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Carbon Pricing Models to Attain 'Net Zero'

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ABSTRACT

Purpose: The objective of the study is to analyze the carbon pricing models that can be used to attain 'Net Zero'. The paper discusses the top 5 countries that are emitters of CO_2 emissions and their commitment towards attaining 'Net Zero'. The ever-increasing Greenhouse Gases (GHG) emissions due to use of fossil fuels pose a significant risk to global development, sustainability and health. Many countries have announced ambitious targets to achieve 'Net Zero' within this century to combat the rising GHG emissions. Carbon pricing models vary from Emission Trading Systems (which can be in the form of baseline-and-credit systems or cap-and-trade) to carbon tax systems. The paper also discusses the recently introduced Carbon Credit Trading Scheme 2023 introduced in India and the way forward.

Design/Methodology/Approach: The paper analyses various studies about carbon pricing models that can be used to attain 'Net Zero'. In addition, the paper discusses some of the measures taken by other countries to combat GHG emissions.

Findings: Two methods of reducing carbon emissions are discussed- Carbon Tax and Emission Trading System (ETS). Carbon tax model provides certainty on the carbon pricing but it may not significantly curtail emissions as polluters who are willing to pay the tax can emit GHG. On the other hand, ETS, is proven to be more effective in meeting GHG reduction targets but it might result in efficiency losses which can be overcome by allowing trading between GHG emitters and GHG savers.

Originality/Value: Governments across the world have committed to achieve 'Net Zero' and carbon pricing models are the core instruments to reach this target. Various countries have/are experimenting with different forms of such carbon pricing models and hence, this topic is highly relevant in today's discussion to achieve sustainability and reduce global warming.

Paper Type: Theme Based Paper

KEYWORDS: Greenhouse Gas (GHG) | Carbon Emissions | Cap-and-Trade | Emissions Trading System (ETS) | Carbon Credits | Carbon Tax

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Introduction

According to UN SDG Report (2023), the world temperature will rise by 1.5 degrees by 2035 and is projected to increase by 2.5 degrees by 2100. There is an urgent need to reduce GHG emissions by 43 percent by 2030 and Net Zero by 2050.

In last decade itself the rate of sea-level rise has almost doubled. (UN, SDG Report, 2023). This points to worrisome situation at the world level. In the year 2019-20, the finances for climate change touched annual average of 803 billion dollars at the global level. The developing countries would need approximately 6 trillion dollars by 2030 to combat climate change (UN, SDG Report, 2023).

The last century was marked by an increasing awareness of risks pertaining to climate change and the need to control and reduce greenhouse gas (GHG) emissions. This was mainly driven by the rapidly increasing carbon dioxide and GHG emissions from the ever-increasing use of fossil fuels. Over the past two decades, China has outnumbered all other countries in CO_2 emissions followed by the United States. India is the third largest emitter of annual CO_2 emissions globally. The following graph depicts the top ten countries and their annual CO_2 emissions since 2001.

The signing of the UN Framework Convention on Climate Change (UNFCC) in 1992, when the signatory countries agreed upon the need to reduce GHG emissionswas the first formal acceptance by nations to control emissions and reduce the impact of climate change. This was followed by the Kyoto Protocol wherein nations pledged to limit their GHG emissions, and subsequently signing of the landmark Paris Agreement in 2015.

The Paris Agreement requires all signatory nations to limit the increase in global average temperature to below 2°C above pre-industrial emission levels and to pursue efforts to curtail the temperature increase to 1.5°C in order to reduce the impacts of climate change. These declarations and multi-national agreements resulted in countries adopting various measures to control GHG emissions. Some of these measures have included the introduction of carbon tax, emissions trading, carbon credits etc. Many countries have also pledged to achieve 'Net Zero' emissions and such models of emissions reduction and control have become even more relevant. "Net Zero' means cutting greenhouse gas emissions to as close to zero as possible, with any remaining emissions re-absorbed from the atmosphere, by oceans and forests for instance" (UN Climate change website- https://www.un.org/en/climatechange/net-zero-coalition)

