China Default GHG Emission Values V1.0– Complementing GLEC Framework v3.0

A brief description of China's transport-related emission factors and GHG emission intensity values

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Executive Summary

This document provides the 1st version of the default values for “well-to-wheel” (WTW) fuel emission factors and greenhouse gas (GHG) emission intensity for China road transport. It is developed by the Smart Freight Centre China team, following the basic requirements of ISO 14083 and GLEC Framework v3.0. It provides a summary of the default values, as well as a brief description of the methodologies, sources, and gap analysis.

The tables of the default data for China shall be used as the supplementary material for Module 1 (Emission factors) and Module 2 (Default fuel efficiency and GHG emission intensity values) for GLEC Framework Section 3 (Data).

As stated in the GLEC Framework, the GLEC default factors are our best attempt to provide reliable estimates as a first step on a company's journey to inclusive, high-quality GHG emission reporting. This document will be continuously updated following data updates and the inclusion of available new datasets.

We have adopted a conservative approach by quoting default values. We strive to use vehicle fuel consumption data that is as close to reality as possible, including the use of official figures on energy’s Net Calorific Values, consolidated carbon emission factor for electricity, as well as carbon emission data, e.g., default carbon content values published by the IPCC, in accordance with the conservativeness principles (cautiously moderate) of ISO 14083.

1. Introduction

Purpose of Document

The purpose of this document is to show the current development of the default values for fuel emission factors and GHG emission intensity values for the transport sector in China. There are existing default values for Europe and North America in ISO 14083[1] and GLEC Framework v3.0[2] that were updated from e.g., Ecoinvent, GREET, HBEFA, SmartWay program, etc. Since China's logistics-relevant emissions account for a large share of the world logistics, using the local defaults and following the requirement of ISO 14083 and GLEC Framework is a trend for companies to conduct logistics GHG accounting and reporting in China. The purpose is to help companies use the nation's accurate local data as much as possible based on the GLEC Framework principles.

The document meets the following principles:

- Data collection and calculation methodologies on calculation and data collection comply with ISO 14083 and GLEC Framework v3.0;
- All default values, as stated in the GLEC Framework, should be used as a last resort when primary data is not available, or as a starting point that can lead to future calculations based on primary data. The GLEC default factors are to provide reliable estimates as a first step on a company's journey to inclusive, high-quality GHG emission reporting.

Foundations (as defined in GLEC Framework v3.0) and Scope

The default data development follows the four "Foundations" as defined in GLEC Framework v3.0.

Table 1: Foundations of the GLEC Framework v3.0 vs. this document (default data for China)

	Foundation in the GLEC Framework	**This document**
1	**All modes in the transport chain**	Road transport. Default data for other modes could be referred to GLEC Framework.
2	**All IPCC GHGs and climate pollutants**	CO2, CH4, and N2O (converted to CO2e @IPCC AR6 GWP100).
3	**All energy life cycles (WTW)**	Include TTW (downstream, operational emissions) and WTT (upstream, energy provision emissions). We used European factor[1] to uplift TTW to WTW for China.
4	**Alignment with international standards**	GLEC Framework v3.0, ISO14083, GHGP, 2006 IPCC Guidelines, IPCC AR6, WB/T 1135-2023, NDRC documents (e.g., Guidance for Compiling Provincial Greenhouse Gas Emission Lists (Trial)《省级温室气体清单编制指南(试行)》[3], Guidelines for Accounting Methods and Reporting of Greenhouse Gas Emissions for Land Transportation

[1] Please note that the uplift although borrowed from a European fuel emission factor isn't 'really European'. The fossil fuel production, refinement and transportation happen outside of Europe in the absolute vast majority of cases. The reason for including the European WTT is more to do with the inclusion of Methane venting and for IPCC AR6 alignment.

		Enterprises《陆上交通运输企业温室气体排放核算方法与报告指南》[4])

Data Format

The default data are presented in the same format as the tables of GLEC Framework Section 3, Module 1 and Module 2.

