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Comprehensive Analysis of the Social and Economic Impact of Carbon Trading Programs in East Asian Countries: Comparative Study

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ABSTRACT (10 PT)

The purpose of this research is to carry out an in-depth investigation on the social and economic effects that carbon trading schemes have had on East Asian nations of various kinds. The purpose of this study is to evaluate the efficiency of carbon trading programs in East Asian countries by employing a comparative analysis. The study's primary objectives are to comprehend the variations in outcomes that occur across different countries and to find the most successful methods for carbon trading. An approach known as case study research is utilized in this study in order to promote a more nuanced understanding of the social and economic implications that carbon trading regimes have in a variety of settings. In order to evaluate the social ramifications of carbon trading, qualitative data will be collected, which will include community perspectives, environmental justice issues, and societal changes. Additionally, economic metrics such as gross domestic product, employment rates, and industrial growth will be studied. For the purpose of formulating climate policies that are more effective, equitable, and environmentally sustainable, the findings of the study can provide policymakers with significant insights. The paper also makes recommendations for future research directions, such as conducting longitudinal studies to evaluate the long-term social and economic repercussions of carbon trading programs, investigating the implications of carbon trading across different sectors, and incorporating the perspectives of stakeholders into future research. According to the findings of the study, carbon trading programs have major economic and social consequences. These programs include the creation of economic incentives for businesses or governments to reduce carbon emissions in an efficient manner, as well as the promotion of a societal atmosphere that is sympathetic to sustainable practices.

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1. INTRODUCTION

Global awareness of climate change has grown, leading countries worldwide to implement creative approaches to mitigate the adverse effects of greenhouse gas emissions. Carbon trading schemes have been shown to be a crucial instrument for advancing sustainable development and tackling environmental issues in this scenario. The journal aims to conduct a thorough examination of the social and economic effects of carbon trading schemes in East Asian countries. It will include detailed descriptions of the programs and offer comparative analysis to discover common trends and differences. (Bellino et al., 2021) East Asian countries are working towards economic growth and environmental sustainability by introducing carbon trading mechanisms to attain a healthy balance. This study's success stems from its comprehensive

examination of the intricate repercussions of carbon trading, considering both environmental effects and wider socio-economic dynamics. (Interview & Pye, 2012) The study attempts to reveal the intricate connections between policy frameworks, market dynamics, and societal effects in East Asian nations participating in carbon trading using a comparative methodology.Social impact analysis encompasses community engagement, equality issues, and the distributional effects of carbon trading policies. This paper analyzes market dynamics, investment patterns, and the macroeconomic impact of the carbon trading program from an economic perspective.

The findings of this study can offer valuable direction for policymakers, researchers, and stakeholders as the global community aims to shift towards a low-carbon future. Shi et al. (2019) This research intends to enhance our comprehension of the interplay between social and economic issues within the realm of carbon trading. It seeks to aid in the advancement of more efficient, fair, and enduring climate policies in East Asia and globally. Analyzing the social and economic implications of carbon trading schemes in East Asian countries is vital due to various significant factors.

To mitigate potential negative economic effects, one strategy is to coordinate financial tools with current fiscal changes to counterbalance increasing net carbon expenses for crucial sectors while maintaining price indicators. Transition strategies could be offered to trade-exposed sectors, such as offering complimentary emission allowances determined by efficiency targets. Over time, carbon pricing could benefit Pakistan's macroeconomic prospects by decreasing energy import costs, minimizing vulnerability to fluctuating energy markets, and optimizing the use of its abundant indigenous low-carbon energy supplies.(Doda et al., 2021) Considering the impact of carbon pricing by both developing and developed countries, as well as the variances in these consequences based on each country's economic growth stage, will be important. (Amari, 2023)

This study offers substantial advantages to policymakers, academics, and stakeholders aiming to attain sustainable economic growth and mitigate the adverse effects of greenhouse gas emissions in East Asian nations. This research offers an in-depth examination of the social and economic effects of carbon trading programs in East Asian nations, covering market dynamics, investment trends, and overall macroeconomic consequences. It aims to offer valuable insights to policymakers for crafting more efficient, fair, and sustainable climate policies. Furthermore, the research can offer understanding of the interplay between social and economic issues within the framework of carbon trading, aiding in the creation of comprehensive and unified climate policy globally.