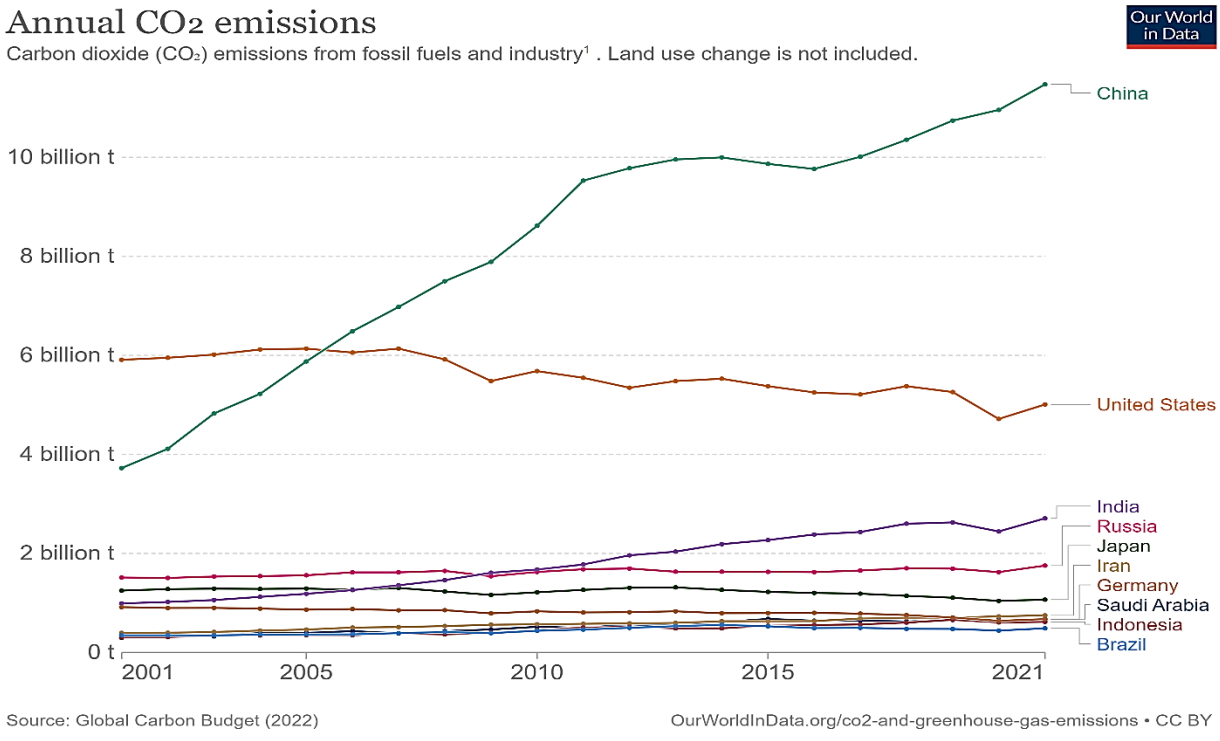

Figure 1: Annual CO_2 Emissions from Fossil Fuels and Industry (2001 - 2021) - Top 10 Countries (by metric tons)

***Source**: https://ourworldindata.org

To achieve 'Net Zero' targets, countries have adopted a variety of measures including transitioning from fossil fuel-based energy to renewable and sustainable energy sources. To enable this transition, a significant number of countries have enacted legislative reforms that include 'Net Zero' as one of their primary goals. Another significant category of reforms that have been adopted by countries include measures for carbon removals and offsets. Additionally, many companies have independently pledged to achieve 'Net Zero' in their respective business areas over the next few decades. The Table No. 1 below shows the year by which the top 5 countries (according to CO_2 emissions) aim to attain Net Zero emissions.

