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MINISTRY OF CLIMATE CHANGE
& ENVIRONMENT

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TARGET CLIMATE WEBINAR: DAY 1

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Target Climate Initiative

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HSBC

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هيئة البيئة - أبوظبي
Environment Agency - ABU DHABI

غرفة دبي
DUBAI CHAMBER

OVERVIEW

WORKSHOP 1

CLIMATE CHANGE

Physical basis, and impacts

BASICS OF GHG INVENTORY

Terms and steps

GHG Estimation

Calculation exercise

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Climate Change

THE PHYSICAL BASIS, AND IMPACTS

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THE PHYSICAL BASIS

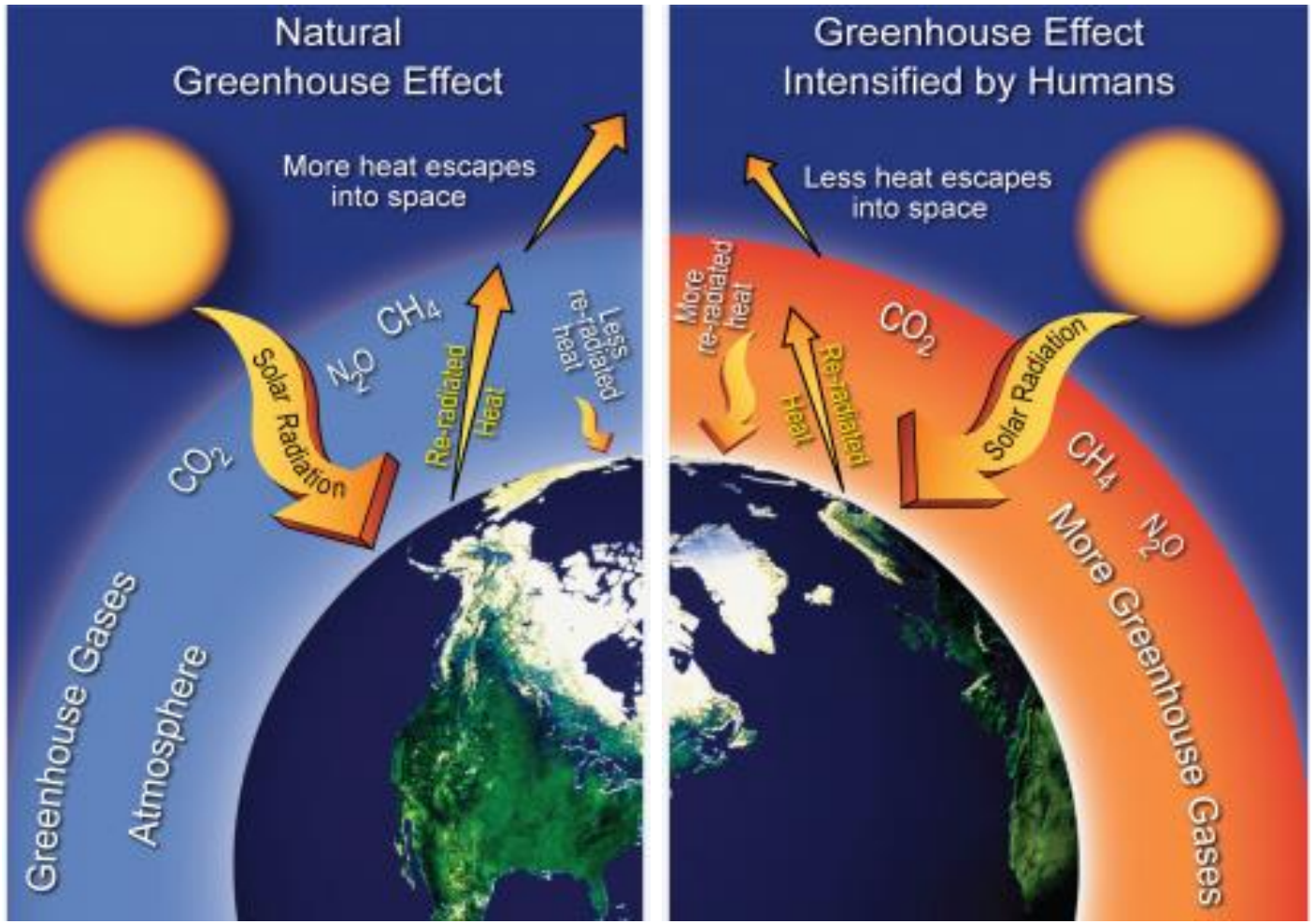
WHAT ARE GREENHOUSE GASES

DO WE NEED THEM?

- Gases that trap heat in the atmosphere and make the Earth warm
- GHGs let the solar radiation pass through the atmosphere to Earth’s surface, where a portion of it is absorbed
- When this absorbed energy is reradiated back by the Earth’s surface to the atmosphere, it gets absorbed by greenhouse gases, thus increasing atmospheric temperature
- This phenomena is similar to what happens in a greenhouse, thus the name GHGs

CLIMATE CHANGE STARTS WITH GREENHOUSE GAS EFFECT

HUMAN INFLUENCE ON THE GREENHOUSE GASES



IMPORTANCE OF GREENHOUSE GASES

BALANCE

- Without greenhouse gases, our planet would be a freezing wasteland and most likely uninhabitable for humans

Too little or no greenhouse gases will make the Earth too cold

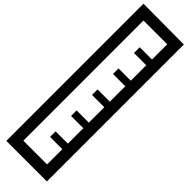
Similarly, a lot of greenhouse gases will make the Earth too warm

TYPES OF GREENHOUSE GASES

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Sulfur Hexafluoride (SF_6)
- Fluorinated gases (HFCs, & HCFCs)
- Water Vapor (H_2O)
- Ozone (O_3)

THE RELATIVE CONTRIBUTIONS OF THESE GASES

HOW DO WE DECIDE?