2. Literature Review

a. Social and Economic Impacts of Carbon Trading Programs in East Asian Countries

In an interconnected carbon market, Asian countries face equality in selling carbon prices to mitigate the problem of carbon leakage. Several leading studies have found that addressing greenhouse gas emissions with carbon markets is indeed an effective way for countries to reduce climate change through cooperation. When viewed from its environmental impact, this partnership can reduce differences in carbon prices between regions by minimizing the movement of emission activities from one country to another and, in some cases, creating a cleaner local environment through conventional pollution reduction. [1]These concepts describe the basic framework for measuring the social impacts resulting from carbon trading programs in East Asian countries.

That focus on the identification of social factors that are influenced by the implementation of programs. In China. For example, for looking at the impact on employment, housing, and community welfare. [2]. How these policies impact household income and levels of social inequality also deserves attention. In South Korea, the impact may differ depending on its unique economic and social characteristics. For example, it can explain how the program impacts high-tech industries, education levels, and social mobility. In Japan, the focus can be placed on the impact on local culture and communities, as well as how society adapts to these changes [3]. Besides looking at social impacts, the focus is shifted toward the economic effects that are brought about by carbon trading programs in East Asian countries. In China, the evaluation is observed through the contribution to economic growth, marked by the increase in investment in environmentally friendly technology, and the impact that is felt particularly in the industrial sector.. In South Korea, it is essential to understand how these programs affect economic competitiveness, industrial diversification, and long-term economic sustainability. In Japan, comparisons can be made regarding the impact on innovation-based economies and traditional industries. Linkages to carbon markets can provide political and economic benefits. Politically, this Linkage carbon market will motivate regions to achieve more ambitious emission reduction targets.

Trade fees can be reinvested in the development of projects to reduce greenhouse gas emissions that cause environmental damage and can be used as investments in sustainable infrastructure and the creation of clean technologies, especially for developing countries. However, linkages with carbon markets can be

hampered when each country has different levels of emissions in their reduction targets and government policies. Other economic benefits from carbon market linkages have three main benefits. First, linkages to carbon markets can reduce abatement costs across economic entities in different countries. A carbon market that connects more cooperation between countries to produce more significant cost reductions. Second, carbon market linkages can increase market liquidity and transaction scale, reduce market fluctuations, and avoid price manipulation. Third, carbon market linkages can reduce competitive losses incurred by countries [4].

b. Integration of Social and Economic Dimensions

At this level, research includes the integration of social and economic dimensions to provide a comprehensive picture of the impact of carbon trading programs. In China, this could include how certain aspects of the economy influence social inequality or provide new opportunities for society. The successful results of implementing the carbon sales program will have a significant impact on several vital sectors because it can provide initiatives to encourage environmentally friendly green technology. If viewed from a social perspective, it can affect workers in the factory industry in the global community, but the existence of environmentally friendly technology can also provide new opportunities for educational training. In South Korea, the focus can be placed on how economic sustainability can have a positive impact on social development and community welfare [5].

As well as KETS, which is trying to achieve its target, creating a free allocation will provide the potential for government revenue and is even intended as support for environmentally friendly sustainability projects. In Japan, the emphasis may be on a balance between economic growth and the preservation of social and cultural values. Japan continues to rely on economic policies to reduce the use of gas emissions, carbon taxes that focus on investment in green technology, and development of economic sectors that aim to be sustainable, with the main focus being the green economy. By analyzing these three countries, this study is expected to provide in-depth insight into the impact of carbon trading programs in East Asia and help detail their impact at social and economic levels [6].

c. Challenges in Carbon Trading: China, Korea, and Japan

China, with its National Carbon Trading System initiated in 2017, faced challenges in aligning its implementation with initial ambitions, impacting global supply chains and competitiveness. Stricter measures could prompt companies to relocate, affecting global emissions. China's MRV system[7], though akin to the EU's, differs notably by recognizing indirect emissions and emphasizing energy efficiency over set limits. Yet, price fluctuations and underdeveloped flexibility mechanisms pose hurdles. Korea, after launching its Carbon Trading System in 2015[8], struggled with policy implementation and administrative disputes. Despite initial successes in emissions exchange, issues arose regarding auction postponements and revenue generation. The system's flexibility allows offset usage, with future phases exploring international cooperation for emissions reduction. Japan lacks a national carbon pricing system, relying instead on initiatives like the Voluntary Carbon Trading System and carbon taxes in select regions[9]. While the Joint Credit Mechanism fosters technology transfer, challenges persist in covering a significant portion of emissions and ensuring robust monitoring and verification frameworks. Each country faces distinct obstacles, ranging from policy alignment and administrative issues to coverage and monitoring challenges, highlighting the complexity of carbon trading system implementations globally.