Table 1: Net Zero Scorecard 2023

Country	Year	Action
China	2060	In Policy Document
United States	2050	In Law
India	2070	In Policy Document
Russia	2060	In Policy Document
Japan	2050	In Law

***Source**- Energy and Climate Intelligence Unit 2023

Such commitments and actions by countries and companies have resulted in the creation and growth of different forms of carbon markets. Such carbon markets and their respective benefits and disadvantages are discussed in the following sections. In Section 2, carbon markets are explained and the next section discusses the carbon pricing schemes in various countries and the last section concludes the study.

About Carbon Markets

Carbon markets are trading platforms that enable purchase and sale of carbon credits. Such carbon credit markets enable companies and individuals to compensate for their GHG emissions by purchasing carbon credits from entities that eliminate or decrease such emissions. There are broadly two types of carbon markets: voluntary and compliance markets. Voluntary carbon markets at the national and international levels enable voluntary issuance, purchase and sale of carbon credits, while policy and/or regulatory obligations at the national, regional or global level are utilized by countries to enable compliance markets.

The currently available voluntary carbon credits originate mainly from business organizations implementing carbon projects or governments implementing programs certified by carbon standards that have resulted in reductions in emissions and/or complete removals. Such demand for carbon credits originates from private individuals seeking to offset their carbon footprints, from organizations that aim to achieve their corporate sustainability goals, and other players looking to profit by trading such credits.

As per the World Bank Report on 'State and Trends of Carbon Pricing' (2023), countries have adopted varying mechanisms for carbon pricing. The most common mechanism is the use of direct carbon pricing instruments, such as Emissions Trading Systems (ETS), carbon taxes, and carbon credit mechanisms. Such direct carbon pricing models involve the application of incentives directly proportional to GHG emissions produced.

ETS permits emitters to trade in emission units to enable them achieve their emissions targets. To ensure compliance with emission targets at the least possible costs, the entities (organizations or individuals) can either adopt internal emissions-abatement measures or participate in trading of emissions units in carbon markets, based on the relative costs of these mechanisms. An ETS provides surety of environmental impact, although the carbon trading price remains flexible. Cap-and-trade and baseline-and-credit are the two primary forms of ETSs. Cap-and-trade systems impose a cap or absolute limit on emissions. Baseline-and-credit systems are systems where a baseline for the emissions levels is defined for specific entities and credits are granted to entities that reduce their emissions below the baseline level. The figure below describes the cap-and-trade market economics:

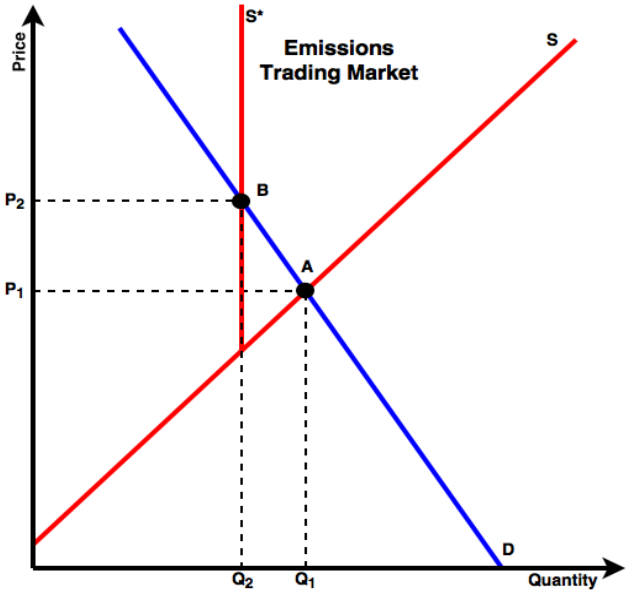

Figure 2: Impact of an Emissions-Trading Framework / System on the Market

***Source**: Energy Education, Encyclopedia, University of Calgary

In Figure No. 2, the horizontal axis shows the quantity of emissions and the vertical axis shows the price of emissions.With the free market forces of demand and supply, equilibrium is attained at point A where supply (S) and demand (D) intersect. The equilibrium price of emissions is P1 and quantity is Q1. When the government imposes a cap on the emissions the supply curve becomes vertical, that is completely inelastic and becomes unresponsive to any change in price. The new supply curve is S*, the new equilibrium is attained where S* and D intersect (point B). The new equilibrium quantity falls to Q2 and the price increases to P2. One of the major drawbacks of this system is that by putting a cap on emissions limits production which can lead to efficiency losses as indicated by the triangular region in the diagram. However, the trading of emission permits amongst more and less polluting firms can offset these efficiency losses.

