



Ministry of Tourism and Environment
Republic of Maldives

Training Report on

Hands-on Training for Estimating Greenhouse Gas Emissions from Energy Sectors in Maldives

Consultancy Services for a GHG Inventory Expert
July 2025

CBIT Maldives

Capacity Building for Improved Transparency
of Climate Change Mitigation and Adaptation
Actions in the Maldives





Ministry of Tourism and Environment
Republic of Maldives

Report on Hands-on Training for Estimating Greenhouse Gas Emissions from Energy Sectors in Maldives

14 July 2025 | Malé, Maldives

Consultancy Services for a GHG Inventory Expert

Linked Project Deliverables:

- *Deliverable 1.2.5 – Workshop 3 of 4*
- *Deliverable 1.4.3 – Training 2 of 3*

CBIT MALDIVES

***Capacity Strengthening for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project***





Ministry of Tourism and Environment

Capacity Strengthening for Improved
Transparency of Climate Change Mitigation
and Adaptation Actions in the Maldives
Project (CBIT Maldives)



This document was developed under the project “Capacity Strengthening for Improved Transparency of Climate Change Mitigation and Adaptation Actions in the Maldives (CBIT Maldives)”, financed by the Global Environment Facility (GEF).

The project is executed by the Ministry of Tourism and Environment, with implementation support from the United Nations Environment Programme (UN Environment).

July 2025

Consultant:

Development Advisory Services Pvt Ltd

Contents

Executive Summary	4
1 Introduction	5
2 Objectives.....	6
3 Training Sessions	6
3.1 Session 1	6
3.2 Session 2	6
4 Participant Engagement & Feedback	7
ANNEX 1: AGENDA	8
ANNEX 2: PARTICIPANT LIST	13
ANNEX 3: TRAINING MATERIALS FOR HAND-ON TRAINING FOR ESTIMATING GREENHOUSE GAS EMISSIONS OF ENERGY SECTORS IN MALDIVES.....	17
ANNEX 4: PHOTOS OF HAND-ON TRAINING FOR ESTIMATING GREENHOUSE GAS EMISSIONS OF ENERGY SECTORS IN MALDIVES	82

Executive Summary

As part of a consultancy project to develop guidelines and protocols for Greenhouse gas emission inventory, a hands-on-training workshop on GHG estimation for energy sectors was held from 14th July 2025. The main objective of the workshop was to provide training on the use of guidelines and protocols for GHG emission estimation for energy sub-categories, including essential aspects such as data collection, emission calculation, and quality assurance and control (QA/QC) procedures.

The workshops were facilitated by GHG Inventory Expert, Mr. Zammath Khaleel. A total of 22 (16 male, 6 female) participants attended the workshop on hands-on training for estimating GHG emissions from Energy. Attendees included representatives from the Climate Change and Energy Departments of the Ministry, the Ministry of Transport and Civil Aviation, Maldives Bureau of Statistics, Maldives Customs Services, Maldives National Defence Force (MNDF), Maldives Airports Company Limited (MACL), State Electric Company Limited (STELCO), State Trading Organization (STO), and Maldives Water and Sewerage Company (MWSC).

The workshops were conducted in an interactive manner with presentations, sample calculations followed by hands on exercises. The sessions were designed to inform the audience on the data requirements for GHG estimation using the guidelines, protocols and tools and clarify any issues in regards to data collection, calculation and GHG inventory compilation.

This training workshop collectively fulfills the following project deliverables of the project;

- Deliverable 1.2.5: Four (4) workshop reports on GHG inventory compilation and maintenance of the database management system.
 - This workshop fulfilled the third of the four required workshops under this deliverable.
 - The first two of the four required workshops were conducted from 22nd to 24th January 2025, covering GHG inventory compilation and reporting (Day 1 and Day 2).
- Deliverable 1.4.3: Three (3) training workshop reports on QA/QC plans
 - This workshop fulfilled the second of the three required workshops under this deliverable.
 - The first QA/QC training workshop was conducted on Day 3 of the workshop held from 22nd to 24th January 2025.

1 Introduction

The Capacity Building Initiative for Transparency (CBIT) project of Maldives is aimed to strengthening institutional capacity for tracking mitigation and adaptation actions and establishing climate finance tracking system in the Maldives. It aims to establish and enhance the Maldives' transparency system, in line with Enhanced Transparency Framework (ETF) of Paris Agreement.

As part of the Maldives CBIT project, Development Advisory Services Pvt Ltd was recruited as consultants to Develop Guidelines and Protocols for Preparation of GHG inventory for Maldives. The main objective of the assignment is to develop nationally appropriate guidelines and toolkits to report GHG emissions in line with the Enhanced Transparency Framework (ETF) of the Paris Agreement.

The hands-on-training workshop on GHG estimation for energy sectors was on 14th July 2025 respectively to train key stakeholders of GHG estimation in Energy sectors on the data requirements and estimating GHG emissions. This training covers data collection, data adaptation, emission calculation and compilation and reporting together with Quality Assurance and Quality Control process. The training was divided into two sessions with hand-on exercises to ensure that the audience understands and apply the highly technical knowledge included in the guideline.

The training workshops began with opening remarks from Mr. Ali Shareef, Special Climate Envoy from Presidents office. In the hands-on training on estimating GHG for energy sector session 1 focused on general provisions of the GHG estimation guidelines while session 2 focused on energy subcategories relevant to Maldives which included 2 focused presentations and hands on exercise on stationary combustion and mobile combustion.

This report aims to archive training material given on the workshop and record feedback from the stakeholders. This report outlines the following;

- **Objectives of the workshop:** the section includes the objectives of training workshop will be described.
- **Training sessions:** this section describes the training method and materials provided during the training period..
- **Engagement and Feedback:** this section captures the main discussions and recommendations made by the participants on the training sessions and materials

2 Objectives

The main objective of the training was to inform and build capacity of key stakeholders that would be engaged in estimating GHG emissions for energy sectors in Maldives. The focused audience would be primary data providers, data aggregators and key sectoral agencies. The training would also serve to build awareness among the data providers and aggregators on how their data will be used in GHG estimation and reporting.

3 Training Sessions

The main focus of the workshop was to cover key aspects of estimating GHG emissions in key energy categories relevant to Maldives. The training was split into 2 sessions. The agenda for the training is included in annex

3.1 Session 1

Session 1 was focused on introducing the guideline with a focus on emission calculation and compilation. The presentation introduced GHG emissions and the importance of compiling national GHG inventory. The session introduced key concepts of GHG inventory including IPCC definitions of various emissions, main IPCC sectors, Global Warming Potentials (GWPs) and TACCC principles. Furthermore, the presentation goes over step by step on the inventory process of GHG inventory compilation introducing key processes like Key Category Analysis, data collection best practices. The presentation is included in the annex.

After the general presentation, a brief presentation was given on estimating emissions using reference approach. Presentation introduced general estimation method for reference approach, possible data sources and potential issues in estimating emissions using reference approach. This presentation was key for the session 1 hand-on exercise. Participants were provided 45 minutes carry out a quick QC of the data provided and calculate GHG emissions using reference approach with the sample data provided.

Participants were also provided with a cheat sheet which provided key factors including density of fuels, Net calorific value and carbon content of each fuel type. At the end of the hands-on exercise, answers were provided for discussions and clarifying any issues.

3.2 Session 2

This session was split into two presentations, estimating emissions from stationary combustion and estimating emissions from mobile combustions. Each presentation was followed by hands on exercise. The presentation covers introduction to subcategories to be reported under Enhanced Transparency

Framework, including the relevance of categories to the national context of Maldives. The training includes key definitions, and emission sources, step-by step guidance on preparation of emissions inventory for reporting with a particular focus on reporting requirements under the Paris Agreement. More guidance was provided on potential data sources including proxy data and appropriating available data for use in emission calculation to improve completeness of the GHG inventory. Furthermore, detail guidance on data quality control for each subcategory of energy combustion and method and guidance on where to report different emission sources in accordance with the IPCC definitions. Training focused on differences in QC processes in different sectors and a need to have expert group for each main category for QC. The step-by-step example was provided to illustrate the emission calculation and reporting for ease of understanding. The hands-on exercise for stationary combustions focused on carrying out QC steps on dummy utility dataset, completing and adapting the dataset for GHG estimation and calculating GHG emissions using tier 1. The hands-on exercise for mobile combustion focused on adapting road transportation data for emission estimating including recategorizing vehicles into IPCC definition and estimating GHG emissions for those. In both the hands-on activities the key focus was on applying QC steps to the dataset and adapting the activity data for emission estimation. For each hands on exercise 45 minutes were given to the participants followed by discussing the final results. The presentations and materials for hands on exercise is included in the annex.

4 Participant Engagement & Feedback

The participants were enthusiastically engaged with the information provided and clarified their understanding on the IPCC subcategories and definitions which differs from national definitions. The participants appreciated the local examples of data sources and step by step calculations and hands-on exercises as it allowed them to practically apply the guideline in actual GHG estimation. The key feedback on improvement future improvement of the training includes, further simplifying the concept descriptions, and including more examples of GHG calculation using local data and more guidance on use of IPCC software and ETF tool. In addition to the feedback to the training, participants also suggested additional data sources and possible ways to improve emission estimates which could be considered in the future GHG inventory. This includes improving factors used in road and marine transportation, switching to LTO method for aviation.

ANNEX 1: AGENDA



Ministry of Tourism and Environment
Republic of Maldives

Hand-on training for estimating greenhouse gas emissions from Energy sector in Maldives

Date: 14th July 2025 | Venue: Meeruma

Overview and Objectives of the training

Estimating a greenhouse gas (GHG) inventory is crucial for the Maldives, a nation particularly vulnerable to climate change due to its low-lying geography. A comprehensive and accurate inventory enables policymakers to assess emissions sources, track progress towards climate commitments, and design effective mitigation strategies. Given the Maldives' commitment to international climate action, precise estimation ensures transparency, supports informed decision-making, and strengthens resilience against environmental changes.

Estimation tools play a key role in this process, providing structured methodologies for data collection, calculation, and reporting. These tools enhance efficiency, standardization, and accuracy in GHG inventory assessments, ensuring consistency with internationally accepted guidelines such as those of the Intergovernmental Panel on Climate Change (IPCC). Their application in the Maldives fosters data-driven climate policies and strengthens national capacity for emissions tracking. The estimation tools for this workshop covers key energy sources of greenhouse gases, namely stationary and mobile combustion of fuel in Maldives.

Furthermore, this workshop aligns with the United Nations Framework Convention on Climate Change (UNFCCC) Enhanced Transparency Framework (ETF), which emphasizes systematic reporting, verification, and improvement of national climate data. By mastering estimation tools, participants will contribute to the Maldives' ability to fulfil its reporting obligations under the Paris Agreement, thereby enhancing the credibility and effectiveness of national climate action.

A critical aspect of this training is the data collection, handling, quality control and assurance, GHG estimation and archiving for energy sectors. Proper management of inventory data ensures accuracy, accessibility, and continuity of information, which is essential for long-term climate planning. During hands-on exercises, participants will gain practical experience in collecting, processing (including QA/QC), estimating GHG and safeguarding data, ensuring it remains useful for future assessments and reporting.

This training workshop will provide both theoretical knowledge and practical application of tools used in GHG inventory estimation for Maldives. **The participants of the training are required to bring their laptop with the IPCC software and Microsoft Excel installed.** The IPCC software can be downloaded from the official website: [Inventory Software - IPCC-TFI](#). Participants who complete all sessions will receive a certificate of participation.

CBIT MALDIVES
Capacity Strengthening for Improved
Transparency of Climate Change Mitigation
and Adaptation Actions in the Maldives Project



Page 1 of 5



Agenda

Participants Arrival and Registration	08:45 – 09:00
Opening Ceremony	09:00 – 09:10
Group photo and Tea / Coffee break	09:10 – 09:30
Session 1: Introduction to GHG inventory process	09:30 – 12:00
<ul style="list-style-type: none"> General guidelines, including IPCC methodologies 	
<ul style="list-style-type: none"> Introduction to IPCC inventory tool 	
<ul style="list-style-type: none"> Key category analysis for emission sources 	
<ul style="list-style-type: none"> Reference approach 	
<ul style="list-style-type: none"> <i>Hands-on exercise:</i> Reference approach 	
Questions and Answers	
Lunch	12:00 – 13:00
Session 2: Energy Sector	13:00 – 16:00
<ul style="list-style-type: none"> Stationary combustion (electricity generation) 	
<ul style="list-style-type: none"> <i>Hands-on exercise:</i> Fuel consumption data processing including QA/QC 	
<ul style="list-style-type: none"> Mobile combustion (transport, fisheries) 	
<ul style="list-style-type: none"> <i>Hands-on exercise:</i> Land/Marine/Aviation/ emissions including QA/QC 	
Closing Ceremony	16:00 – 16:15
<ul style="list-style-type: none"> Certificate Distribution Closing Remarks 	
Tea	16:15

Participants

1. Climate Department, Ministry of Tourism and Environment
2. Energy Department, Ministry of Tourism and Environment
3. Tourism Statistics Section, Ministry of Tourism and Environment
4. Energy section of Utility Regulatory Authority (URA)
5. Ministry of Transport and Civil Aviation
6. Ministry of Fisheries Marine Resources and Agriculture
7. National Bureau of Statistics
8. Maldives Customs Services
9. Maldives National Defence Force
10. Maldives Airports Company Limited
11. State Trading Organization
12. STELCO
13. FENAKA
14. Maldivian Gas
15. Villa Gas
16. Regional Airports
17. MWSC

CBIT MALDIVES
Capacity Strengthening for Improved
Transparency of Climate Change Mitigation
and Adaptation Actions in the Maldives Project



Page 2 of 5



Background of the CBIT Maldives Project

Anthropogenic climate change is widely accepted as the most significant environmental challenge faced by the world in the 21st century. The Fifth Assessment Report (AR5) (2014) and the Global Warming at 1.5 °C (2018) special report by the Intergovernmental Panel on Climate Change (IPCC) confirm that climate change is an existential threat for low lying coral islands like Maldives. The Maldives is one of the most vulnerable countries for adverse impacts of global climate change.

Maldives' Nationally Determined Contribution (NDC) highlights food security, critical infrastructure, public health, water security, coastal protection, and coral reef biodiversity as key vulnerabilities of the country. In addition to these vulnerabilities, Maldives, like other Small Island Developing States (SIDS), face specific developmental challenges. They include high transportation and logistical costs, exploitation of natural resources, poor management of waste and pollution, and a small population leading to unsustainable economies of scale for different development agendas.

The 21st Conference of the Parties (COP21) was a key milestone for the international climate negotiations due to adoption of the Paris Agreement (PA), which came into force in 2016. Maldives was among the first countries to sign and ratify the PA in April 2016. One of the unique aspects of the PA is the contribution of both Annex 1 Parties and non-Annex 1 Parties in climate change mitigation and adaptation efforts in the form of NDCs. Article 13 of the PA outlines the transparency framework relating to the transparency of action and support. The main purpose of the transparency framework is to improve mutual accountability amongst the Parties in terms of their efforts for emissions reduction, adaptation efforts and support needed and received for addressing climate change.

Parties to the United Nations Framework Convention on Climate Change (UNFCCC) agreed on the Katowice climate package during the 24th Conference of the Parties (COP24) held in Katowice in December 2018. The Katowice climate package included eight guiding principles for the modalities, procedures and guidelines (MPGs) of the Enhanced Transparency Framework (ETF) under the PA, these include 1) Building on and enhancing the transparency arrangements under the Convention, recognizing the special circumstances of the Least Developed Countries (LDCs) and Small Island Developing States (SIDS), and implementing the transparency framework in a facilitative, non-intrusive, non-punitive manner, respecting

CBIT MALDIVES
Capacity Strengthening for Improved
Transparency of Climate Change Mitigation
and Adaptation Actions in the Maldives Project



Page 3 of 5



national sovereignty and avoiding placing undue burden on Parties; 2) The importance of facilitating improved reporting and transparency over time; 3) Providing flexibility to those developing country Parties that need it in the light of their capacities; 4) Promoting transparency, accuracy, completeness, consistency and comparability; 5) Avoiding duplication of work and undue burden on Parties and the secretariat; 6) Ensuring that Parties maintain at least the frequency and quality of reporting in accordance with their respective obligations under the Convention; 7) Ensuring that double counting is avoided; and 8) Ensuring environmental integrity. Furthermore, the ETF requires all Parties to compile national greenhouse gas (GHG) inventories and to report on the implementation of mitigation actions (tracking of NDC implementation) on a regular basis.

