

# Energy and Environment Engineering

Dr K D Yadav

Associate Professor

Environmental Section

Department of Civil Engineering

S. V. National Institute of Technology, Surat

Mobile: +91-9428398266

E mail: [kdy@ced.svnit.ac.in](mailto:kdy@ced.svnit.ac.in)



# Carbon Credit

# Definition of Carbon Credit

Carbon credit as *“a certificate showing that a government or company has paid to have a certain amount of carbon dioxide removed from the environment”*

Carbon credit as a *“generic term to assign a value to a reduction or offset of greenhouse gas emissions.. usually equivalent to one tonne of carbon dioxide equivalent (CO<sub>2</sub>-e)*

carbon credit as a *“permit that allows the holder to emit one ton of carbon dioxide” .....*which *“can be traded in the international market at their current market price*

# Carbon Credit

A carbon credit is a tradable permit or certificate that provides the holder of the credit the right to emit one ton of carbon dioxide or an equivalent of another greenhouse gases.

The main goal for the creation of carbon credits is the **reduction of emissions** of carbon dioxide and other greenhouse gases from industrial activities to reduce the effects of global warming.

**It provide a way to reduce the carbon pollution load in the atmosphere**

## Trading of Carbon Credits

Carbon credits can be traded on both private and public markets. Current rules of trading allow the international transfer of carbon credits.

The prices of carbon credits are primarily driven by the levels of supply and demand in the markets. Due to the differences in the supply and demand in different countries, the prices of the carbon credits fluctuate.

## Types of Carbon Credit

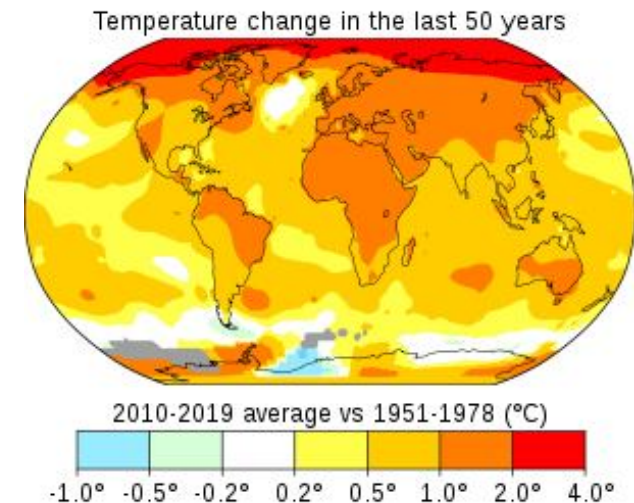
1. **Voluntary emissions reduction (VER):** A carbon offset that is exchanged in the over-the-counter or voluntary market for credits.
2. **Certified emissions reduction (CER):** Emission units (or Carbon credits) created through a regulatory framework with the purpose of offsetting a project's emission.

The main difference between the two is that there is a third party certifying body that regulates the CER as opposed to the VER.

**Global warming** occurs when carbon dioxide (CO<sub>2</sub>) and other air pollutants and greenhouse gases collect in the atmosphere and absorb sunlight and solar radiation that have bounced off the earth's surface

**Global warming** is the ongoing rise of the average temperature of the Earth's climate system and has been demonstrated by direct temperature measurements and by measurements of various effects of the warming.

Major factor responsible for global warming is green house gases.....



Average global temperatures from 2010 to 2019 compared to a baseline average from 1951 to 1978. Source: NASA.

## **Greenhouse gas** (sometimes abbreviated **GHG**)

A gas that absorbs and emits radiant energy within the thermal infrared range. Greenhouse gases cause the greenhouse effect on planets. The primary greenhouse gases in Earth's atmosphere are water vapor (H<sub>2</sub>O), carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and ozone (O<sub>3</sub>).

## **Clean Development Mechanism (CDM)**

**CDM** is one of the Flexible Mechanisms defined in the Kyoto Protocol (IPCC, 2007) that provides for emissions reduction projects which generate Certified Emission Reduction units (CERs) which may be traded in emissions trading schemes.

**Certified Emission Reductions (CERs)** are a type of emissions unit (or carbon credits) issued by the Clean Development Mechanism (CDM) Executive Board for emission reductions achieved by CDM projects and verified by a DOE (Designated Operational Entity) under the rules of the Kyoto Protocol.

## History of Carbon Credit:

The concept of carbon credits came into existence as a result of increasing awareness of the need for controlling emissions.

The mechanism was formalized in the Kyoto Protocol, an international agreement between more than 170 countries, and the market mechanisms were agreed through the subsequent Marrakesh Accords.

**Kyoto Protocol** is an international treaty which extends the 1992 United Nations Framework Convention on Climate Change (UNFCCC) that commits state parties to reduce greenhouse gas emissions, based on the scientific consensus that (part one) global warming is occurring and (part two) it is extremely likely that human-made CO<sub>2</sub> emissions have predominantly caused it. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. There are currently 192 parties (Canada withdrew from the protocol, effective December 2012) to the Protocol.