2. Methodology

China default values in this document include fuel emission factors, fuel efficiency, and GHG emission intensity values. Fuel emission factors are divided into “well-to-tank” (WTT) energy provision emissions and “tank-to-wheel” (TTW) operational emissions. The “well-to-wheel” (WTW) emissions, also referred to as fuel life-cycle emissions, is the sum up of the WTT and TTW emissions.

For diesel, LPG, and gasoline, the calculation of fuel emission factors first considers the emissions of CO2, CH4, and N2O from vehicle fuel combustion (TTW). The emission factors for corresponding energy sources are mainly calculated based on relevant official and IPCC default values. To calculate the TTW CO2 emission intensity, we mainly used the actual fuel efficiency of different vehicle types (in L/100km) and then converted it into transport activity-based fuel efficiency (in L/tkm) by considering the parameters of the vehicle’s designed load capacity (maximum load in tonne), load factor, and the empty running rate, and finally converted to CO2e emissions per tkm. CH4 and N2O emissions are calculated based on IPCC default emission factors and converted to CO2e based on IPCC AR6 GWP100.

For electricity, we referred to grid emission factors from China’s official document (in kgCO2/kWh). With the combination of vehicle electricity consumption (kWh/100km), designed maximum load capacity, load factor, and empty running rate, we then obtained the transport activity-based emission intensity (in gCO2/tkm).

We used the European fuel emission factor (i.e., the TTW to WTW ratio) from GLEC Framework v3.0 to uplift TTW to WTW for China in this document.

3. Fuel Emission Factors

Table 2: Fuel Emission Factors

Energy carrier	Lower heating value (MJ/kg)	Density (kg/l)	GHG emission (energy provision/WTT) gCO2e/MJ	GHG emission (operational/TTW) gCO2e/MJ	GHG emission (total/WTW) gCO2e/MJ	GHG emission (energy provision/WTT) kgCO2e/kg	GHG emission (operational/TTW) kgCO2e/kg	GHG emission (total/WTW) kgCO2e/kg	Non-CO2 GHG emissions (operational/TTW) gCO2e/MJ
Diesel	42.652	0.830	22.409	73.766	96.175	0.956	3.146	4.102	1.181
LNG	44.200	0.420	27.881	65.366	93.247	1.232	2.889	4.122	3.561
Electricity	N.A.	N.A.	158.417	-	158.417	N.A.	N.A.	N.A.	
Gasoline	43.070	0.740	22.275	69.771	92.046	0.959	3.005	3.964	1.857
LPG	50.179	0.540	22.036	63.708	85.744	1.106	3.197	4.303	1.902

Key Data Sources

The fuel emission factor calculations are based on various official and peer-reviewed sources, including China Energy Statistical Yearbook (2021)[5], Guidance for Compiling Provincial Greenhouse Gas Emission Lists (Trial)（省级温室气体清单编制指南(试行)）[3], Guidelines for Accounting Methods and Reporting of Greenhouse Gas Emissions for Land Transportation Enterprises（陆上交通运输企业温室气体排放核算方法与报告指南）[4], 2019 Refinement to the 2006 IPCC Guidelines[6], GB/T 2589-2020 (2021) General Rules for Calculation of the Comprehensive Energy Consumption (综合能耗计算通则)[7], MEE (2023) Notice on the management of greenhouse gas emissions reporting of enterprises in the power generation industry from 2023 to 2025 (Huanban Climate Letter [2023] No. 43). （关于做好2023—2025 年发电行业企业温室气体排放报告管理有关工作的通知）（环办气候函〔2023〕43 号）[8], IPCC AR6[9], and WB/T 1135-2023 (2023.7)[10] Requirements of the GHG emission Accounting and Reporting for Logistics Service Provider (物流企业温室气体排放核算与报告要求), etc.

