Classroom

In this section of Resonance, we invite readers to pose questions likely to be raised in a classroom situation. We may suggest strategies for dealing with them, or invite responses, or both. “Classroom” is equally a forum for raising broader issues and sharing personal experiences and viewpoints on matters related to teaching and learning science.

Carbon Credits: Project Based Learning to Enhance Conceptual Understanding

Environmental science is a mandatory subject for engineering freshmen in all branches in India. Students learn various topics related to the environment such as ecosystem, natural resources, renewable and non-renewable resources, biodiversity, conservation of biodiversity, environmental pollution, greenhouse gases, global warming, ozone depletion, Kyoto protocol, Montreal protocol, the concept of green building, low carbon lifestyle, etc. One of the important concepts in reducing greenhouse gas emissions (mainly carbon dioxide) is the concept of ‘carbon credits’. Various books and websites explain carbon credits but none in a manner easily comprehensible to freshman engineering. An earnest attempt is made in this short didactic article to explain carbon credits lucidly. No new concept is conveyed in this short article; it only ameliorates classroom teaching. Further, a project-based learning (PBL) activity is suggested, which can enhance students’ comprehension of the concept of trading carbon credits. This topic can also be taught in engineering chemistry.

R. Sanjeev
Department of Chemistry
Geethanjali College of Engineering and Technology
Cheeryal 501 301, Telangana.

R. Veda Vrath
Department of Chemistry
L. N Gupta Evening College
Hyderabad 500 002, India.

Pandiri Sreedhar
Department of Chemistry
Geethanjali College of Engineering and Technology
Cheeryal 501 301, Telangana.

Anikumar Ambala
Department of Chemistry
Geethanjali College of Engineering and Technology
Cheeryal 501 301, Telangana.

V. Jagannadhram
Department of Chemistry
Osmania University, Hyderabad
500 007, India.
Email: jagannadham1950@yahoo.com

*Vol.27, No.4, DOI: https://doi.org/10.1007/s12045-022-1356-8
Introduction

Before we plunge to understand the concept of carbon credits, let us understand the greenhouse effect and enhanced greenhouse effect, i.e., global warming. One of the books followed by freshman engineering for their mandatory environmental science course is *Environmental Studies* by Anubha Kaushik and C. P. Kaushik. This book [1], very lucidly explains the greenhouse effect and enhanced greenhouse effect. The greenhouse effect and enhanced greenhouse effect explained in this book [1], verbatim, is described in the following discussion.

Discussion

Troposphere, the lowermost layer of the atmosphere, traps heat by a natural process due to the presence of certain gases. This effect is the greenhouse effect, similar to the warming effect observed in horticulture greenhouses made of glass. The short-wavelength radiations from the Sun pass through the atmosphere and reach the Earth. However, the long-wavelength radiations emitted by the warm Earth’s surface are partly absorbed by some gases in the atmosphere. These gases are called greenhouse gases (GHG). Since long-wavelength radiations are heat radiations, their absorption by GHG heats the atmosphere, which radiates some energy (heat) back to the Earth and some to the space.

This naturally occurring phenomenon is called the greenhouse effect. Due to this phenomenon, the temperature of the Earth’s surface increases. The amount of heat trapped in the atmosphere depends mostly on the concentrations of ‘heat trapping’ or greenhouse gases and the length of time they stay in the atmosphere. The major GHGs are carbon dioxide, ozone, methane, nitrous oxide, chlorofluorocarbons, and water. It is because of the greenhouse effect that the average temperature on Earth remains 15°C. Had there been no greenhouse effect, the Earth’s temperature would have been -18°C, and most of the species wouldn’t have survived. Hence, this natural warming of the Earth by the phenomenon of the greenhouse effect is essential.
The foregoing paragraph [1] explains the need for the presence of greenhouse gases. But due to anthropogenic activities like vehicular pollution, industrial pollution, deforestation, massive use of air conditioners, etc., the concentration of GHGs in the atmosphere is increasing appreciably. This is increasing the average surface temperature beyond 15°C. This phenomenon is known as the ‘enhanced greenhouse effect’ or ‘enhanced global warming’ or simply ‘global warming’. It goes without saying that global warming has detrimental effects on various ecosystems. Concerted efforts are being made globally to reduce the concentration of GHGs. Scientists and financial wizards of the world have come out with an amazing solution to reduce the GHGs—the trading of carbon credits. To understand the concept of carbon credits, let us consider the following imaginary example of carbon dioxide emission by an industry in India.