Another mechanism to reduce the emissions is by specifying the rate of taxation on GHG emissions or the carbon content of fossil fuels, i.e., a price per CO_2e (CO_2 equivalent), a carbon tax explicitly establishes a price on carbon emissions. The figure below describes the impact of carbon tax on the economy. The Y-axis depicts the price of emissions and X-axis the quantity of emissions. Since carbon emissions impose negative externality wherein the emissions have an adverse effect on others. A tax on carbon is a way to ensure the emitter faces the correct cost of its actions and is a way to internalize the negative externality.

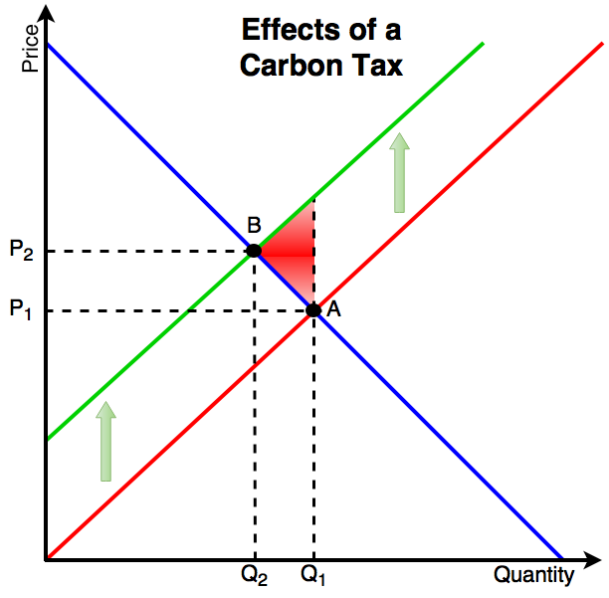

Figure 3: Impact of Carbon Tax on the Economy

*__Source__: Energy Education, Encyclopedia, University of Calgary

In Figure No. 3 above, the Y axis shows the price of carbon and X axis the quantity of carbon. According to the market forces of demand and supply, the equilibrium is attained at point A where demand and supply intersect. The equilibrium price and quantity are P1 and Q1 respectively. This outcome is not socially efficient as carbon imposes negative externality on others. Because the producer doesn't take into account the negative effect on others it tends to overproduce and hence, over pollute. In order to offset these effects, the imposition of tax on carbon shifts the supply curve upwards and the price increases to P2 and quantity falls to Q2. This reduces the demand for fossil fuel products and the tax generates revenue for the governments to be able to invest in cleaner technologies.

This method has an advantage over ETS, as it does not put a cap on the emissions, as long as it is profitable for the firms, they can produce provided they pay the carbon tax. One of the shortcomings of a carbon tax is that there is no certainty on the amount of pollution reduction. Anyone can pollute as much as they want provided they pay the carbon tax. On the other hand, under ETS, there is a certainty regarding the amount of pollution reduction because of the cap on emissions. Thus, while the pricing of carbon emissions is fixed, the environmental outcome of a carbon tax regime remains uncertain. A carbon tax differs from an ETS since outcomes in the form of a reduction in emissions are not predetermined, but the carbon price is fixed.

According to the World Bank Report on 'Partnership for Market Readiness: A Guide to Developing Domestic Carbon Crediting Mechanisms' (2021), the third common type of carbon pricing model involves a crediting mechanism in which GHG emission reductions from various projects/ activities can be sold in domestic or international markets. Such a crediting mechanism involves the issuance of carbon credits as per an established accounting protocol and has its own registry.