We produce larger amounts of some GHGs more than others. Carbon Dioxide is the GHG we hear people talk about the most. That's because we produce more Carbon Dioxide than any other GHG

Some GHGs stay in the atmosphere for only a short time, but others can stay in the atmosphere for longer and affect the climate for thousands of years

Not all GHGs are created equal! Some trap more heat than others. For example, one kg of Methane traps about 25 times as much heat as one kg of Carbon Dioxide

GLOBAL WARMING POTENTIAL

GWP

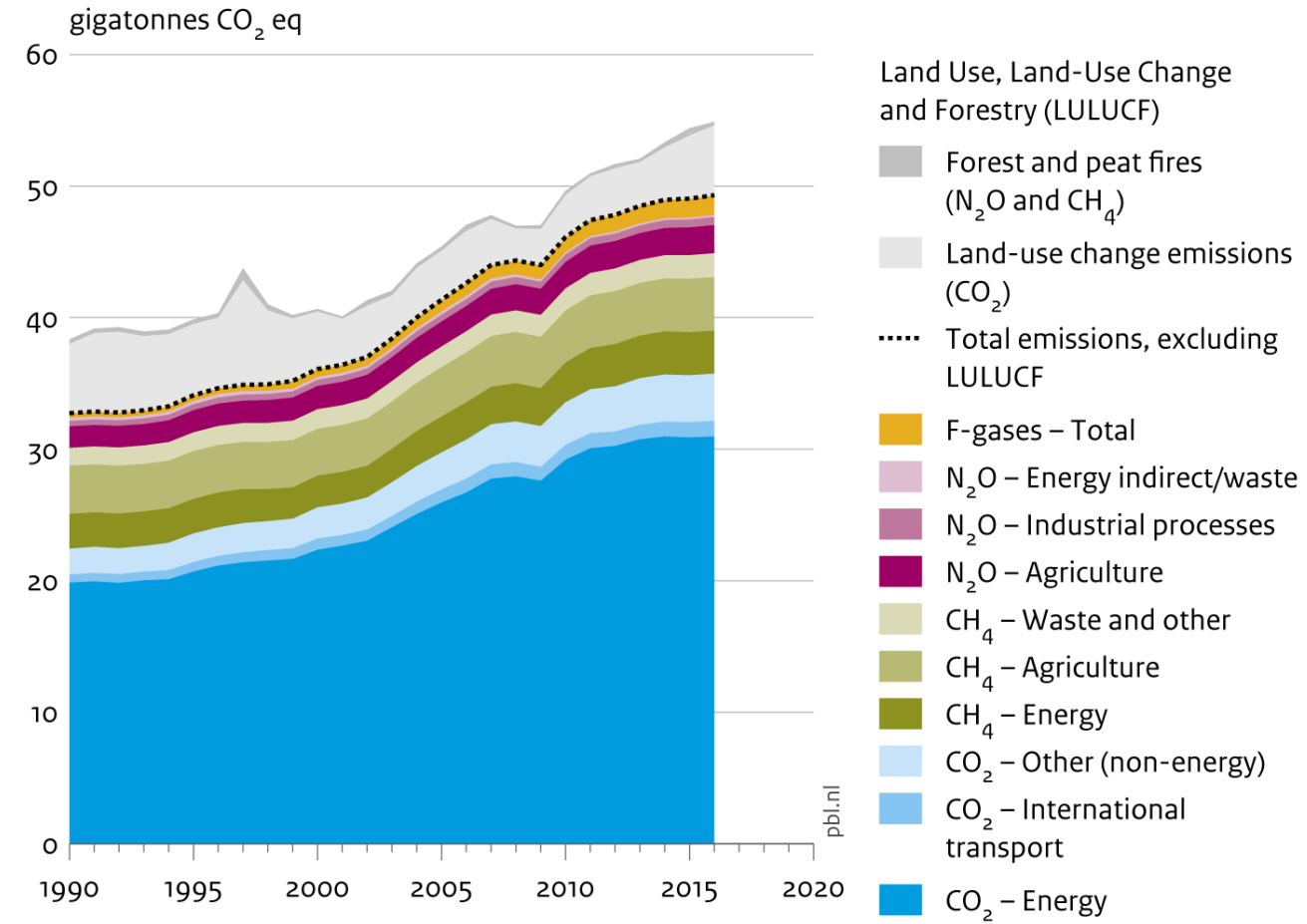
- Global Warming Potential (GWP) is ***a measure of how much energy*** the emissions of 1 ton of a gas will absorb over a given period, relative to the emissions of 1 ton of Carbon Dioxide (CO2).

- The ***larger the GWP***, the more that a given gas warms the Earth compared to CO2 over a given time period.

