



مرکز الإحصاء
STATISTICS CENTRE



Climate Change 2016

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Introduction

Recently, reducing the impacts of climate change has become the concern worldwide, and has become the main concern for governments and international bodies, to monitor, regulate and reduce air pollutant emissions.

International bodies and organizations are seeking to create legislation and standards to control pollutant emissions, and to develop statistics to monitor size of the production of pollutants and its impact on the climate, and the impact of temperatures rising caused by global warming, and its impact on the ecological systems in the region.

Abu Dhabi Emirate Government has paid the utmost attention to climate change; Environment Agency-Abu Dhabi issued two reports of greenhouse gas emissions inventory for the Emirate of Abu Dhabi. Therefore, SCAD would like to thank Environment Agency-Abu Dhabi and National Centre for Meteorology and Seismology for supplying SCAD with the data that influenced the development of this report.

Climate

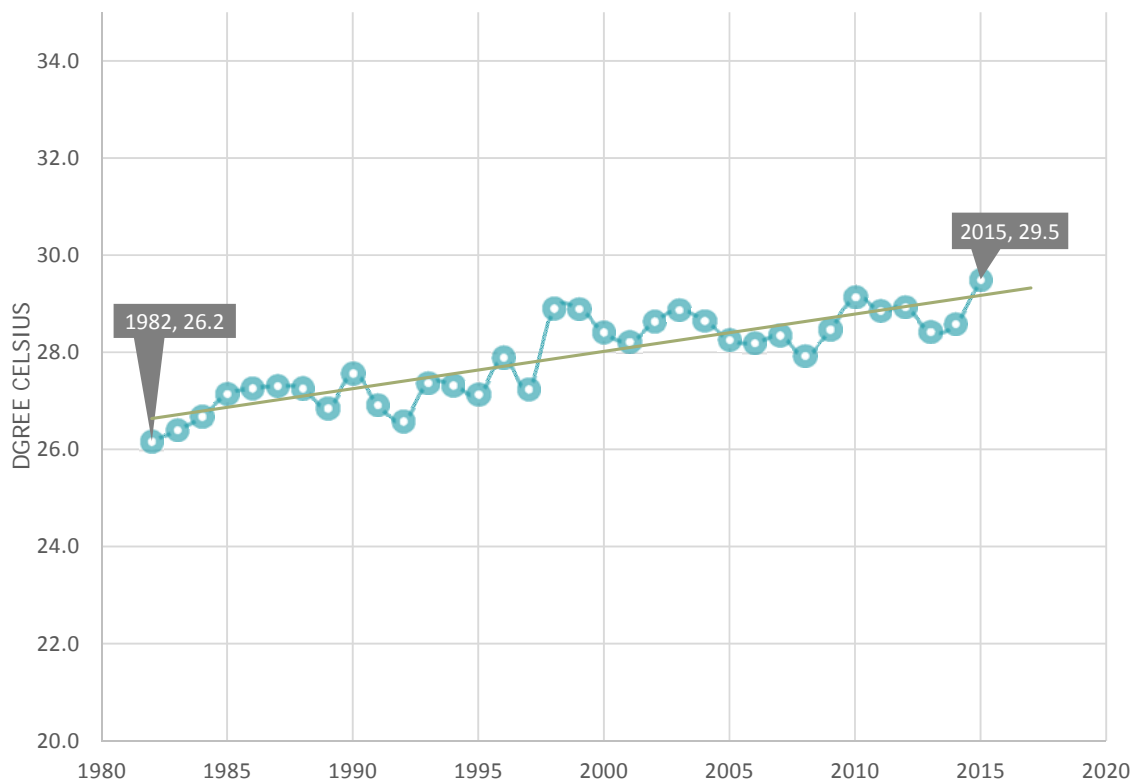
Climate change is a global phenomenon, but have local effects, which vary from one place to another on the global surface. This phenomenon known as the gradual increase of temperature in the lower layer of the atmosphere surrounding the Earth, Due to the increase of greenhouse gases such as Carbon Dioxide, Methane and emissions of CFCs. The presence of these gases is necessary to maintain the temperature of the earth, nevertheless human activities from the industrial revolution, technology and dependency on fossil fuels as the primary source of energy, has led to increase the rate of emission of greenhouse gases, which exceeds the amount atmosphere needs. As well as increment in its concentration, which led to the occurrence of global warming, increase Earth temperature more than its normal levels, due to increment in gases absorption rate of infrared radiation, causing climate change in the world.

It's been proven by the official international reports, that the climate change that has occurred in recent times, especially temperatures increment have already affected many physical and biological systems, resulting cases of floods, droughts and sea levels rising. Adapting to these changes considered as necessary strategy at all levels in all parts of the world to complement the efforts to alleviate the possibility of disturbing climate change, and the potential consequences in coastal urban areas that sets below sea level.

Annual Temperature

Current study included measurement of temperatures over the past three decades. Where the study targeted average temperature data and its alteration, taking Abu Dhabi International Airport station data as a reference for change, where it's the oldest station in the Emirate of Abu Dhabi listed so far. Figure (1) shows the steady increase in average temperatures in the Emirate of Abu Dhabi since 1982 until 2015, where the change rate of temperatures over 30 years from 1985 to 2015 reached 8.2%.

