



ESTIMATING ENERGY EMISSIONS – MOBILE

JANUARY 24, 2025

PREPARED BY: DEVELOPMENT ADVISORY SERVICES



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

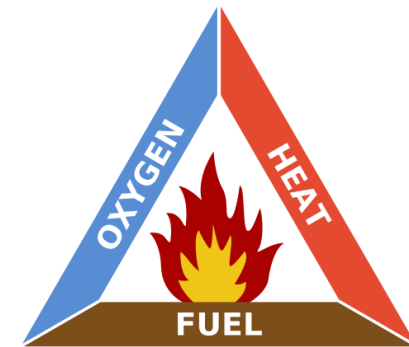
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility
INVESTING IN OUR PLANET



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
INVESTING IN OUR PLANET



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)



MALDIVES CONTEXT



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

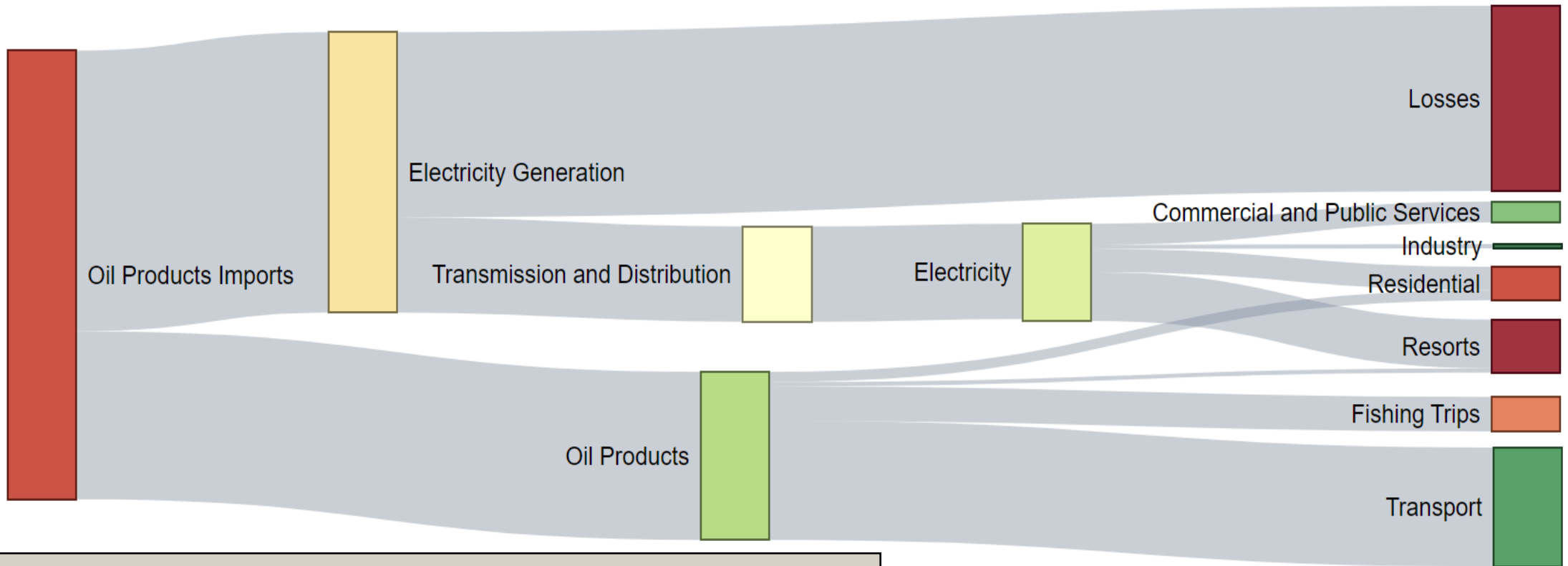
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility
INVESTING IN OUR PLANET