GREENHOUSE GASES

Gas	Source	GWP
Carbon Dioxide (CO_2)	Emission from factories, Deforestation	1
Methane	Waste disposal, Mining activities, and Agricultural grazing	28
Nitrous oxide (N2O)	Emission from cars, Emission from factories, and Fertilizers	298
Sulfur Hexafluoride (SF6)	Electrical substations, Magnesium smelters	22,800
Hydrofluorocarbons (HFCs)	Refrigerators, Deodorants, and Air conditioners	124 -14,800
Perfluorocarbons (PFCs)	Foil paper and Chipset	7,390 -12,200

GLOBAL EMISSIONS PER TYPE OF GAS



Source: EDGAR v4.3.2 (EC-JRC/PBL 2017); Houghton and Nassikas (2017); GFED 4.1s (2017)

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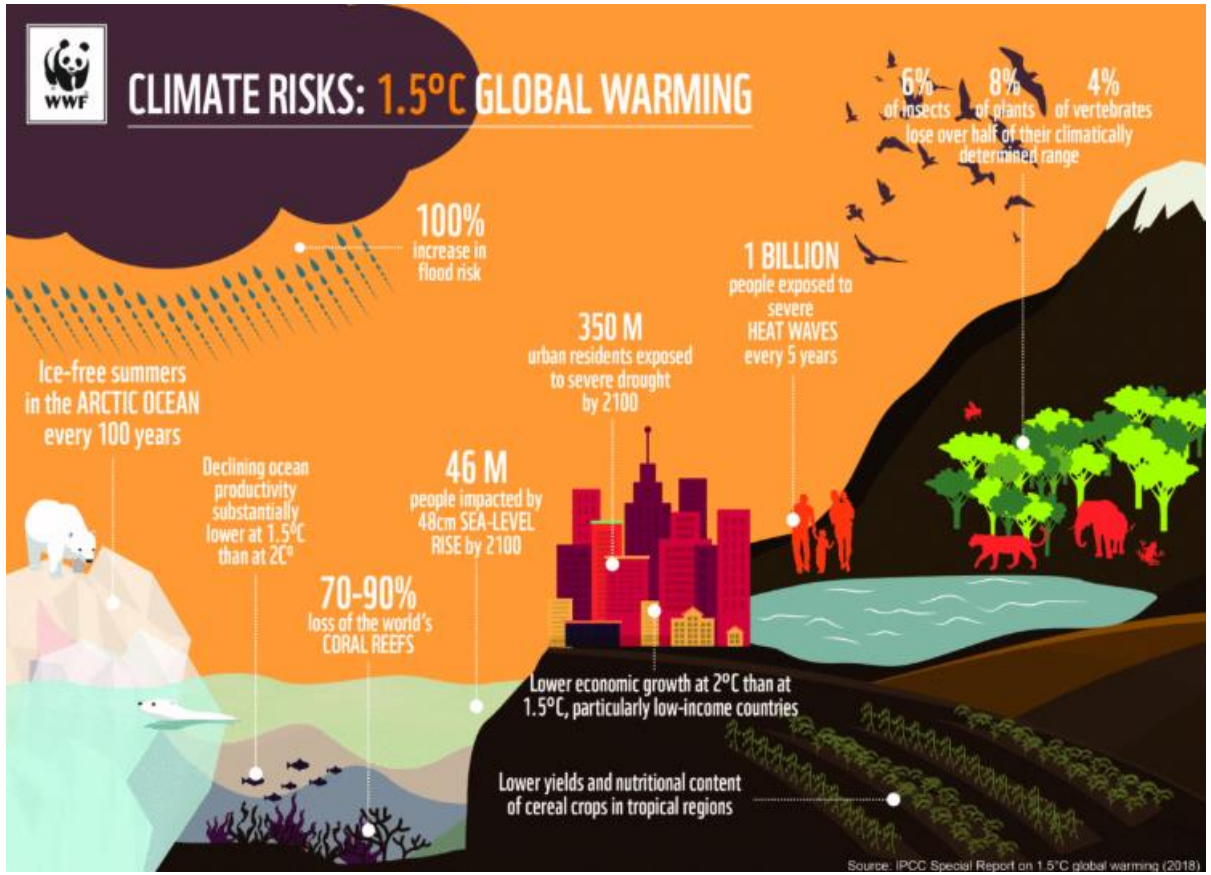
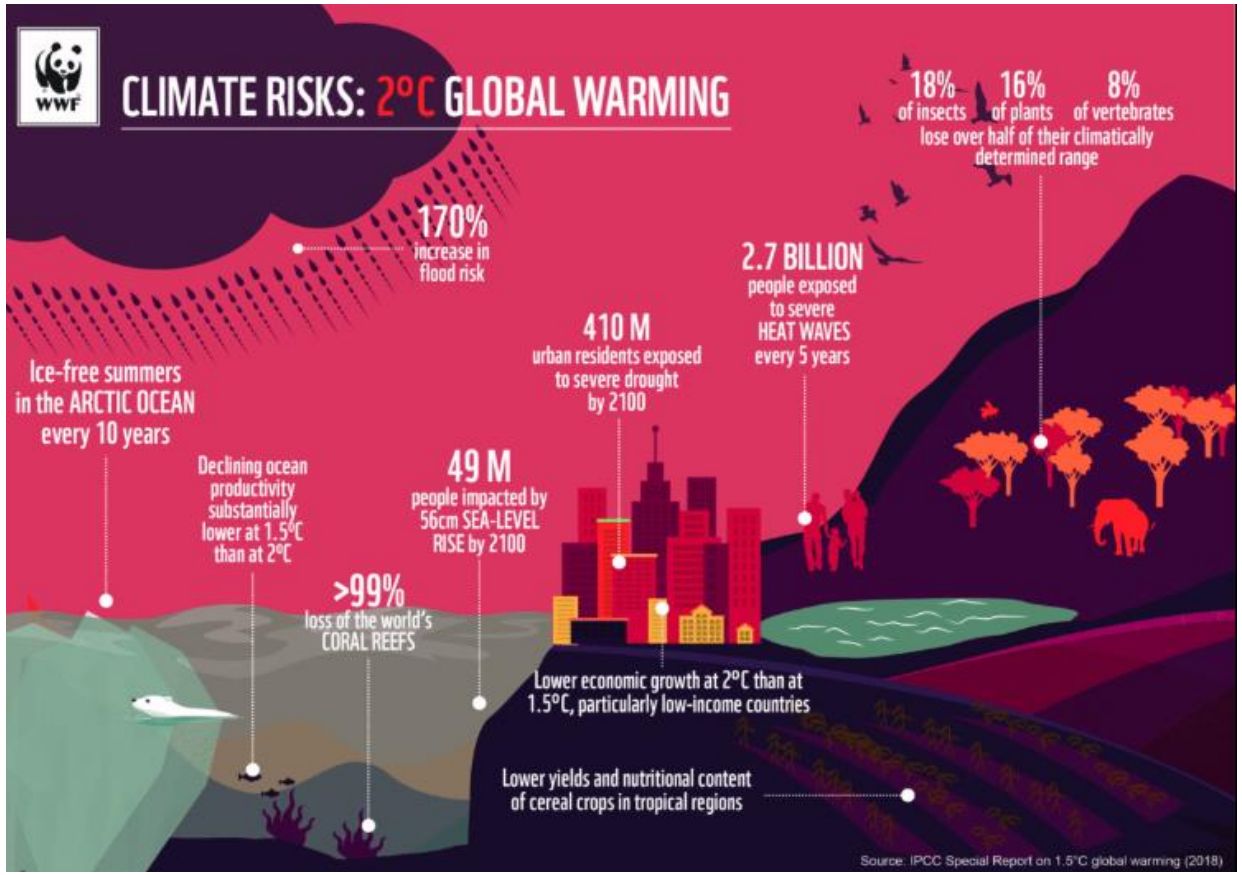
IMPACTS