The Maldives is committed to meet the requirements of the ETF, despite of the flexibility provided for SIDS. There is need, therefore, for the Maldives to (i) establish a permanent institutional arrangement for GHG inventory compilation and tracking of NDC commitments, (ii) develop a centralized climate data management system for GHG data, tracking of mitigation actions, adaptation actions and support received and needed and (iii) develop tools and train experts to meet the enhanced transparency framework under the Paris Agreement.

This CBIT project has been developed with the objective of strengthening institutional capacity for tracking mitigation and adaptation actions and establishing climate finance tracking system in the Maldives. It aims to establish and enhance the Maldives' transparency system, in line with ETF of the PA. To achieve this objective, the following efforts are needed:

- (i) strengthening and formalizing long-term institutional arrangements.
- (ii) systemizing data collection and processing.
- (iii) developing indicators and advancing methodologies, as well as improving the overall data quality and management procedures, for preparing GHG inventories, tracking mitigation and adaptation actions and climate finance in an integrated manner. The final goal is to inform the national decision-making process as well as regularly report to the UNFCCC process.



The project includes two components:

- Component 1: The Maldives' National Greenhouse Gas (GHG) Inventory System improved.
- Component 2: The Maldives' Transparency Framework for mitigation and adaptation actions and resilience building, including tracking support for implementation.

Component 1 is designed to enable Maldives to meet the GHG inventory reporting requirements under the Modalities, Procedures and Guidelines (MPGs) outlined under the ETF of PA. Particularly, Chapter II of the MPGs contained in the annex of decision 18/CMA.1.

Component 2 is designed to meet the NDC tracking requirements of MPGs and both components are aimed to enable Maldives to submit the Biennial Transparency Reports (BTRs) in a timely and regular manner.

CBIT MALDIVES
*Capacity Strengthening for Improved
Transparency of Climate Change Mitigation
and Adaptation Actions in the Maldives Project*



Page 5 of 5

ANNEX 2: PARTICIPANT LIST



Ministry of Tourism and Environment Republic of Maldives

Signing Sheet

Hands-on Training for Estimating Greenhouse Gas Emissions from Energy Sector in Maldives
Date: 14th July 2025

#	Institution	Name	Designation	Signature
1	Utility Regulatory Authority	Aminath Fizna	Senior Environment Analyst	
2	Energy Department, Ministry of Tourism and Environment	Mohamed Suhadh Naseer	Programme Officer	
3	Energy Department, Ministry of Tourism and Environment	Hawwa Liuza	Assistant Director	
4	Climate Department, Ministry of Tourism and Environment	Ahmed Masoon	Programme Officer	
5	Climate Department, Ministry of Tourism and Environment	Juruath Abdulla Nafiz	Programme Officer	
6	Climate Department, Ministry of Tourism and Environment	Fathimath Raufa Moosa	Project Technical Coordinator	



Ministry of Tourism and Environment
Republic of Maldives

7	Tourism Statistics Section, Ministry of Tourism and Environment	Mohamed Sinan	Environment officer	
8	Ministry of Transport and Civil Aviation	Ali Ibrahim	Assistant Surveyor	02
9	Ministry of Transport and Civil Aviation	Ali Ameen	Assistant Transport Officer	
10	National Bureau of Statistics	Mariyam Shadeena	Deputy Statistician	
11	National Bureau of Statistics	Aishath Aniya	Statistical Officer	
12	Maldives Customs Services	Ibrahim Shareef	Superintendent	
13	Maldives Customs Services	Mohamed Sobah	Senior Customs Officer Grade 3	
14	Maldives Customs Services	Mohamed Hamdhoon <i>Abdul Hameedh</i>	Senior Customs Officer Grade 32	
15	State Electric Company Limited (STELCO)	Fathimath Rafeaha Riyaz	Assistant Engineer	
16	State Electric Company Limited (STELCO)	Mohamed Faizan Faiz	Assistant Engineer	



Ministry of Tourism and Environment
Republic of Maldives

17	State Electric Company Limited (STELCO)	Ahmed Rizhan Qasim	Service Supervisor	
18	Maldives Airports Company Limited (MACL)	Hussain Arubaan Fawwaaz	Manager, Environment Management	
19	Maldives Airports Company Limited (MACL)	Adam Firas	Senior Officer, Environment Management	
20	Maldives Airports Company Limited (MACL)	Mohamed Javeed	Manager, HSSE	2
21	State Trading Organization (STO)	Aminath Najiyath Shareef	Governance Associate	
22	State Trading Organization (STO)	Mikail Ibrahim Shareef Mohamed	Governance Associate	
23	Male' Water & Sewerage Company (MWSC)	Ahmed Zaid Nasih	Assistant Electrical Engineer	
24	Male' Water & Sewerage Company (MWSC)	Furugaan Ibrahim	Assistant General Manager, Operations	
25	MNDF	Cpt Ali Abdululla	STS OPS Cdr.	1
26	MNDF	Maj Abdululla Nazeen	ENME	



Ministry of Tourism and Environment
Republic of Maldives

27	CBIT Maldives. Ministry of Tourism and Environment	Shahidul Karim Mohamed Inaz	Technical Consultant	
28	President Office	Ali shareef	Special envoy for Climate Change	
29	Climate Change Ministry of Tourism and Environment	Ahmed waheed	Director	
31	Development Advisory Services	Zamirah khudaf MP		
32				
33				
34				
35				
36				
37				

ANNEX 3: TRAINING MATERIALS FOR HAND-ON TRAINING FOR ESTIMATING GREENHOUSE GAS EMISSIONS OF ENERGY SECTORS IN MALDIVES

Introduction to GHG Inventory and Planning



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



What are greenhouse gases



**Carbon dioxide
(CO₂)**



**Methane
(CH₄)**



**Nitrous Oxide
(N₂O)**



**Fluorinated
Gases**



**Water Vapor
(H₂O)**



Ministry of Tourism and Environment
Republic of Maldives

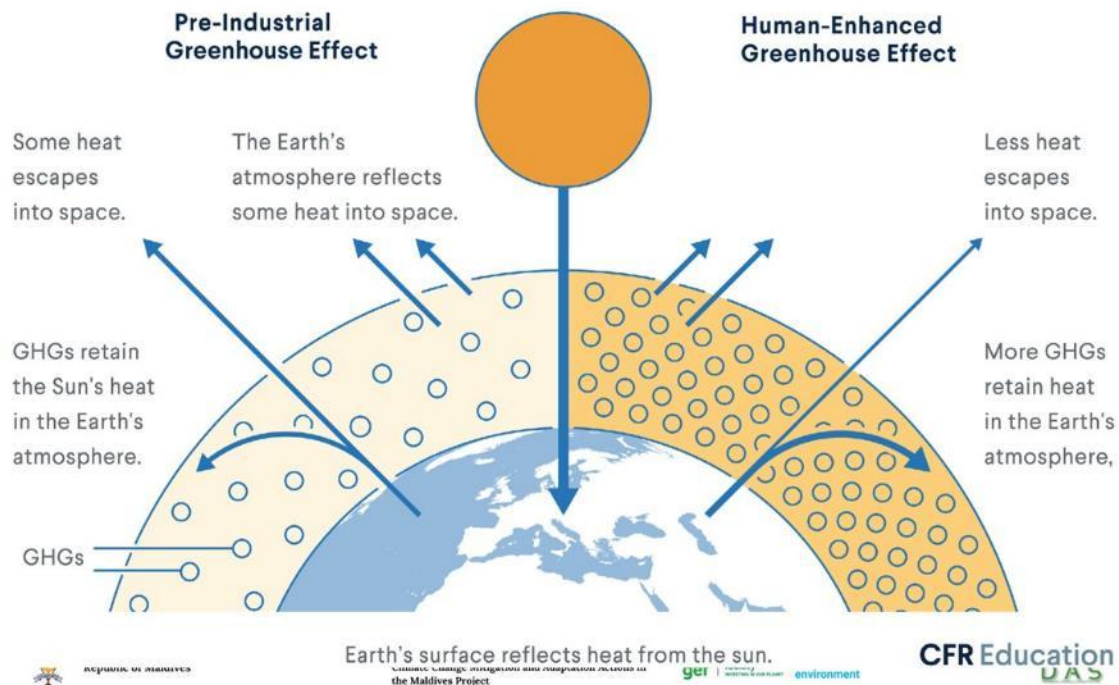
CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment





What are the key sources of GHGs?



Fossil Fuel Use – Burning coal, oil, and gas for electricity, heating, and transportation releases CO₂ and other GHGs.



Industrial Production – Energy-intensive industries like steel, cement, and chemical production emit significant GHGs.



Agriculture – Livestock farming, deforestation, and synthetic fertilizers release CH₄ and N₂O.



Deforestation – Clearing forests reduces carbon sinks while releasing stored CO₂ into the atmosphere.



Waste Management – Landfills produce CH₄ from decomposing organic waste, while incineration emits CO₂ and pollutants.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



Why are GHG inventories important for the Maldives?



- Reporting obligations under the UNFCCC
 - Meet requirements of the Enhanced Transparency Framework (ETF) of the Paris Agreement
 - National Inventory Report
 - Track Progress of NDC
- Emissions reduction and carbon markets
 - Carbon Budget submission

Important Tool Planning and informed decision making



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



Existing Methodologies and Guidances



- 1996 IPCC Guidelines
- Revised 1996 IPCC Guidelines
- IPCC GPG 2000
- GPG-LULUCF
- **2006 IPCC Guidelines**
- IPCC Wetlands Supplement
- IPCC KP supplement
- **2019 Refinement Guidelines**



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



GHG Inventory concepts

- **Anthropogenic emissions and removals:** These are greenhouse gas emissions and removal processes, stemming from human activities.
- Anthropogenic activities that emit GHGs to the atmosphere in the Maldives include (not limited to):
 - Combustion of fossil fuels to produce energy.
 - Agricultural activities such as farming and crop production.
 - Deforestation.
 - Burning of waste and decomposition of organic waste in landfills.
- Although not entirely relevant to the context of the Maldives, some anthropogenic interventions that can remove carbon dioxide from the atmosphere include:
 - Afforestation
 - Reforestation
 - Carbon Capture and Storage



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global environment
facility

UN
environment



GHG Inventory concepts

- **Greenhouse Gases:** The greenhouse gases covered depend on the national context and key category analysis. Based on previous inventories and assessments, the following three gases are the most relevant to the Maldives:
 - Carbon dioxide (CO₂)
 - Methane (CH₄)
 - Nitrous oxide (N₂O)
 - F-Gases
- **Sectors and Categories:** Greenhouse gas emission and removal estimates are categorized into primary sectors, each encompassing related processes, sources, and sinks [1]. These sectors are:
 - Energy
 - Industrial Processes and Product Use (IPPU)
 - Agriculture, Forestry, and Other Land Use (AFOLU)
 - Waste
 - Other (e.g., indirect emissions from nitrogen deposition originating from non-agricultural sources)
- Each sector includes individual categories (e.g., transport) and sub-categories (e.g., cars). Inventories are typically built starting from the sub-category level, following IPCC methodologies, and aggregated to calculate national totals.
- Emissions from international transport (ships and aircraft) are reported separately and not included in national totals.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global environment
facility

UN
environment



GHG Inventory concepts

- **Global Warming Potential (GWPs):** GWP is a metric that compares the radiative forcing of a metric ton of a particular greenhouse gas over a specified time-period (e.g., 100 years) to the radiative forcing of a metric ton of CO₂ over the same period [1].

Global Warming Potential (GWP ₁₀₀)		
CO ₂	CH ₄	N ₂ O
1	28	265



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



GHG Inventory Concepts (others)

- **National Territory:** GHG emissions and removals reported in the national inventory must occur within the national territory.
- **Inventory Year and Time Series:** National inventories report GHG estimates for the year of emissions or removals. In cases of incomplete data, estimation methods like averaging or extrapolation can be used. Countries are encouraged to maintain consistent time series data.
- **Inventory Reporting:** A national inventory report consists of two components: standardized reporting tables covering all relevant gases, categories, and years, and a written report detailing the methodologies and data used to generate estimates. The ETF's Common Reporting Formats (CRFs) must be followed to meet Paris Agreement obligations.



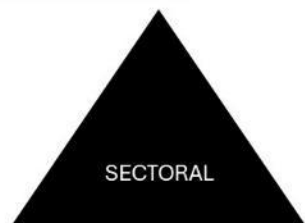
Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project

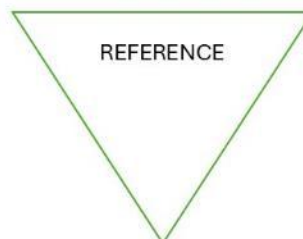


Reference Approach vs Sectoral approach

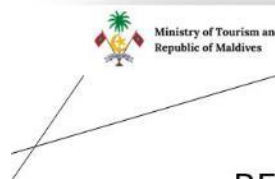
Bottom-up approach, which gives a Breakdown emissions by specific sectors (e.g., transportation, industry).



Top-down Approach, using a country's energy supply data to calculate emissions



With in 5%



CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



REFERENCE APPROACH VS SECTORAL APPROACH

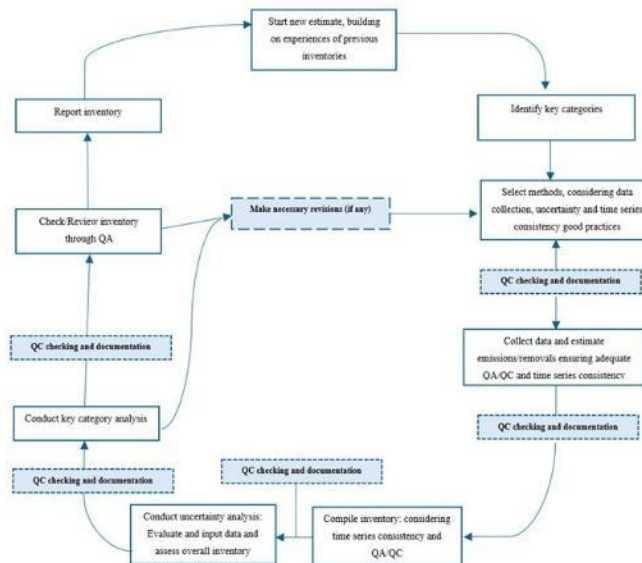


12

TACCC principles

- **Transparency:** Assumptions and methodologies should be clearly explained and documented
- **Accuracy:** Emission and removal estimates should be neither over nor under the true values
- **Consistency:** Inventories should be internally consistent with previous years' inventories
- **Completeness:** Inventories should be complete
- **Comparability:** Inventories should be comparable

Overall Inventory Development Process



INVENTORY PROCESS

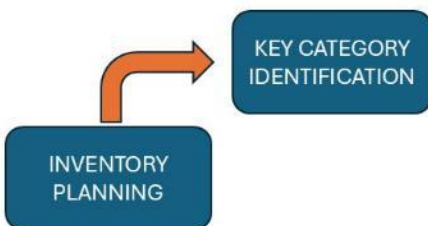


Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



INVENTORY PROCESS



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



Key Categories

A key category is one that is prioritized within the national inventory system because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level, the trend, or the uncertainty in emissions and removals. Whenever the term key category is used, it includes both source and sink categories.

- For a new inventory, make rough estimates based on previous knowledge of activities, emission sources, and experience with similar inventories.
- For continuing inventories, use the last national inventory to carry out Key category analysis
- Where quantitative analysis is not feasible, due to incomplete data, qualitative assessments may be done
- The IPCC provides **two approaches** to conduct key category analysis: both focused on identifying key categories based on their contributions to the **absolute level** and **trend** of emissions and removals.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



Key category analysis

Level assessment

key categories are the ones that, when added together in descending order of magnitude, account for 95 percent of the total level of emissions and removals.

