German, Italian and Latin American consortium for resource efficient logistics hubs & transport

Emission intensity factors for logistics hubs

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– updated/extended results (12/2024) –

To overcome the data gap on operational greenhouse gas (GHG) emissions of logistics hubs, the international partners of the GILA project[1] – Fraunhofer IML, Politecnico di Milano, GreenRouter and Universidad de los Andes – organized market studies to update their initial data base on carbon emission intensity values of logistics sites. This document summarizes the approach and outcomes of the four market studies in consecutive years (2020-2024)[2, 3] with the focus on logistics sites offering storage and/or transhipment as well as liquid bulk terminals.

Data collected by each institution were processed, anonymised and finally merged into one database that allowed to elaborate the collected information. The method adopted for the first 2021 market study was replicated and further refined for the later editions. Today, all sites have been transferred to one anonymised consolidated database, and in case a site participated in multiple surveys, the latest relevant dataset has been used for establishing the results described in the following.

As a result, the GILA database covers 871 logistics real estates and 71 terminals, in total 942 logistics hubs from 153 companies and 52 countries worldwide, 83% of them located in Europe. Their operators have provided annual information on energy consumption, refill of refrigerants, as well as throughput and logistical area indoors. The assessment scope used for calculating average emission intensity values is in accordance with the "Guide for Greenhouse Gas Emissions Accounting at Logistics Hubs"[4] and considers requirements of the ISO 14083[5]. As shown in the following process chart, the collected data was validated as regards to completeness and outliers; a detailed verification of each individual site is not included. For the elaboration of average GHG KPIs, only sites establishing a total carbon footprint calculation were considered.

[1] Project information available at https://www.iml.fraunhofer.de/en/fields_of_activity/logistics--traffic--environment/environment_and_resource_logistics/project--gila---german--italian---latin-american-consortium-for-.html

[2] Dobers, K.; Fossa, A.; Perotti, S.; Jarmer, J.P.: Energy efficiency and GHG emission intensity values for logistics sites. GILA webinar. 02.02.2023. https://reff.iml.fraunhofer.de/

[3] Dobers, K.; Fossa, A.; Perotti, S.; Jarmer, J.P.: Energy efficiency and GHG emission intensity values for logistics sites. GILA webinar. 03.02.2022.

[4] Dobers, K., Jarmer, J.-P.: Guide for Greenhouse Gas Emissions Accounting at Logistics Hubs. doi:10.24406/publica-2261. 2023

[5] ISO 14083:2023. Greenhouse gases – Quantification and reporting of greenhouse gas emissions arising from transport chain operations. https://www.iso.org/standard/78864.html

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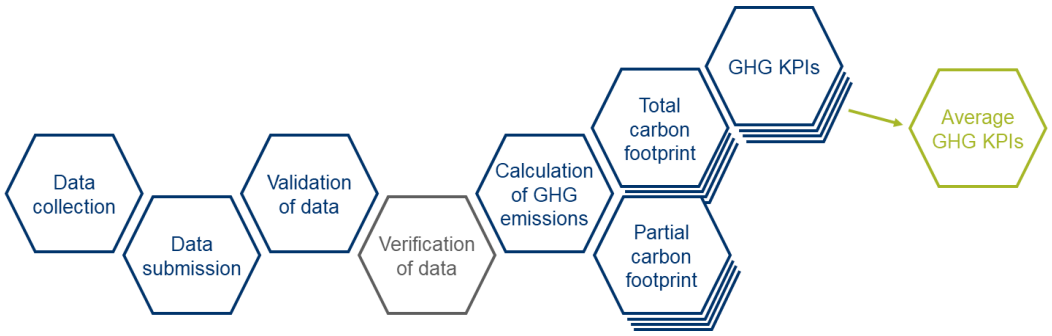

Due to varying data availability and quality (e.g. completeness of consumption data according to assessment scope, provision of base units throughput and size), a reduced number of 287 hubs has been used to calculate tonne-based emission intensity values per hub type (468 hubs for m² based emission intensity values). This database differentiates four hub types, i.e.