PROJECTED IMPACTS OF CLIMATE CHANGE

THE FIGHT TO STAY BELOW 1.5 C





PROJECTED IMPACTS ON CLIMATE CHANGE

THE GULF

- UAE and Gulf temperatures are projected to increase 2-3°C during the summer by 2060-2079
- Sea surface temperatures of the Arabian Gulf could warm by about 1-2°C by the end of century
- Sea Level Rise could be between 1-9 m
- Arabian Gulf expected to become more saline
- Humidity is projected to increase by about 10% over the Arabian Gulf by 2060-2079

QUIZ TIME

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BASICS OF GHG INVENTORY

Terms & References

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Common Terms

BASICS OF GHG INVENTORY

COMMON TERMS

Emission Factor

A factor or value that relates the quantity of GHG released due to an activity.

Example: Grid Emission Factor tCO_2e/KWh .

Grid Emission Factor

Refers to CO_2 emissions per unit of electricity generated

Embodied Energy

The sum of all the energy required to produce any goods or services, from the mining and processing of natural resources to manufacturing, transport and product delivery

BASICS OF GHG INVENTORY

COMMON TERMS

Calorific Value

Amount of heat produced when a unit weight or volume of the fuel is completely burnt.

Units: Joules & Calories.

Oxidation Factor

Measure the percentage of carbon that is oxidized when combustion occurs. The oxidation factor is used to calculate the amount of the fuel that is contributing to greenhouse gas emissions.

Biological Oxygen Demand (BOD)

Amount of dissolved oxygen needed by aerobic biological organisms to break down organic material present in water.

BASICS OF GHG INVENTORY

COMMON TERMS

Temporary Removal

This refers to emission reductions that are temporary for e.g. afforestation project where the timber is eventually harvested. The CO_2 is sequestered in the wood biomass; however, upon harvesting the wood is either combusted as fuel or degrades after its end of life use, releasing the CO_2 back into the atmosphere.

Permanent Reduction

This refers to avoidance of CO_2 emission into the atmosphere permanently For e.g. if diesel used for generation of electricity and is replaced with solar, it helps in the permanent removal of CO_2 emissions.

BASICS OF GHG INVENTORY

COMMON TERMS

Baseline Emissions

Baseline emissions refer to the production of GHGs that have occurred in the past and which are being produced prior to the introduction of any strategies to reduce emissions.

The baseline measurement is determined over a period of time, typically 1-3 years.

Emission Reductions

Reduction of GHG emissions through implementation of a project or activity.

BASICS OF GHG INVENTORY

COMMON TERMS

Emission Neutral

Emission neutral fuel is energy fuel or energy systems which have no net greenhouse gas emissions or carbon footprint.

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GHG Inventory - Steps

GHG INVENTORY STEPS

Methodology

Define Boundary

Identify emission sources

Collect Activity Data

Set Emission Factors

Calculate Emissions

REPORTING EMISSIONS - SCOPES

Scope 1 Emissions

Direct GHG emissions occurring from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc. Also, emissions from chemical production in owned or controlled process equipment.