Carbon Pricing Schemes Across Countries

India

Over the years, India has become one of the largest emitters of carbon dioxide and GHG emissions, next only to the United States and China. The major contributors of India's CO_2 emissions arise from power generation which is primarily based on thermal (coal-based) power plants. The following Figure 4 depicts the steep increase in per-capita CO_2 emissions from fossil fuels in India. The steep decrease in per-capita emissions witnessed in 2019 and 2020 is attributable to the COVID-19-induced national lockdowns that stopped all industrial activities and transportation across the country for a major part of these years.

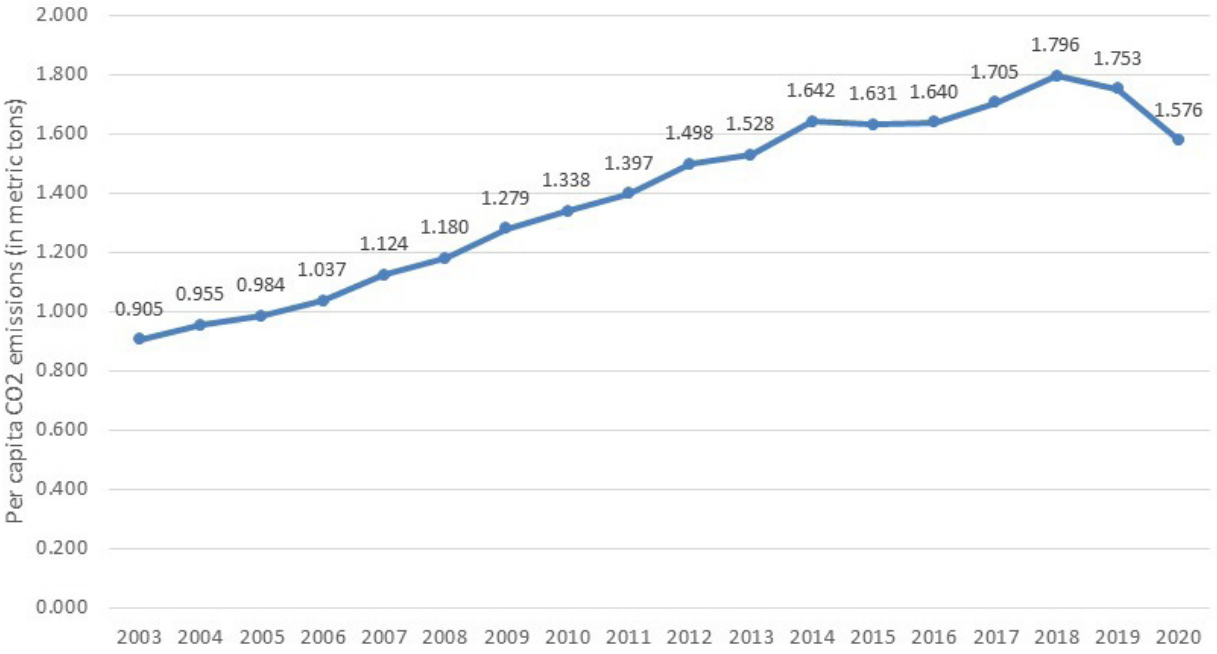

Figure 4: Per capita carbon dioxide (CO_2) emissions from fossil fuels in India from 1970 to 2022 (in metric tons)

*Source: World Development Indicators, The World Bank

With the objective of reducing such sharply increasing GHG emissions, developing a national-level carbon pricing framework and encouraging the trading of carbon credits, the Government of India recently approved the development of the national carbon trading markets. This framework is known as the 'Carbon Credit Trading Scheme 2023' and represents the initial steps towards the development of India's first regulated domestic carbon trading market.

Through this Carbon Credit Trading Scheme, the Government plans to develop relevant methodologies for estimating the reduction potential of carbon emissions and develop required processes for validating, registering, and verifying such emissions reductions. The Government also proposes to set up institutional and governance structures to define the role of each stakeholder in development of the Indian Carbon Market. To start with, the Government has set emissions reduction targets for four sectors, namely - petrochemicals, iron and steel, cement and pulp and paper – for a period of three years. As a result of this initiative, companies operating in these four sectors would be able to trade on the country's carbon trading market starting April 2025 and thus would be able to buy and sell carbon credits to meet their goals.