Trend assessment

Key categories are those whose trend most significantly diverges from the overall trend

IPCC code	Category	Greenhouse gas	2011 Level	2022 Level	2022 Trend
1.A.4	Other Sectors - Liquid Fuels	CO ₂	X	X	X
1.A.1	Energy Industries - Liquid Fuels	CO ₂	X	X	X
1.A.3.d	Water-borne Navigation - Liquid Fuels	CO ₂	X	X	X
1.A.3.b	Road Transportation - Liquid Fuels	CO ₂	X	X	X
1.A.3.a	Civil Aviation - Liquid Fuels	CO ₂	X	X	X
1.A.3.e	Other Transportation - Liquid Fuels	CO ₂	-	-	X
4.C	Incineration and Open Burning of Waste	CH ₄	X	X	X



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



Qualitative Criteria for Key Category Analysis

Where quantitative analysis is not feasible, due to incomplete data, qualitative assessments may be done

Mitigation Impact	• Prioritize categories where emissions have decreased or removals increased due to mitigation efforts, ensuring transparency in assessment methods.
Anticipated Growth	• Identify categories likely to see rising emissions or declining removals, using expert judgment as needed.
Uncertainty Reduction	• Focus on categories with significant uncertainty, even if not using Approach 2. Improving estimates in high-uncertainty areas will enhance inventory accuracy.
Completeness Assurance	• For incomplete inventories, assess key categories qualitatively, prioritize data collection based on preliminary estimates, and consult inventories of similar countries for guidance.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project

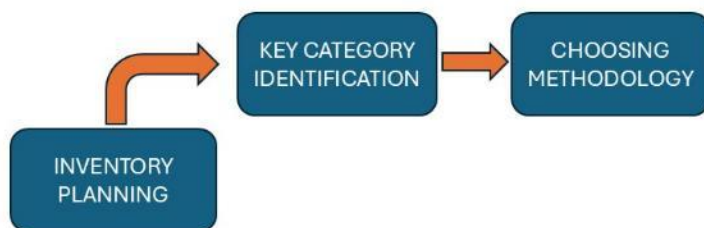


global
environment
facility

UN
environment



INVENTORY PROCESS



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



Choosing Methodologies

There are **three methodological tiers (Tier 1, Tier 2 and Tier 3)** that may be used for GHG inventories

A tier **represents the level of complexity and effort required to estimate GHG emissions** and removals.

Higher-tier methodologies generally provide more accurate estimates, but they require detailed and high-quality data, which can be resource-intensive to collect.

The **choice of tier is dependent on the country context, availability of resources and data.**



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



Methodological Tiers

	Estimation Method	Example of Data collection required
Tier 1 - Basic	Emissions = Default Emission factor x National Activity data (aggregated)	Total Fuel combusted for electricity generation
Tier 2 - Intermediate	Emissions = Country Specific emission factor x Specific activity data	Fuels combusted for electricity generation together with the average combustion rates of the technology used
Tier 3 - Advanced	Emission measurements or models to estimate emissions accurately	Stack emissions for all the power houses



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project

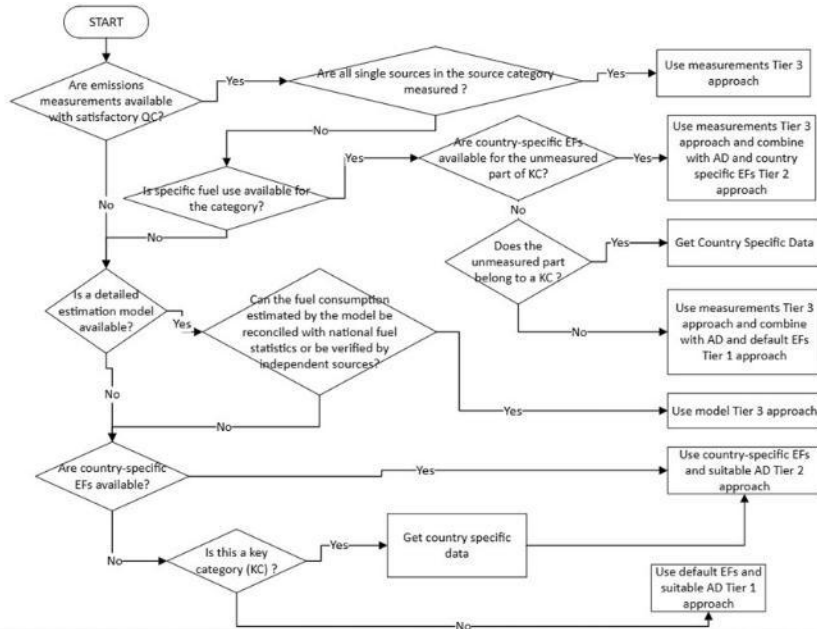


global
environment
facility

UN
environment



The step-by-step guide to choosing the right methodology (Tier)



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project

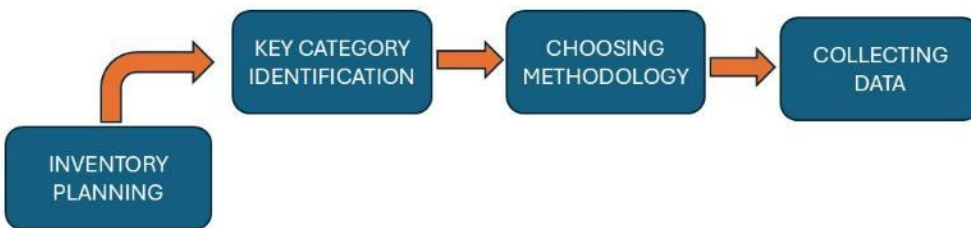


global
environment
facility

UN
environment



INVENTORY PROCESS



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



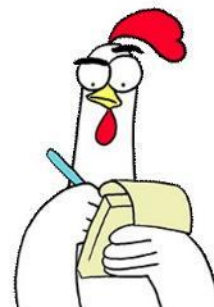
global
environment
facility

UN
environment



Best Practices in Data collection

- Prioritize **collecting data that enhances estimates for the most significant key categories**, considering their contribution, potential for change, and uncertainty.
- Choose data collection methods that **progressively enhance inventory quality**, aligning with data quality goals.
- Establish data collection practices (such as resource allocation, planning, documentation) that **continuously enhance the inventory data**.
- Gather **data at an appropriate level of detail** based on the chosen method.
- **Regularly review data collection activities** and methodological requirements to drive ongoing and efficient inventory improvement.
- **Establish agreements with data providers** to ensure consistent and continuous information flow.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



Collecting data

- Recommended existing data source prioritization
 - National Statistical Agencies – Maldives Bureau of Statistics, MCS
 - Sectoral Experts/Government Agencies – URA, MOT, MPL . . .
 - Other National Experts –consultants
 - IPCC EFDB
 - International Organizations – World Bank, FAO
 - Historical references – FNC, SNC, BUR, Carbon Audit 2009
 - Academia – MNU
 - Inventory Reports of other similar countries

Source	Type of Activity Data
Maldives Customs Services	Fuel import/export data
State Trading Organization (STO)	Fuel import/export/stock data
Fuel Supply Maldives	Fuel import/export/stock data
Maldives Gas	Fuel import/export/stock data
Villa Hakatha	Fuel import/export/stock data
Villa Gas	Fuel import/export/stock data
Hawks Pvt Ltd	Fuel import/export/stock data
Meridiam Services	Fuel import/export/stock data
Asian Gas and Oil and Coastal Blocks	Fuel import/export/stock data
Hakatha One	Fuel import/export/stock data
Fuel Express Maldives	Fuel import/export/stock data
Maldives Airports Company Limited	Fuel stock/consumption data
Regional Airports	Fuel stock/consumption data
STELCO	Fuel Consumption Data
FENAKA	Fuel Consumption Data
MWSC	Fuel Consumption Data
Utility Regulatory Authority (Previously MEA)	Fuel Consumption data
Resorts	Fuel Consumption data and bed-nights or occupancy data
MIFCO	Fuel Consumption Data
MPL including Regional Ports	Fuel Consumption Data
MNDF/MPs	Fuel Consumption Data
Horizon Fisheries	Fuel Consumption Data
Ministry of Transport/ Transport Authority	Vehicle/vessel registry data
Ministry of Fisheries	Data on fishing trips/vessels
Ministry of Tourism	Bed nights/occupancy rates
Maldives Bureau of Statistics	Demography and socio-economic data/indices



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



Collecting data

- Conduct an **initial screening of existing data** sources through a literature review
- If officially published data is unavailable, **formal requests should be sent to relevant agencies and stakeholders**, clearly specifying requirements to ensure the data meets expectations
- These **requirements** include:
 - **Define the data set** including the disaggregation, time series, details about sectors and sub-sectors, national coverage, requirements for uncertainty data, emission factors, and units of activity data
 - **Define the format** (e.g., spreadsheet) and the structure of the data set
 - Include **descriptions of the assumptions** made in the data sets
 - **Specify how often the data set is updated** and which elements are updated
 - Documentation and QA/QC Procedures
 - Contact Information



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



Generating new data

- Generating new data may become necessary **when representative emission factors, activity data, or other estimation parameters are unavailable**
- To optimize resources, **new data should be generated as an extension of existing programs rather than through entirely new initiatives.**
 - Example rather than have an independent survey incorporate new question into existing surveys like HIES, Census, Waste Accounting etc
- Before deciding on a new survey, three key steps should be taken



Review Available Data

- Assess existing data systems
- Identify planned surveys
- Published data usually stem from detailed datasets that can be restructured for inventory purposes

Explore Administrative Sources

- Consider using administrative records, which can be adapted to inventory purpose on a lower cost

Incorporate New Questions or Modules into existing surveys

- Adding questions to existing surveys is often more cost effective than launching standalone surveys



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



Adapting data for Estimation

- **Filling Gaps in Periodic Data**

- When data collection intervals not aligning with annual inventory cycle (example waste audit data)

- **Time Series Revision**

- when the data provider revises their historical data (example: data reconciliation process leading historical value revisions)

- **Incorporating Improved Data**

- When new and improved data is available allowing higher tier estimated

- **Incomplete Coverage**

- When data do not fully represent the entire country. Proxy data can be used to extrapolate (example use of bed nights to estimate fuel use in resorts)

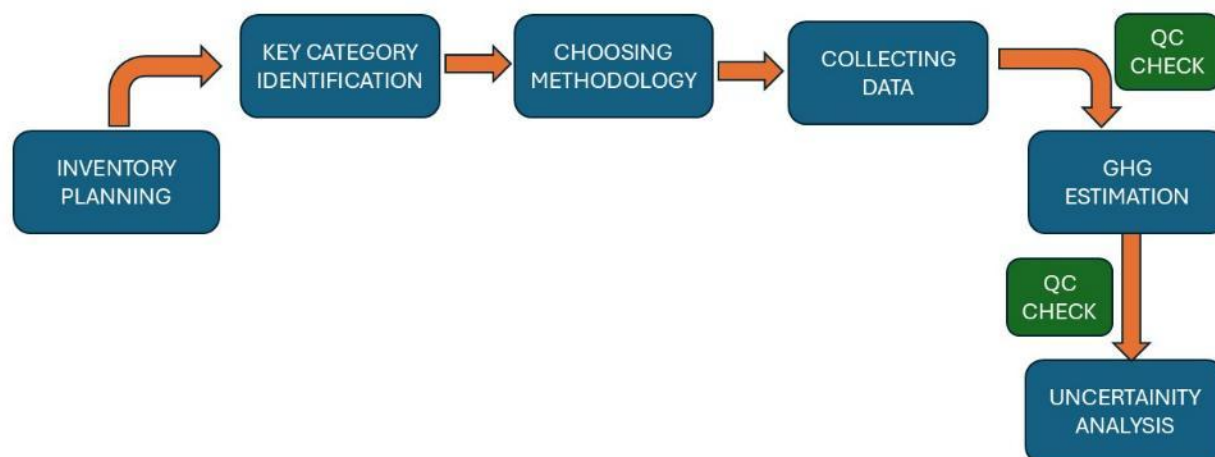


Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



INVENTORY PROCESS



Ministry of Tourism and Environment
Republic of Maldives

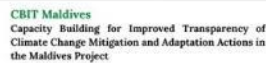
CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



Basis GHG Estimation



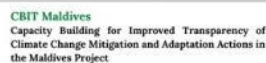
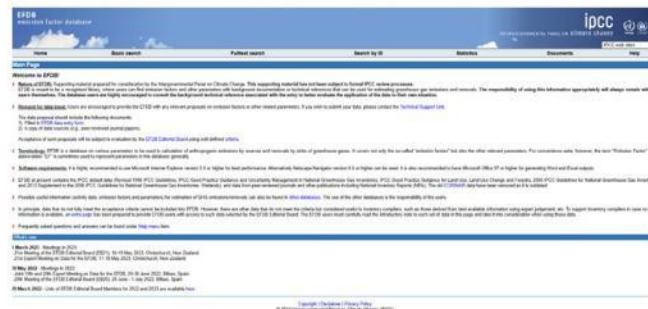
$$\text{Emissions} = \text{Activity Data (AD)} \times \text{Emission Factors (EF)}$$



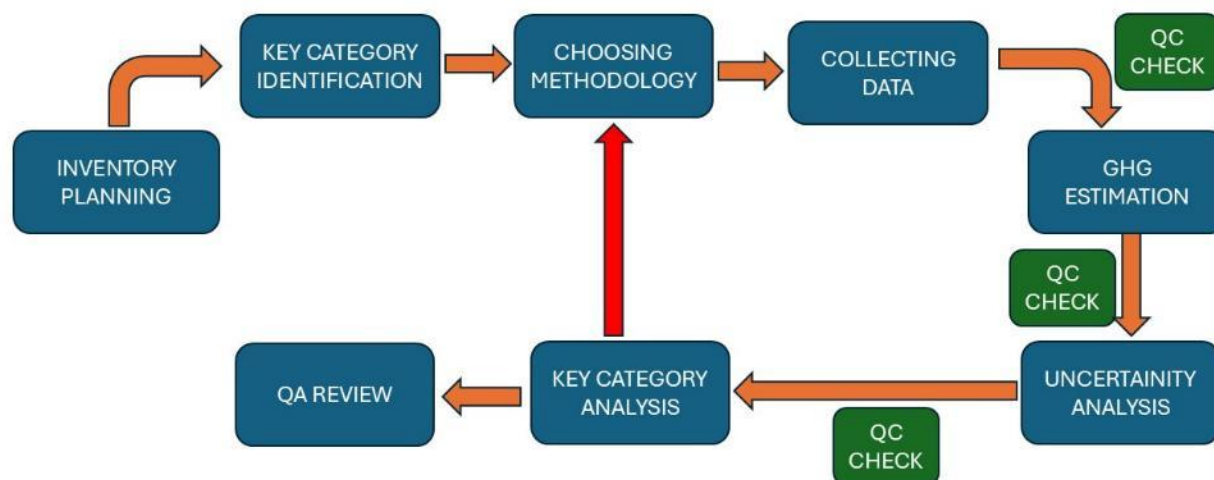
Choosing Emission Factors



- In the absence of country-specific peer-reviewed studies in the Maldives, IPCC default emission factors and Tier 1 methods are appropriate for estimating greenhouse gas emissions.
- The **Emission Factor Database (EFDB)** is a continuously updated web-based platform that facilitates information exchange on emission factors and related parameters.
- Experts and researchers can access the EFDB via the IPCC or IPCC-NGGIP websites, or directly at <http://www.ipcc-nggip.iges.or.jp/EFDB/main.php>.
- The platform enables experts to share new emission factors globally, enhancing collaboration and improving inventory assessments.