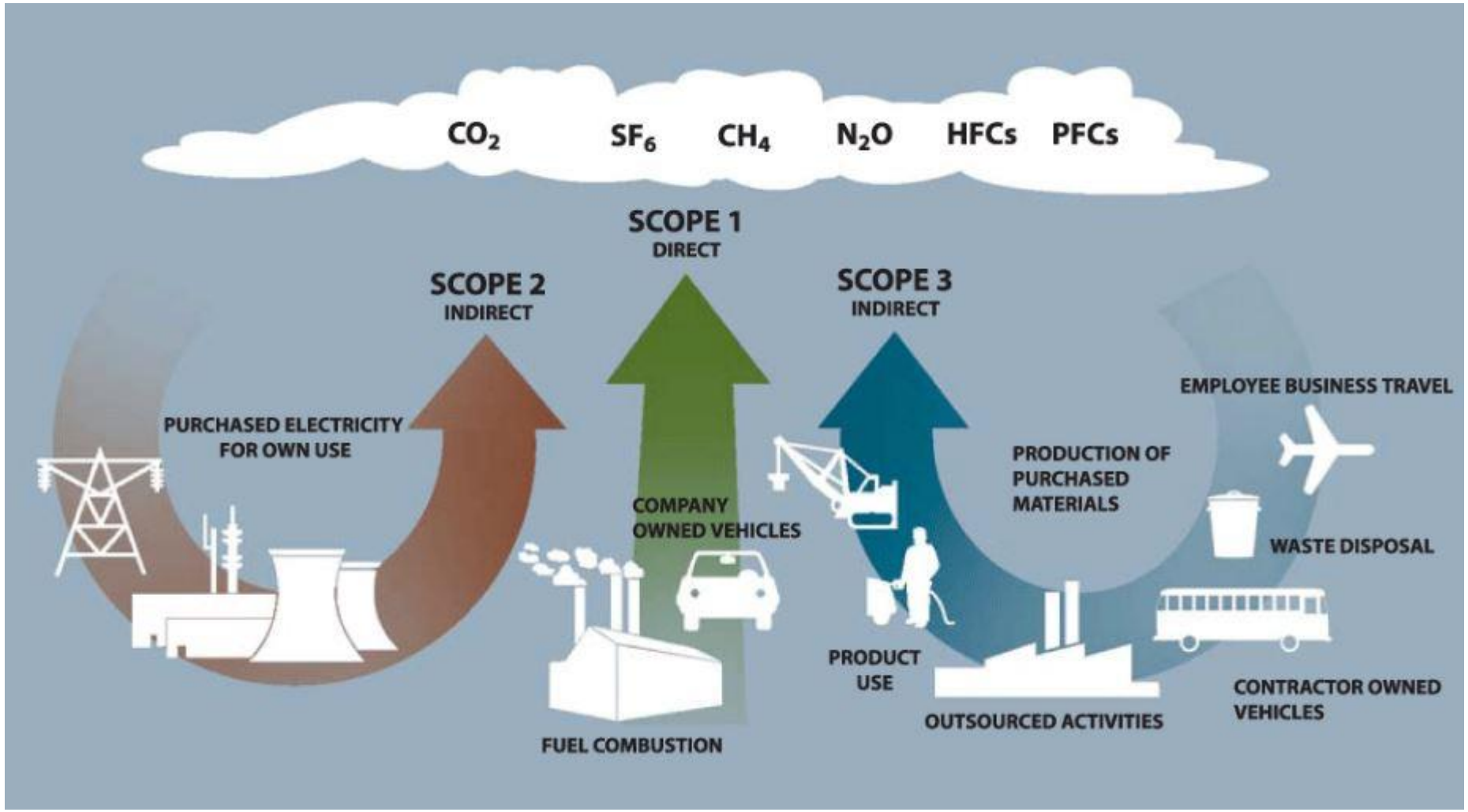
Scope 2 Emissions

Scope 2 accounts for GHG emissions from the generation of purchased electricity. Scope 2 emissions physically occur at the facility where electricity is generated.

