# GREENHOUSE GAS (GHG)
# CALCULATION REPORT OF 2023

## A. Scope Calculation

This Greenhouse Gas (GHG) report provides the scale of Scope 1 and 2 GHG emissions of the project and its significance over its lifetime as well as proposed mitigation measures**.** The scope of this calculation covers only for Scope 1 and Scope 2 GHG emissions. Two emissions scenarios are presented for comparison and to identify the GHG impact of the project.

1. Scope 1
   This scope addresses indirect emissions from the purchase of energy, Carbon dioxide, $CH_4$, and $N_2O$ are emitted when fuel is combusted to generate electricity or to produce heat, steam, or cooling. Scope 1 emissions are those from sources that are directly controlled and owned by the company, including direct combustions from stationary sources, mobile sources, process emissions (flares), venting emissions, and fugitive emissions.
2. Scope 2
   Scope 2 emissions are indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling. Although scope 2 emissions physically occur at the facility where they are generated, they are accounted for in an organization's GHG inventory because they are a result of the organization's energy use.

Greenhouse gas (GHG) emissions are produced by mobile sources as fuels are burned. Carbon Dioxide ($CO_2$), Methane ($CH_4$), and Nitrous Oxide ($N_2O$) are emitted directly through the combustion of fuels in different types of mobile equipment. GHG calculation for this project is reported in line with Minister of Environment Regulation of Republic of Indonesia No. 12 of 2012 Guidelines for the Emission Load Calculation for Oil and Gas Industry Activities.

## B. GHG Calculation Methodology

To calculate and estimate GHG emission load or volume, this calculation followed Tier-1 method. Tier 1 method for $CO_2$ emission calculation is estimated fuel consumption based on type and operational hours of emission source. Meanwhile Tier 1 method for $CH_4$ and $N_2O$ emission calculation is estimation of fuel consumption based on energy output and operational hours of emission source. As per the GHG Protocol, the GHG emissions have been calculated by multiplying activity data from the proposed activities by its relevant emission factor. The emission factors for Tier 1 in this report are based on API Compendium Guideline 2021 for Mobile Combustion and Ministry of Energy and Mineral Resources of Indonesia No. 163.K/HK.02/MEM.S/20218 for electricity as reference, below:

Tabel 1 List of Emission Factors for GHG Calculation PT KPB

| No. | Type of Emission | Emission factor | Reference |
|---|---|---|---|
| | **Mobile Combustions** | | |
| 1 | $CO_2$ (Gas oil) | 0,0743* | API Compendium, Table 4-5 |
| 2 | $CH_4$ (Gas/diesel oil) | 0,0003* | API Compendium, Table 4-5 |
| 3 | $N_2O$ (Gas/diesel oil) | 0,0006* | API Compendium, Table 4-5 |

| No. | Type of Emission | Emission factor | Reference |
|---|---|---|---|
| | **Electricity** | | |
| 1 | $CO_2$ | 1,14** | Ministry of Energy and Mineral Resources of Indonesia, No. 163.K/HK.02/MEM.S/2021, Grid Mahakam |

*Source: *API GHG Compendium, 2021*

*** Ministry of Energy and Mineral Resources of Indonesia No. 163.K/HK.02/MEM.S/2021*

Global Warming Potentials (GWPs) are a quantified measure of the globally averaged relative radiative forcing impacts of particular greenhouse gases in the atmosphere. It is defined as the cumulative radiative forcing – both direct and indirect effects – integrated over time from the emission of a unit mass of gas relative to some reference gas. The Global Warming Potentials (GWP) Values for this GHG Emission Calculations based on the IPCC Fifth Assessment Report, 2014 is shown below:

Tabel 2 Global Warming Potentials (GWP) Values IPCC AR5

| No. | Chemical formula | GWP | Reference |
|---|---|---|---|
| 1 | $CO_2$ | 1 | IPCC Fifth Assessment Report (AR5) |
| 2 | $CH_4$ | 28 | IPCC Fifth Assessment Report (AR5) |
| 3 | $N_2O$ | 265 | IPCC Fifth Assessment Report (AR5) |

As per the GHG Protocol, the GHG emissions have been calculated by multiplying activity data from the proposed activities by its relevant emission factor. The formula for calculating $CO_2$ emissions using Method-1 is as follows:

**Proposed Activity data x GHG emissions factor = GHG volume**

Activity data is a quantifiable measure of activity, such as operating hours or volumes of fuels used. Emission factors convert the activity data into GHG volumes. Activity data has been sourced from client data. Where specific data is not available, assumptions and industry benchmarks have been used to fill data gaps.