3. METHODS

3.1. Research Design

This study employs a comparative analysis to assess the effectiveness of carbon trading programs in East Asian nations. The focus is on understanding variations in outcomes across different countries and identifying best practices for carbon trading. Utilizing a case study approach allows for in-depth examination of specific instances within each East Asian nation such as South Korea, Japan, and China. This facilitates a nuanced understanding of the social and economic impacts of carbon trading programs in diverse contexts.

3.2. Data Collection

Qualitative data, including community perceptions, environmental justice considerations, and societal changes, will be gathered to assess the social implications of carbon trading, economic indicators such as GDP, employment rates, and industry growth also will be analyzed.

3.3. Sampling Criteria

The study will focus on a representative sample of East Asian nations, considering geographical diversity, economic development, and existing variations in carbon trading policies. Nations may include but are not limited to China, Japan, and South Korea. Case studies will be selected based on the duration of carbon trading implementation, policy frameworks, and the diversity of socioeconomic landscapes within each nation.

Policy Implication

1. Policymakers should collaborate to harmonize carbon trading policies across East Asian nations. This fosters consistency, making it easier for businesses to navigate and ensuring a more effective regional approach to carbon reduction [10].
2. Prioritize policies that address social equity concerns, ensuring that the benefits and burdens of carbon trading programs are distributed fairly across diverse socioeconomic groups within each nation [11].
3. Policymakers should invest in public awareness campaigns to educate citizens about the positive impacts of carbon trading and foster a supportive societal environment for sustainable practices [12].
4. Policymakers should establish robust monitoring and evaluation mechanisms to track the progress and impact of carbon trading programs continuously. This allows for timely adjustments and improvements based on real-time data [9].
5. Encourage international collaboration on research and implementation of carbon trading initiatives. Sharing best practices and resources can enhance the effectiveness of policies and contribute to global efforts in combating climate change [13].
6. Policymakers should design incentives that encourage businesses to adopt innovative, low-carbon technologies and practices. This fosters a culture of continuous improvement and stimulates the development of sustainable solutions [14].

Suggestions for Future Research

1. Conduct longitudinal studies to assess the long-term social and economic impacts of carbon trading programs. This includes evaluating their sustainability and adaptability to evolving global and regional contexts.
2. Future research should explore the cross-sectoral implications of carbon trading, considering its effects on various industries. This analysis can inform targeted policies for specific sectors and enhance overall program effectiveness.
3. Incorporate stakeholder perspectives, including businesses, environmental organizations, and local communities, in future research. This ensures a comprehensive understanding of diverse interests and fosters inclusive policymaking.
4. Evaluate Policy Interactions, Conduct research to evaluate the interactions between carbon trading policies and other environmental and economic policies. Understanding how these policies complement or conflict with each other can inform a more coherent and integrated policy framework.
5. Investigate the adaptability of existing carbon trading frameworks to technological advancements. This research should explore how emerging technologies may impact the efficiency and relevance of carbon trading programs.
6. Future research should incorporate indigenous knowledge and perspectives, particularly in regions with diverse cultural backgrounds. This ensures that carbon trading policies respect and integrate traditional ecological wisdom into contemporary sustainability strategies.

4. Conceptual Theory (Environmental Economics Theory)

Nicholas Georgescu-Roegen is a scientist who introduced important concepts in environmental economics, known as "thermodynamic economics" or "biological economics". One of his notable works is the book titled "The Entropy Law and the Economic Process," published in 1971 [15]. Georgescu-Roegen's thoughts in environmental economics focus on thermodynamic concepts, especially the concept of entropy. Entropy is a measure of disorder or randomness in a system, and in the economic context, Georgescu-Roegen applies it to describe the limitations of non-renewable natural resources [16].

Georgescu-Roegen emphasizes that conventional economics tends to overlook the limitations of natural resources, and economic growth models based on unlimited consumption of natural resources are not sustainable in the long run. He asserts that natural resources cannot be replenished infinitely and that economic processes producing waste and pollution will lead to environmental degradation and a decline in the quality of natural resources [17]. In his thinking, Georgescu-Roegen emphasizes the importance of considering physical constraints in economic systems and suggests that society should shift from limitless growth models towards a more sustainable economy. He emphasizes the need to reduce consumption of natural resources, extend product lifespans, improve efficiency in resource utilization, and replace technologies and production processes that are more environmentally friendly [18].