EU Emissions Trading System

Before signing the Kyoto Protocol, it was expected that most of the European Union nations would introduce carbon tax as the preferred measure to reduce GHG emissions, however, the EU created the largest market-based framework to limit GHG emissions in the form of the EU Emissions Trading System (EU ETS). Each EU member nation prepared its respective National Allocation Plans (NAP) which set emission targets for specified sectors. However, most EU member nations were anxious about the negative impact of such NAPs on their industrial sectors. Such market experiences and changes in emissions allocation have impacted the final structure of the EU ETS.

Over the past few years, EU ETS has become the cornerstone of the EU's policy to tackle rising GHG emissions and in tackling climate change. Based on the 'cap and trade' principle of carbon markets and pricing, EU ETS is enabled by the ETS Directive and has transformed the EU into the world's largest carbon market. Additional sectors have been gradually included in the EU ETS framework with all EU member countries collectively committing to become climate neutral by 2050.

United States

The United States witnessed several attempts at introducing legislation for emissions reductions, including the 2003 Climate Stewardship Act, the American Clean Energy and Security Act 2009 etc. The Clean Energy & Security Act proposed to establish a national-level emissions trading program focused mainly on the country's industrial and energy sectors. The scope of the proposed Act was later increased to cover transportation after many years. Despite there being no national-level legislation, many regions introduced plans to implement their own GHG emissions reduction programs.

Conclusion

The United Nations, 13th Sustainable Development Goal (SDG) is Climate Action- "Take urgent action to combat climate change and its impacts" (United Nations (UN) Website). According to UN SDG Report (2023),the world temperature will exceed by 1.5 degrees by 2035 and is projected to increase by 2.5 degrees by 2100. There is an urgent need to reduce GHG emissions by 43 percent by 2030 and Net Zero by 2050. In last decade itself the rate of sea-level rise has almost doubled. (UN, SDG Report, 2023). This points to worrisome situation at the world level. In the year 2019-20, the finances for climate change touched annual average of 803 billion dollars at the global level. The developing countries would need approximately 6 trillion dollars by 2030 to combat climate change (UN, SDG Report, 2023).

As the awareness to limit and reduce GHG emissions has increased, countries have developed different institutional and legislative models to combat such emissions. The carbon pricing models adopted to achieve 'Net Zero' have their respective advantages and drawbacks. Two such models are expected to be widely adopted – 'cap-and-trade' system and carbon tax. Governments would make their decisions on adopting the relevant models for carbon pricing based on political, environmental, and national circumstances.