Figure (1): Annual Average Temperature in Abu Dhabi Emirate

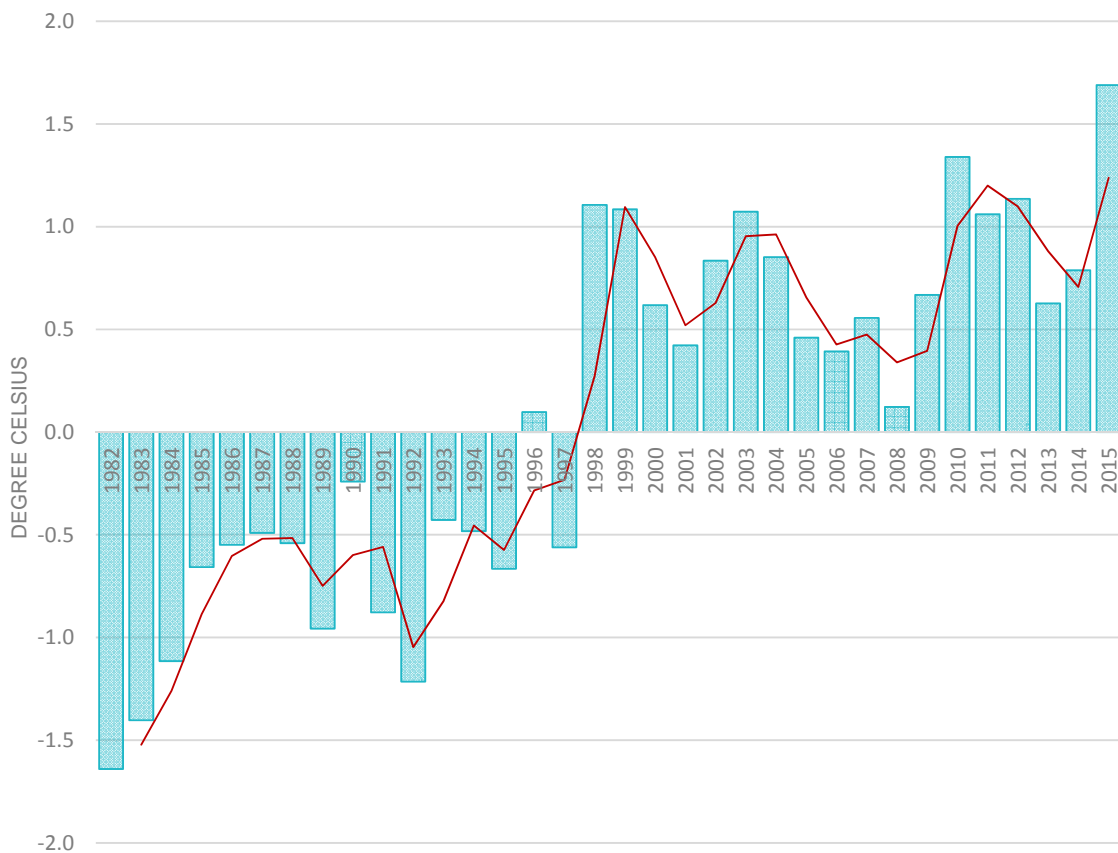


Source: National Centre of Meteorology and Seismology, Statistics Centre- Abu Dhabi

Annual Air Temperature Deviations

The following study describes deviation on average annual temperatures degrees for long-term period of 33 year, where long-term average was 27.8 Degree Celsius. Figure (2) shows, in 2015 temperature increased about 1.7 degrees Celsius above average compared to 1.6 degrees Celsius less than the long-term average in 1982. Scientists expects steady increase in temperatures over the coming decades if preventive measures have not been able to control climate change and to ensure its mission in reducing the steady increase of temperature, which will have a significant impact on global warming, snow melting and sea level rise.

