YETI AIRLINES GHG INVENTORY MANAGEMENT PLAN

BACKGROUND

This document provides the methodology used to conduct the Greenhouse Gas (GHG) Inventory for Yeti Airlines covering the period of 2016 – 2018. It is meant to provide the necessary replicability and verification of the results based on the factors, calculations, and assumptions utilized. The assessment follows the UN methodology [1]and is compliant with internationally accepted standards including in particular the WRI Greenhouse Gas Protocol and ISO 14064 Part 1.

BOUNDARIES

The GHG inventory encompasses the operations of Yeti Airlines. This inventory seeks to recognize and measure the most material emission sources for this period, outlined below. Other direct or indirect emissions may be relevant, and may be considered for inclusion in future GHG inventories.

 Aircraft operations	In 2018, Yeti Airlines operated nine aircrafts for which jet fuel usage and release of refrigerant gases (for J-41 fleets only) are relevant for the carbon footprint. The fleet consisted of six British Aerospace Jetstream 41 planes and three ATR72-500 model aircrafts. They all use Jet-A1 fuel.
 Vehicle operations	The inventory also included 18 vans, 10 busses, 4 jeeps and 3 tractor operated by Yeti Airlines in year 2018 period. Fuel consumption and refrigerant gas leaks from these vehicles are relevant for the carbon footprint. Petrol and Diesel are consumed as fuel.
 Facility operations	Yeti Airlines operates several facilities including in particular: ● The Head Office ● Airport Offices ● Aircraft Hangar In these facilities, grid electricity consumption and combustion of generator fuels for electricity generation as well as leakage of refrigerants from air conditioners are relevant for the carbon footprint.

The GHG inventory includes the six greenhouse gases (GHG) originally covered by the Kyoto Protocol: CO_2, CH_4, N_2O, HFCs, PFCs and SF_6. GHG emissions are aggregated using the common comparable unit of carbon dioxide equivalents (CO_2e), using the global warming potential (GWP) of each substance.

GREENHOUSE GAS CALCULATION

Corporate GHG emissions are categorized into different scopes to help delineate and aggregate emissions between companies while avoiding duplication or omission of emission sources. Based on above-

mentioned standards, companies must report Scope 1 and Scope 2 emissions comprehensively at a minimum.

Yeti Airlines operated on a fiscal year from July to June till the year 2017 for vehicles and facilities. In year 2018, for the robustness of the report all the data was reported on a calendar year basis, including air travel data.

Scope 1

Scope 1 includes direct GHG emissions from sources that are owned or controlled by the company, including in particular the combustion of fuel. The major source of Scope 1 emissions for Yeti Airlines is due to fuel consumption from airplanes. Other sources of Scope I emissions include stationary fuel combustion for ground power units and generators, fuel consumed by official vehicles, and refrigerant gases released from airplanes, vehicles, facility heating and air-conditioning.

During 2018 GHG inventory exercise data was collected, gathered and calculated by Yeti personnel itself. The following details provide the background methodology and assumptions associated with this process.

AIR TRAVEL EMISSIONS

The following data related to air travel was collected based on the calendar years for 2016 to 2018:

- REPORTING YEAR
- MONTH
- FUEL CONSUMPTION (litre)
- PASSENGERS FLOWN
- KILOMETRES FLOW
- REFRIGERANT GASES (KG)
- TYPE OF REFRIGERANT GAS

Using this data, the CO_2 equivalent (CO_2e) emissions were calculated for fuel consumption as well as refrigerant losses based on the following approaches:

AIRPLANE FUEL EMISSIONS:

- The following emission factors were used: [2]

JET-A1 emission factor (CO2)	0.002490989	tonnes/ltr of fuel
JET-A1 emission factor (CH4)	0.000000348	tonnes CO2e/ltr of fuel
JET-A1 emission factor (N2O)	0.0000000209	tonnes CO2e/ltr of fuel

- The CO_2e emissions were calculated using the following formula:

  (Fuel (ltr) * CO_2 factor) + (fuel (ltr) * CH_4 factor) + (fuel (ltr) * N_2O factor)

- 'Radiative forcing' [3] has not been considered in the calculation, which aligns with the UN Greening the Blue methodology and IPCC guidelines. If international best practice and guidance changes, it may be considered in the future.
- Different factors were not considered for take-off and landing but should be considered in future inventories.