INVENTORY PROCESS



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



QA Review: Completeness check (Notation Keys)

- Notation keys **provide essential information on emission estimates** or removals that are incomplete, partial, or need clarification
- They **enhance the transparency** and help stakeholders **interpret the data, ensuring that specific emissions or removal are understood within their context**

Notation Key	Definition
NO	(Not occurring) for activities or processes in a particular source or sink that do not occur within a country
NE	(Not estimated) for existing emissions by sources and removals by sinks of greenhouse gases which have not been estimated.
NA	(Not applicable) for activities in a given source/sink category that do not result in emissions or removals of a specific gas.
IE	(Included elsewhere) or emissions by sources and removals by sinks of greenhouse gases estimated but included elsewhere in the inventory instead of the expected source/sink category. Where "IE" is used in an inventory, the country should indicate, using the CRF completeness table (CRT 9?) where in the inventory the emissions or removals from the displaced source/sink category have been included and explain why they have placed these emissions or removals in a different category.
C	(Confidential) for emissions by sources and removals by sinks of GHGs where the reporting would involve the disclosure of confidential information
FX	(Flexibility) for cells where data are not available or reported because of a flexibility provision applied by a country that needed flexibility in the light of its capacity.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



QA Review: Completeness check (Units)

- **Consistency of Units:**
 - Emissions and removals should be expressed in mass units consistently within each sector.
- **Preferred Unit:**
 - Generally, emissions in summary and sectoral tables are expressed in gigagrams (Gg), but other SI mass units may be used for increased transparency.
- **Appropriate Significant Digits:**
 - The number of significant digits in reported values should be appropriate to their magnitude. A precision of 0.1 percent of the national total is considered adequate for each gas.
- **CO2 Equivalents:**
 - For certain gases specified in individual sector tables, emissions and removals should be reported in terms of carbon dioxide equivalents (CO₂e), which accounts for their global warming potential.
- **Transparency in Conversion Factors:**
 - All conversion factors used to convert data from original units to the chosen reporting units should be documented transparently.



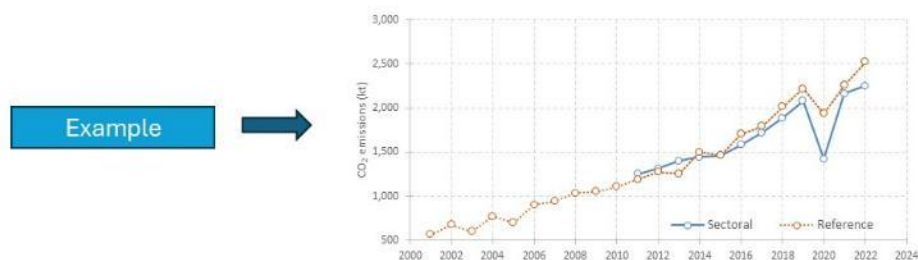
Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



QA review: Completeness check (time series)

- It is **considered good practice to ensure that all reporting tables are complete for each year** including
 - Summary table,
 - Sectoral table, and
 - cross-sectoral tables
- **Create trend tables/graphs** that summarize aggregated inventory data from different years.

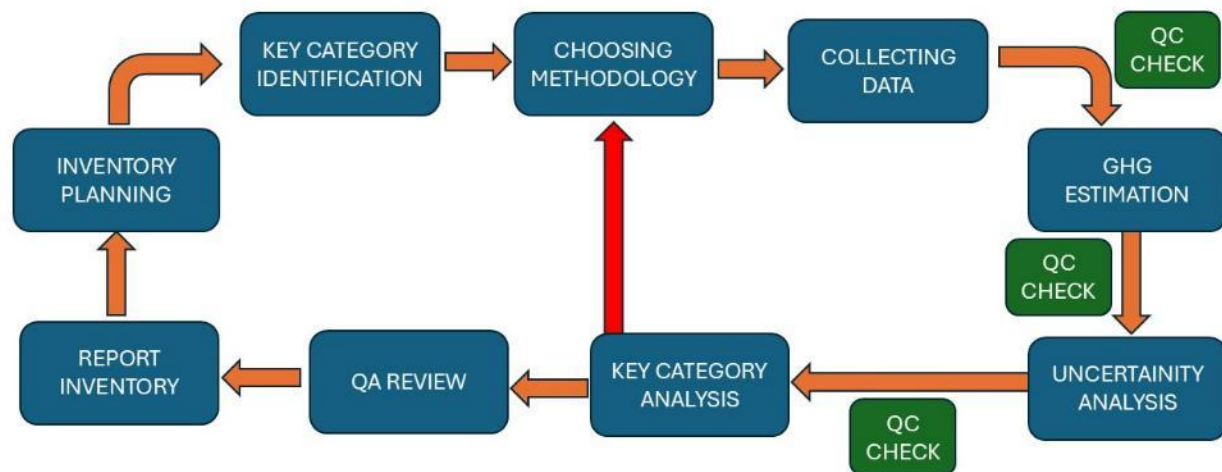


Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



INVENTORY PROCESS



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



UN
environment



GHG Inventory Reporting: CRT Tables

- CRT tables are a set of tables that all Parties to the Paris Agreement will be required to use, starting in 2024, to report their national GHG inventories to the UNFCCC

Multiple sheets of Sectoral Background Tables, showing detailed data for various sectors.

Sectoral Background Tables

Multiple sheets of Sectoral Report Tables, showing detailed data for various sectors.

Sectoral Report Tables

Multiple sheets of Summary / Cross-sectoral / Trends Tables, showing aggregated data and trends.

Summary / Cross-sectoral / Trends Tables



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



UN
environment



GHG Inventory Reporting – Archiving

- **Use of IPCC Inventory Software:**

- The inventory is established using the IPCC inventory software, which ensures standardized and consistent calculations. This software also includes data backup features, contributing to data security.

- **Excel Sheets for Data Storage:**

- sector-specific data, raw and processed data are stored in Excel sheets.

- **Documentation and Comments:**

- the commenting feature in the IPCC software is utilized to input remarks in relevant fields. These comments serve as a valuable resource for maintaining continuity and improving the inventory in the future.

- **Centralized Data Storage:**

- all datasets used for inventory preparation are centrally archived at the Ministry

- **Cloud Storage for Redundancy:**

- This ensures data integrity and minimizes the risk of data loss.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

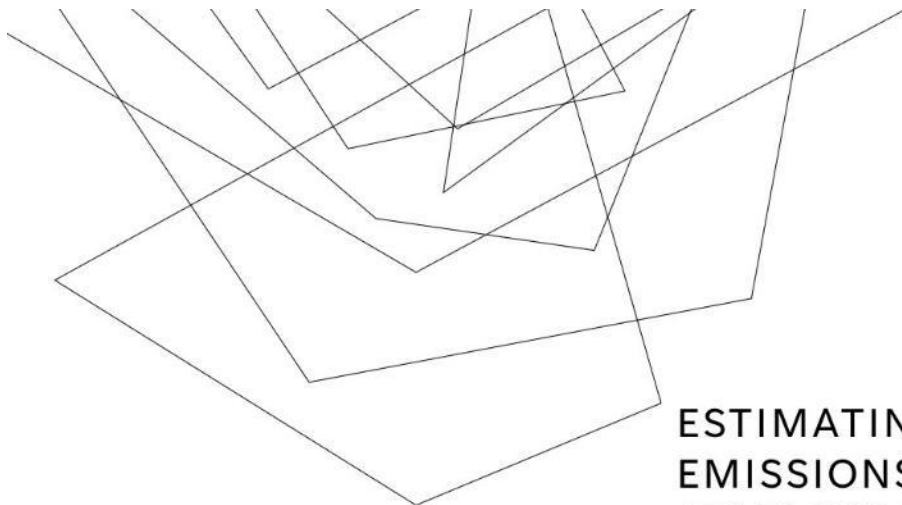
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment





ESTIMATING ENERGY EMISSIONS – STATIONARY

JANUARY 23, 2025
PREPARED BY: DEVELOPMENT ADVISORY SERVICES



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



INTRODUCTION



Energy sector comprises of **emissions resulting from activities by fuel combustion and as fugitive emissions** i.e. escape without combustions.

What is fuel combustion?

"the intentional oxidation of materials within an apparatus that is designed to provide heat or mechanical work to a process, or for use away from the apparatus"

What is fugitive emissions?

Fugitive emissions in the energy sector arise from extraction, transformation and transportation of primary energy carriers.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



STATIONARY COMBUSTION

- Most of the emissions in an inventory occurs due to stationary combustion
- Stationary combustions is comprised of the following according to the IPCC 2006 guidelines:
 - Energy industries
 - Manufacturing Industries and Construction
 - Other Sectors
- These slides provide a guidance for calculating emissions from stationary combustion (eg: energy generation)



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



MALDIVES ENERGY CONTEXT



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project

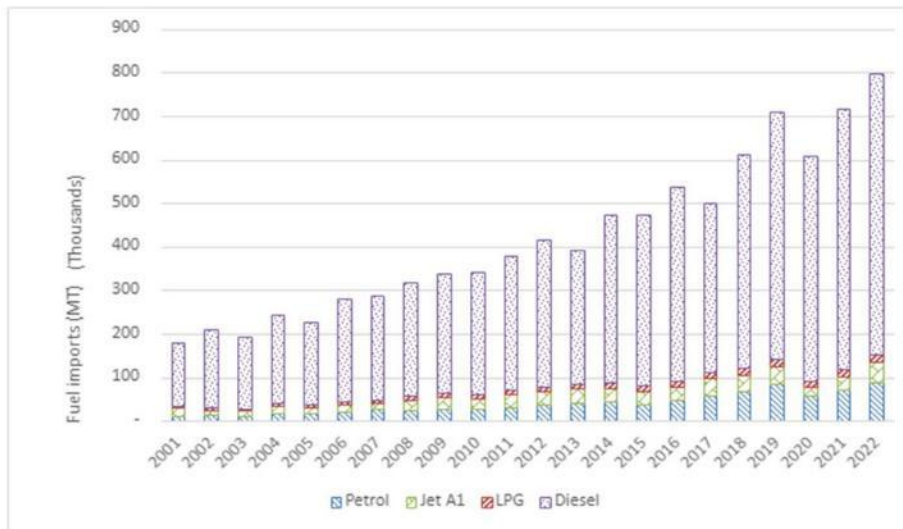


global
environment
facility

UN
environment



NATIONAL CONTEXT – ENERGY USE

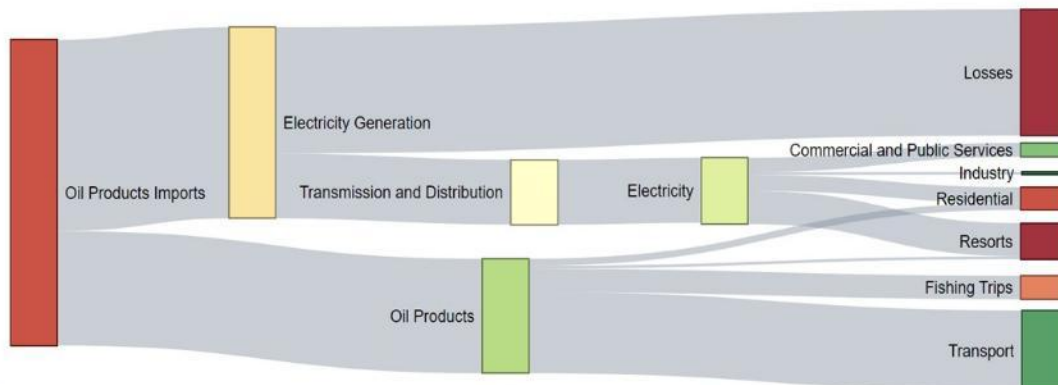


Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



NATIONAL CONTEXT – ENERGY



Sankey diagram. How the flow of oil products and electricity from import through generation, transmission, and distribution. Transport is the most significant energy consumer overall, while within the electricity pathway, residential users and resorts appear to be the primary consumers



Ministry of Tourism and Environment
Republic of Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



INTRODUCTION



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



SOURCE CATEGORIES

- In estimating emission, it is **important to clearly identify the main source categories that is relevant to Maldives** national circumstances.
- Maldives imports refined fossil fuel products to meet its energy needs and thus does not have any emission sources resulting from exploration and exploitation of primary energy sources (a.k.a. Oil and gas fields, coal mines etc.) and conversion of primary energy sources into secondary fuels in refineries and power plants.
- Maldives does not have any industry that utilizes hydrocarbons for any industrial production



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



FUEL DEFINITIONS



As a first step, terminologies used for the fuels in the Maldives must be identified and matched with the relevant IPCC terms

Fuel (Imported Maldives)	IPCC convention	Explanation
Petrol	Motor Gasoline	This is light hydrocarbon oil for use in internal combustion engines such as motor vehicles, excluding aircraft. Motor gasoline is distilled between 35 °C and 215 °C and is used as a fuel for land based spark ignition engines.
Marine Gas Oil	Gas/Diesel Oil	Gas/diesel oil includes heavy gas oils. Gas oils are obtained from the lowest fraction from atmospheric distillation of crude oil, while heavy gas oils are obtained by vacuum redistillation of the residual from atmospheric distillation. Gas/diesel oil distils between 180 °C and 380 °C. Several grades are available depending on uses: diesel oil for diesel compression ignition (cars, trucks, marine, etc.), light heating oil for industrial and commercial uses, and other gas oil including heavy gas oils which distil between 380 °C and 540 °C and are used as petrochemical feedstocks.
Diesel		
Kerosene Oil	Jet Kerosene	This is medium distillate used for aviation turbine power units. It has the same distillation characteristics and flash point as kerosene (between 150°C and 300°C but not generally above 250°C). In addition, it has particular specifications (such as freezing point) which are established by the International Air Transport Association (IATA). Note that other forms of kerosene in Maldives, is also considered under Jet kerosene.
Jet A1		
Cooking Gas/LPG	Liquified Petroleum Gases	These are the light hydrocarbons fraction of the paraffin series, derived from refinery processes, crude oil stabilisation plants and natural gas processing plants comprising propane (C ₃ H ₈) and butane (C ₄ H ₁₀) or a combination of the two. They are normally liquified under pressure for transportation and storage.
Propane, Liquified		
Butanes, Liquified		



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



CONVERSIONS

- The activity data or the fuel information provided by the users are mostly available either in volume (litres) or in mass units (metric tonnes)
- The volume or mass units need to be converted to energy units based on either Gross Calorific Value (GCV) or Net Calorific Value (NCV)
- The energy units used are the SI units (e.g. J – Joules) or multiples of SI units (e.g. TJ).



Fuel - IPCC convention	Net Calorific Value, NCV (TJ/Giga grams)	Carbon content (tC/TJ)	Density (kg/L) or (T/m ³)
Motor Gasoline	44.3	18.9	0.75
Gas/Diesel Oil	43	20.2	0.84
Jet Kerosene	44.1	19.5	0.8
Liquified Petroleum Gases	47.3	17.2	0.54



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



EMISSION CONVERSIONS

- Emissions will **need to be reported in common units of Carbon dioxide equivalent or CO₂eq.**
- According to the ETF MPGs, the Global Warming Potential (GWP₁₀₀) from the IPCC 5th Assessment Report has to be used for conversion.