Given the time constraint and data availability, this GHG calculation uses the tier 1 method, as defined by Minister of Environment Regulation No. 12 of 2012, to calculate emission load of greenhouse gas volume and to assume the emission factors. In addition, other GHG emission factors have been sourced from publicly available information, such as the API Compendium (2021) guideline, Proceedings of Scientific Meeting & Exhibition of Research and Development of Ministry of Energy and Mineral Resources (2017) and Minister of Environment Regulation No. 12 of 2012. In this GHG report only $CO_2$, $CH_4$ and $N_2O$ will be calculated and reported for the Project.

1. Emission Calculation (GHG) Mobile Combustion
   a. Emision Calculation for $CO_2$, $CH_4$, and $N_2O$
      The formula for calculating $CO_2$ emissions as follows:

$$Eco_2 = AD\ x\ EF$$

Where:

$ECO_2$ = Total emission of $CO_2$ (ton $CO_2$/year)
AD = Acitivity Data (MJ)
EF = Emission Factor (kg/MJ)

Activity data is consumption data per type of fuel that has been converted to energy unit. The formula converts fuel consumption data from mass units (tons) to energy units (TJ) are as follows:

$$ADco_2 = F_c\ x\ \rho\ x\ NCV\ x\ 10^{-6}$$

Where:

$AD_{CO2}$ = Acitivity Data of Fuel (MJ)
Fc = Fuel Consumption per year ($m^3$/year)
NCV = Net Calorific Value of Fuel (MJ/kg)
ρ = Density of fuel ($kg/m^3$)

2. Emission Calculation for Electricity of $CO_2$, as follows:

$$Eco_2 = EC\ x\ EF$$

Where:

$ECO_2$ = Total emission of $CO_2$ (ton $CO_2$/year)
EC = Electricity Usage (kWH/year)
EF = Emission Factor (ton/MWh)

## C. Result of GHG Calculation

GHG emissions from mobile sources (operational vehicles) are deemed to be based on fuel based method and electricity. Scope 1 and Scope 2 emissions that arise from the construction phase are only from transport and imported electricity respectively. In total, 2023 GHG emissions for Scope 1 were quantified at 978,08 tCO2e and for Scope 2 were quantified at 55.420,60 tCO2e. Total GHG Emissions for vehicle and electricity in 2023, are shown below in Table 3 and 4.

Tabel 3 GHG Emissions for Mobile Vehicles in 2023

| No | Project Description | Number of Unit | Data Activity | | | Emission Factor (kg/MJ) | | | GHG Emission (ton/year) | | | GHG Emission (tonCO2e/year) | | | TOTAL tCO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type of Fleet | | Fuel Consumption (m3/year) | NCV (MJ/kg) | Density (kg/m3) | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ | $CH_4$ | $N_2O$ | |
| 1 | All Vehicles | 113 | 367,25 | 42,66 | 837,50 | 0,0743 | 0,000003 | 0,0000006 | 974,8915027 | 0,04 | 0,01 | 975 | 1,10 | 2,09 | 978,08 |

*Source: Calculation Result of PT KPB, Jan-Dec 2023*

Tabel 4 GHG Emissions for Electricity in 2023

| No | Description | Time | Electricity Consumption (kWh) | Grid EF (kg/ kWh) | GHG Emission (tonCO2e/year) | TOTAL tCO2e |
|---|---|---|---|---|---|---|
| | | | | $CO_2$ | $CO_2$ | |
| 1 | Electricity (PLN) | Jan-Dec 2023 | 48.614.560 | 1,14 | 55.420,60 | 55.420,60 |

*Source: Calculation Result of PT KPB, Jan-Dec 2023*