Gap Analysis

a. ***WTT emission factors:*** The current official documents in China don't provide a consolidated emission factor for all electricity power plants, and CH4 and N2O emissions may not be included in the official document's GHG extent. Thus, in this document, we provide the TTW emission factors for CH4, and N2O based on IPCC factors. We also have to use the European scale-up factors from the GLEC Framework to adjust the TTW to WTW for China. TTW:WTW ratio from Europe in GLEC Framework v3.0 is 76.7% for diesel, 75.8% for gasoline, 70.1% for LNG, and 74.3% for LPG.

   From the most officially recognized sources for emission factors in China, we cannot find emissions associated with energy production infrastructures and other upstream non-fuel emissions (e.g., resource extraction, and material manufacturing)[11]. This is not in line with ISO 14083 and GLEC Framework. To be compliant with these standards, further work on this part is needed.

b. ***National-level grid emission factor:*** In China's official document, the national-level grid emission factor is only for CO_2, other GHGs as required in ISO 14083 and GLEC Framework are not included here.

c. ***Energy carriers only include diesel, NG, and electricity:*** Currently, six energy carriers were identified: 1) diesel, 2) liquified natural gas (LNG) and compressed natural gas (CNG), 3) gasoline, 4) electricity, 5) liquified petroleum gas (LPG), and 6) hydrogen. In this document, we only provide emission factors for diesel, LNG/CNG, and electricity, since other fuel types for China's road transport are still in a small share.

4. Fuel Efficiency & GHG Emission Intensity Values

Table 3: Default fuel efficiency and GHG emission intensity values[2]