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Annexure 15.3.3

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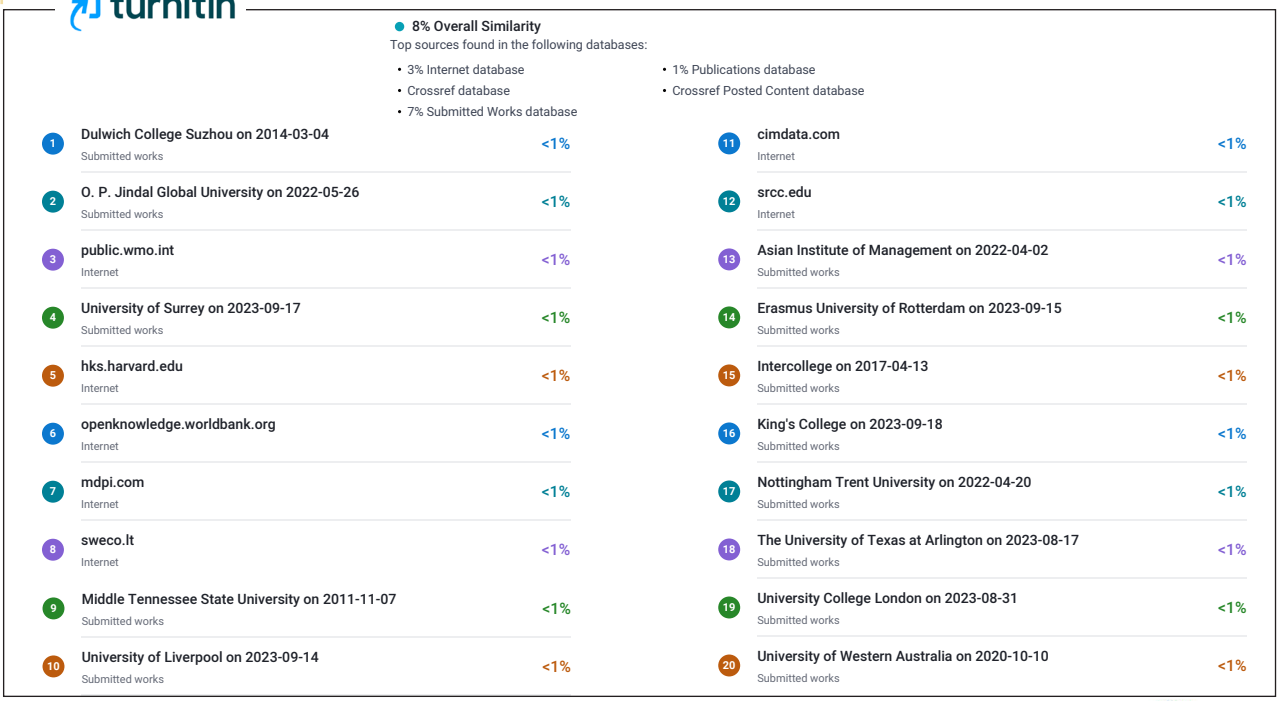

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Reviewers Memorandum

Reviewer's Comment 1: The paper has discussed the approach through which we can reach towards carbon neutrality. This paper provides a comprehensive overview of the current global climate crisis and the various carbon pricing schemes across countries. The inclusion of data and figures adds credibility to the content.

Reviewer's Comment 2: The paper effectively presents the challenges posed by climate change and the efforts of different countries to address greenhouse gas emissions. The use of data from the UN SDG Report and the Energy and Climate Intelligence Unit adds credibility to the content. However, the author could have done more literature review apart from the reports mentioned to make the paper more comprehensive.

Reviewer's Comment 3: This paper provides a clear and informative overview of the current climate crisis and the various carbon pricing schemes adopted by countries such as India, the EU, and the United States. However, it lacks a thorough discussion of the potential environmental and economic impacts of these schemes. Moreover, a deeper analysis of the political and economic factors influencing the adoption of specific carbon pricing models would provide valuable insights.These limitations provide scope for further research in this area.

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Conflict of Interest: Author of a Paper had no conflict neither financially nor academically.

Editorial Excerpt

The article has 08% of plagiarism which is the accepted percentage as per the norms and standards of the journal for publication. As per the editorial board's observations and blind reviewers' remarks the paper had some minor revisions which were communicated on a timely basis to the author (Simran), and accordingly, all the corrections had been incorporated as and when directed and required to do so. The comments related to this manuscript are noticeably related to the theme "**Carbon Pricing Model to attain Net Zero**" both subject-wise and research-wise. This paper offers a well-structured and informative analysis of carbon pricing schemes and the global efforts to combat climate change. However, the author could have done a detailed analysis of the environmental and economic impacts of different carbon pricing models, as well as a deeper exploration of the challenges faced by countries in achieving their Net Zero targets.After comprehensive reviews and the editorial board's remarks, the manuscript has been categorized and decided to publish under the "**Theme Based Paper**" category.

Acknowledgement

The acknowledgment section is an essential part of all academic research papers. It provides appropriate recognition to all contributors for their hard work and effort taken while writing a paper. The data presented and analyzed in this paper by the author (Simran) is collected first handily and wherever secondary data is used the proper acknowledgment and endorsement are depicted. The authors are highly indebted to all who facilitated accomplishing the research. Last but not least, I/we endorse all reviewers and editors of GJEIS in publishing in the present issue.

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