Global Warming Potential (GWP ₁₀₀)		
CO ₂	CH ₄	N ₂ O
1	28	265



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



METHODOLOGIES

- There are **two general methodologies** for estimating the CO₂ emissions from fuel combustion.
- **Method 1** is the **sectoral approach** where estimates are based on consumption data.
- **Method 2** is the **reference approach**, which is also known as the 'top-down' approach to estimate CO₂ emissions.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



APPROACH 1: REFERENCE



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



REFERENCE APPROACH

- Reference approach calculates CO₂ emissions from fuel combustion activities.
- As Maldives does not produce any fossil fuels the apparent consumption is calculated only for secondary fuels.
- The main level of data required is high level fuel supply data (the total energy supply data without any disaggregation in specific energy-related activities).
- In addition, fuel export and storage or fuel stock statistics are also required for the estimation of the apparent consumption

Apparent consumption = Total Import – Total Export – International bunkering – stock

MCS,

MCS,

STO, MACL

STO, MACL



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



DATA SOURCES FOR REFERENCE APPROACH

Data sources	Data				
	Import	Export	Stock	International Bunkering	Fuels Covered
Maldives Customs Services	X	X		X	Diesel, Petrol, Kerosene, Jet A1, LPG
State Trading Organization	X	X	X	X	Diesel, Petrol, Kerosene, Jet A1
Fuel Supply Maldives	X	X	X		Diesel, Petrol, Kerosene, Jet A1
Maldivian Gas	X	X	X		LPG
Villa Hakatha	X	X	X		Diesel, Petrol, Kerosene, Jet A1
Villa Gas	X	X	X		LPG
Hawks Pvt Ltd	X	X	X		Diesel, Petrol
Meridiam Services	X	X	X		Diesel, Petrol
Asian Gas and Oil and Coastal Blocks	X	X	X		Diesel, Petrol
Hakatha one	X	X	X		Diesel, Petrol
Fuel Express Maldives	X	X	X		Diesel, Petrol
Maldives Airports Company Limited			X	X	Diesel, Petrol, Kerosene, Jet A1
Regional Airports			X	X	Diesel, Petrol, Kerosene, Jet A1



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility



UN
environment



ESTIMATION METHOD

General Formula used to estimate
CO₂ emissions under reference
approach



CO₂emissions

$$= \sum_{all\ fuels} [((Apparent\ consumption * Conv\ factor * Carbon\ content) * 10^{-3} - Excluded\ carbon) * Carbon\ oxidation\ factor * 44/12]$$

$$Apparent\ consumption = Total\ Import - Total\ Export - International\ bunkering - stock$$

$$Conv\ factor = NCV\ value\ from\ the\ table\ for\ the\ respective\ fuel\ type$$

$$Carbon\ content = Carbon\ content\ value\ from\ the\ table\ for\ the\ respective\ fuel\ type$$

$$Carbon\ oxidation\ factor = 1, (assuming\ all\ are\ fuel\ are\ combusting\ at\ 100\%)$$



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility



UN
environment



STEP BY STEP GUIDE FOR REFERENCE APPROACH

(1) Obtain data from stakeholders:

Obtain the data (import, export, international bunkering and stock change data) from stakeholders. Check if this is in liters, or metric tons



(2) Convert data to mass units (Giga grams)

Use the density conversion factors to calculate the mass in gigagrams (Gg).

Example



TOTAL IMPORTS OF SELECTED ITEMS IN 2011

Description	Quantity(MT)
Marine Gas Oil (Diesel) Total	304,172.80
Aviation Gas	30,707.60
Propane, Liquefied	11,566.15
Petrol	31,121.57
Grand Total	377,893.79

RE-EXPORT OF FUEL IN 2011

DESCRIPTION	QUANTITY (in MT)
Marine Gas Oil (Diesel)	26273.78
Aviation Gas	94,399.88



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



STEP BY STEP GUIDE FOR REFERENCE APPROACH

(3) Estimate Apparent Fuel Consumption in Gg

Apparent consumption = Total Import - Total Export - International bunkering- stock

Example



Fuel	Import	Export	Bunkering	Stock	Apparent Consumption
Marine Gas Oil (Diesel)	304.17		26.27		277.9
Aviation Gas	30.71		94.40		?
Propane, Liquefied	11.57				11.57
Petrol	31.12				31.12

TOTAL IMPORTS OF SELECTED ITEMS IN 2011

Description	Quantity (Gg)
Marine Gas Oil (Diesel)	304.17
Aviation Gas	30.71
Propane, Liquefied	11.57
Petrol	31.12
Grand Total	

RE-EXPORT OF FUEL IN 2011

DESCRIPTION	
Marine Gas Oil (Diesel)	26.27
Aviation Gas	94.40



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



STEP BY STEP GUIDE FOR REFERENCE APPROACH

(3) Estimate Apparent Fuel Consumption in Gg

Apparent consumption = Total Import - Total Export - International bunkering- stock

Example



Fuel	Import	Export	Bunkering	Stock	Apparent Consumption
Marine Gas Oil (Diesel)	304.17		26.27		277.9
Aviation Gas	125.11		94.40		30.71
Propane, Liquefied	11.57				11.57
Petrol	31.12				31.12



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



STEP BY STEP GUIDE FOR REFERENCE APPROACH

(4) Convert Apparent Consumption to common Energy Unit (TJ)

*Apparent consumption (TJ) = Conv factor * Apparent consumption (Gg)*

Example



Fuel	Apparent Consumption in Gg	NCV TJ/Gg	Apparent Consumption in TJ
Marine Gas Oil (Diesel)	277.9	43	
Aviation Gas	30.71	44.1	
Propane, Liquefied	11.57	47.3	
Petrol	31.12	43	



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



STEP BY STEP GUIDE FOR REFERENCE APPROACH

(4) Convert Apparent Consumption to common Energy Unit (TJ)

$$\text{Apparent consumption (TJ)} = \text{Conv factor} * \text{Apparent consumption (Gg)}$$

Example



Fuel	Apparent Consumption in Gg	NCV TJ/Gg	Apparent Consumption in TJ
Marine Gas Oil (Diesel)	277.9	43	11,949.7
Aviation Gas	30.71	44.1	1354.31
Propane, Liquefied	11.57	47.3	547.26
Petrol	31.12	43	1338.16



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



STEP BY STEP GUIDE FOR REFERENCE APPROACH

(5) Estimate total carbon content (Gg of Carbon)

$$\text{Total Carbon content (Gg C)} = \text{Apparent consumption TJ} * \text{carbon content} / 1000$$



(6) Estimate net carbon emissions

$$\text{Net carbon (Gg)} = \text{Total Carbon content} - \text{Excluded carbon}$$

Example



Fuel	Apparent Consumption in TJ	Carbon Content tC/TJ	Total Carbon content in Gg C
Marine Gas Oil (Diesel)	11,949.7	20.2	241.38
Aviation Gas	1354.31	19.5	26.41
Propane, Liquefied	547.26	17.2	9.41
Petrol	1338.16	18.9	25.29

STEP BY STEP GUIDE FOR REFERENCE APPROACH

(7) Estimate actual carbon emissions under reference approach

Actual carbon emissions Gg= Net carbon Carbon oxidation factor*44/12*

Fuel	Apparent Consumption in TJ	Carbon Content tC/TJ	Total Carbon content in Gg C	Actual carbon emissions Gg
Marine Gas Oil (Diesel)	11,949.7	20.2	241.38	885.06
Aviation Gas	1354.31	19.5	26.41	96.84
Propane, Liquefied	547.26	17.2	9.41	34.50
Petrol	1338.16	18.9	25.29	92.73



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global environment
facility

UN
environment



APPROACH 2: SECTORAL



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global environment
facility

UN
environment



SECTORAL APPROACH

Estimates made **based on energy use in individual sectors**
 The emissions factors catered to sector specific and technology specific activities
More segregated data required from sectoral agencies



Ministry of Tourism and Environment
 Republic of Maldives

CBIT Maldives
 Capacity Building for Improved Transparency of
 Climate Change Mitigation and Adaptation Actions in
 the Maldives Project



CATEGORIES OF STATIONARY EMISSION FOR SECTORAL APPROACH

Category Code	Category	Relevance to Maldives Context
1A	Fuel Combustion Activities	Refer to subcategories for relevance
1A 1	Energy Industries	Refer to subcategories for relevance
1A 1 a	Electricity and Heat Production	Refer to subcategories for relevance
1A 1 a i	Electricity Generation	This category should cover all electricity generation from public utilities. The activity data should cover data on electricity generated to be sold as well as own on-site use
1A 1 a ii	Combined Heat and Power Generation (CHP)	There is no operational Combined Heat and Power Generation in Maldives
1A 1 a iii	Heat Plants	There is no heat production plants that generates heat to sold to retailers or customers in Maldives
1A 1 b	Petroleum Refining	This activity does not occur in Maldives
1A 1 c	Manufacture of Solid Fuels and Other Energy Industries	This activity does not occur in Maldives



Ministry of Tourism and Environment
 Republic of Maldives

CBIT Maldives
 Capacity Building for Improved Transparency of
 Climate Change Mitigation and Adaptation Actions in
 the Maldives Project



Category Code	Category	Relevance to Maldives Context
1A	Fuel Combustion Activities	Refer to subcategories for relevance
1A2	Manufacturing Industries and Construction	Some activities under this category does occur in Maldives. Details given below
1A2 a	Iron and Steel	This activity does not occur in Maldives
1A2 b	Non-Ferrous Metals	This activity does not occur in Maldives
1A2 c	Chemicals	This activity does not occur in Maldives
1A2 d	Pulp, Paper and Print	This activity does occur however printing press does not have stand-alone power generation and draws power from the utility producers
1A2 e	Food Processing, Beverages and Tobacco	This activity does occur and would cover all food processing fuel combustion with the exception of fish processing plants. This would entail bottling activities done by MAWC, MWSC, Island beverages etc that uses own fuel combustions to operate.
1A2 f	Non-Metallic Minerals	This activity does occur and should cover on site power generation for cement factories operated by Villa and STO
1A2 g	Transport Equipment	This activity does occur and should cover onsite power generation at boat building, boat yards and slipways operating across Maldives
1A2 h	Machinery	This activity does occur however does not have standalone power generation and draws power from the utility producers and therefore included in 1A1ai
1A2 i	Mining (excluding fuels) and Quarrying	Sand mining activity for dredging, harbour and reclamation projects
1A2 j	Wood and Wood Products	This activity does occur however does not have stand-alone power generation or onsite fuel combustion
1A2 k	Construction	This activity does occur however does not have stand-alone power generation and draws power from the utility producers
1A2 l	Textile and Leather	This activity does occur however does not have standalone power generation and draws power from the utility producers
1A2 m	Non-specified Industry	Any GHG emitting activity via fuel combustion from any manufacturing industrial activity not listed above. Note that emissions from fisheries industry is covered under 1A4c and therefore this sub-category for Maldives is assumed to be not occurring



Ministry of Tourism and Environment
Republic of Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



Category Code	Category	Relevance to Maldives Context
1A4	Other Sectors	Refer to subcategories for relevance
1A4 a	Commercial / Institutional	This occurs in Maldives and covers onsite fuel combustion activities in all commercial and institutional buildings. This covers fuel combustion for cooking, heating at restaurants, hotels, resorts and any other commercial buildings. In Maldivian context it covers mostly LPG use for cooking in commercial context. The fuel use for electricity generation in industries such as resorts should be included under this sub-category
1A4 b	Residential	This occurs in Maldives and covers all onsite fuel combustion activities in residential dwellings. Mostly covers LPG use of for cooking
1A4 c	Agriculture/Forestry/Fishing/Fish farms	Refer to subcategories for relevance
1A4 c i	Stationary	This occurs in Maldives and covers onsite fuel combustion activities (including power generation) in fish processing plants and agricultural islands
1A4 c ii	off-road vehicles and other machineries	This occurs in Maldives and covers all mobile fuel combustion in agricultural islands including off road transport, land tilling. However the information is likely going to scattered to very small quantities and needs a survey to collect
1A5	Non-Specified	Refer to subcategories for relevance
1A5 a	Stationary	This occurs in Maldives and covers stationary fuel combustion onsite at military facilities/training facilities (eg. Girifushi etc) including cooking, power production.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

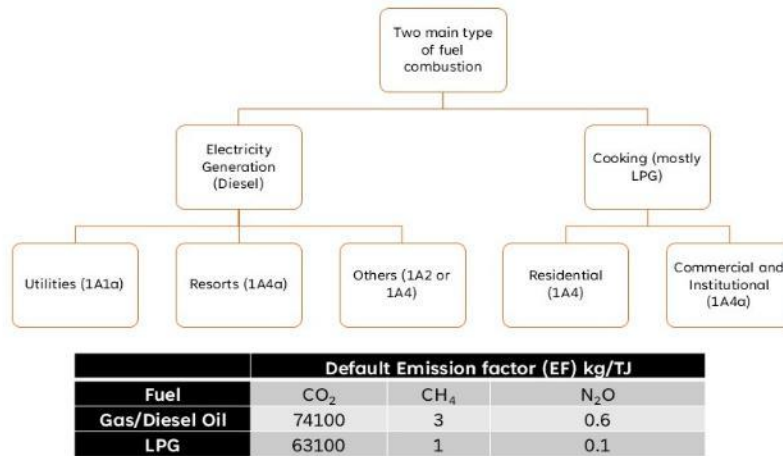
UN
environment



DATA FOR SECTORAL APPROACH

The information required for the estimation of emission and QA/QC process includes;

1. Total fuel used for electricity generation (litres),
2. total number of units produced (kWh) segregated by sources including those produced by renewable energy sources,
3. total billed units and total lube oil consumption for all of their powerhouses.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

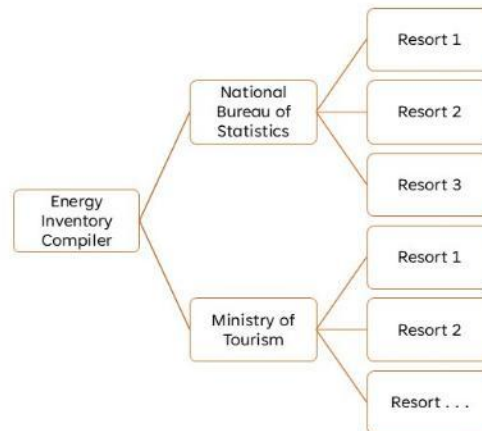
UN
environment



ACTIVITY DATA FROM RESORTS

The information required for the estimation of emission and QA/QC process includes;

1. **Fuel usage for electricity in litres**
2. Electricity production in kWh from different sources including Renewable energy sources
3. Fuel used for cooking in litres or kg
4. Fuel used for waste incineration if any in litres by fuel types
5. average occupancy for the resort - % or bednights



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



ACTIVITY DATA FROM OTHERS

- Other Electricity generation (related to some industrial and construction activities): **Annual Fuel used for electricity generation**
- Below table highlights some of these sectors and potential sources of data to capture



Sector	Information source
1A2e – Food and Beverages	MAWC, MWSC (water bottling operation only) and Island Beverage
1A2f – Non-ferrous	Villa and STO cement operations and other concrete pre-casting operations
1A2g – Transport machineries	Slipways and other boat building operations (eg: Al-Shaali and Gulfcraft)
1A4a – Commercial and institutional	MPL, MACL and other ports and airports power generation
1A4ci	– Power generation and heating/cooking fuel use from fish processing factories and plants like MIFCO,
Fisheries/Agriculture	Horizon and ENSIS.