Vehicle type	Vehicle size	Load Characteri	Load Factor	Empty Running	Fuel	Fuel Intensity (kg/tkm) TTW	Fuel Intensity (l/tkm) TTW	Emission intensity (gCO2e/tkm) WTT	Emission intensity (gCO2e/tkm) TTW	Emission intensity (gCO2e/tkm) WTW
Rigid Truck	LDT 3.5-4.5 t GVW	Average	93.00%	19.50%	Diesel	0.108	0.130	104.39	343.65	448.04
Rigid Truck	MDT 4.5-5.5 t GVW	Average	93.00%	19.50%	Diesel	0.096	0.115	92.52	304.57	397.09
Rigid Truck	MDV 5.5-7.0 t GVW	Average	93.00%	19.50%	Diesel	0.092	0.111	88.93	292.73	381.66
Rigid Truck	MDV 7.0-8.5 t GVW	Average	93.00%	19.50%	Diesel	0.072	0.086	68.88	226.75	295.63
Rigid Truck	MDV 8.5-10.5 t GVW	Average	93.00%	19.50%	Diesel	0.060	0.073	57.98	190.85	248.83
Rigid Truck	MDV 10.5-12.5 t GVW	Average	93.00%	19.50%	Diesel	0.054	0.065	51.42	169.25	220.67
Rigid Truck	HDV 12.5-16.0 t GVW	Average	93.00%	19.50%	Diesel	0.049	0.059	47.04	154.83	201.87
Rigid Truck	HDV 16.0-20.0 t GVW	Average	93.00%	19.50%	Diesel	0.035	0.043	33.81	111.28	145.09
Rigid Truck	HDV 20.0-25.0 t GVW	Average	93.00%	19.50%	Diesel	0.025	0.030	23.67	77.92	101.59
Rigid Truck	HDV 25.0-31.0 t GVW	Average	93.00%	19.50%	Diesel	0.021	0.026	20.24	66.62	86.86
Rigid Truck	HDV >31.0t GVW	Average	93.00%	19.50%	Diesel	0.022	0.027	21.18	69.71	90.89
Articulated Truck	HDV up to 18.0 t GVW	Average	93.00%	19.50%	Diesel	0.037	0.044	34.95	115.06	150.01
Articulated Truck	HDV 18.0-27.0 t GVW	Average	93.00%	19.50%	Diesel	0.025	0.030	23.80	78.35	102.15
Articulated Truck	HDV 27.0-35.0 t GVW	Average	93.00%	19.50%	Diesel	0.023	0.027	21.47	70.67	92.14
Articulated Truck	HDV 35.0-40.0 t GVW	Average	93.00%	19.50%	Diesel	0.019	0.023	17.94	59.07	77.01
Articulated Truck	HDV 40.0-43.0 t GVW	Average	93.00%	19.50%	Diesel	0.018	0.022	17.35	57.11	74.45
Articulated Truck	HDV 43.0-46.0 t GVW	Average	93.00%	19.50%	Diesel	0.018	0.021	16.65	54.82	71.48
Articulated Truck	HDV 46.0-49.0 t GVW	Average	93.00%	19.50%	Diesel	0.017	0.021	16.52	54.37	70.89
Articulated Truck	HDV above 49.0 t GVW	Average	93.00%	19.50%	Diesel	0.017	0.021	16.40	53.98	70.37
Dump Truck	LDT 3.5-4.5 t GVW	Average	93.00%	19.50%	Diesel	0.128	0.154	123.96	408.05	532.01
Dump Truck	MDT 4.5-5.5 t GVW	Average	93.00%	19.50%	Diesel	0.095	0.115	92.13	303.26	395.39
Dump Truck	MDV 5.5-7.0 t GVW	Average	93.00%	19.50%	Diesel	0.090	0.109	87.26	287.24	374.50
Dump Truck	MDV 7.0-8.5 t GVW	Average	93.00%	19.50%	Diesel	0.070	0.085	67.69	222.82	290.51
Dump Truck	MDV 8.5-10.5 t GVW	Average	93.00%	19.50%	Diesel	0.061	0.073	58.21	191.61	249.82
Dump Truck	MDV 10.5-12.5 t GVW	Average	93.00%	19.50%	Diesel	0.052	0.063	49.90	164.26	214.16
Dump Truck	HDV 12.5-16.0 t GVW	Average	93.00%	19.50%	Diesel	0.048	0.058	45.75	150.61	196.36
Dump Truck	HDV 16.0-20.0 t GVW	Average	93.00%	19.50%	Diesel	0.035	0.043	33.91	111.62	145.53
Dump Truck	HDV 20.0-25.0 t GVW	Average	93.00%	19.50%	Diesel	0.023	0.028	22.17	72.98	95.15
Dump Truck	HDV 25.0-31.0 t GVW	Average	93.00%	19.50%	Diesel	0.021	0.026	20.45	67.31	87.76
Dump Truck	HDV above 31.0 t GVW	Average	93.00%	19.50%	Diesel	0.019	0.022	17.73	58.38	76.11
Articulated Truck	14-24 t GVW	Average	93.00%	19.50%	LNG	0.059	0.141	71.38	167.35	238.73
Articulated Truck	24-25 t GVW	Average	93.00%	19.50%	LNG	0.028	0.068	34.13	80.02	114.15
Articulated Truck	25-29 t GVW	Average	93.00%	19.50%	LNG	0.024	0.057	28.42	66.62	95.03
Articulated Truck	29-31 t GVW	Average	93.00%	19.50%	LNG	0.020	0.047	23.49	55.07	78.56
Articulated Truck	31-60 t GVW	Average	93.00%	19.50%	LNG	0.016	0.038	18.92	44.37	63.29
Dump Truck	14-24 t GVW	Average	93.00%	19.50%	LNG	0.045	0.108	55.13	129.26	184.39
Dump Truck	24-25 t GVW	Average	93.00%	19.50%	LNG	0.023	0.054	27.27	63.92	91.19
Dump Truck	25-29 t GVW	Average	93.00%	19.50%	LNG	0.020	0.046	23.51	55.12	78.64
Dump Truck	29-31 t GVW	Average	93.00%	19.50%	LNG	0.016	0.038	19.41	45.51	64.92
Dump Truck	31-60 t GVW	Average	93.00%	19.50%	LNG	0.013	0.031	15.61	36.61	52.22
Rigid Truck	14-24 t GVW	Average	93.00%	19.50%	LNG	0.046	0.109	55.51	130.13	185.64
Rigid Truck	24-25 t GVW	Average	93.00%	19.50%	LNG	0.023	0.054	27.27	63.92	91.19
Rigid Truck	25-29 t GVW	Average	93.00%	19.50%	LNG	0.019	0.045	22.99	53.90	76.89
Rigid Truck	29-31 t GVW	Average	93.00%	19.50%	LNG	0.016	0.039	19.52	45.75	65.27
Rigid Truck	31-60 t GVW	Average	93.00%	19.50%	LNG	0.013	0.031	15.74	36.90	52.63
Truck	LDV up to 4.5 t GVW	Average	93.00%	19.50%	Electricity	-	-	128.99	-	128.99
Truck	MDV 4.5-12.0 t GVW	Average	93.00%	19.50%	Electricity	-	-	71.30	-	71.30
Truck	HDV above 12 t GVW	Average	93.00%	19.50%	Electricity	-	-	138.34	-	138.34