A private chemical manufacturing industry in India is emitting (say) 50,000 tons of carbon dioxide per month. It is a known fact that carbon dioxide is the rogue gas responsible for global warming. But the government rules of the state allow the industry to emit only (say) 30,000 tons of carbon dioxide per month. Either the owner of this industry has to reduce his/her emissions by 20,000 tons, or if this is not possible, he/she has to be penalized monetarily. The monetary penalty does not safeguard the environment. Reducing the emissions by changing the manufacturing process might hamper his/her profits considerably and the revenue generated for the state. A viable trade-off between the profits, eventually the revenue generated for the state, and reducing the emission of this rogue gas is the business of carbon credits. What the owner can do is, rent a forest from an underdeveloped country (say) Eritrea for the next 20 years (assuming that the owner would run this industry for 20 years), to the extent that it absorbs 20,000 tons of carbon dioxide per month. The forest serves as a carbon sink for the absorption of 20,000 tons of carbon dioxide per month for the next 20 years. It is the responsibility of the owner to safeguard the forest for the next 20 years. By doing so, not only is the underdeveloped county making money, but the
forest cover is also safeguarded.

This manner of trading carbon dioxide emissions is the business of carbon credits. The owner of the chemical industry is not only penalized for the excess emissions but he/she is also involved in offsetting the excess carbon dioxide emissions. In one part of the world (India), an industry is involved in excess emissions of rogue gas, and in the other part of the world (Eritrea), the excess emissions are neutralized. Globally, the excess carbon dioxide emissions are neutralized. If this Earth-centric business of carbon credits thrives, the environment of the Earth would be far better in the future.

Having understood what carbon credits is, students can carry out a 'project-based learning (PBL) activity' for their college/university. Let the students have a look at the past year's power bills of their college/university. Say, they find that the average consumption is about Rs. 10 lakhs per month. Then, the students should calculate the amount of coal burnt, and as a consequence, the carbon dioxide emitted per month for the consumption of the conventional power. Let us say, the carbon dioxide emitted is 10,000 tonnes per month. If their college/university switches to solar panels, it results in the reduction of their emission of carbon dioxide by 10,000 tonnes per month. Thus certified emission reduction (CER) credits can be earned, each equivalent to one ton of carbon dioxide. The carbon credits earned can be sold to the appropriate authority. By carrying out this PBL, the concept of carbon credits is crystallized, and the monetary calculations (in the long run) projected would enable the college to save money. Further, it goes without saying, if the college/university installs solar panels, it conforms to eco-friendly practices, which is extremely essential for the well-being of the environment.

Before concluding this article, to mention, the money earned through the trading of carbon credits by the Delhi Metro Rail Corporation (DMRC) [1]. The DMRC earns Rs. 47 crores per year. About 18 lakh people, who were traveling by cabs, cars, buses, two/three-wheelers, are now using the metro rail, thus, reducing carbon dioxide emissions. These certified emission reduction
(CER) credits have been traded as carbon credits resulting in the revenue generation of Rs. 47 crores per year.

**Conclusion**

The reduction of carbon dioxide emissions is of paramount importance globally. Hence, a conceptual understanding of the trading of carbon credits is essential not only for the students of environmental science but for people of many walks of life. Once the students enter their professions, they can endeavor to implement this wherever possible.

**Suggested Reading**