(1) Hubs where transhipment is the main service (>80 % of goods handled)

(2) Hubs where both transhipment and warehousing are relevant services

(3) Hubs where warehousing is the main service (>80 % of goods handled), and

(4) Liquid bulk terminals.

As an additional categorization, the hub conditions have been used by differentiation between ambient, chilled, frozen, or mixed temperature hubs.

The hub sizes vary from a few tonnes to more than 1.7 million tonnes outbound, with around 70 000 tonnes as median value for real estates and 250 to 23 million tonnes with a median value of 650 000 tonnes for liquid bulk terminals. 22% of the operators specified that they use a hub-specific electricity mix. However, only an average national emission factor for the relevant year was used for calculating the average emission intensity value as specified in the table below. Natural gas is the main heating energy source, although liquid bulk terminals also use steam for heating purposes. Energy sources for non-electrified material handling are diesel, biodiesel, propane, petrol or LPG. The refrigerant types R-410A, R-404A and R-717 are the most frequently used ones as specified by the participating hubs.

The following tables summarize the results of average GHG emission intensity values of the sample size, allocated to one of the defined hub types. The relevant sample size per hub type is outlined in brackets.

Logistics hub emission intensity values for different types (tonne-based)

[kg CO_2e / t]	**Ambient**		**Mixed**	
Transhipment	1.3	(99)	2.5	(8)
Storage + transhipment	5.6	(57)	18.4	(10)
Warehouse	45.5	(67)	≥50	estimate
Liquid bulk terminals	3.3	(24)	7.2	(23)

Logistics hub emission intensity values for different types (square meter-based)

[kg CO_2e / m^2/a]	Ambient		Mixed		Chilled		Frozen	
Transhipment	16.7	(61)	19.5	(7)				
Storage + transhipment	28.0	(124)	64.4	(43)	80.1	(16)	103.9	(9)
Warehouse	23.6	(138)	22.8	(21)				

Considering the constrained sample size, further interpreting the data at this point looks inappropriate. Still, it is crucial to emphasize the relevance for further research to establish useful average emission intensity values for logistics sites in the future, instead. For example, next to extending the database and its global coverage, we plan to link the hubs' performance indicators with their status of implementation of green measures, such as investments in energy efficiency technology and strategies. For this, the market study also covers a list of around measures, companies can select as implemented or the relevant degree of priority.

In spring 2025 there will be the next market study for extending the sample size. Interested companies can participate in the future market studies by using the REff Tool® or as participant in the Osservatorio Contract Logistics "Gino Marchet" of Politecnico di Milano. A consolidated analysis and elaboration of annually updated KPIs is planned, which combines all data sets from the international market studies performed until then.

For participating in this work, please contact us!
Updates are published on https://reff.iml.fraunhofer.de/.

Data requirements for participating in annual market study

Data collection of the market study is realised by using e.g. the REff Tool®. Here, each company receives its own database, so that confidentiality is guaranteed.

Information required for participation covers the following:

- Specification of hub (name, location, country)
- Classification of hub (warehouse, transhipment, storage & transhipment, terminal types: container, liquid bulk, dry bulk, roll on/roll off)
- Temperature requirement(s) (ambient, chilled, frozen, heated)
- Reporting year (12 months)
- Annual consumption of resources:
    - Electricity,
    - Heating energy (natural gas, biogas, heating oil, district heating, LPG, geothermal energy, wood chips, wood pellets, stream, diesel),
    - Other energy used for e.g., material handling (diesel, biodiesel, petrol, ethanol, LPG, LNG, CNG, hydrogen)
    - Refrigerants
- Annual throughput.

This information is needed to realise the quantification of greenhouse gas emissions and emission intensity values as required by the ISO 14083:2023.

We also ask for additional information (e.g. size of logistics buildings), so that we can analyse and classify participating hubs in more detail.

Please support this research by

- Participating with your own hubs (one or more hubs),
- Involving your sub-contractors in these activities.