Figure (2): Annual Air Temperature Deviations in Abu Dhabi Emirate

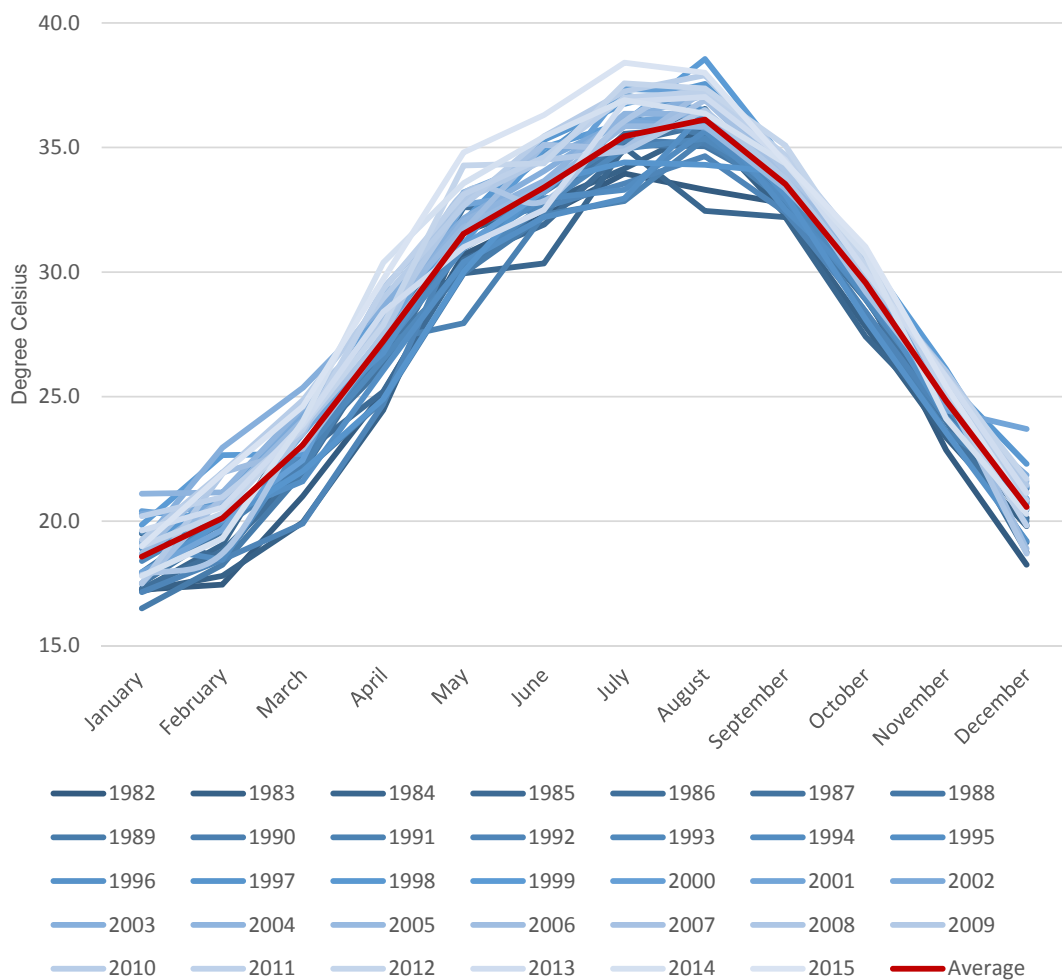


Source: National Centre of Meteorology and Seismology, Statistics Centre- Abu Dhabi

Monthly Air Temperature

Figure (3) shows the measurement of average monthly temperature during previous 33 years. Where the study shows monthly temperatures over the years compared to long-term monthly average temperature. There have been a steady increase in monthly temperatures between years 1982-2015, where the lowest average temperature over the past 33 years recorded in January 1989 at an average rate of 16.5 degrees Celsius, while the highest average temperature within the same period was in August 1999, recording 38.6 degrees Celsius.

Figure (3): Monthly Average Air Temperature in Abu Dhabi Emirate

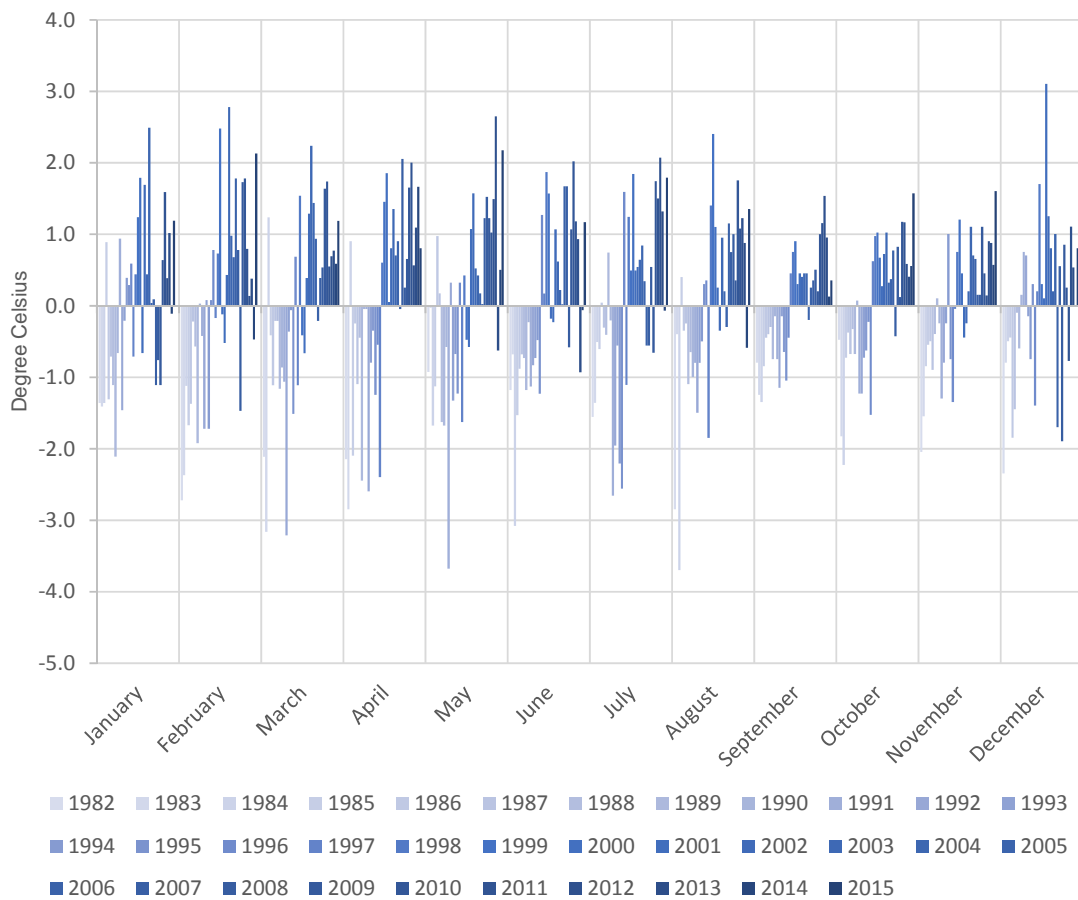


Source: National Centre of Meteorology and Seismology, Statistics Centre- Abu Dhabi

Monthly Air Temperature Deviations

Historical data shows the changes in monthly average temperatures in current period, compared to the end of last century. Figure (4) shows the changes between temperatures during the same months over the years, compared to the long-term average within the same period. As an example, in August between years 1982 and 2015, temperature were less than 2.8 degrees Celsius in 1982 than long-term average increasing up 1.4 degrees Celsius than the long-term average in 2015.