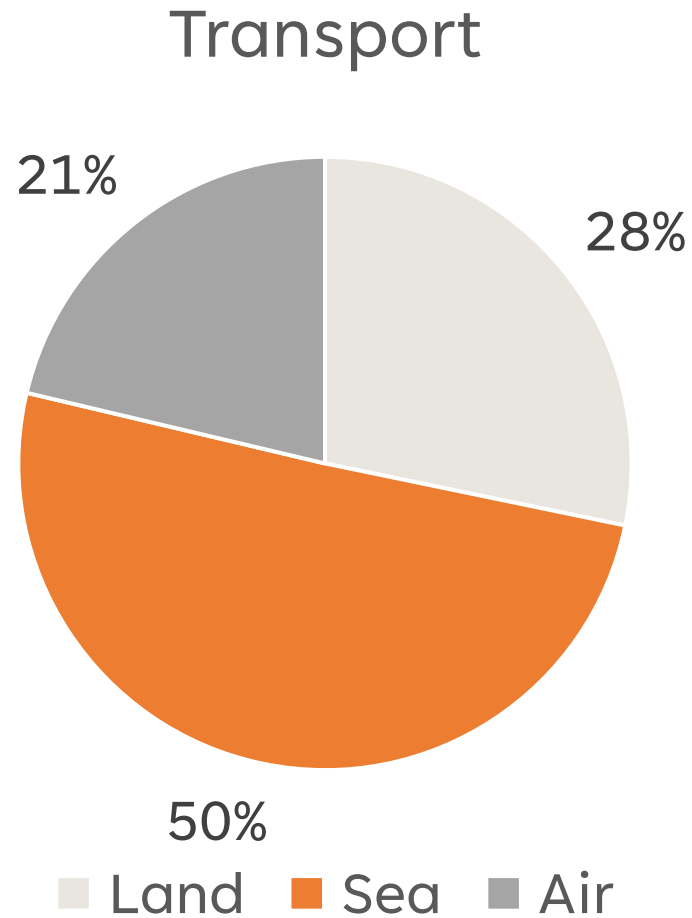


NATIONAL CONTEXT - ENERGY

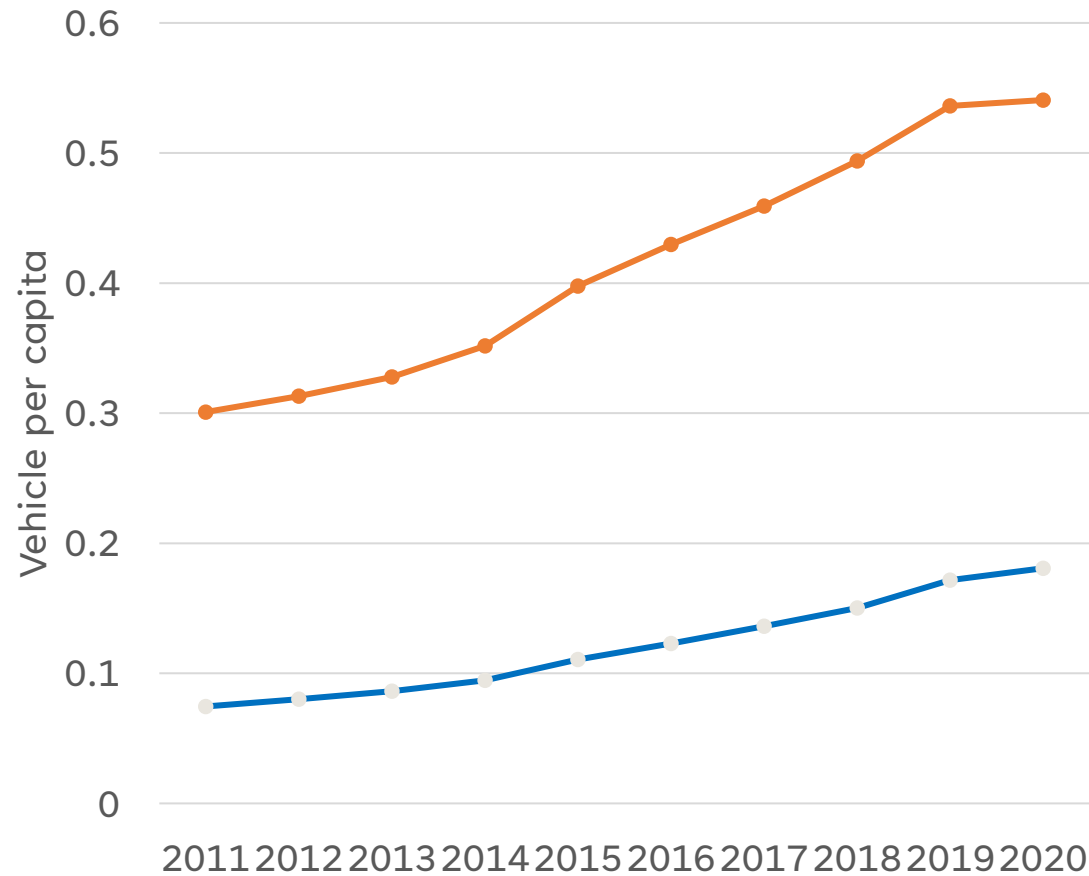


Sankey Diagram – Showing energy supply and demand

NATIONAL CONTEXT – EMISSIONS FROM TRANSPORT SECTOR



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
INVESTING IN OUR PLANET