**United Nations Framework Convention on Climate Change (UNFCCC)** is an international environmental treaty adopted on 9 May 1992 and opened for signature at the Earth Summit in Rio de Janeiro from 3 to 14 June 1992. It then entered into force on 21 March 1994, after a sufficient number of countries had ratified it. The **UNFCCC objective is to "stabilize greenhouse gas concentrations in the atmosphere** at a level that would prevent dangerous anthropogenic interference with the climate system



# Kyoto protocols ????



- As a part of United national frame work on climate change the “Kyoto Protocol” was established to create policies and measures to reduce green house gas (GHG) emissions.
- Kyoto protocol requires industrialized nations to reduce their green house gases.

Source: slideshare.net

# Carbon Check (India) Private Ltd

Carbon Check (India) Private Limited is a certification body with headquarters in New Delhi, India. We started as a marketing office to Carbon Check (Pty) Ltd in 2012 and have been operating ever since. In eighty-first meeting of the Executive Board of UNFCCC in Lima, Peru the accreditation was transferred from Carbon Check (Pty) Ltd to Carbon Check (India) Private Limited.

Carbon Check (Pty) Ltd started as the only accredited Designated Operational Entity (DOE) on the African continent, situated in Johannesburg, South Africa. Carbon Check was founded in 2009. In April 2011 at EB60 the Executive Board of the CDM granted Carbon Check "Designated Operational Entity" status.

Carbon Check is accredited, certified, or recognized, for providing verification and validation services in each respective regime as applicable, by the.....

1. United Nations Framework Convention on Climate Change (UNFCCC)
2. Verified Carbon Standard (VCS)
3. Gold Standard Foundation (GS)
4. Social Carbon
5. California Air Resource Board (ARB)
6. Climate, Community & Biodiversity (CCB) Standards

For more details please refer <https://www.carboncheck.co.in/>

## Carbon credits in India – Facts

- India signed the Kyoto protocol in August 2002.
- India is the 2<sup>nd</sup> largest seller of carbon credits globally with 489 CDM projects.
- The average annual CERs from registered projects during July 2008 to February 2009 grew by 20.92%
- Indian projects are estimated to receive 246 million CER's by December 2012.

**Certified Emission Reductions (CER's)  
Clean Development Mechanism (CDM)**

## Outlook for India

- Delhi metro has been certified by the United nations as the first metro rail-based system in the world to get carbon credit for reducing pollution by 6.3 lakhs tons every year.
- The organization has also earned carbon credit worth Rs. 47 crores.
- No other metro in the world could get the carbon credit for above because of stringent requirements
- Delhi metro has helped to remove more than 91000 vehicles from the roads of Delhi
- Every passenger who chooses to travel by metro, contributes in the reduction of emissions to the extent of 100 grams of carbon dioxide for every trip of 10 kms.

**Refer the important link related to Carbon Credit**

<https://www.carbonfootprint.com/calculator.aspx>

**Carbon footprint calculator**

<https://carbonfund.org/calculation-methods/>

**Calculation Methods for CO<sub>2</sub>**

<https://academic.oup.com/ijlct/article/9/1/52/665521>

**Estimation of carbon credit and direct carbon footprint by solar photovoltaic cells in West Bengal, India**

<https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references>

**Greenhouse Gases Equivalencies Calculator**

# Carbon Credit Traders In India



- Andhyodaya Green Energy
- Grasim Industries Ltd.
- Indo Gulf Fertilizers
- Indus Technical & Financial Consultants Ltd
- Madhya Pradesh Rural Livelihoods Project
- Rajasthan Renewable Energy Corporation
- Reliance Energy Ltd.
- Tata Motors Limited
- Tata Steel Limited
- Bajaj Finserv Limited
- Dhariwal Industries Ltd
- Tata Power Company Limited
- BlueStar Energy Services Inc.
- Valera Global Inc.



## How to calculate the CO<sub>2</sub> emission from the fuel consumption?

### Diesel:

1 liter of diesel weighs 835 gram. Diesel consist for 86.2% of carbon, or 720 gram of carbon per liter diesel. In order to combust this carbon to CO<sub>2</sub>, 1920 gram of oxygen is needed. The sum is then  $720 + 1920 = 2640$  gram of CO<sub>2</sub>/liter diesel.

An average consumption of 5 liters/100 km then corresponds to  $5 \text{ L} \times 2640 \text{ g/L} / 100 \text{ (per km)} = 132 \text{ g CO}_2/\text{km}$ .

### Petrol:

1 liter of petrol weighs 750 gram. Petrol consists for 87% of carbon, or 652 gram of carbon per liter of petrol. In order to combust this carbon to CO<sub>2</sub>, 1740 gram of oxygen is needed. The sum is then  $652 + 1740 = 2392$  gram of CO<sub>2</sub>/liter of petrol.

