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## **PRELIMINARY STUDY**

# **GREENHOUSE GAS EMISSIONS INVENTORY FOR KFUPM FOR 2023**

**Prepared for  
Office of Planning and Quality**

**Prepared by  
Sustainability Research Group  
Applied Research Center for Environment & Marine Studies (CEMS)**

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## **INTRODUCTION**

This brief document provides a preliminary study titled *Greenhouse Gas Emissions Inventory for King Fahd University of Petroleum & Minerals* prepared in response to a request by Office of Planning and Quality dated March 23, 2024. It is prepared by Applied Research Center for Environment & Marine Studies (CEMS). The inventories of anthropogenic emissions from sources and removal by sinks of greenhouse gases (GHG) for the University following appropriate, relevant guidelines, including the GHG Protocol for Project Accounting (WBCSD & WRI, 2004) and the 2019 refinement to the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (IPCC, 2019).

This inventory report includes emissions from sources and removal by sinks of selected major greenhouse gases (i.e., carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O)) for Scope 1 and Scope 2. Scope 1 includes direct emissions from sources that are owned or controlled by the reporting entity. Scope 2 includes indirect emissions from the reporting company's use of purchased power, steam, heating, and cooling. All other indirect emissions that occur in an entity's value chain are included in Scope 3.

The following sections provided the objective, methodology, and preliminary results of this brief study.

## **OBJECTIVES**

The main objective of this brief study is to develop preliminary inventory of anthropogenic emissions and removal by sinks of GHG for KFUPM. It is expected that the Office of Planning and Quality will take the required actions to conduct studies including time-series GHG emissions of KFUPM, key category analysis considering available source categories of GHG emissions, and analysis of mitigation opportunities and challenges for KFUPM.

## **METHODOLOGY**

GHG emissions can be estimated following appropriate, relevant guidelines, including the GHG Protocol for Project Accounting (WBCSD & WRI., 2004), and the 2019 refinement to the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National greenhouse gas inventories (IPCC, 2019). The GHG protocol offers a comprehensive framework for quantifying and reporting GHG reductions resulting from climate change mitigation projects. The emissions for different entities are estimated following Scope 1, Scope 2, and Scope 3. Direct GHG emissions under Scope 1 come from sources under an organization's control or ownership (e.g., emissions associated with fuel combustion in boilers, furnaces, and vehicles). Indirect GHG emissions under Scope 2 are those brought on by purchasing electricity, steam, heat, or cooling. Scope 2 emissions are accounted for in a company's GHG inventory even though they are really produced at the facility where they are produced due to the organization's energy use. Scope 3 emissions are the outcome of operations on resources that the reporting company does not own or control, but which are indirectly impacted by the organization through its value chain. All sources outside of an organization's Scope 1 and Scope 2 boundary are included in Scope 3 emissions. Most of an organization's overall GHG emissions frequently come from Scope 3 emissions, also known as

value chain emissions. The majority of an organization's overall GHG emissions frequently come from Scope 3 emissions, also known as value chain emissions.

GHG emissions from the use of electricity from the national grid can be estimated using national grid emission factors for the Kingdom of Saudi Arabia. The Designated National Authority of the Kingdom of Saudi Arabia established the official grid emission factor (GEF) according to Clean Development Mechanism (CDM) regulations for baseline conditions for the electricity grid in the Kingdom of Saudi Arabia. The GEF for different greenhouse gases provides the opportunity to estimate greenhouse gas emissions using electricity use data from any entity using electricity from the national grid. According to DNA [2021], the GEF is 0.568 tons of carbon dioxide per Mega Watt Hour (ton of CO<sub>2</sub>/MWh). The International Energy Agency also developed the grid emission factor for Saudi Arabia. The Kingdom is expected to develop methodologies for estimating GHG emission avoidance through various economic diversification and adaptation initiatives to assess total avoidance as per the Nationally Determined Contributions (NDC).

Renewable energy projects contribute to GHG emission avoidance. If the relevant estimate of GHG emissions avoidance is not available for any renewable energy development project, it is assumed that the rate of estimated CO<sub>2</sub> emissions avoidance is the same as the national rate of CO<sub>2</sub> emissions from electricity generation. An appropriate methodology should be used for other types of initiatives that may contribute to GHG emission avoidances.

## DATA DESCRIPTION

The required data of this study includes mainly fuel combustion in different activities, fugitive emissions, and electricity use. Due to the limited time, a comprehensive survey could not be conducted for collecting all the required activity data. The activity data used in this study include fuel consumption by road transportation, generator use, natural gas use in the central kitchen, and electricity use by academic and housing facilities (Table 1).

Table 1. Data Description.

Source Category	Fuel Type	Quantity	Unit
Bus	Diesel	51,708	Liter
Passenger Car	Gasoline	306,943	Liter
Generator	Diesel	22,000	Liter
Central Kitchen	Natural Gas	510,000	Liter
Electricity	Electricity	388,627,441	Kilowatt-Hour

## RESULTS

Based on the limited available data the GHG emissions inventory of KFUPM was prepared (Table 2). The carbon dioxide equivalent is estimated considering the 100-year Global Warming Potential (GWP) of CH<sub>4</sub> and N<sub>2</sub>O, which are 21 and 310, respectively. The total GHG emissions (Scope 1 and Scope 2) of KFUPM for 2023 is 222,399 tons of carbon dioxide equivalent. The Scope 1 GHG emissions of KFUPM is 1,659 tons of carbon dioxide equivalent and the Scope 2 GHG emissions is 220,740 tons of carbon dioxide equivalent.

Table 2. Greenhouse Gas Emissions Inventory of KFUPM for the year 2023.

Source Category	Greenhouse Gas Emissions			
	CO <sub>2</sub> (Ton)	CH <sub>4</sub> (Ton)	N <sub>2</sub> O (Ton)	Total (Ton of CO <sub>2</sub> equivalent)
Bus	137.77	0.01	0.01	140
Passenger Car	699.40	0.33	0.03	716
Generator	58.62	0.00	0.00	59
Central Kitchen	742.89	0.01	0.00	744
Electricity	220,740.39	-	-	220,740
<b>Total Greenhouse Gas Emissions of KFUPM</b>				<b>222,399</b>

*Note: CH<sub>4</sub> and N<sub>2</sub>O emissions are not estimated for electricity due to the unavailability of the national grid emission factors.*

## REMARKS

The results of this study should be considered with due consideration of the limited time and information. Typically, this kind of study requires at least several months to complete by adopting appropriate institutional arrangement, source identification, estimation, QA&QC, and verification process.

## REFERENCES

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