Figure (4): Variations of Monthly Temperature in Abu Dhabi Emirate

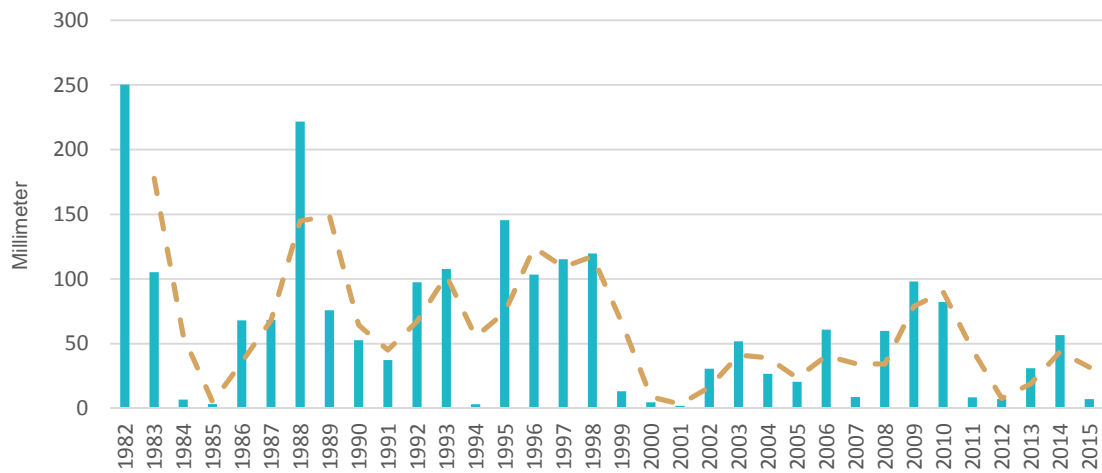


Source: National Centre of Meteorology and Seismology, Statistics Centre- Abu Dhabi.

Total Annual Rainfall

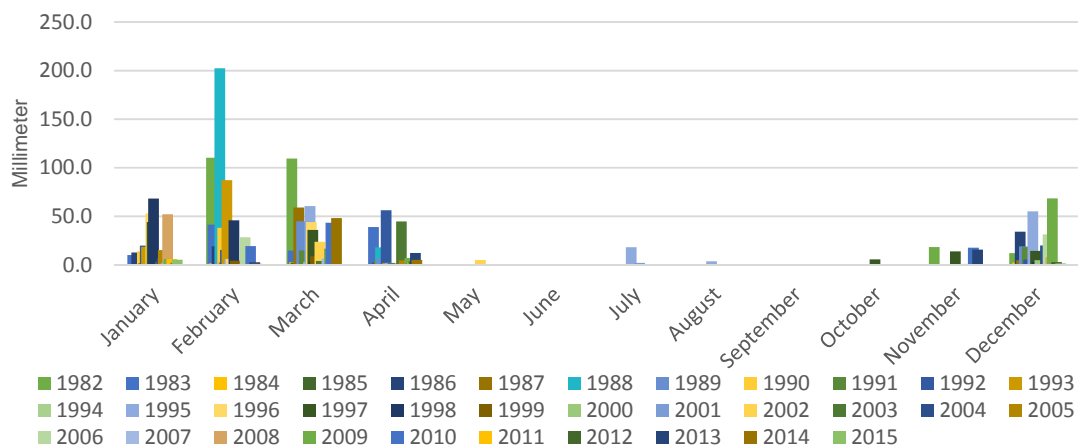
Emirate of Abu Dhabi known with its few and sudden rainfalls that falls within few days in winter season in different parts on Abu Dhabi Emirate. Rains fall during winter, spring and summer season on the mountainous areas in Al Ain region. Following study displays measuring rainfall in Abu Dhabi International Airport station only. Figure (5) shows, rainfall rates over the past 33 years, 1982 recorded the highest amount of rainfall 250.3 millimeter compared to the least amount of rainfall which were recorded in 2001 by 2.1 millimeter. As shown in Figure (6) the amount of monthly rainfall during the same period, mentioning the highest amount of rain during the 33-year-old in February 1988, which was 202.4 millimeter.

Figure (5): Annual Total Rainfall in Abu Dhabi Emirate



Source: National Centre of Meteorology and Seismology, Statistics Centre- Abu Dhabi.

Figure (6): Monthly Total Rainfall in Abu Dhabi Emirate



Source: National Centre of Meteorology and Seismology, Statistics Centre- Abu Dhabi.

Greenhouse Gases

Greenhouse gases plays an active role in raising the rate of surface temperature , to reduce the emissions, modern technologies, clean and renewable alternatives for optimal use of natural resources must be implemented. In 2012, total greenhouse gas emissions counted 115,301 Giga grams – CO₂ equivalent by an increase of 16.3% than 2010. Land-use change and forestry sector removed 4,737 Giga grams of carbon dioxide, which incorporated into the biomass amounting almost 5% of the total Carbon Dioxide (CO₂), therefore the amount of net greenhouse gas emissions in the Emirate of Abu Dhabi was 110.564 Giga grams - carbon dioxide equivalent. Table (1) shows rate of greenhouse gas emissions and Carbon Dioxide (CO₂) in the Emirate of Abu Dhabi for the years 2010 and 2012. Table (2) shows total emissions by types of greenhouse gases, Carbon Dioxide (CO₂) got the highest proportion of total emissions reaching 81.4% of the total in the Emirate of Abu Dhabi. Carbon Dioxide (CO₂) emissions per capita reached 40.5 tons in 2012 compared to 37.2 tons in 2010.