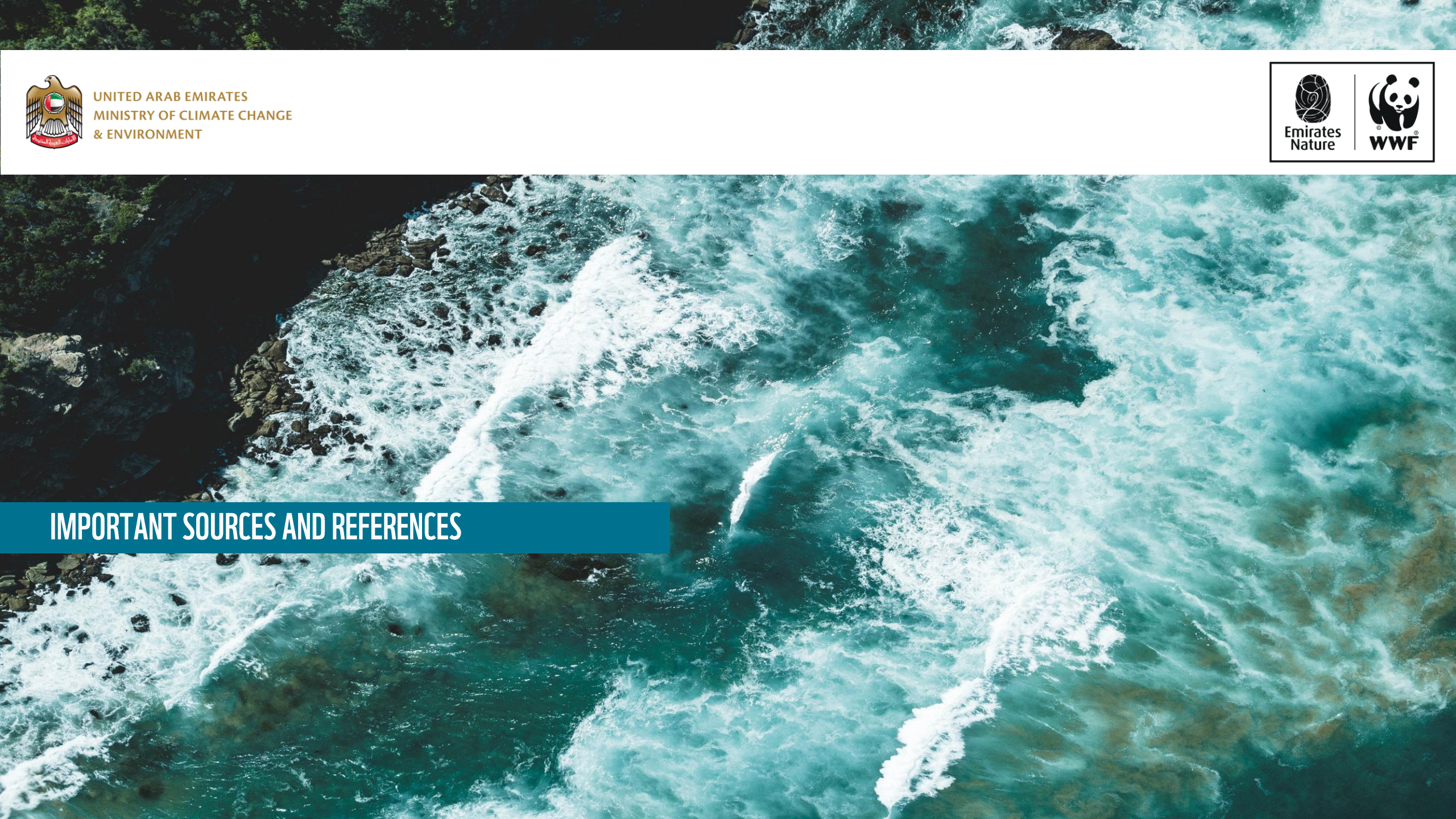
Scope 3 Emissions

Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company but occur from sources not owned or controlled by the company. Some examples of Scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

EMISSION SCOPES



Source: https://i2.wp.com/synergyfiles.com



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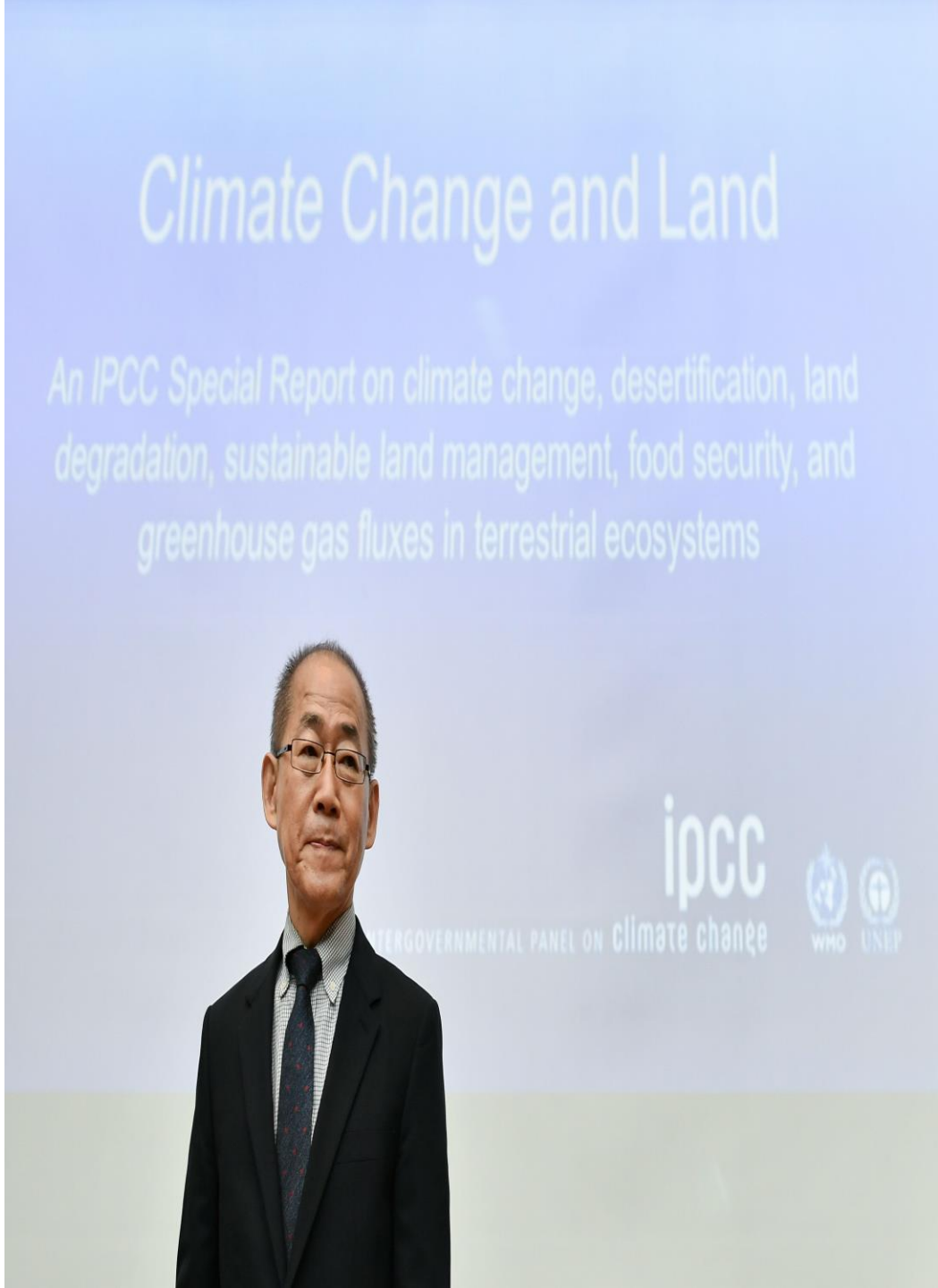
IMPORTANT SOURCES AND REFERENCES

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

IPCC

- The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change.

- The IPCC provides regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation.



INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

IPCC

- IPCC guidelines are used for default calorific values and emission factors for different fuels.