An average consumption of 5 liters/100 km then corresponds to  $5 \text{ L} \times 2392 \text{ g/L} / 100 \text{ (per km)} = 120 \text{ g CO}_2/\text{km}$ .

### LPG:

1 liter of LPG weighs 550 gram. LPG consists for 82.5% of carbon, or 454 gram of carbon per liter of LPG. In order to combust this carbon to CO<sub>2</sub>, 1211 gram of oxygen is needed. The sum is then  $454 + 1211 = 1665$  gram of CO<sub>2</sub>/liter of LPG.

An average consumption of 5 liters / 100 km then corresponds to  $5 \text{ L} \times 1665 \text{ g/L} / 100 \text{ (per km)} = 83 \text{ g of CO}_2/\text{km}$ .



Density -  $\rho$  - and specific volume of some commonly used fuels:

Fuel	Density@15°C - $\rho$ -		Specific Volume - $v$ -	
	(kg/m <sup>3</sup> )	(lb/ft <sup>3</sup> )	(m <sup>3</sup> /1000 kg)	(ft <sup>3</sup> per ton)
Anthracite	720 - 850	45 - 53	1.2 - 1.4	42 - 50
Bituminous coal	690 - 800	43 - 50	1.2 - 1.5	45 - 52
Butane (gas)	2.5	0.16	400	14100
Charcoal, hard wood	149	9.3	6.7	240
Charcoal, soft wood	216	13.5	4.6	165
Coke	375 - 500	23.5 - 31	2.0 - 2.7	72 - 95
Diesel 1D <sup>1)</sup>	875	54.6	1.14	40.4
Diesel 2D <sup>1)</sup>	849	53	1.18	41.6
Diesel 4D <sup>1)</sup>	959	59.9	1.04	36.8
EN 590 Diesel <sup>2)</sup>	820-845	51-53	1.18-1.22	42-43
Gas oil	825-900	51-56	1.1-1.2	36-43
Gasoline	715-780	45-49	1.3-1.4	45-49
Fuel Oil No.1 <sup>3)</sup>	750-850	47-53	1.2-1.3	42-47
Fuel Oil No.2 <sup>3)</sup>	810-940	51-59	1.1-1.2	38-44
Heavy fuel oil	800-1010	50-63	1.0-1.3	35-44
Kerosene	775-840	48-52	1.2-1.3	42-46
Natural gas (gas)	0.7 - 0.9	0.04-0.06	1110-1430	39200-50400
Peat	310 - 400	19.5 - 25	2.5 - 3.2	90 - 115
Propane (gas)	1.7	0.11	590	20800
Wood	360 - 385	22.5 - 24	2.5 - 2.8	90 - 100

Note 1) Diesel fuels are in USA broken up into 3 different classes: **1D**, **2D** and **4D**. The difference between these classes depends on *viscosity* and *boiling point ranges*. **4D** fuels tend to be used in low-speed engines. **2D** fuels are used in warmer weather and are sometimes mixed with **1D** fuel to create a competent winter fuel. **1D** fuel is preferred for cold weather as it has a lower viscosity. It used to be standard to see the fuel number on the pump, but a lot of gas stations do not state the fuel number anymore.

Note 2) European diesel standard from 2005

Note 3) Fuel oil is a kind of product with a lot of classes and under classes as well as varying specifications in different markets. The density ranges given represents the variation, however, some products may be outside these ranges.

- ❖ Diesel density: 820-860 g/m<sup>3</sup>
- ❖ Petrol ( Gasoline) density: 710-770 g/m<sup>3</sup>
- ❖ LPG density: 525-580 g/m<sup>3</sup>
- ❖ CNG density: 700-900 g/m<sup>3</sup>

Bio-**CNG** contains about 92-98 % of methane and only 2-8 % **carbon** dioxide.

[https://www.mrpl.co.in/sites/default/files/Indian\\_Standard\\_Specification\\_Fo  
r\\_Petroleum\\_Products-2019.pdf](https://www.mrpl.co.in/sites/default/files/Indian_Standard_Specification_Fo_r_Petroleum_Products-2019.pdf)

INDIAN STANDARD FOR PETROLEUM PRODUCTS SPECIFICATION FOR YEAR  
2019

Calculate the CO<sub>2</sub> emission load in the SVNIT Campus with following data.....

1. 150 number Cars with diesel fuel runs daily 12 kilometre (25kmpl)
2. 75 number Cars with petrol fuel runs daily 15 kilometre (20kmpl)
3. 15 number Cars with CNG/ LPG fuel runs daily 10 kilometre (15kmpl)
4. 175 number two wheelers with petrol fuel runs daily 30 kilometre (40kmpl)

Density ( g/m<sup>3</sup>): Diesel: 850, Petrol: 750,CNG:550

Carbon(%): Diesel: 85, Petrol: 82,CNG:80

Thank You