AIRPLANE REFRIGERANT EMISSIONS:

- The Global Warming Potential factor for R401A refrigerant used in the airplanes is 1182 GWP. [4]
- The formula for the refrigerant emissions is : [5]

  Tonnes of CO2e = Refrigerant leakage (kg) * 1182 / 1000

VEHICLE EMISSIONS

The following data related to vehicle emissions was collected for 2016 to 2018:

- REPORTING YEAR
- PERIOD START
- PERIOD END
- VEHICLE TYPE
- NUMBER OF VEHICLES
- FUEL TYPE
- FUEL USAGE (litres)
- UNIT

Using this data, the CO_2e emissions were calculated for fuel consumption as well as refrigerant losses based on the following approaches:

VEHICLE FUEL EMISSIONS:

- Only two types of fuel are used in the vehicles: petrol and diesel. The emission factors used are in the table below. [5]

Petrol (CO_2)	0.00000231	tonnes CO_2e/l
Petrol (CH_4)	0.00000059	tonnes CO_2e/l
Petrol (N_2O)	0.0000002	tonnes CO_2e/l
Diesel (CO_2)	0.00000264	tonnes CO_2e/l
Diesel (CH_4)	0.00000011	tonnes CO_2e/l

Diesel (N2O)	0.0000001	tonnes CO2e/l

- The CO_2e emissions for each vehicle were calculated using the following formula:

  (Fuel (l) * CO_2 factor) + (fuel (l) * CH_4 factor) + (fuel (l) * N_2O factor)

VEHICLE REFRIGERANT EMISSIONS:

- The Global Warming Potential factor for R401A refrigerant used in the vehicles is 1182 GWP. [4]
- The estimated leakage of refrigerant annually is: [6]
  - Passenger car: 0.00016 tonnes/vehicle/yr.
  - Other vehicles: 0.00024 tonnes/vehicle/yr.
- The formula for the annual refrigerant emissions is therefore:

  Tonnes of CO_2e = leakage amount * 1182

FACILITY FUEL AND REFRIGERANT EMISSIONS

The following data related to Scope I emissions from facilities was collected from 2016 to 2018:

- BASELINE YEAR
- PERIOD START
- PERIOD END
- IDENTIFIER
- DIESEL AMOUNT (LITRES)
- PETROL AMOUNT (LITRES)
- ESTIMATED AIR-CONDITIONED SPACE (M2)

Using this data, the CO_2e emissions were calculated for stationary combustion fuel consumption (ground power unit and generators) as well as refrigerant losses based on the following approaches:

STATIONARY COMBUSTION FUEL EMISSIONS:

- Only two types of fuel are used in the vehicles: petrol and diesel. The emission factors used are in the table below. [5]

Petrol (CO_2)	0.00000231	tonnes CO_2e/l
Petrol (CH_4)	0.00000059	tonnes CO_2e/l
Petrol (N_2O)	0.0000002	tonnes CO_2e/l

Diesel (CO_2)	0.00000264	tonnes CO_2e/l
Diesel (CH_4)	0.00000011	tonnes CO_2e/l
Diesel (N_2O)	0.0000001	tonnes CO_2e/l

- The CO_2e emissions for each fuel were calculated using the following formula:

  (Fuel (l) * CO_2 factor) + (fuel (l) * CH_4 factor) + (fuel (l) * N_2O factor)

FACILITY REFRIGERANT EMISSIONS:

- The Global Warming Potential factor for R401A refrigerant used in the vehicles is 1182 GWP. [4]
- The estimated leakage of refrigerant annually is based on square metres (m^2) is 0.00000215285253 tonnes/m^2. [7]
- The formula for the annual refrigerant emissions is therefore:

  Tonnes of CO_2e = leakage amount * 1182

Scope 2

Scope 2 accounts for GHG emissions from the generation of purchased (grid) electricity and/or district heating/cooling. Scope 2 emissions physically occur at the facility where electricity (or hot/cold steam/water) is generated.