Table (1): Greenhouse gas and Carbon Dioxide Emissions in the Emirate of Abu Dhabi
(Giga gram)

Sector	Greenhouse Gas Emissions (CO ₂ -eq.)		Carbon Dioxide Emissions	
	2010	2012	2010	2012
	Energy	71,924	85,385	67,540
Industrial Processes	17,907	19,535	10,367	11,223
Land-Use Change and Forestry	- 4609	- 4,737	- 4,609	- 4,737
Agriculture	2,413	1,936	0	0
Waste	6,857	8,445	0	0
Total Emissions	99,101	115,301	77,907	93,875
Net Emissions	94,491	110,564	73,298	89,138

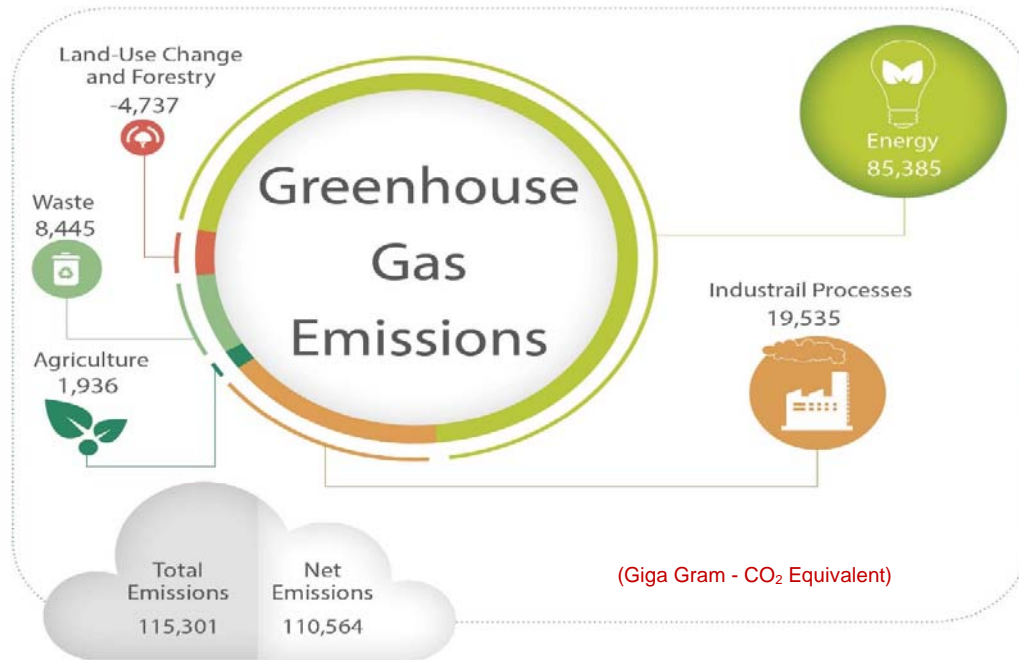
Source: Environment Agency - Abdu Dhabi - Greenhouse Gas Inventory Report .

Table (2): Total of Direct Greenhouse Gases Emissions by Gas Type

Gas	Contributing of greenhouse gas		Emissions amount (Giga gram)	
	2010	2012	2010	2012
	Carbon Dioxide (CO ₂)	78.6%	%81.4	77,907
Methane (CH ₄) - (CO ₂ -eq.)	8.8%	%10.4	8,692	12,038
Nitrous Oxide (N ₂ O) - (CO ₂ -eq.)	5.0%	%1.1	4,961	1,213
Perfluorocarbons (PFCs) - (CO ₂ -eq.)	7.6%	%7.1	7,540	8,175

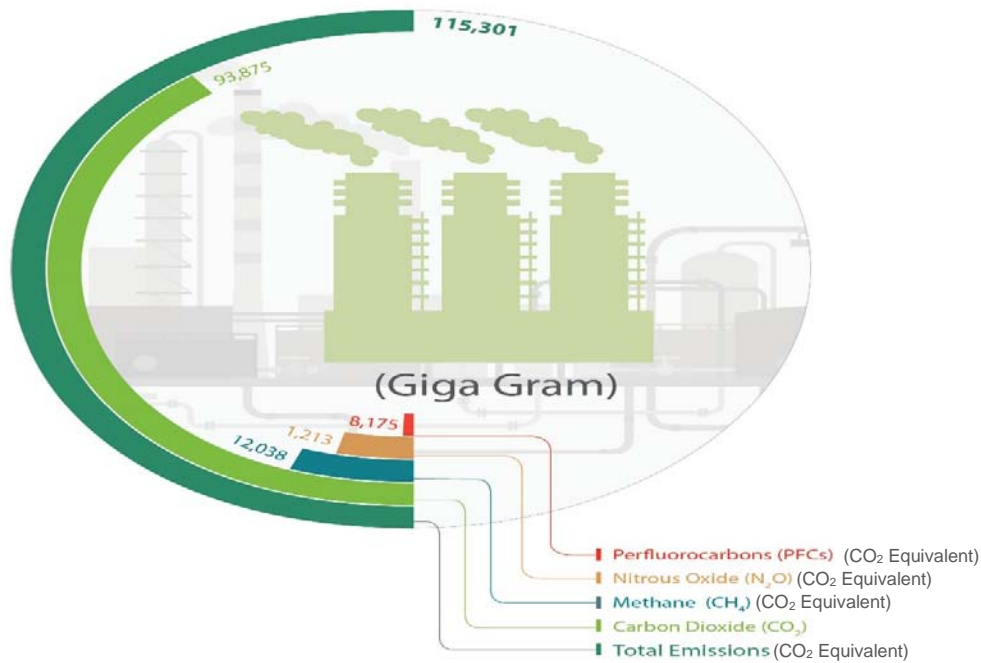
Source: Environment Agency - Abdu Dhabi - Greenhouse Gas Inventory Report .

Infographic (1): Greenhouse gas and Carbon Dioxide Emissions in the Emirate of Abu Dhabi - 2012



Source: Environment Agency - Abu Dhabi - Greenhouse Gas Inventory Report. Statistics Center – Abu Dhabi.

Infographic (2): Total of Direct Greenhouse Gases Emissions by Gas Type - 2012



Source: Environment Agency - Abu Dhabi - Greenhouse Gas Inventory Report. Statistics Center – Abu Dhabi.