Thus, the environmental economics theory according to Nicholas Georgescu-Roegen highlights the importance of considering physical and thermodynamic aspects in economic analysis, as well as recognizing the limitations of natural resources in developing sustainable economic models. In the context of the research "Comprehensive Analysis of the Social and Economic Impacts of Carbon Trading Programs in East Asian

Nations," the concept of entropy and Georgescu-Roegen's approach to environmental economics can provide significant contributions, particularly in understanding the economic and social impacts of carbon trading programs.

First, in the economic aspect, Georgescu-Roegen emphasizes that economic growth based on unlimited consumption of natural resources is unsustainable. By applying this thinking to carbon trading programs, we can understand that efforts to reduce carbon emissions must also consider the underlying limitations of natural resources. In economic analyses of carbon trading programs, it is important to consider the long-term impacts of sustainable natural resource exploitation.

Second, in the social aspect, Georgescu-Roegen's concepts are also relevant. For example, in evaluating the social impacts of carbon trading programs, we need to consider how these policies affect various sectors of society, including workers, local communities, and other vulnerable groups. Georgescu-Roegen's entropy concept also emphasizes the importance of considering ecological balance in social and economic interactions. Thus, Nicholas Georgescu-Roegen's thinking on environmental economics can provide a strong conceptual foundation for analyzing the social and economic impacts of carbon trading programs, highlighting the importance of considering the limitations of natural resources and maintaining ecological balance in economic systems.

5. RESULTS AND DISCUSSION

5.1. Overview of socio-economic of Carbon Trading.

The issue of climate change is the main focus of the world today[19]. Carbon trading or emissions trading is generally traded on the broad market using a pollution control approach that supports the economics of incentives to increase the amount of reductions in carbon emissions and pollution which is the main key to reducing the level of greenhouse gases (GHG), especially carbon dioxide (CO2) [20]. The problem of carbon emissions is very crucial because it has a serious impact on climate change. Therefore, carbon trading is a responsible step towards mitigating climate change [21].

Carbon trading is the process of buying and selling credits that allow a company or other entity to emit a certain amount of carbon dioxide gas with the aim of reducing overall carbon dioxide gas emissions. Carbon trading based on a cap and trade system that successfully reduced sulfur pollution in the 1990s[22]. The carbon trading system allows countries to buy carbon, which is the right to burn it. If a country buys carbon, it buys the right to burn it. The carbon trading system emerged in response to the Kyoto Protocol, which called for 38 industrial economies to reduce carbon dioxide gas emissions[23]. Carbon is an element stored in fuels such as coal and oil. When this fuel is wicked, carbon dioxide is produced and serves as a greenhouse gas [24].

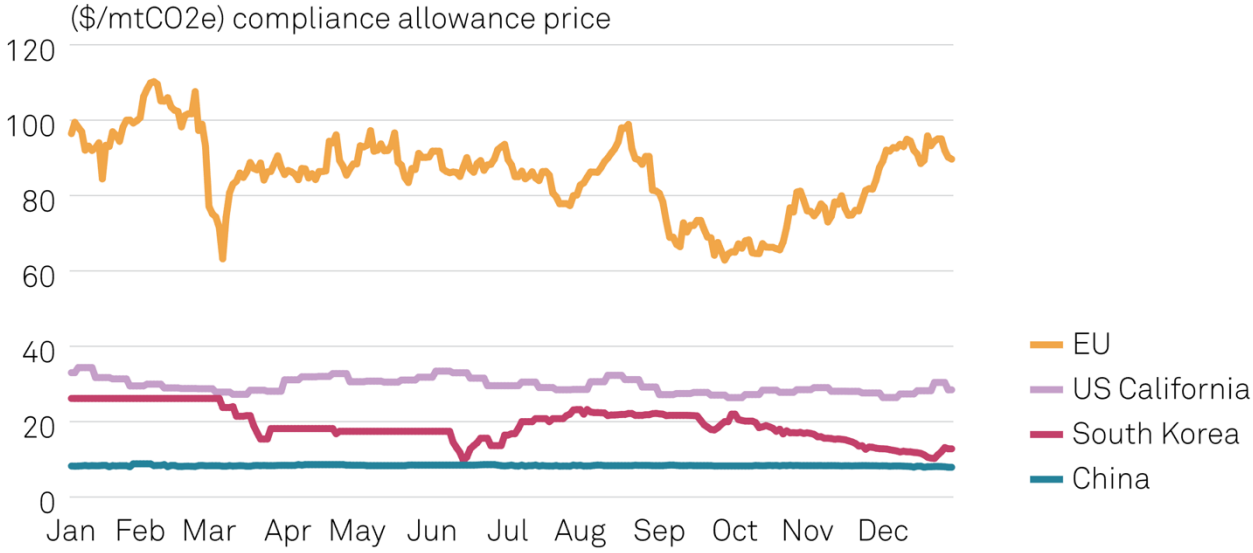


Fig 1. Cross Comparsion of Carbon Trading.