UN
environment



SECTORAL APPROACH OVERVIEW



Ministry of Tourism and Environment
Republic of Maldives

CBIT Maldives

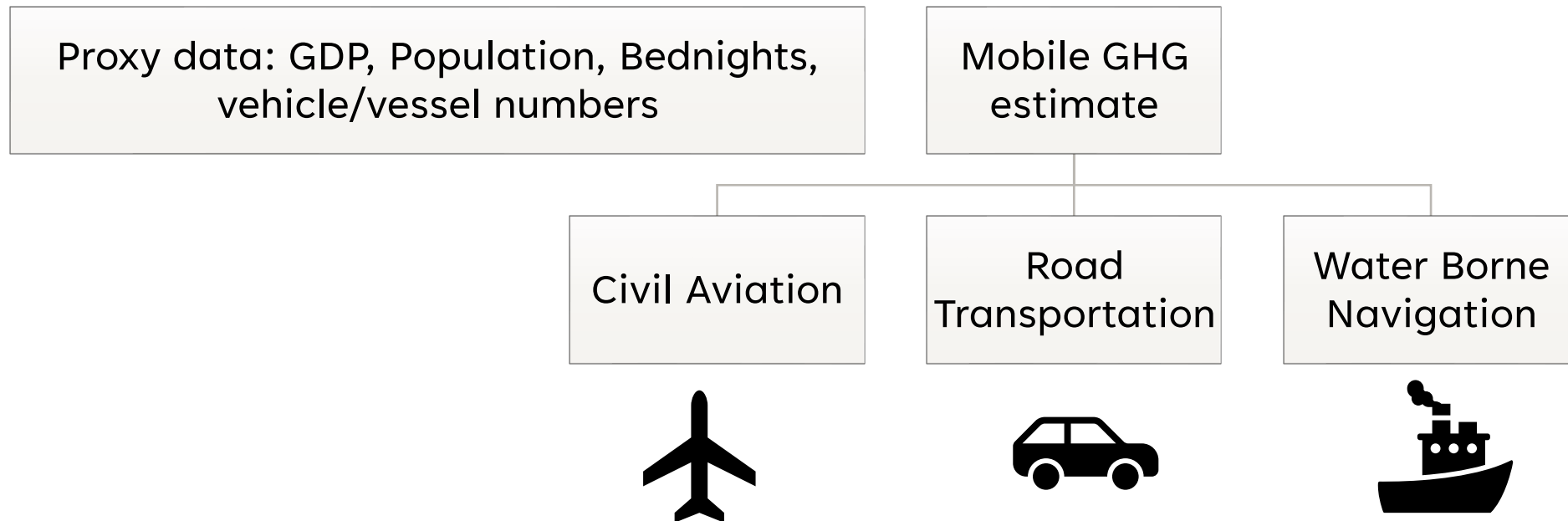
Capacity Building for Improved Transparency of
Climate Change Mitigation and Adaptation Actions in
the Maldives Project