Energy Sector Emissions

Energy sector emissions arise from fuel combustion or Fugitive emissions. In 2012, emissions from energy sector totaled 85.385 Giga grams – CO₂ equivalent, as shown in Table (3), producing the highest amount of emissions from energy industries (combustion) by 63% of total direct emissions of greenhouse gases from energy sector. Figure (7), shows a comparison in amounts of emissions in directions for both years 2010 and 2012 in energy sector.

Table (3): Amount of Direct Greenhouse Gas Emissions by sub-sectors of Energy Sector – 2012

(Giga gram – CO₂ equivalent)

Sector	Amount
Transport	19,372
Other Energy	424
Oil/gas Fugitives	2,148
Manufacturing	9,311
Energy Industries (combustion)	54,130
Total	85,385

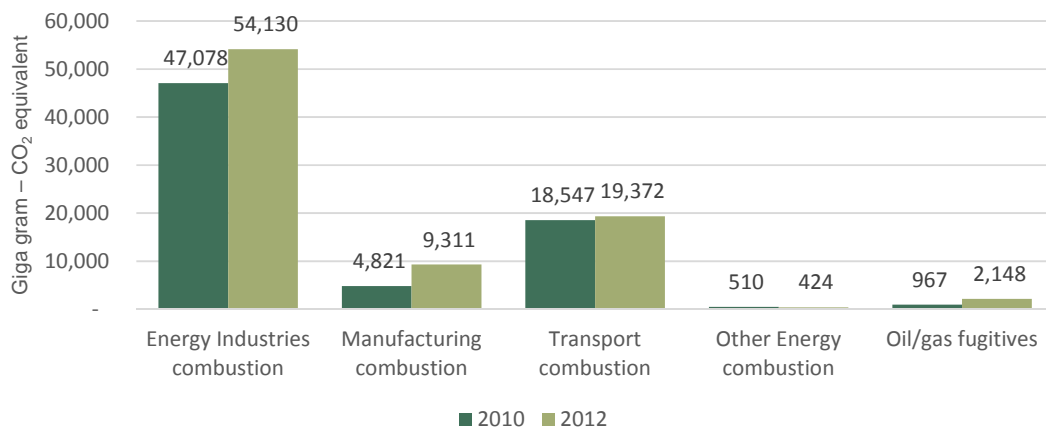
Source: Environment Agency - Abdu Dhabi - Greenhouse Gas Inventory Report .

Table (4): Total of Direct Greenhouse Gases Emissions from Energy Sector by gas type - 2012

Gas Type	Amount (Giga gram)	Percentage (%)
Nitrous Oxide (N ₂ O) - (CO ₂ -eq.)	481	0.6
Methane (CH ₄) - (CO ₂ -eq.)	2,252	2.6
Carbon Dioxide (CO ₂)	82,652	96.8
Total	85,385	100

Source: Environment Agency - Abdu Dhabi - Greenhouse Gas Inventory Report .

Figure (7): Direction of Greenhouse Gas Emissions in Energy Sector



Source: Environment Agency - Abdu Dhabi - Greenhouse Gas Inventory Report, Statistics Center – Abu Dhabi.

Industrial Sector Emissions

Industrial processes sector covers the use of greenhouse gases in products, those products results from using fossil fuel carbon in non-energy purposes. In 2012, total greenhouse gas emissions of industrial sector reached 19,535 Giga grams – CO₂ equivalent, as shown in Table (5), where carbon dioxide represents the highest proportion of the total greenhouse gases emitted by the industrial sector emissions by 57.5% of the total, Figure (8) shows the amount of emissions from the sub-sectors of the industrial sector.

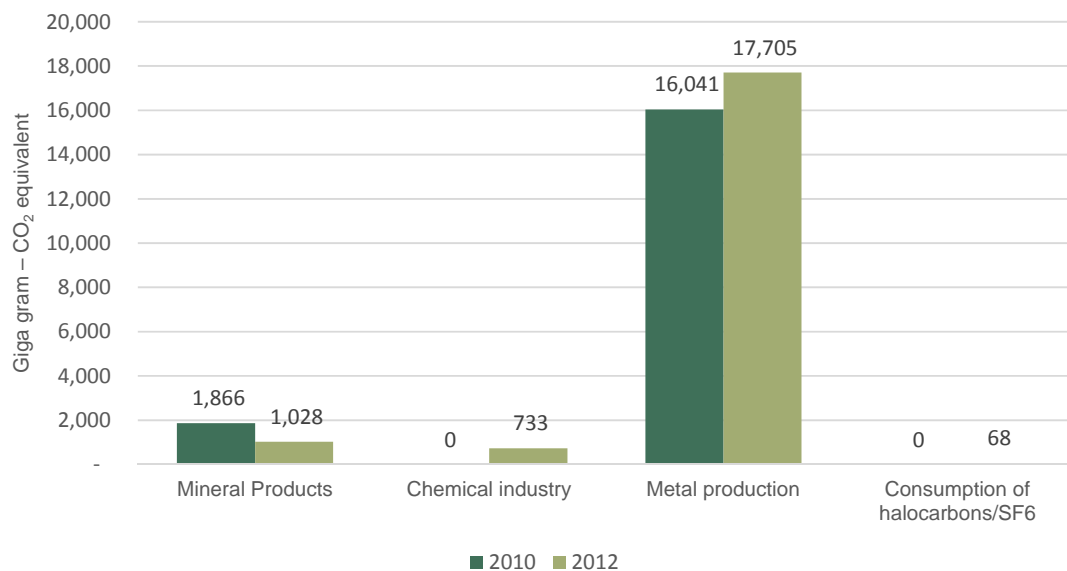
Degree Celsius

Table (5): Total of Direct Greenhouse Gases Emissions from Industry sector by gas type - 2012

Gas Type	Amount (Giga gram)	Percentage (%)
Perfluorocarbons (PFCs) - (CO ₂ -eq.)	8,175	41.8
Methane (CH ₄) - (CO ₂ -eq.)	137	0.7
Carbon Dioxide (CO ₂)	11,223	57.5
Total	19,535	100

Source: Environment Agency - Abdu Dhabi - Greenhouse Gas Inventory Report .