East Asian countries, including South Korea, Japan, and China, are developing voluntary and regulated carbon trading systems. South Korea has started the Emissions Trading System (ETS) in 2015, which covers about 70% of the economy including the domestic energy, industrial and aviation sectors. South Korea also aims to achieve carbon neutrality by 2050[8]. Meanwhile, Japan, one of the world's largest

carbon dioxide emitters, will start a phased carbon pricing scheme from April 2023 to encourage companies to cut emissions. On the other hand, China, Japan, and South Korea are also major players in the global carbon trading landscape. These three countries have deep trade ties and trade ties, as well as common environmental challenges. Therefore, there is a push for carbon market cooperation among these three countries [25].

Carbon trading programs have significant economic and social impacts. Economically, carbon trading creates economic value for greenhouse gases produced by companies or countries. It allows companies or countries to buy or sell the right to produce carbon emissions[26]. With a carbon trading mechanism, companies or countries that are able to reduce carbon emissions more efficiently can sell their remaining emission quotas to other parties in need. Conversely, companies or countries that struggle to reduce carbon emissions can buy additional emission quotas. Thus, carbon trading creates economic incentives for companies or countries to reduce carbon emissions efficiently [27]. Socially, carbon trading programs can also have a significant impact. For example, the allocation of carbon trading proceeds to environmental and social projects can provide direct benefits to communities, especially in terms of sustainable development and environmental quality improvement[28]. In addition, the implementation of carbon trading programs can also affect society through changes in the energy, industry, and transportation sectors. With economic incentives to reduce carbon emissions, companies or countries can also develop environmentally friendly technologies that can ultimately provide social benefits to society at large [29].

In looking at the effects of carbon trading both economically and socially by the three countries, namely South Korea, Japan, and China, it produces a different comparison of each influence caused by carbon trading. In general, the impact of carbon trading has been mentioned concretely before, both from economic and social impacts. The two are very interrelated and have a very significant impact. Therefore, in looking at the impacts caused by carbon trading specifically, it is necessary to analyze each country that is the object of research.

5.2. Analysis of Carbon Trading Programs in East Asian Nations

The success of carbon trading systems in China, Korea, and Japan relies on integrating social and economic aspects after examining the socio-economic overview of Carbon Trading in these countries. Implementing a carbon trading program in China could affect workers in the manufacturing sector while also creating new prospects for educational training. In South Korea, the emphasis is on how economic sustainability can positively influence social development and overall well-being. Japan may prioritize achieving equilibrium between economic advancement and the conservation of social and cultural values. This research aims to provide a comprehensive understanding of the effects of carbon trading programs in East Asia by examining three specific countries, focusing on their social and economic implications. Policymakers should focus on implementing policies that tackle social justice issues, guarantee equitable distribution of benefits and burdens from carbon trading programs among different socio-economic groups within each country, and allocate resources to public awareness campaigns to educate people about the benefits of carbon trading and promote a community culture that encourages sustainable practices.

a. South Korea

South Korea managed to overcome the economic crisis and continues to develop at a rapid pace. In the period of economic crisis, South Korea recorded a high economic growth rate, which was 4-5% per year. Even in 2008, 2009, and 2010, when the global economy was in crisis, South Korea achieved remarkable economic growth of 6.3%[30]. The implementation of carbon trading programs in South Korea can affect certain sectors of the economy, such as energy, industry, and finance. This program can create incentives for companies to reduce carbon emissions and improve energy efficiency, so as to increase the company's competitiveness in the global market[31]. In the process of pursuing intensive growth amid a shortage of capital and resources, South Korea created an export-based economic structure centered on enterprises. This reflects the impact of a focus on economic growth through the export sector as part of efforts to reduce carbon emissions and promote sustainable growth .