global
environment
facility
INVESTING IN OUR PLANET



SECTORAL APPROACH



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 |

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 |

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. |

RELEVANT IPCC CATEGORIES FOR MOBILE FUEL COMBUSTION

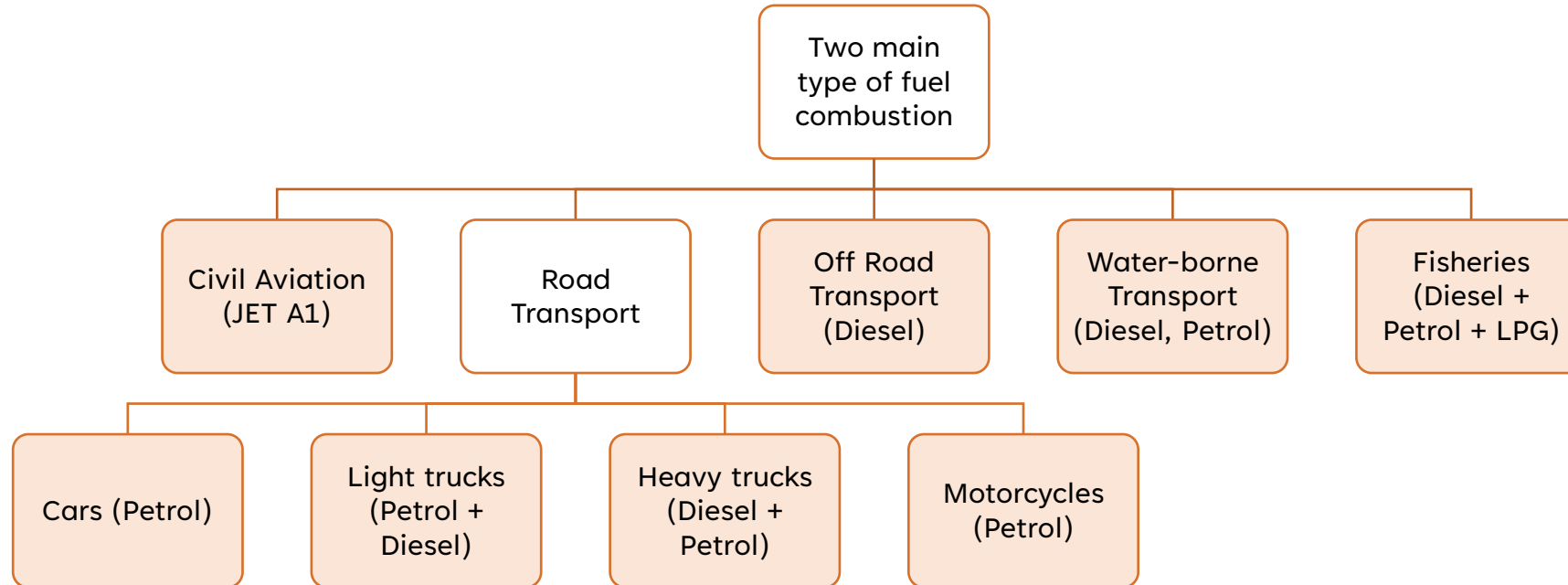
| IPCC Category Code | CRT category code | Category | Relevance to Maldives Context |
|--------------------|-------------------|---|---|
| 1A | | Fuel Combustion Activities | |
| 1A4 | 1A4 | Other Sectors | |
| | 1A4a | Commercial/institutional | |
| | 1A4a ii | Off-road vehicles and other machinery | 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 be 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