Figure (8): Amount of Direct Greenhouse Gas Emissions by sub-sectors from Industry sector – 2012



Source: Environment Agency - Abdu Dhabi - Greenhouse Gas Inventory Report, Statistics Center – Abu Dhabi.

Agricultural Sector Emissions

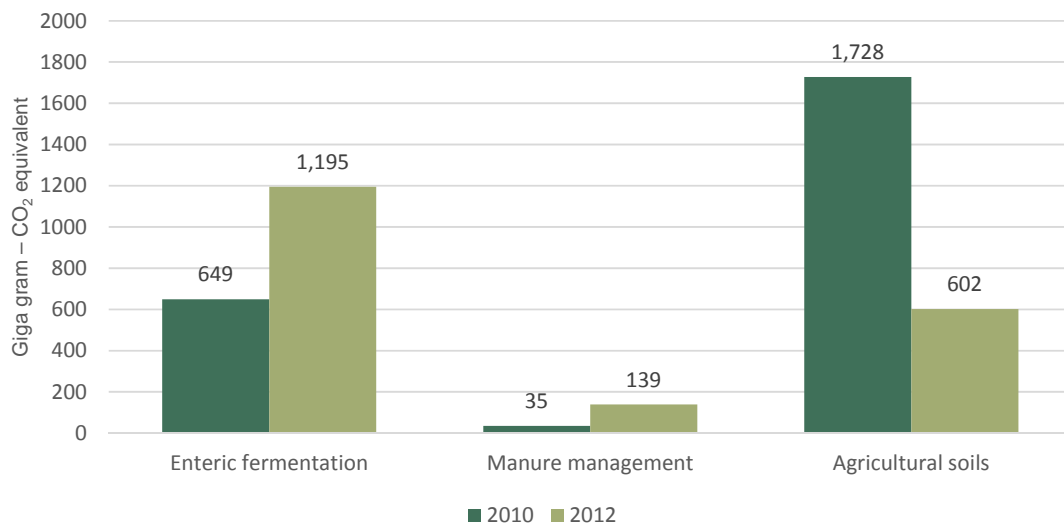
Agriculture sector includes the emissions from enteric fermentation, compost management, and agricultural soils. In 2012, total greenhouse gas emissions for agriculture sector totaled 1,936 Giga grams – CO₂ equivalent, as shown in Table (6) where is the methane recorded the highest amount of total greenhouse gases released by the agriculture sector, which accounted for 66% of the total. Figure (9) shows the amount of emissions from the sub-sectors of agriculture sector.

Table (6): Total of Direct Greenhouse Gases Emissions from Agriculture sector by gas type - 2012

Gas Type	Amount (Giga gram)	Percentage (%)
Nitrous Oxide (N ₂ O) - (CO ₂ -eq.)	659	34
Methane (CH ₄) - (CO ₂ -eq.)	1,277	66
Total	1,936	100

Source: Environment Agency - Abdu Dhabi - Greenhouse Gas Inventory Report .

Figure (9): Amount of Direct Greenhouse Gas Emissions by sub-sectors from Agriculture sector – 2012



Source: Environment Agency - Abdu Dhabi - Greenhouse Gas Inventory Report, Statistics Center – Abu Dhabi.

Waste Sector Emissions

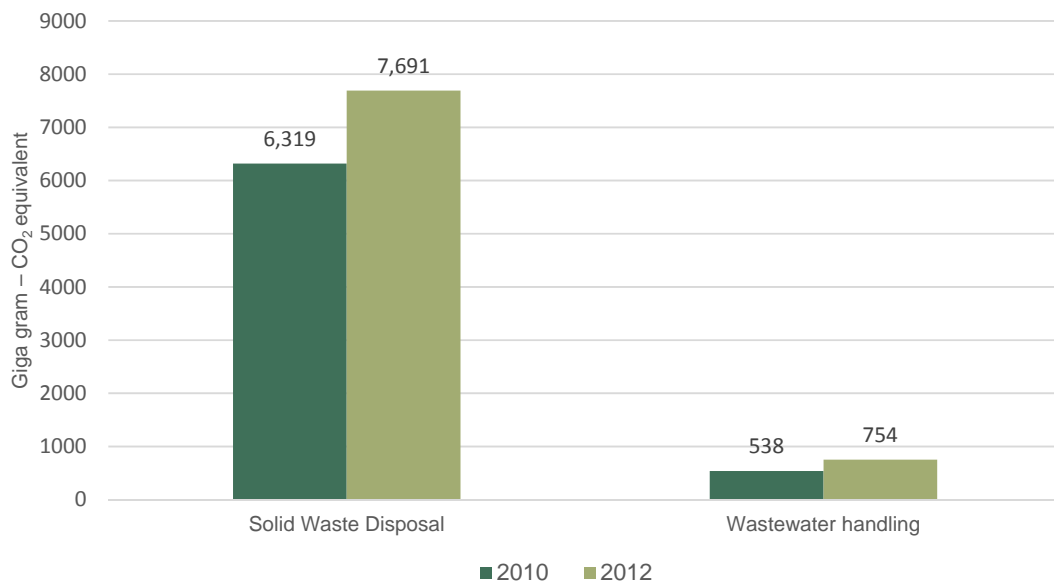
Waste sector includes emissions resulting from the impact of disposal of solid waste and emissions from sewage treatment. In 2012, greenhouse gas emissions from waste sector totaled 8,445 Giga grams – CO₂ equivalent as shown in Table (7) as methane represents the highest amount of greenhouse gases in waste by 99% of the total. Figure (10) shows amount of emissions from the sub-sectors of the waste sector.