Source: https://www.ipccnggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf

Table 2.2
DEFAULT EMISSION FACTORS FOR STATIONARY COMBUSTION IN THE ENERGY INDUSTRIES
(kg of greenhouse gas per TJ on a Net Calorific Basis)

Fuel	CO2			CH4			N2O		
	Default Emission Factor	Lower	Upper	Default Emission Factor	Lower	Upper	Default Emission Factor	Lower	Upper
Crude oil	73,300	71,100	75,500	r 3	1	10	0.6	0.2	2
Orimulsion	r 77,000	69,300	85,400	r 3	1	10	0.6	0.2	2
Natural Gas Liquids	r 64,2000	58,300	70,400	r 3	1	10	0.6	0.2	2

TABLE 1.2
DEFAULT NET CALORIFIC VALUES (NCVs) AND LOWER AND UPPER LIMITS OF THE 95% CONFIDENCE INTERVALS

Fuel type English description	Net calorific value (Tj/Gg)	Lower	Upper
Crude oil	42.3	40.1	44.8
Orimulsion	27.5	27.5	28.3
Natural Gas Liquids	44.2	40.9	46.9

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

IPCC

- IPCC Fifth Assessment Report, 2014 (AR5) is used for selecting the GWP of the gases.

Global Warming Potential Values

Industrial designation or common name	Chemical formula	GWP values for 100-year time horizon		
		Second Assessment Report (SAR)	Fourth Assessment Report (AR4)	Fifth Assessment Report (AR5)
Carbon dioxide	CO2	1	1	1
Methane	CH4	21	25	28
Nitrous oxide	N2O	298	298	265
Substances controlled by the Montreal Protocol				
CFC-11	CCl3F	3,800	4,750	4,660
CFC-12	CCl2F2	8,100	10,900	10,200

DEPARTMENT OF ENVIRONMENT,FOOD AND RURAL AFFAIRS - UK

DEFRA

- DEFRA factors are used for calculating vehicular and aviation emissions.

Activity	Haul	Class	unit	WithRF			
				KgCO2	KgCO2	KgCH4	KgN2O
Flights	Short-haul,	Average passenger	Passenger.km	0.15832	0.15753	0.00001	0.00078
		Economy class	Passenger.km	0.15573	0.15495	0.00001	0.00077
		Business class	Passenger.km	0.2336	0.23243	0.00001	0.00116
	Long-haul,	Average passenger	Passenger.km	0.19562	0.19464	0.00001	0.00097
		Economy class	Passenger.km	0.14981	0.14906	0.00001	0.00074
		Premium economy class	Passenger.km	0.2397	0.2385	0.00001	0.00119
		Business class	Passenger.km	0.43446	0.43229	0.00002	0.00215
		First class	Passenger.km	0.59925	0.59626	0.00002	0.00297

Engineering toolbox

- Engineering toolbox is used to refer to the density of different fuels.

SOURCE: https://www.engineeringtoolbox.com/fuels-densities-specific-volumes-d_166.html

Fuel	Density@15°C - ρ - (kg/m3)
Diesel	875
EN 590 Diesel	820-845
Gas Oil	825-900
Gasoline	715-780
Heavy Fuel Oil	800-1010
Natural Gas	0.7-0.9
Propane (gas)	1.7
Wood	360-385

GHG PROTOCOL

GHG PROTOCOL CORPORATE STANDARDS

- Provides requirements and guidance for preparing GHG Inventory using standardized approaches and principles.

- It also provides strategies to manage and reduce GHG emissions and enhance consistency and transparency in GHG accounting and reporting.

Source: https://ghgprotocol.org/corporate-standard

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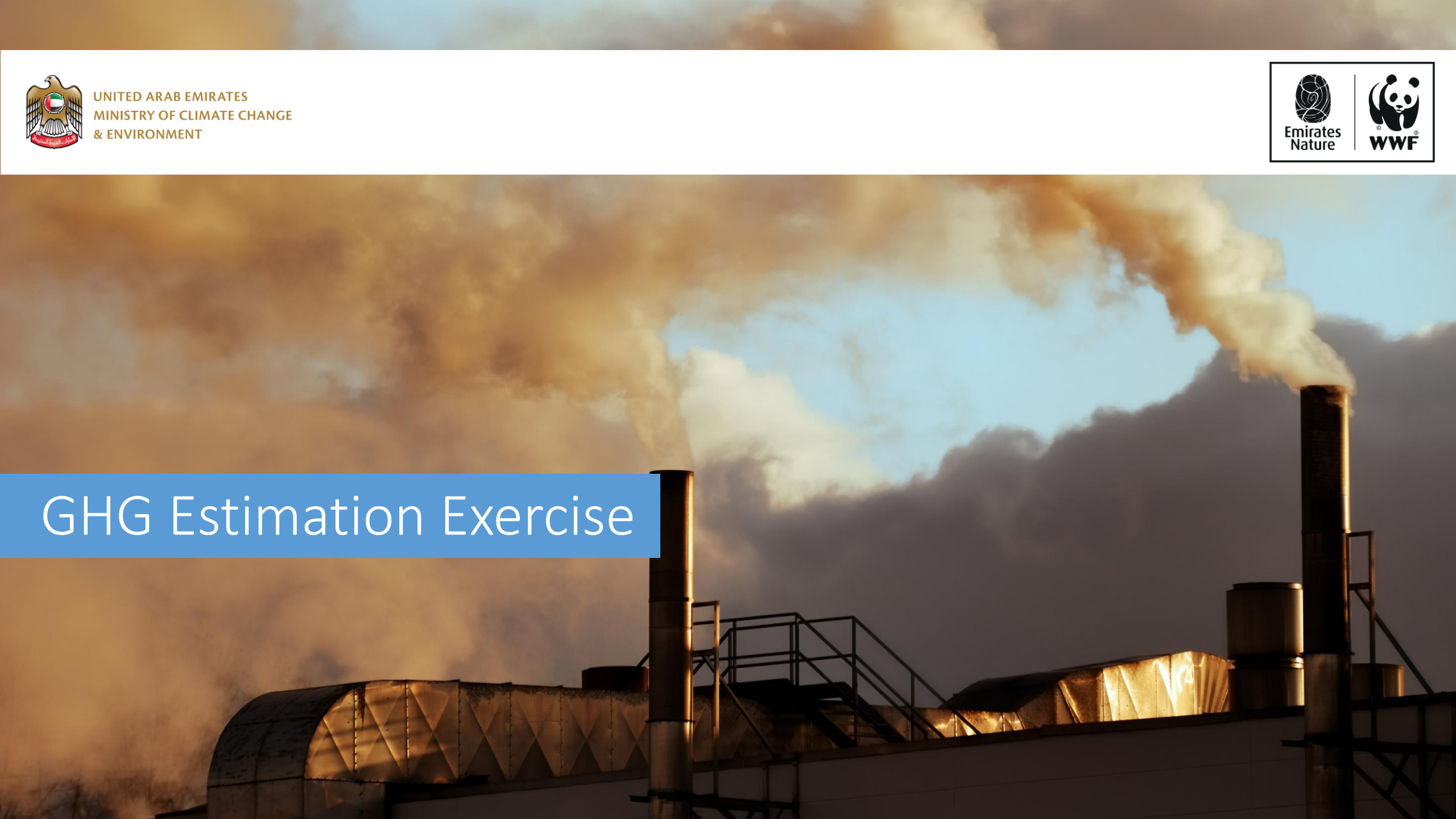