Economic cooperation is often carried out by South Korea in various forms with developed countries such as Japan and the United States [32]. In addition, South Korea also has strong trade ties with China, which are affected by Koguryo's historical disputes, trade relations, and military ties. In this context of carbon trading South Korea has also started an Emissions Trading System (ETS) in 2015, which covers about 70% of the economy including the domestic energy, industrial and aviation sectors[33]. The implementation of carbon trading programs in South Korea can affect certain sectors of the economy, such as energy, industry, and finance, and can create new opportunities in the development of green technologies [34]. Thus, the carbon trading program has had a significant impact on South Korea's economic growth, export-based economic structure, and trade relations with other countries.

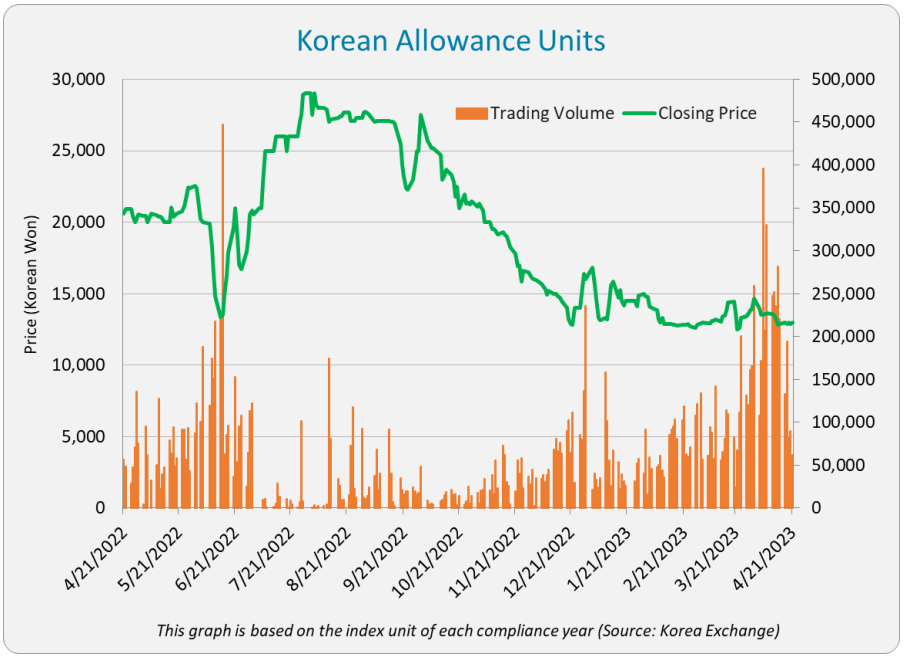


Fig 2. Korean Allowance Units.
(Source: https://www.opisnet.com/)

Carbon allowance prices in Asia's second-oldest emissions trading scheme[35], South Korea's ETS (K-ETS), are facing challenges due to market uncertainty and worries about an excess of free allowances coupled with low buying interest. According to Korea Exchange data, Korean Allowance Units in the K-ETS experienced a price decrease of approximately 20% in the first four months of 2023. Korean allowance units for the years 2022-2023[36]. Korea's regulatory program, like others in the APAC area, is undergoing significant overhaul. In March 2023, the government unveiled its strategy to reach carbon neutrality, which involves reducing emissions targets for industry and increasing targets for energy transition and international offset credits. The government intends to enhance auction and benchmarking allocation processes and introduce consignment trading for the K-ETS.

b. Japan

Japan has introduced a carbon credit trading scheme as part of efforts to achieve the target of reducing carbon emissions by 46% by 2030 from 2013 levels and becoming carbon neutral by 2050[37]. The scheme allows companies to buy and sell carbon credits, which can help them achieve their carbon emissions targets. However, Japan faces greater challenges than any other country in meeting this target because as the world's third-largest economy, it generates about 1.1 billion tons of carbon dioxide annually from power plants. Economic transformation to achieve carbon neutrality by 2050[38], which will bring risks and opportunities to the company. This economic transformation will affect various sectors, including energy-intensive, transportation, and industrial sectors. Companies will have to develop new technologies and change production processes to reduce carbon emissions.

