions, an initial data gathering and analysis of 196 European logistics sites of 42 companies were conducted with the focus on logistics buildings covering transhipment and warehouses. Their operators have provided annual information on e.g. energy consumption, refill of refrigerants, and throughput. The assessment scope used for calculating average emission intensity values is in accordance with the "Guide for Greenhouse Gas Emissions Accounting at Logistics Sites".[vi]

Due to varying data availability and quality (e.g. completeness of assessment boundaries, provision of base units "tonnes", "pallets", "parcels" or "letters"), a reduced number of 189 sites has been used to calculate emission intensity values per site. Moreover, for some site types only data from less than three different companies could be collected (especially CEP sector), which reduces the further processed and published information for keeping confidentiality to in total 53 sites.

This database has been used for further analysis differentiating three site types, i.e.

(1) Sites with only transhipment activities (ambient) as well as

(2) Sites with transhipment and storage activities (ambient and refrigerated).

The site sizes vary from 2,800 tonnes to 6.3 Mio tonnes outbound with 65,000 tonnes as median value. All operators specified a site-specific electricity mix, however, an average European emission factor was used for calculating the average emission intensity value as specified in the table below. This electricity emission factor refer to the base year 2016 as published by IEA[vii]. Almost all sites use natural gas as heating energy source, seven sites use heating oil; the use of district heating and geothermal or wood-based energy is rare. Refrigerated sites refilled the following refrigerants: R-410A, R-404A, or R-134a. For sites, where operators have not specified an average weight of pallets handled, an average conversion factor of 450 kg per pallet was assumed, which was relevant for 10 sites.

The following table summarizes the results of the analysis covering 53 logistics sites. The values vary for each type of logistics site significantly: e.g. in the case of ambient storage sites from 0.4 to 45.0 kg CO_2e/tonne with a median value of 5.4 kg CO_2e/tonne.

GHG intensity values for three types of logistics sites in Europe.

Type of logistics site	Number of sites	Median
Transhipment (ambient)	4	1.2 kg CO_2e/tonne
Storage + transhipment (ambient)	34	5.4 kg CO_2e/tonne
Storage + transhipment (refrigerated)	15	11.7 kg CO_2e/tonne

Considering the constrained sample size, we refrain from further interpreting the data at this point. We want to emphasize the relevance for further research to establish useful average emission intensity values for logistics sites in the future, instead.

Future work will focus on extending the sample size and establishing a more comprehensive set of emission intensity values that e.g. reflect regional industrial preferences for technologies and climate conditions and consider industry sectors with additional effects on emissions, e.g. CEP, food, automotive, clothes. For this, we have developed e.g. the online tool "REff – Resource Efficiency at Logistics Sites".[viii] REff offers support in data collection, provides GHG emissions information for each site and will help establishing a research database on logistics sites.

For participating in this work, please contact us at contact-reff@iml.fraunhofer.de.

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[i] World Economic Forum. Supply Chain Decarbonization: The Role of Logistics and Transport in Reducing Supply Chain Carbon Emissions. 2009.

[ii] McKinnon, A.C. Decarbonizing logistics: Distributing goods in a low carbon world. 2018. New York, Kogan Page Ltd (page 14)

[iii] Ries, J.M.; Grosse, E.H.; Fichtinger, J. Environmental impact of warehousing: a scenario analysis for the United States. International Journal of Production Research, 55(21), pp. 6485-99. https://doi.org/10.1080/00207543.2016.1211342. Cited in McKinnon, see endnote (ii)

[iv] Baker, P.; Merchant, C. Reducing the environmental impact of warehousing. In: Green Logistics: Improving the environmental management of logistics [McKinnon et al. (eds.)]. 2015. 3rd edition, London, Kogan Page Ltd. Cited in McKinnon, see endnote (ii)

[v] Rüdiger, D.; Dobers, K.; Ehrler, V.Ch.; Lewis, A. Carbon footprinting of warehouses and distribution centers as part of road freight transport chains. 4th International Workshop on Sustainable Road Freight Transport. Cambridge. 30.11./01.12.2017

[vi] Dobers, K.; Rüdiger, D.; Jarmer, J.P. Guide for Greenhouse Gas Emissions Accounting at Logistics Sites. 2018. ISBN 978-3-8396-1434-1. http://publica.fraunhofer.de/documents/N-532019.html

[vii] IEA International Energy Agency. Global electricity emission factors 2018

[viii] REff Assessment Tool. Resource Efficiency at Logistics Sites. Fraunhofer IML. 2019. https://reff.iml.fraunhofer.de/