GHG Estimation Exercise

EMISSIONS FROM ELECTRICITY CONSUMPTION

WHAT DO WE NEED TO KNOW?

- Electricity Used
- Grid Emission Factor

EMISSIONS FROM ELECTRICITY CONSUMPTION

Annual Electricity Consumption - **30,000 kWh**

Grid Emission Factor - **0.45 Kg CO_2/kWh**

Total GHG Emission =
Annual Electricity Consumption * Grid Emission Factor

= 30,000 * 0.45

= 13,500 Kg CO_2

REFRIGERANT EMISSIONS FROM COOLING/HVAC

WHAT DO WE NEED TO KNOW?

- Equipment type
- Refrigerant type
- Refrigerant gas mix
- GWP of the gases
- Annual refrigerant top-up
- Total refrigerant charge (for end of life emission)

REFRIGERANT EMISSIONS FROM COOLING/HVAC

Refrigerant - R410a, top up quantity - **3kg**

R410a is made of **50% CHF_2CF_3** and **50% CH_2F_2**

GWP - **CH_2CF3 = 2,800**

CH_2F_2 = 677

Combined GWP for R410a :**1738.5 $kgCO_2$/kg R410a**

Total GHG emission
= Kg of refrigerant top-up * GWP for R410a

= 3 Kg of refrigerant top-up * 1738.5 $kgCO_2$ per kg of R410a

= 5,215.5 $KgCO_{2e}$

EMISSIONS FROM BOILER /DIESEL GENERATOR

WHAT DO WE NEED TO KNOW?

- Type of equipment
- Type of fuel used
- Calorific value
- Emission factor
- Fuel consumption
  - Directly measured
  - Fuel purchase records
  - Back up calculation from rated capacity

EMISSIONS FROM BOILER /DIESEL GENERATOR

Annual fuel consumption : **13,000 Liters**

Emission factor for diesel: **3.2 tCO_2/tonne**

Net Calorific Value(NCV) of diesel: **0.043000 TJ/tonne**

Default emission factor: **74.1 tCO_2/TJ**

Fuel density of diesel: **0.000959 tonnes/liter**

IPCC

IPCC

Engineering tool box

Total GHG emission

= Fuel consumption*emission factor*fuel density

= 13,000 * 3.2 * 0.000959

= 39.72 tCO_2

EMISSIONS FROM SEWAGE TREATMENT PLANT

WHAT DO WE NEED TO KNOW?

- Quantity of water treated
- Biological Oxygen Demand (BOD) of the outlet/treated water

EMISSIONS FROM SEWAGE TREATMENT PLANT

Quantity of water treated : **1,923,000 Liter**

BOD (kg/l) : **0.000086**

CH_4 emission Kg: **0.18 kg CH_4/ Kg BOD**

CH_4 Global Warming Potential: **28**

Methane emissions

= Quantity of water treated * BOD* CH_4 Emission

= 1,923,000* 0.000086 * 0.18

= 29.76 kg Methane

= 29.76*28 kg CO_2

= 833 tCO_2e

EMISSIONS FROM AIR TRAVEL

WHAT DO WE NEED TO KNOW?

- Number of trips
- Approx. distance traveled and class

EMISSIONS FROM AIR TRAVEL

Number of trips : **2**

Distance traveled in economy class per trip: **3,200 Km**

Emission factor for economy Class: **0.0175 Kg of CO_2e/Km**

Total GHG emission

= Distance traveled * emission factor

= 3,200 * 0.0175

= 56 KgCO_2e

112

QUIZ TIME

TODAY'S MAIN TAKEAWAYS

How and why is climate change happening?

Basics of GHG Management – Terms and concepts

Useful resources and references

Basic Calculations to convert – Activity data into emissions

WHAT TO EXPECT IN WORKSHOP 2

Introducing the GHG Inventory tool and guidelines

Practical application of the tool to calculate emissions.

Setting GHG Reduction Targets.

Q&A

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