To achieve carbon neutrality by 2050[39], Japan must accelerate the reduction of dependence on fossil fuels in production, especially for energy-intensive sectors. Reducing dependence on fossil fuels will help reduce carbon emissions and will help develop new technologies to reduce carbon emissions. Japan introduced a TCCM tax on fossil fuels in 2012, with a tax rate of 289 yen (about $2) per ton of CO2[40]. This tax will affect fossil fuel prices and will encourage companies to reduce their use of fossil fuels. However, TCCM's current tax rate is lower than carbon tax rates in other countries[41], which will affect compliance with Japan's carbon emission targets. Studies show that the average company can keep up with the increase in TCCM taxes, but there is a very low tail that can suffer from financial shortfall. The effect of TCCM tax on companies will affect compliance with Japan's carbon emission targets and will affect compliance with the company's economic conditions.

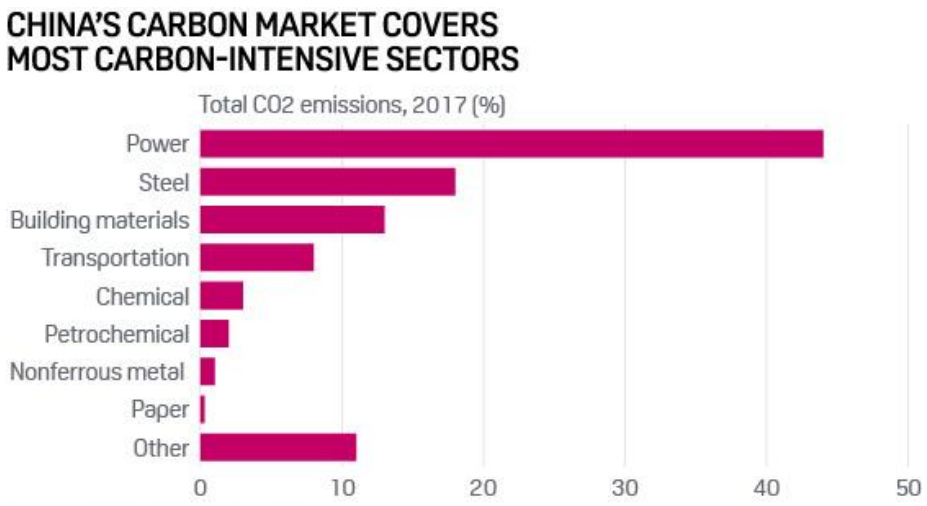
c. China

In China, carbon trading has been an ongoing practice for several years. China's carbon trading policy builds on a carbon emission reduction policy framework. In December 2009[42], China showed great commitment in pushing for the implementation of the Copenhagen Agreement during the Climate Change Conference, where it targeted reducing carbon intensity by 40-45% from 2005 levels by 2020[43]. To

achieve this target, the Chinese government has taken a series of strategic steps, including analysis and assessment of carbon intensity targets, preparation of a national greenhouse gas inventory, and introduction of carbon trading policies. In the context of carbon trading policy, China adopts a market-oriented approach that involves allocating carbon quotas to companies and allowing trading based on market demand and supply mechanisms. The implementation of this carbon trading policy began with the establishment of pilot projects in various regions of China. Areas such as Shenzhen, Beijing, Shanghai, Tianjin, Guangdong, Hubei, and Chongqing were the starting places of these carbon trading pilot projects in previous years. Furthermore, the Fujian region was also one of the carbon trading pilot projects in 2016.

It is important to note that carbon trading trials in China have three main characteristics that set them apart. First, carbon trading pilot projects are spread across different regions, leading to spatial and operational separation between carbon markets. Second, the vitality levels of these pilot projects vary, and are often linked to local economic growth rates. For example, carbon markets in Shenzhen, Shanghai, Guangdong and Beijing are more active due to higher economic growth in those regions. In addition, regional carbon trading pilot projects have accumulated a wealth of valuable experience in the establishment of national carbon markets. In July 2021, China reached an important milestone by launching a national carbon emissions trading market in the power generation sector, after going through several years of pilot practices of carbon trading at the regional level[44]. This shows that China has successfully established a carbon trading policy system that includes a national carbon market in the power generation sector as well as eight regional carbon trading pilot projects.

Table 2. China Carbon Market Covers Most Carbon-Intensive Sectors



Source: www.spglobal.com

According to Qiao[42], the initial plan in carbon trading refers to the electricity sector which is predicted to be the first sector in the ETS, where this sector must meet commitments to the Global carbon regime due to the presence of several chemicals, buildings such as petrochemicals, nonferrous metals, paper that affect carbon emissions. Collectively, these sectors account for 89% of China's CO2 carbon emissions, specifically for the electricity sector, which emits 44% of its content and 18% of steel, and 13% of building materials[45]. In these contents, the electricity sector is blamed as the largest CO2 carbon emitting sector in China. However, in this case the role of consumers is very important in imposing limits on electricity sector consumption at net-zero carbon emissions which not only reduce economic growth, but also revolutionize how the economy grows. According to Yin[46], China needs a carbon market that helps reasonably allocate carbon emissions and capital flows in a stable way that cannot be achieved simply by developing a market like the EU at erratic prices.