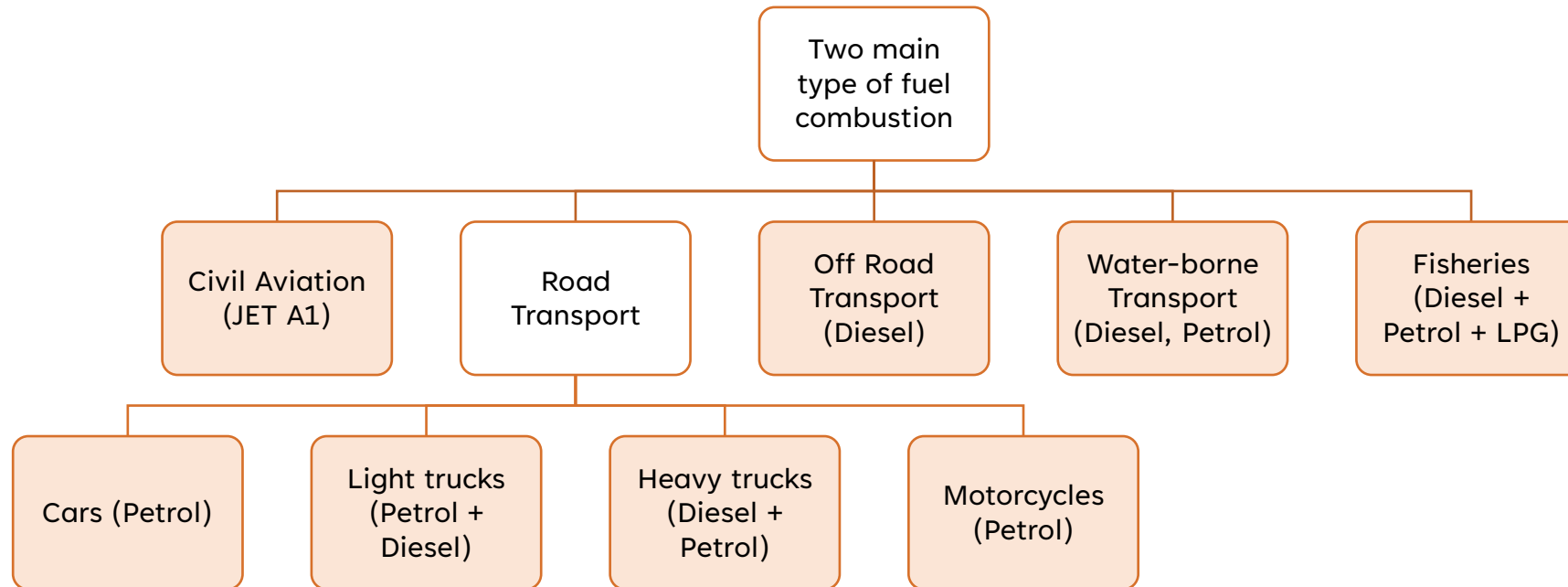
| IPCC Category Code | CRT category code | Category | Relevance to Maldives Context |
|--------------------|-------------------|--------------------------------|---|
| 1A | | Fuel Combustion Activities | |
| 1A5 | 1A5 | Non-Specified | |
| 1A5b | 1A5b | Mobile | In the CRT all of the sub categories under this is reported together |
| 1A5bi | | Mobile (aviation component) | This occurs in Maldives and covers aviation fuel combustion by MNDF military flights/drones and search and rescue operations |
| 1A5bii | | 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 |
| 1A5biii | | 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



DATA FOR SECTORAL APPROACH



What data from which sources??

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
INVESTING IN OUR PLANET



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 |

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/) ⁽¹²⁾ | | | | | | | LTO FUEL CONSUMPTION (Kg/LTO) |
|--|-------------------------------|---|--------------------------------|---------------------------------|-----------------|-------|-----------------------|---------------------------------|-------------------------------|
| | | CO ₂ ⁽¹¹⁾ | CH ₄ ⁽⁸⁾ | N ₂ O ⁽⁹⁾ | NO _x | CO | NM VOC ⁽⁸⁾ | SO ₂ ⁽¹⁰⁾ | |
| | 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 |
| | Beech King Air ⁽⁵⁾ | 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 |



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



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
INVESTING IN OUR PLANET



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)