FACILITY GRID EMISSIONS

The following data related to scope 2 emissions from generating facilities was collected for 2016 to 2018:

- BASELINE YEAR
- PERIOD START
- PERIOD END
- IDENTIFIER
- GRID ELECTRICITY (KWH)

Using this data, the CO2e emissions for grid electricity were calculated based on the following approach:

- Nepal electricity grid factor: 0.00000388 tonnes CO_2e/kWh[1]
- The CO_2e emissions were calculated using the following formula:

  Electricity consumed (kWh) * grid factor

Scope 3

Scope 3 is an optional category to report any other indirect emissions. Companies are encouraged to include indirect emission sources that represent a significant portion of their overall carbon footprint. In the case of Yeti Airlines, such emission sources are unlikely to be material for the baseline assessment. However, in the future additional sources may be included here.

Finland Study

Average passenger aircraft emissions and energy consumption per passenger kilometre in Finland 2008

	Unit emissions of passenger air traffic [g/pkm]										
	CO	HC	NO_X	CH_4*	N_2O*	SO_2	CO_2	CO_2eq.**	Fuel consumption [g/pkm]	Fuel consumption [l/pkm]	Energy consumption [MJ/pkm]
DOMESTIC, SHORT-DISTANCE ≤ 463 km											
weighted average	**0.49**	**0.030**	**1.1**	**0.0018**	**0.0070**	**0.083**	**257**	**259**	**82**	**0.10**	**3.5**
jet engine scheduled	0.84	0.069	1.5	0.0024	0.0097	0.12	354	357	113	0.14	4.8
turboprop engine scheduled	0.24	0.0021	0.77	0.0013	0.0051	0.059	188	190	59	0.074	2.6
DOMESTIC, LONG-DISTANCE > 463 km											
weighted average	**0.54**	**0.038**	**0.67**	**0.0012**	**0.0048**	**0.056**	**177**	**178**	**56**	**0.070**	**2.4**
jet engine scheduled	0.60	0.043	0.71	0.0013	0.0050	0.058	184	185	58	0.073	2.5
turboprop engine scheduled	0.14	0.0013	0.45	0.00087	0.0035	0.040	128	129	40	0.051	1.7
EUROPE, SHORT-DISTANCE ≤ 463 km											
weighted average	**0.76**	**0.059**	**1.1**	**0.0018**	**0.0070**	**0.084**	**257**	**260**	**82**	**0.10**	**3.5**
jet engine scheduled	0.88	0.075	1.1	0.0018	0.0073	0.089	269	271	85	0.11	3.7
turboprop engine scheduled	0.36	0.0048	1.1	0.0015	0.0060	0.069	220	221	69	0.087	3.0
EUROPE, LONG-DISTANCE > 463 km											
weighted average	**0.43**	**0.031**	**0.50**	**0.0010**	**0.0041**	**0.048**	**148**	**149**	**47**	**0.059**	**2.0**
jet engine scheduled	0.45	0.032	0.52	0.0011	0.0042	0.049	154	155	49	0.061	2.1
jet engine charter	0.22	0.016	0.32	0.00057	0.0023	0.026	83	84	26	0.033	1.1
LONG-HAUL FLIGHTS											
weighted average	**0.095**	**0.0070**	**0.45**	**0.00078**	**0.0031**	**0.036**	**113**	**114**	**36**	**0.045**	**1.6**
jet engine scheduled	0.094	0.0069	0.53	0.00092	0.0037	0.043	134	135	43	0.054	1.8
jet engine charter	0.097	0.0073	0.29	0.00046	0.0019	0.022	67	68	22	0.027	0.93

Considering a study by Finland from 2008, Yeti is performing relatively well based on grams per passenger kilometres as compared to European airlines (at 127 g CO_2eq/Pax-km). While this study is over ten years old, it is still applicable considering that the fleets of many airlines are also over a decade old.

REFERENCES

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7. "Since the purchase quantity is not known, a floor area based annual leakage rate of the refrigerant has been estimated using the methodology proposed by the World Resources Institute, as part of a consulting assignment for UN in 2008.," [Online].