Key Data Sources

The main source of the fuel efficiency and transport activity and performance data (e.g., distance, load factor, empty running rate) is from Xi'an Jiaotong University's report "Preliminary Investigation and Research on Freight Industry" [12]. The calculation of road emission intensity factors follows mainly the 2006 IPCC Guidance, GHGP, and GLEC Framework, as well as China's national-level and industry standards regarding transport GHGs accounting and report, e.g., NDRC's "GHGs Accounting Methods and Reporting Guidelines for Land Transport Enterprises". Other sources related to calculations including WB/T 1135-2023 (2023.7)[10] "Requirements of the GHG emission Accounting and Reporting for Logistics Service Provider" (物流企业温室气体排放核算与报告要求), "Guidance for Compiling Provincial Greenhouse Gas Emission Lists (Trial)" （省级温室气体清单编制指南(试行)）[3], and IPCC AR6 [9].

Gap Analysis

a. ***GHG emission intensity values are based on the SFD, but the "out of route trips/deviation" are not considered.*** The values in the future could be uplifted to account for the "out of route trips/deviation" from the planned route equating to the 5% Distance Adjustment Factor (DAF)

[2] Please note that the load factors quoted used to calculated transport activity are considerably higher than one might expect when comparing to other regions in the world.

between the Shortest Feasible Distance (SFD) and actual distances. We expect to revisit this topic before the next update of the GLEC Framework. This will be an “all across the board” application – meaning for North America, India, China and Europe all at once.

5. Future Improvements

Improvements and updates are scheduled in the following aspects:

- ***Enhance the compliance, consistency, and accuracy of the data.*** We will expand the sample coverage to include more data from local companies and partners and continue to update data from the literature, databases, and fleet samples to enhance the consistency of values over time and space. We will incorporate more research on lifecycle GHG emissions from road transport in China, including energy production infrastructure and other upstream non-fuel-related emissions, to improve the accuracy and compliance of the calculations in the energy supply part. We will continue to collect real-life cases, such as HFCs emissions from refrigerant leaks, to supplement default values for this aspect in China.
- ***Expand to other modes.*** We will include the default data for other transport modes gradually in future versions, such as inland waterways, domestic rail, domestic aviation, and logistics hubs.
- ***Expand to other GHGs and air pollutants.*** Other GHGs, such as HFCs from refrigerant leakage, the CH4 leakage, as well as other GHGs and air pollutants.
- ***Provide more disaggregated default values.*** We will continue to collect road transport activity and fuel consumption data from literature and partners, continuously update values such as load factor and empty running rate, and try to provide disaggregated values by vehicle category, cargo type, and transport scenarios to better reflect actual operating conditions.
- ***Expand to other energy carriers (e.g., hydrogen).*** Companies in China’s logistics market, especially in the road sector, are very active in piloting hydrogen trucks. Hydrogen emission factors have a wide range of values depending on upstream energy sources and production technologies. Future works will also focus on the inclusion of hydrogen emission factors to meet the accounting and reporting needs of local companies.

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