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. |

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 iawfcSokIrcTcsijwr | | | | | | | | 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



global
environment
facility
INVESTING IN OUR PLANET

UN
environment



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
INVESTING IN OUR PLANET

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

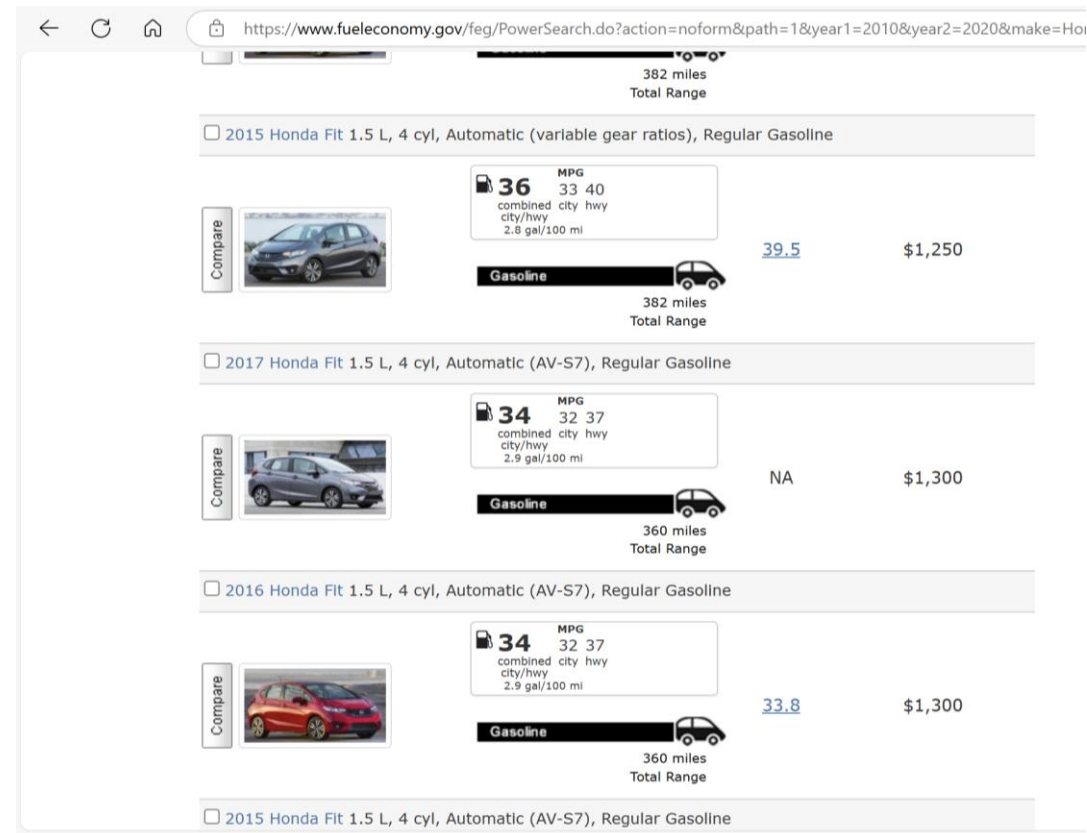
| Fuel | CO ₂ | CH ₄ | N ₂ O |
|----------------|-----------------|-----------------|------------------|
| Gas/Diesel Oil | 74100 | 3.9 | 3.9 |
| Petrol | 69300 | 33 | 3.2 |

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/>.



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



global
environment
facility
INVESTING IN OUR PLANET



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.



METHODS

Fuel Consumption method

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

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

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

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

| | | Emission factor (EF) kg/TJ | | |
|-------------------|------|----------------------------|-----------------|------------------|
| Fuel | NCV | 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 |

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 | Barge Handlers | Heavy | BH003 | Diesel | 13,497 | 32802 | 4,370 | 1058.15 | 329.02 | 913.41 | | | |
| | 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 | 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 | | | | | | | | | |



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.



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



global
environment
facility
INVESTING IN OUR PLANET



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.



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



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 |

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 ^Δ | 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 |
| | Baitheli | 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
INVESTING IN OUR PLANET



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 |



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