Ministry of Tourism and Environment
Republic of Maldives

CBT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global environment
facility
UN environment



ACTIVITY DATA FROM UTILITIES

	Generated Units (kWh)			Consumed Units (kWh)			Demand (kW)		Consumption (Lits)		Consumers		Production %			%			
Power House	by Diesel	by PV	Generated Total	Billed	P.H Usage	Total Consumed	Minimum	Maximum	Fuel	Lub Oil	Connection	Disconnection	Total	Diesel	PV	Billed	P.H Usage	Loss	
Kaashidhoo	105,120.00	-	105,120.00	97,606.00	3,982.00	101,588.00	110.00	215.00	30,430.00	53.00	3	0	450	100.00	0.00	92.85	3.79	96.64	3.36
Kaashidhoo	101,320.00	-	101,320.00	96,599.00	3,716.00	100,315.00	110.00	198.00	29,360.00	162.00	1	1	450	100.00	0.00	95.34	3.67	99.01	0.99
Kaashidhoo	116,850.00	-	116,850.00	108,842.00	4,348.00	113,190.00	119.00	220.00	33,382.00	128.00	3	3	450	100.00	0.00	93.15	3.72	96.87	3.13
Kaashidhoo	120,630.00	-	120,630.00	111,124.00	4,348.00	115,472.00	98.00	290.00	34,930.00	130.00	0	0	450	100.00	0.00	92.12	3.60	95.72	4.28
Kaashidhoo	123,036.00	-	123,036.00	114,987.00	4,625.00	119,612.00	112.00	219.00	34,622.00	102.00	2	0	452	100.00	0.00	93.46	3.76	97.22	2.78
Kaashidhoo	105,690.00	1,384.00	107,074.00	102,684.00	4,219.00	106,903.00	89.00	209.00	30,630.00	97.00	2	1	453	98.71	1.29	95.90	3.94	99.84	0.16
Kaashidhoo	111,140.00	6,537.00	117,677.00	109,968.00	4,184.00	114,152.00	99.00	211.00	32,241.00	165.00	0	0	453	94.44	5.56	93.45	3.56	97.00	3.00
Kaashidhoo	115,810.00	6,153.00	121,963.00	115,087.00	3,957.00	119,044.00	100.00	248.00	33,606.00	113.00	1	0	454	94.96	5.04	94.36	3.24	97.61	2.39
Kaashidhoo	106,800.00	6,780.00	113,580.00	106,370.00	4,008.00	110,378.00	93.00	248.00	30,499.00	135.00	0	0	454	94.03	5.97	93.65	3.53	97.18	2.82
Kaashidhoo	109,670.00	6,328.00	115,998.00	110,072.00	3,715.00	113,787.00	99.00	209.00	31,437.00	139.00	4	1	457	94.54	5.46	94.89	3.20	98.09	1.91
Kaashidhoo	103,910.00	5,728.00	109,638.00	104,186.00	3,637.00	107,823.00	100.00	240.00	29,572.00	115.00	2	0	459	94.78	5.22	95.03	3.32	98.34	1.66
Kaashidhoo	102,470.00	5,367.00	107,837.00	100,996.00	3,710.00	104,706.00	88.00	191.00	28,790.00	169.00	1	0	462	95.02	4.98	93.66	3.44	97.10	2.90
Kaashidhoo	1,322,446.00	38,277.00	1,360,723.00	1,278,521.00	48,449.00	1,326,970.00	88.00	290.00	379,499.00	1,508.00	19	6	462	97.21	5.37	93.99	3.56	97.55	2.45
Gaafaru	59,044.00	-	59,044.00	55,565.00	667.00	56,232.00	55.00	110.00	17,920.00	52.00	2	0	205	100.00	0.00	94.11	1.13	95.24	4.76
Gaafaru	55,550.00	-	55,550.00	52,898.00	799.00	53,697.00	52.00	109.00	18,345.00	61.70	2	0	207	100.00	0.00	95.23	1.44	96.66	3.34
Gaafaru	64,857.00	-	64,857.00	54,786.00	1,212.00	55,998.00	58.00	118.00	22,706.00	92.00	1	0	208	100.00	0.00	84.47	1.87	86.34	13.66
Gaafaru	69,337.00	-	69,337.00	65,095.00	940.00	66,035.00	44.00	137.00	22,090.00	79.00	1	0	209	100.00	0.00	93.88	1.36	95.24	4.76
Gaafaru	66,830.00	-	66,830.00	59,162.00	840.00	60,002.00	54.00	116.00	22,856.00	81.00	3	1	211	100.00	0.00	88.53	1.26	89.78	10.22
Gaafaru	57,322.00	-	57,322.00	45,947.00	765.00	46,712.00	42.00	113.00	20,486.00	42.00	1	0	212	100.00	0.00	80.16	1.33	81.49	18.51
Gaafaru	61,909.00	-	61,909.00	59,927.00	830.00	60,757.00	41.00	119.00	22,952.00	54.00	1	0	213	100.00	0.00	96.80	1.34	98.14	1.86
Gaafaru	68,615.00	-	68,615.00	64,646.00	885.00	65,531.00	57.00	126.00	24,886.00	103.00	0	0	213	100.00	0.00	94.22	1.29	95.51	4.49
Gaafaru	61,139.00	-	61,139.00	57,919.00	846.00	58,765.00	47.00	129.00	20,097.00	75.30	0	0	213	100.00	0.00	94.73	1.38	96.12	3.88
Gaafaru	63,055.00	-	63,055.00	59,213.00	839.00	60,052.00	50.00	122.00	20,432.00	78.00	3	0	216	100.00	0.00	93.91	1.33	95.24	4.76
Gaafaru	55,724.00	-	55,724.00	51,636.00	775.00	52,411.00	59.00	118.00	18,938.00	55.00	0	0	216	100.00	0.00	92.66	1.39	94.05	5.95
Gaafaru	63,297.00	-	63,297.00	59,508.00	775.00	60,283.00	58.00	121.00	19,836.00	54.00	4	0	220	100.00	0.00	94.01	1.22	95.24	4.76
Gaafaru	746,679.00	-	746,679.00	686,302.00	10,173.00	696,475.00	41.00	137.00	251,544.00	827.00	18	1	220	100.00	0.00	91.89	1.36	93.25	6.75



Ministry of Tourism and Environment
Republic of Maldives

Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global environment
facility
UN environment



QUALITY ASSURANCE (QA)/ QUALITY CONTROL (QC)



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



UN
environment



QUALITY CHECKS

1. This data is obtained monthly for better quality assurance and consistency checks.
2. A basic check for any outliers on the total fuel use data and number of units produced.
3. Further this will need to be checked with the previous years for the same powerhouse to check for consistency before finalizing that the data could be safely used.
4. It is good practice to seek expert judgment and contact the stakeholder to see if any outliers observed is a true event in the dataset.
5. The next basic check is to check for number of units produced per litre (kWh/L).



Ministry of Tourism and Environment
Republic of Maldives

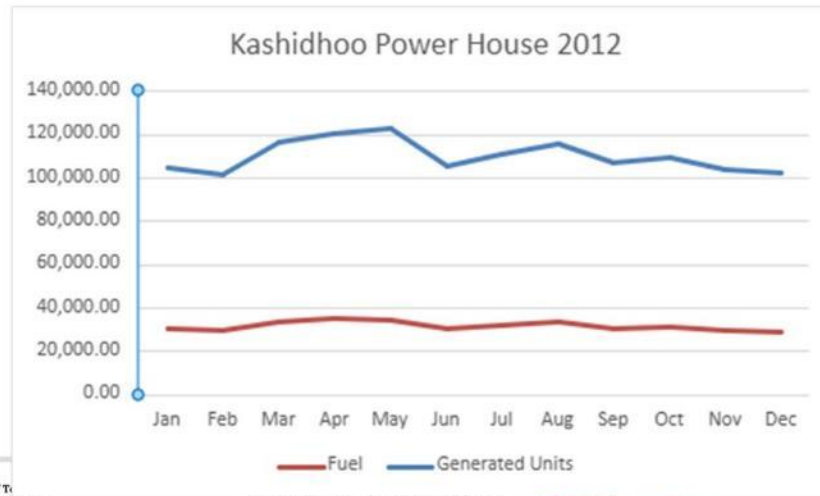
CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



UN
environment



QUALITY CONTROL OF THE DATA – CONSISTENCY



Example



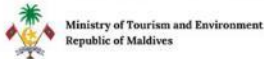
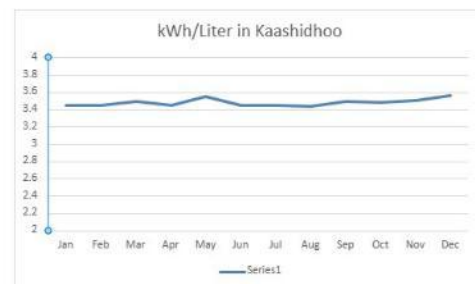
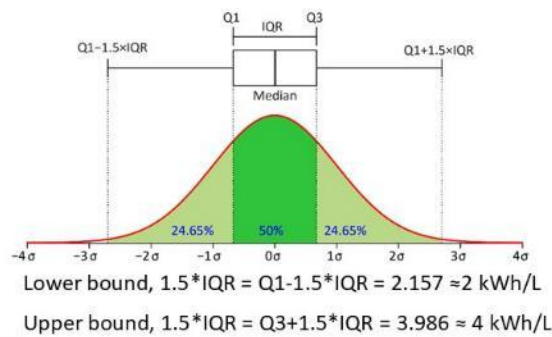
Climate Change Mitigation and Adaptation Actions in the Maldives Project

gef | global environment facility | UN environment



QUALITY CONTROL OF THE DATA – TECHNICAL CHECK

The datasets are quality controlled using a cutoff limit based on the following statistical analysis.



CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project

gef | global environment facility | UN environment



EXAMPLES



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



ADAPTING DATA FOR INVENTORY

	2021 Diesel Consumption (liters)	Population (2014 Census)	% of Pop in islands with data	Total Diesel Use in Liters
Utility A	90,151,697.04	183,738.00	94% ?	
Utility B	140,575,448		100%	140,575,448



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



ADAPTING DATA FOR INVENTORY

	2021 Diesel Consumption (liters)	Population (2014 Census)	% of Pop in islands with data	Total Diesel Use in Liters
Utility A	90,151,697.04	183,738.00	94%	96,266,689
Utility B	140,575,448		100%	140,575,448



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global environment
facility

UN
environment



ADAPTING DATA FOR INVENTORY

- Convert fuel liters to mass units

$$Total\ fuel\ use\ (Gg) = Total\ fuel_{Litres} * Density_{fuel} / 1000,000$$

	Liters	Density	Mass (Gg)
A	96,266,689	0.84	
B	140,575,448	0.84	



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global environment
facility

UN
environment



ADAPTING DATA FOR INVENTORY

- Convert fuel liters to mass units

$$Total\ fuel\ use\ (Gg) = Total\ fuel_{Litres} * Density_{fuel} / 1000,000$$

	Liters	Density	Mass (Gg)
A	96,266,689	0.84	81
B	140,575,448	0.84	118



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



GHG ESTIMATION

- The following formula will give the apparent consumption in energy units (TJ)

$$Consumption\ in\ (TJ) = Total\ fuel\ mass_{Gg} * NCV_{of\ the\ fuel}$$

The following formula can be used to calculate the emissions of the respective gas in terms of Gg.

$$Emissions\ in\ (Gg) = Consumption_{TJ} * EF_{of\ the\ fuel} / 1000,000$$

Fuel	Net Calorific Value, NCV (TJ/Giga grams)	Default Emission factor (EF) kg/TJ		
		CO ₂	CH ₄	N ₂ O
Gas/Diesel Oil	43	74100	3	0.6

	Mass (Gg)	CO ₂ (Gg)	CH ₄ (Gg)	N ₂ O (Gg)
A	81	257.657	0.0104315	0.002086
B	118	376.2491	0.0152328	0.003047



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



GHG AGGREGATION

	Mass (Gg)	CO ₂ (Gg)	CH ₄ (Gg)	N ₂ O (Gg)
A	81	257.657	0.0104315	0.002086
B	118	376.2491	0.0152328	0.003047

Global Warming Potential (GWP₁₀₀)

CO ₂	CH ₄	N ₂ O
1	28	265

	CO ₂ (Gg)	CH ₄ in CO ₂ eq (Gg)	N ₂ O in CO ₂ eq (Gg)	Total emissions Gg of CO ₂ eq
A	257.657			
B	376.2491			



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



GHG AGGREGATION

	Mass (Gg)	CO ₂ (Gg)	CH ₄ (Gg)	N ₂ O (Gg)
A	81	257.657	0.0104315	0.002086
B	118	376.2491	0.0152328	0.003047

Global Warming Potential (GWP₁₀₀)

CO ₂	CH ₄	N ₂ O
1	28	265

	CO ₂ (Gg)	CH ₄ in CO ₂ eq (Gg)	N ₂ O in CO ₂ eq (Gg)	Total emissions Gg of CO ₂ eq
A	257.657	0.292080836	0.552867296	258.502
B	376.2491	0.045698267	0.001827931	376.2966
				634.7986



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



ACTIVITY DATA FOR COOKING

- Segregated data from suppliers

- Commercial reported under 1A4a
- Residential reported under 1A4b

	Company A		Company B	
	Domestic (kg)	Commercial (kg)	Domestic (kg)	Commercial (kg)
2011	2,790,926.00	2,898,958.00	2,938,133.00	2,938,133.00
2012	3,102,373.00	2,898,234.00	2,009,236.50	2,009,236.50
2013	3,436,636.00	3,097,717.00	2,900,828.50	2,900,828.50

$$\text{Emissions in (Gg)} = \text{Consumption}_{TJ} * EF_{\text{of the fuel}} / 1000,000$$

	Net Calorific Value, NCV (TJ/Gg)	Default Emission factor (EF) kg/TJ		
Fuel		CO ₂	CH ₄	N ₂ O
LPG	47.3	63100	1	0.1



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



ACTIVITY DATA FOR COOKING

- Segregated data from suppliers

- Commercial reported under 1A4a
- Residential reported under 1A4b

Fuel	Actual carbon emissions Gg in 2011 Reference approach
Propane, Liquefied	34.50

	Company A		Company B	
	Domestic (kg)	Commercial (kg)	Domestic (kg)	Commercial (kg)
2011	2,790,926.00	2,898,958.00	2,938,133.00	2,938,133.00
2012	3,102,373.00	2,898,234.00	2,009,236.50	2,009,236.50
2013	3,436,636.00	3,097,717.00	2,900,828.50	2,900,828.50

$$\text{Emissions in (Gg)} = \text{Consumption}_{TJ} * EF_{\text{of the fuel}} / 1000,000$$

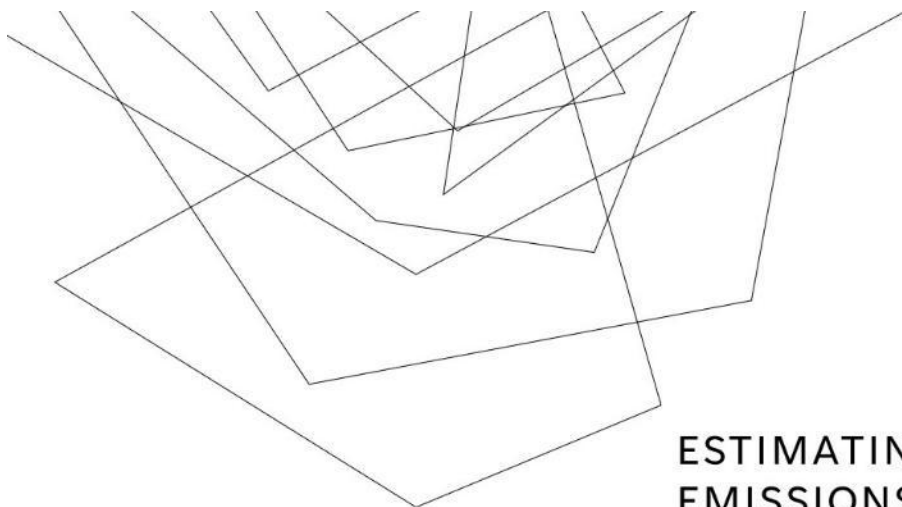
	Net Calorific Value, NCV (TJ/Gg)	Default Emission factor (EF) kg/TJ		
Fuel		CO ₂	CH ₄	N ₂ O
LPG	47.3	63100	1	0.1



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project





ESTIMATING ENERGY EMISSIONS – MOBILE

JANUARY 24, 2025
PREPARED BY: DEVELOPMENT ADVISORY SERVICES



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



INTRODUCTION

Energy sector comprises of **emissions resulting from activities by fuel combustion and as fugitive emissions** i.e. escape without combustions.

What is fuel combustion?

"the intentional oxidation of materials within an apparatus that is designed to provide heat or mechanical work to a process, or for use away from the apparatus"

What is fugitive emissions?