Table (7): Total of Direct Greenhouse Gases Emissions from Waste sector by gas type - 2012

Gas Type	Amount (Giga gram)	Percentage (%)
Nitrous Oxide (N ₂ O) - (CO ₂ -eq.)	73	0.9
Methane (CH ₄) - (CO ₂ -eq.)	8,372	99.1
Total	8,445	100

Source: Environment Agency - Abdu Dhabi - Greenhouse Gas Inventory Report .

Figure (10): Amount of Direct Greenhouse Gas Emissions by sub-sectors from Waste sector – 2012



Source: Environment Agency - Abdu Dhabi - Greenhouse Gas Inventory Report, Statistics Center – Abu Dhabi.

Explanatory Notes

Glossary

- **Climate Change**

A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and / or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in landuse also Climate variability

- **Greenhouse Gases**

Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. This property causes the greenhouse effect. Water vapor (H₂O), carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄), and ozone (O₃) are the primary greenhouse gases in the Earth's atmosphere. Moreover, there are a number of entirely human- made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine- and bromine- containing substances, dealt with under the Montreal Protocol. Besides CO₂, N₂O, and CH₄, the Kyoto Protocol deals with the greenhouse gases sulfur hexafluoride (SF₆), hydro fluorocarbons (HFCs), and per fluorocarbons (PFCs).

- **Air pollution**

It is the presence of contaminant or pollutant substances a pollutant in air that do not disperse properly and interfere with human health or welfare, or produce other harmful environmental effects.

- **Global Warming**

One of the environmental risks posed by the increasing carbon dioxide and other gases gas concentration levels in the air, which results warming in a comprehensive and global, and attendant climate change may affect agricultural systems prevailing in many agricultural regions of the world total failure, this heating leads to rise sea levels over the next century, leading to the inundation of coastal areas that may be of agricultural, industrial or human density areas.

- **Carbon Dioxide (CO₂)**

It is a colorless, odorless and non-poisonous gas that results from fossil fuel combustion and is normally a part of ambient air. It is also produced in the respiration of living organisms (plants and animals), and considered to be the main greenhouse gas, contributing to climate change

- **Methane (CH₄)**

Hydrocarbon gas that has no color, non-toxic and non-flammable that arises in the anaerobic decomposition of organic compounds. Methane is a greenhouse gas and a hydrological carbon component that's part of the greenhouse gases that formed through: the decomposition of waste in landfills in isolation from oxygen, digestion of animal, decomposition of animal waste, production and distribution of natural gas, oil and coal production and uncompleted combustion of fossil fuels. Methane, one of the six greenhouse gases, which is due to reduction under the Kyoto Protocol.

- **Nitrous Oxide (N₂O)**

Relatively inert oxide of nitrogen produced because of microbial action in the soil, use of fertilizer containing nitrogen, burning of timber, and so forth. This nitrogen compound may contribute to greenhouse and ozone– depleting effects.

- **Perfluorocarbons (PFCs)**

A group of chemicals composed of carbon and fluorine only. These chemicals (predominantly CF₄ and C₂F₆) were introduced as alternatives, along with hydrofluorocarbons, to the ozone depleting substances. In addition, PFCs are emitted as by-products of industrial processes and are also used in manufacturing. PFCs do not harm the stratospheric ozone layer, but they are powerful greenhouse gases. These chemicals are predominantly human-made, though there is a small natural source of CF₄.

- **Fossil Fuels:**

Coal, petroleum and natural gas which derived from the remains of ancient plant and animal alive.

- **Climate:**

Conditions of the atmosphere at a particular location (microclimate) or region over a long period. It is the long –term summation of atmospheric elements- such as solar radiation,

temperature, humidity, precipitation type (frequency and amount), atmospheric pressure, and wind (speed and direction), and their variation.

- **Equivalent CO₂ (carbon dioxide):**

The concentration of carbon dioxide that would cause the same amount of radiative forcing as a given mixture of carbon dioxide and other greenhouse gases.

- **Fugitive Emissions:**

Intentional or unintentional release of greenhouse gases may occur during the extraction, processing and delivery of fossil fuels to the point of final use. These are known as fugitive emissions.

- **Halocarbons**

Compounds containing either chlorine, bromine or fluorine and carbon. Such compounds can act as powerful greenhouse gases in the atmosphere. The chlorine and bromine containing halocarbons are also involved in the depletion of the ozone layer.

- **Sulfur Hexafluoride (SF₆)**

A colorless gas soluble in alcohol and ether, slightly soluble in water. A very powerful greenhouse gas used primarily in electrical transmission and distribution systems and as a dielectric in electronics.

- **Composting:**

Composting is a biological process that submits biodegradable waste to anaerobic or aerobic decomposition, and that results in a product that recovered.

Data Sources

Data obtained from the National Centre of Meteorology and Seismology, Environment Agency – Abu Dhabi. The data are processed and passed to Statistic Centre – Abu Dhabi for further editing and compilation mentioned in this release.

Notes on tables

Due to rounding, totals may not equal the sum of component parts. Unless otherwise indicated, all tables in this publication relate to the Emirate of Abu Dhabi. However, when mentioned in table titles or within table cells “Abu Dhabi” refers only to the Region of Abu Dhabi and not the whole Emirate.

More information and next release

For more information about environmental statistics and other official statistics, please visit the statistics link on the SCAD website at <http://www.scad.ae>

The next release expected in December 2018.

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