Fugitive emissions in the energy sector arise from extraction, transformation and transportation of primary energy carriers.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



MOBILE COMBUSTION

- Mobile combustion involves the burning of fuels for transportation, whether by road, rail, air, or sea
- These slides provide a guidance for calculating emissions from mobile combustion (eg: road transportation, sea transportation, aviation)



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



MALDIVES CONTEXT



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project

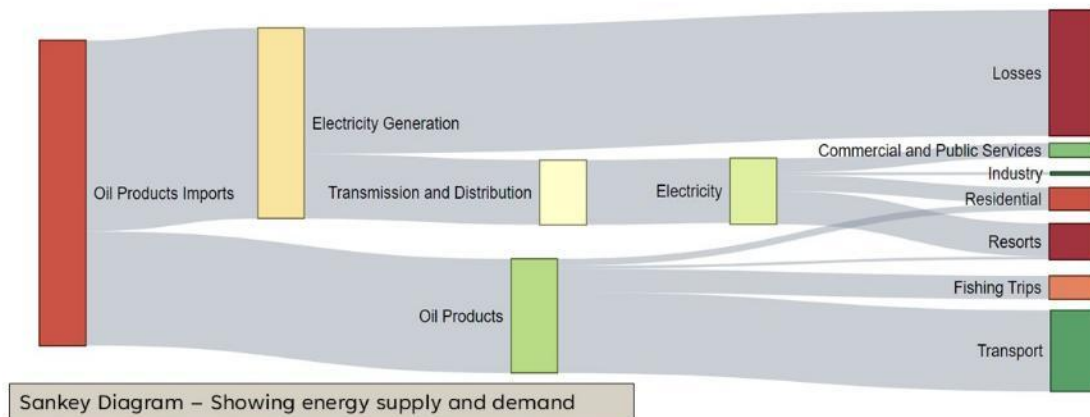


global
environment
facility

UN
environment



NATIONAL CONTEXT - ENERGY



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project

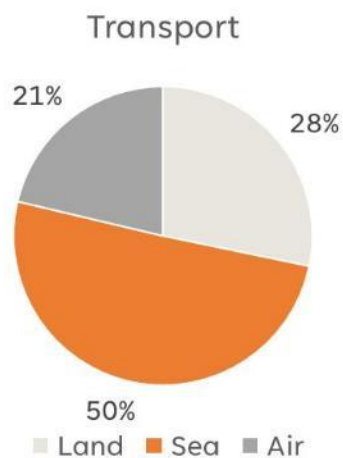


global
environment
facility

UN
environment



NATIONAL CONTEXT – EMISSIONS FROM TRANSPORT SECTOR



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project

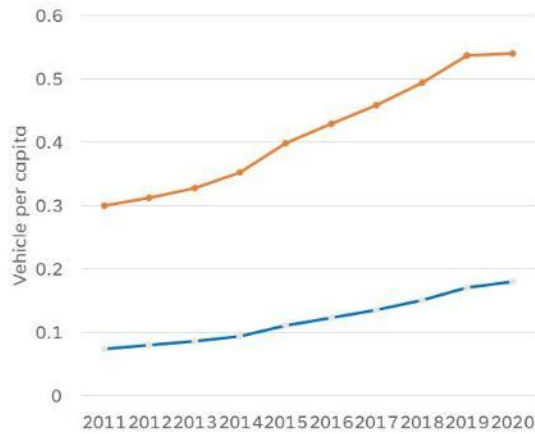


global
environment
facility

UN
environment



NATIONAL CONTEXT – TRANSPORT SECTOR



Vehicle per capita Male – 7.5%
 Vehicle per capita Atolls – 11%
 Speedboat/Launch – 8.8%
 Dhoani – 2.3%



Ministry of Tourism and Environment
 Republic of Maldives

Atolls Male

CBIT Maldives
 Capacity Building for Improved Transparency of
 Climate Change Mitigation and Adaptation Actions in
 the Maldives Project



global
 environment
 facility

UN
 environment



SECTORAL APPROACH OVERVIEW



Ministry of Tourism and Environment
 Republic of Maldives

CBIT Maldives
 Capacity Building for Improved Transparency of
 Climate Change Mitigation and Adaptation Actions in
 the Maldives Project

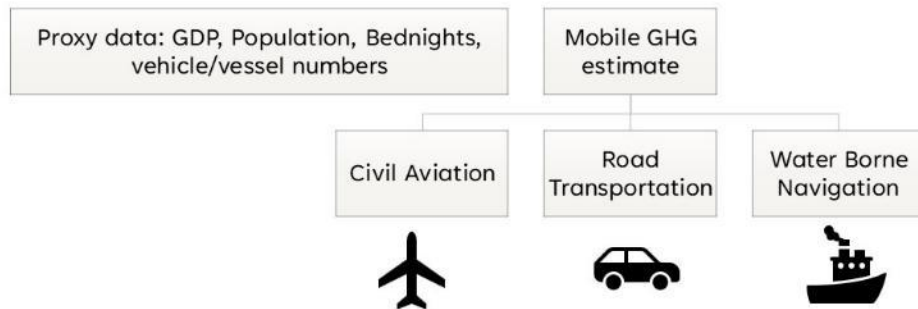


global
 environment
 facility

UN
 environment



SECTORAL APPROACH



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



RELEVANT IPCC CATEGORIES FOR MOBILE FUEL COMBUSTION

IPCC Category Code	CRT category code	Category	Relevance to Maldives Context
1A		Fuel Combustion Activities	
1A3	1A3	Transport	
1A3a		Civil aviation	
1A3ai	memo item	International Aviation (International Bunkers)	This covers all international aviation. Data should be collected from all international airports in Maldives regarding the refueling. For tier 2 the method would requires flight movements which would be available from the airports. Note only flights departing to or arriving from foreign airport should be considered in this calculation
1A3aii	1A3a	Domestic Aviation	This covers all domestic aviation including sea plane operations. Data should be collected from all airports in Maldives regarding the refueling. For tier 2 the method would requires flight movements which would be available from the airports. Note no flights departing to or arriving from foreign airport should be considered in this calculation



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



RELEVANT IPCC CATEGORIES FOR MOBILE FUEL COMBUSTION

IPCC Category Code	CRT category code	Category	Relevance to Maldives Context
1A		Fuel Combustion Activities	
1A3b	1A3b	Road Transportation	
1A3bi	1A3bi	Cars	This covers all road transport through cars as defined by IPCC. This includes public and private cars fuel consumption
1A3bii	1A3bii	Light duty trucks	This covers all road transport through Light duty trucks as defined by IPCC. This includes public and private trucks and buses fuel consumption
1A3biii	1A3biii	Heavy duty trucks and buses	This covers all road transport through trucks and buses as defined by IPCC. This includes public and private trucks and buses fuel consumption
1A3biv	1A3biv	Motorcycles	This covers all road transport through Motorcycles as defined by IPCC. This includes public and private motorcycles fuel consumption
1A3bv		Evaporative emissions from vehicles	This covers evaporative emissions from vehicles including lubricants evaporation
1A3bvi		Urea-based catalysts	This is assumed to be not occurring in Maldives



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



RELEVANT IPCC CATEGORIES FOR MOBILE FUEL COMBUSTION

IPCC Category Code	CRT category code	Category	Relevance to Maldives Context
1A		Fuel Combustion Activities	
1A3d		Water-borne Navigation	
1A3di		International Water-borne Navigation (International Bunkering)	This covers all emissions related to international maritime vehicles that is either coming from or going to a foreign port. The reexport value for diesel is considered as data
1A3dii	1A3d	Domestic Water-borne Navigation	This covers all domestic transport excluding fishing. This means all passenger and cargo transport irrespective of economic sector.
1A3e	1A3e	Other Transportation	
1A3ei	1A3ei	Pipeline Transport	This does not occur in Maldives
1A3eii		Off-road	This occurs in Maldives and covers all transport activity undertaken within all ports, harbours and off-road activities taking place at reclamation sites covering land and sea vehicles.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



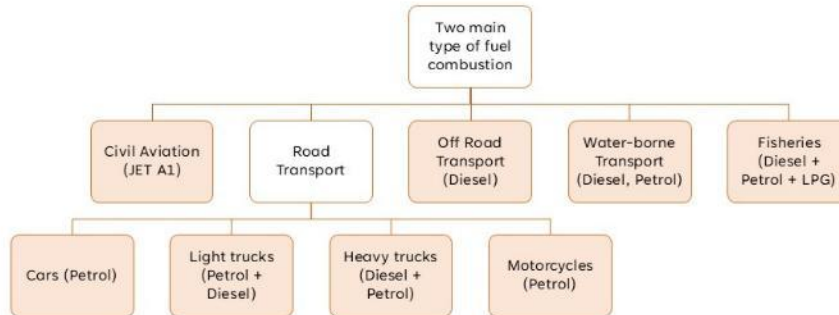
RELEVANT IPCC CATEGORIES FOR MOBILE FUEL COMBUSTION

IPCC Category Code	CRT category code	Category	Relevance to Maldives Context
1A		Fuel Combustion Activities	
1A4	1A4	Other Sectors	
	1A4a	Commercial/institutional	
	1A4a ⁱⁱ	Off-road vehicles and other machinery	IPCC category 1A3e ⁱⁱ commercial/institutional component is reported here.
	1A4b	Residential	
	1A4b ⁱⁱ	Off-road vehicles and other machinery	IPCC category 1A3e ⁱⁱ residential component is reported here. In the Maldives there are no residential off road transport to be considered
1A4c	1A4c	Agriculture/Forestry/Fishing/Fish farms	
1A4c ⁱⁱ	1A4c ⁱⁱ	off-road vehicles and other machineries	This occurs in Maldives and covers all mobile fuel combustion in agricultural islands including off road transport, land tilling. However, the information is likely going to scattered to very small quantities and needs a survey to collect
1A4c ⁱⁱⁱ	1A4c ⁱⁱⁱ	Fishing (mobile combustion)	This occurs in Maldives and is key category. It covers all emissions from fishing vessels including for transport, cooking and other auxiliary purposes on the vessel.

RELEVANT IPCC CATEGORIES FOR MOBILE FUEL COMBUSTION

IPCC Category Code	CRT category code	Category	Relevance to Maldives Context
1A		Fuel Combustion Activities	
1A5	1A5	Non-Specified	
1A5b	1A5b	Mobile	In the CRT all of the sub categories under this is reported together
1A5b ⁱ		Mobile (aviation component)	This occurs in Maldives and covers aviation fuel combustion by MNDF military flights/drones and search and rescue operations
1A5b ⁱⁱ		Mobile (water-borne component)	This occurs in Maldives and covers water-borne fuel combustion by coastguard and Marine Police services and any other marine based fuel combustion carried out by military including search and rescue operations
1A5b ⁱⁱⁱ		Mobile (other)	
		Multi-lateral Operations	This could include refueling of vessels and air crafts for military operations by non-Maldivian military. This should not be included in the national total but reported as a memo-item.

DATA FOR SECTORAL APPROACH

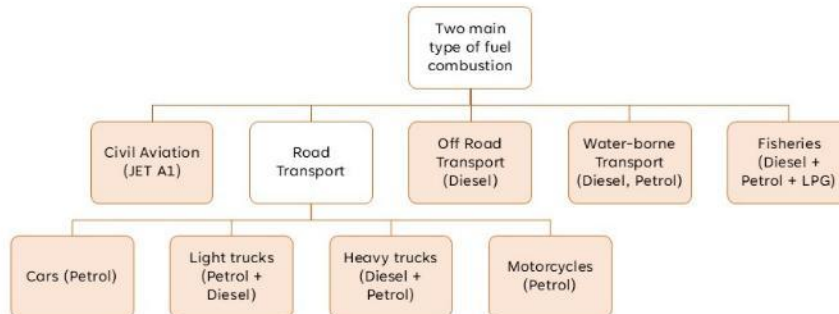


Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



DATA FOR SECTORAL APPROACH



What data from which sources??



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



CIVIL AVIATION



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



OVERVIEW

- Emissions from aviation sector comes from the combustion of jet fuel (jet kerosene and jet gasoline) and aviation gasoline.
- In the Maldives, the types of aviation gases used (kerosene oil, Jet A1 and other sources of kerosene) are considered under Jet Kerosene
- In the Maldives, Tier 1 is used to estimate emissions from the civil aviation sector due to the limited availability of quality data.
- Tier 1 method of calculating emissions for the aviation sector is based on an aggregate quantity of fuel consumption data for aviation multiplied by the default emission factors.

Fuel	NCV	Emission factor (EF) kg/TJ		
		CO ₂	CH ₄	N ₂ O
Jet Kerosene	44.1	7150 0	0.5	2



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



ESTIMATION METHODS

Fuel Consumption method

Data Required: Fuel use for aviation data segregated between international and domestic preferably in monthly intervals

Data Source: MACL, Regional Airports

Jet Fuel Sales January 2016		Liters
International		13,564,200
Domestic		3,454,166
MACL OWN CONSUMPTION		440
Total		17,018,806

Domestic Sales details		
(SEAPLANE) ISLAND AVIATION SERVICES		172,441
TRANS MALDIVIAN AIRWAYS		1,717,938
ISLAND AVIATION SERVICES		1,273,861
FLY ME (DOM)		262,526
MANTA AIR		0
EXTRA / ADHOC FLIGHTS		27,400
Total		3,454,166

Landing and Take off method

Data Required: landing and take-off activity data including aircraft type and route

Data Source: MACL, Regional Airports, CAA

Emissions = LTO Emissions + Cruise emissions

AIRCRAFT		LTO emissions factors (kg/LTO) ⁽¹⁾							LTO FUEL CONSUMPTION (kg/LTO)
		CO ₂ ⁽¹⁾	CH ₄ ⁽⁶⁾	N ₂ O ⁽⁶⁾	NO _x	CO	NM VOC ⁽⁶⁾	SO ₂ ⁽⁶⁾	
	A300	5450	0.12	0.2	25.86	14.80	1.12	1.72	1720
	A310	4760	0.63	0.2	19.46	28.30	5.67	1.51	1510
Turboprop ⁽⁶⁾	Beech King Air ⁽⁷⁾	230	0.06	0.01	0.30	2.97	0.58	0.07	70
	DHC8-100 ⁽⁶⁾	640	0.00	0.02	1.51	2.24	0.00	0.20	200
	ATR72-500 ⁽⁷⁾	620	0.03	0.02	1.82	2.33	0.26	0.20	200



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility



QUALITY CHECKS

- Compare the fuel use data (for both international and domestic with imports)
- Check the trends of multiple years or within the year for outliers and provide reasonable explanation for outliers
- fuel usage data from the individual operators could also be obtained and compared with data provided by MACL



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility



ROAD TRANSPORT



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



OVERVIEW

- Emissions for road transport can be estimated using either fuel consumed (fuel sold) or distance travelled. Generally, CO₂ calculations are made using fuel sold and non-CO₂ estimations are made using data on distance travelled.
- The choice of method (Tier 1 or 2) for calculating emissions of CH₄ and N₂O should be based on the availability and quality of data. This involves use of vehicle activity levels using VKT, age, emissions control technology.
- Due to limited availability of quality data, Maldives uses a VKT approach to estimate the fuel consumption with default emissions factors for all gases to calculate emissions for road transport (Tier 1)



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



IPCC DEFINITIONS OF VEHICLES

<i>Cars</i>	Emissions from automobiles so designated in the vehicle registering country primarily for transport of persons and normally having a capacity of 12 persons or fewer.
<i>Light duty trucks</i>	Emissions from vehicles so designated in the vehicle registering country primarily for transportation of light-weight cargo or which are equipped with special features such as four-wheel drive for off-road operation. The gross vehicle weight normally ranges up to 3500-3900 kg or less.
<i>Heavy duty trucks and buses</i>	Emissions from any vehicles so designated in the vehicle registering country. Normally the gross vehicle weight ranges from 3500-3900 kg or more for heavy duty trucks and the buses are rated to carry more than 12 persons.
<i>Motorcycles</i>	Emissions from any motor vehicle designed to travel with not more than three wheels in contact with the ground and weighing less than 680 kg.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



ESTIMATION METHODS

Fuel Consumption method

Data Required: Fuel use for road transport
segregated by fuel

Data Source: FSM, HAKATHA, VILLA HAKATHA etc

Vehicle Kilometer travelled method

Data Required: Total vehicles, distance travelled
and vehicle fuel economy segregated by vehicle
type

Data Sources: Ministry of Transport, NBS

Type of Vehicles	Registered <small>lawfu Sakku Tesijjer</small>								Major vehicles	Other vehicles	Not considered in 60 th percentile
	2010	2011	2012	2013	2014	2015	2016	2017			
Total	47,917	52,199	56,467	61,418	68,210	78,997	89,237	99,411	Motor cycle	Ambulance	Battery Scooter
Motor cycle	38,860	42,570	46,409	50,778	56,503	65,571	74,354	81,913	Car	Crane	Battery Car
Car	3,348	3,510	3,708	3,994	4,495	5,269	5,754	6,165	Bus	Fork-Lift	Battery tricycle
Bus	99	128	132	140	151	163	178	196	Pick-Up	Excavator	Electric bicycle
Pick-Up	1,681	1,755	1,806	1,860	1,990	2,251	2,550	2,813	Lorry	Dumper	
Lorry	750	756	768	772	783	802	820	852	Van	Tractor	
Van	986	1,038	1,077	1,154	1,248	1,371	1,485	1,596	Jeep	Loader	
Jeep	391	474	484	491	506	552	574	599	Truck	Fuel tank truck	
Ambulance	18	19	21	23	25	79	89	113	Taxi* (as explained above)	Bouser	
Bouser	32	34	36	36	39	42	45	53			
Crane	125	130	134	139	145	153	175	218			
Truck	402	440	474	499	549	684	799	1,014			
Fork-Lift	214	221	237	247	257	287	313	375			
Excavator	304	333	345	369	415	461	544	655			
Dumper	111	113	113	132	147	150	155	166			



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



ACTIVITY DATA: VEHICLE KILOMETER TRAVELED (VKT)

Vehicle	Fuel	Fraction for type of gas	Km/day	Km/year	Km/Litre	Litre/km
Motor cycle	Petrol	1	13	4745	15	0.0667
Car ★	Petrol	1	22	8030	12	0.11
Taxis ★	Petrol	1	100	36500		0.11
Bus ❖	Petrol	0.023	40	14600	5	0.164
	Diesel	0.977	40	14600	8	0.42
Pick-up Δ	Petrol	0.3208	20	7300	7	0.143
	Diesel	0.678	20	7300	10	0.125
Lorry ❖	Petrol	0.021	40	14600	5	0.22
	Diesel	0.979	40	14600	8	0.3
Van Δ	Petrol	0.4819	40	14600	5	0.142
	Diesel	0.5178	40	14600	8	0.125
Jeep Δ	Petrol	0.7337	20	7300	7	0.142
	Diesel	0.2663	20	7300	10	0.125
Truck ❖	Petrol	0.0383	40	14600	5	0.22
	Diesel	0.9616	40	14600	8	0.3
Other vehicles ❖	Diesel	1	5	1825	8	0.3

★ = Passenger cars with 3-way catalyst, Δ = Light duty trucks with 3-way catalyst, ❖ = Heavy duty trucks and buses



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global environment
facility
UN environment



CALCULATION

$$\text{Total fuel use (Gg)} = \text{Total fuel}_{\text{Litres}} * \text{Density}_{\text{fuel}} / 1000,000$$

$$\text{Emissions in (Gg)} = \text{Total fuel mass}_{\text{Gg}} * \text{NCV}_{\text{of the fuel}} * \text{EF}_{\text{of the fuel}} / 1000,000$$

Emission Factor (EF) kg/TJ

Fuel	CO ₂	CH ₄	N ₂ O
Gas/Diesel Oil	74100	3.9	3.9
Petrol	69300	33	3.2



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global environment
facility
UN environment



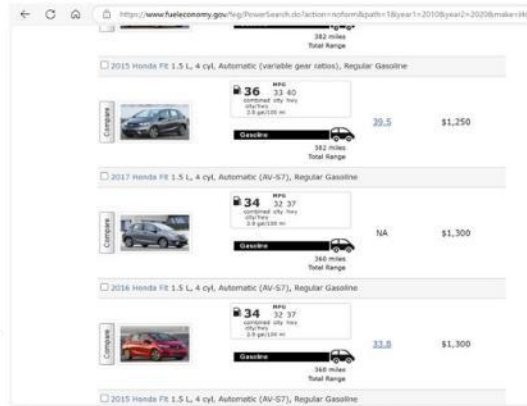


QUALITY CHECKS

Cross check data and assumptions with similar estimates available from other national studies in transport sector

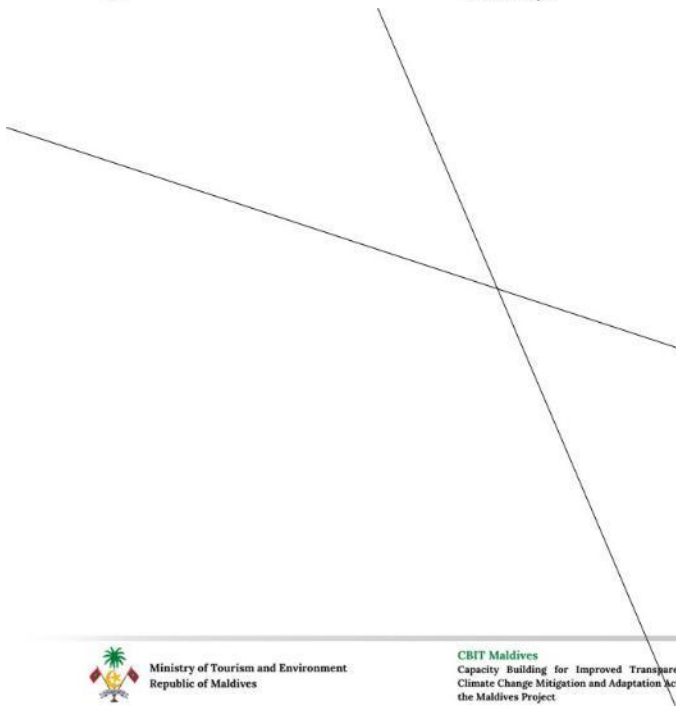
Cross reference could also be made with other similar vehicle fleets elsewhere.

For example, reference them with mileage data from comparative vehicle models in the US Department of Energy's database of vehicle fuel efficiency available at <https://www.fueleconomy.gov/>.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



OFF-ROAD TRANSPORTATION



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



OVERVIEW

- Off-Road Transport emission calculations for Maldives has not been calculated separately in the past inventories prior to 2022 and have been grouped together in land transport.
- This is mainly due to the limited use of off road vehicles as defined in IPCC and it is mostly restricted to Ports, Airport and project based operations in Maldives.
- Emissions for off-road transport can be estimated from either fuel consumed at Airports, Ports and project based off road activities.
- As this has not been identified as a key category in the previous inventories, it is recommended to estimate the emissions via Tier 1 method as similar to the road transport.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



METHODS

Fuel Consumption method

Data Required: Fuel use for off road transport segregated by fuel

Data Source: MTCC, STO, MPL, MACL, Regional airports

$$\text{Total fuel use (Gg)} = \text{Total fuel}_{\text{Litres}} * \text{Density}_{\text{fuel}} / 1000,000$$

$$\text{Emissions in (Gg)} = \text{Total fuel mass}_{\text{Gg}} * \text{NCV}_{\text{of the fuel}} * \text{EF}_{\text{of the fuel}} / 1000,000$$

Fuel	NCV	Emission factor (EF) kg/TJ		
		CO ₂	CH ₄	N ₂ O
Gas/Diesel Oil	43	74100	4.15	28.6
Petrol – 4 stroke	44.3	69300	50	2
Petrol – 2 stroke	44.3	69300	130	0.2



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



SAMPLE DATA SET FOR OFF ROAD TRANSPORTATION

Type of vehicle	Heavy/Light	Vehicle Name	Fuel type	Fueling (MCH)			Fueling (Hulhumale)			Fueling (Thilafushi)		
				2021 (L)	2022 (L)	2023 (L)	2021 (L)	2022 (L)	2023 (L)	2021 (L)	2022 (L)	2023 (L)
Reach Stacker	Reach Stacker	Heavy	RS003	Diesel	13,488	17787	581					
	Reach Stacker	Heavy	RS004	Diesel	23,948	5543						
	Reach Stacker	Heavy	RS005	Diesel	24,120	32879	20,190					
	Reach Stacker	Heavy	RS006	Diesel	50,783	70209	21,954					
	Reach Stacker	Heavy	RS007	Diesel	304			18565.9	44731.87	13934.26		
	Reach Stacker	Heavy	RS008	Diesel				20413.1	35230.94	17584.88		
	Reach Stacker	Heavy	RS009	Diesel	72,551	52132	15,605					
	Reach Stacker	Heavy	RS010	Diesel	46,427	51506						
	Reach Stacker	Heavy	RS011	Diesel			3,721					
	Reach Stacker	Heavy	RS012	Diesel			4,219					
	Reach Stacker	Heavy	RS013	Diesel			4,423					
	Reach Stacker	Heavy	RS014	Diesel			680			758		
	Barge Handlers	Heavy	BH003	Diesel	13,497	32802	4,370	1058.15	329.02	913.41		
Barge Handlers	Barge Handlers	Heavy	BH005	Diesel	1,354			23957.6	47081.55	16461.83		
	Barge Handlers	Heavy	BH006	Diesel	68,038	51816	7,243					
	Barge Handlers	Heavy	BH007	Diesel		46236	23,546					
RTG	RTG	Heavy	RT001	Diesel	63,416	66700	19,301					
	RTG	Heavy	RT002	Diesel	57,720	65067	18,027					
Terminal Tractor	Terminal Tractor	Heavy	TT003	Diesel								
	Terminal Tractor	Heavy	TT004	Diesel		468	27	381.79	148.17			
	Terminal Tractor	Heavy	TT007	Diesel		1148	668	168.45				
	Terminal Tractor	Heavy	TT012	Diesel								



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



QUALITY CHECKS

- Assess the data received by comparing the data with multiple years and see if there are any outliers or discrepancies.
- Compare the information between comparative operations to see if there are significant differences.
- Compare the fuel consumption rates with level or size of the operations from the data provider.
- Consult the expert group to verify the validity of the data received and any outliers and discrepancies identified in previous steps.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



WATER BORNE NAVIGATION



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



OVERVIEW

- Water-borne navigation encompasses all types of water-borne transport, ranging from cargo, passenger ferries, recreational craft to large ocean-going cargo ships, primarily powered by large, slow, and medium-speed diesel engines.
- In Maldives, there are no country specific emissions factors for the transport sector. Establishing a country specific emissions factors require careful planning and research data to be collected – which is not available
- To estimate the emissions using fuel consumption, fuel sales data to the marine vessels (if available) could be used as a Tier 1 method.
- Fuel sales data need to be obtained from public and private fuel sellers, where they sell the fuel to marine vessels.



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



METHOD

Fuel Consumption method

Data Required: Fuel use for water borne transport segregated by fuel

Data Source: Fuels sales data from marine vessels (both public and private) including fishing vessels, cargo boats, speedboats, passenger ferries, tug boat and those used for military purposes



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global environment
facility
UN environment



ESTIMATION METHOD – WATER BORNE NAVIGATION

$$\text{Total fuel use (Gg)} = \text{Total fuel}_{\text{Litres}} * \text{Density}_{\text{fuel}} / 1000,000$$

$$\text{Emissions in (Gg)} = \text{Total fuel mass}_{\text{Gg}} * \text{NCV}_{\text{of the fuel}} * \text{EF}_{\text{of the fuel}} / 1000,000$$

Fuel	NCV	Emission factor (EF) kg/TJ		
		CO ₂	CH ₄	N ₂ O
Gas/Diesel Oil	43	74100	7	2
Petrol	44.3	69300	7	2



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global environment
facility
UN environment



WATER BORNE NAVIGATION - GENERAL

Estimate fuel use based on potential run hours (similar to VKT)

	Vessel type	Fuel type	Fraction of active vessels	Fraction of operating vessels per year	Fuel consumption (l/hr)	Annual Hours of operation
Passenger	Dhoni ^A	Diesel	0.95	0.50	39.00	625.00
	Passenger ferry	Diesel	1.00	1.00	39.00	3650.00
	Speed boats	Petrol	0.19	0.70	65.00	1200.00
Cargo	Dhoni*	Diesel	0.95	0.60	39.00	871.20
	Bahtheli	Diesel	0.92	0.50	27.00	871.20
	Barge	Diesel	0.93	0.50	57.00	580.80
	Oil barge	Diesel	1.00	0.50	32.00	580.80
	Oil tankers	Diesel	0.60	0.50	32.00	580.80
	Landing craft	Diesel	0.91	0.50	32.00	580.80

Δ 20% of Dhoni should be applied as Passenger Dhoni

** 3% of Dhoni should be applied as cargo Dhoni*



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment



WATER BORNE NAVIGATION - TOURISM

A parameter for litres/bednight can be used to estimate the fuel consumption by the safaris in the tourism sector.

Fuel	Resorts (fuel liters/bednight)	Safaris (fuel liters/bednight)
Petrol	2.60	1.06
Diesel	2.78	15.87

Year	Registered Bed Capacity (end Year)	Bed Capacity in Operation (annual average)	Bed Night Capacity	Tourist Bed Nights ⁻¹
2018	45,419	41,887	15,290,704	9,477,680
Resorts	32,137	29,400	10,731,344	8,000,049
Hotels	1,862	1,759	642,480	255,389
Guest Houses	8,563	8,000	2,921,048	944,521
Safari Vessels	2,857	2,728	995,832	277,720



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility

UN
environment





QUALITY CHECKS

- Cross checked with similar estimates available from other national studies in marine transport sector.
- Cross reference with other similar marine transport in other small island developing countries.
- Seek expert opinion or judgement when in doubt



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project

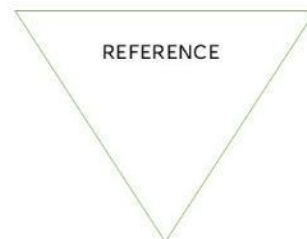
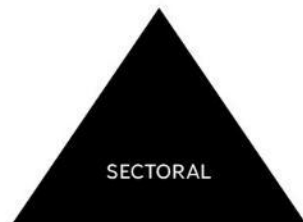


global
environment
facility

UN
environment



REFERENCE APPROACH VS SECTORAL APPROACH



Within 5%



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



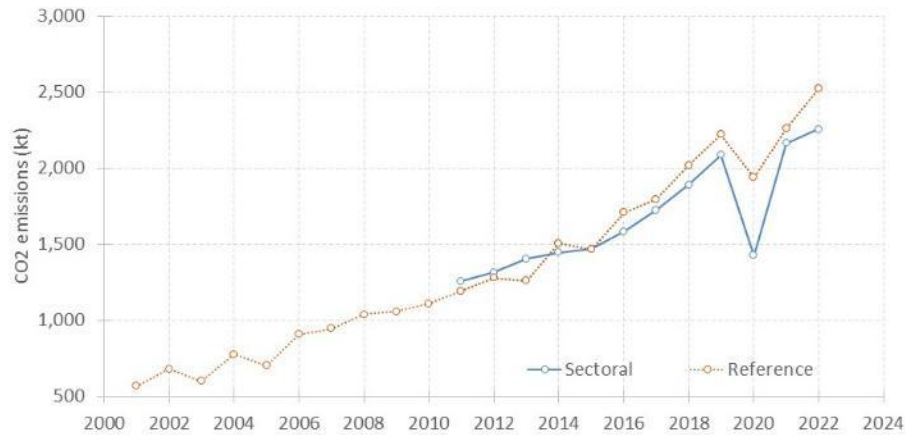
global
environment
facility

UN
environment





REFERENCE APPROACH VS SECTORAL APPROACH



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility



Hands on Exercise for Reference approach

- Task 1: Review the data provided in the excel sheet and identify any quality issues if any
- Task 2: Estimate the emissions for the time series data provided

$$CO_2 \text{ emissions} = \sum_{\text{all fuels}} [((\text{Apparent consumption} * \text{Conv factor} * \text{Carbon content}) * 10^{-3} - \text{Excluded carbon}) * \text{Carbon oxidation factor} * 44/12]$$

Apparent consumption = Total Import – Total Export – International bunkering – stock

Conv factor = NCV value from the table for the respective fuel type

Carbon content = Carbon content value from the table for the respective fuel type

Carbon oxidation factor = 1, (assuming all are fuel are combusting at 100%)



TQRCG



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility



Hands on Exercise for Stationary Combustion

Utility A caters utility to 3 islands of similar demographics.

Utility provided the information in the data sheet regarding its power generation and fuel use (refer to the data sheet).



Tasks

1. Conduct a preliminary data check and identify key issues
2. Devise a method to complete the dataset based on the information provided
3. Estimate the total emissions from utility operations in those 3 islands (use the factors provided in cheat sheet)



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



Hands on Exercise for Road Transport

The dataset provides the number of registered road vehicles in the country. Assume all vehicles are active vehicles



Tasks

1. Calculate the amount of fuel used for road transport by IPCC vehicle category using VKT method
2. Calculate the total emissions for road transport



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



ANNEX 4: PHOTOS OF HAND-ON TRAINING FOR ESTIMATING GREENHOUSE GAS EMISSIONS OF ENERGY SECTORS IN MALDIVES