On the other hand, carbon trading can have a positive impact on the Chinese economy[47]. One of the most significant economic impacts of carbon trading is the reduction of carbon emissions. Experts have conducted research on the impact of reducing carbon emissions from carbon emission trading systems. Several studies have shown that regional carbon trading effectively reduces corporate emissions, resulting in reductions in total emissions and emissions intensity. This can help China achieve its carbon emission reduction targets and promote sustainable economic development. Another economic impact of carbon trading is the economic cost of carbon trading policies. Several studies have examined the economic impact of carbon trading policies[33]. Their findings suggest that national carbon markets can effectively reduce economic costs by increasing competition in low-carbon industries and encouraging technological

innovation. This could help China promote the development of low-carbon industries and boost its economic competitiveness.

5.3. Identify Best Practices from China, Japan and South Korea in Carbon Trading Figures and Tables

The application of carbon trading practices in South Korea, Japan, and China has uniqueness and specificity. Each country has different applications but is the same in its goal of working to reduce CO2 carbon. Both China, South Korea and Japan have two different ways[48], the first approach is to connect well-performing markets such as ETS Shanghai, Beijing, Guangdong and Shenzhen in China, and ETS Tokyo and Saitama in Japan[8]. This is a well-designed pilot program in regions with similar levels of economic development. Another approach is to link carbon markets with similar trading systems. In particular, Japan and the Republic of Korea have adopted a system of restrictions and trade, and the markets in these two countries can be connected more smoothly. However, the PRC's carbon market is essentially a tradable system of performance standards, which is more difficult to attribute to a system of restrictions and trade. Thus, as expected, the power generation industries of seven pilot projects in the PRC only began to be combined in 2017[49]. In the long run, multilateral relations can be achieved in East Asia through the establishment of cross-regional relations and bilateral relations.

Table 3. Commitments of the PRC, Japan, and the Republic of Korea in Major Climate

Treaty	PRC	Japan	Republic of Korea	Target Year
Kyoto Protocol	No requirement	Reduce emissions by 6% compared to 1990	No requirement	2012
Copenhagen Accord	Reduce emissions intensity by 40%-45% compared to 2005	Reduce emissions by 25% compared to 1990	Reduce emissions 30% below the BAU level	2020
Paris Agreement	Peak emissions around 2030	Reduce emissions by 26% compared to 2013	Reduce emissions 37% below the BAU level	2030

Source: https://direct.mit.edu

However, connecting these carbon markets still presents major challenges and obstacles. First, the heterogeneous and even incompatible design of the market between countries makes relations difficult. In particular, the PRC, Japan and the Republic of Korea have different regulations on monitoring, reporting and verification (MRV); allocation of allowances; and the sectors covered[50]. Second, the potential for cross-border wealth transfer between interrelated markets is another controversial issue[51]. Third, some countries may have incentives to over-allocate allowances[47], depressing market prices and transaction volumes. Lastly, these relationships can fall victim to geopolitical conflicts and disputes. Successful linkages with East Asian carbon markets need to overcome these barriers[38][33].

Based on the implementation of best practice commitments by carbon trading from the 3 countries, in terms of participating in important international climate agreements and taking domestic actions to control carbon emissions. The most important international climate agreements include the United Nations Framework Convention on Climate Change, the Kyoto Protocol, the Copenhagen Agreement, and the Paris Agreement. Table 1 lists the emissions targets of the PRC, Japan and the Republic of Korea under the last three climate agreements. From the results of the analysis, China has succeeded in reducing carbon emissions and economic costs through effective carbon trading policies. Meanwhile, information on the social and economic impacts of carbon trading policies in South Korea Korea also plans to reduce GHG emissions by 37% from BAU levels across all economic sectors by 2030[40][44]. Japan has also implemented various measures to reduce carbon emissions, but still needs to accelerate reducing dependence on fossil fuels to achieve its carbon neutral target.

6. CONCLUSION

Carbon trading has emerged as a pivotal mechanism in global efforts to address climate change, with East Asian countries like China, South Korea, and Japan implementing diverse strategies to mitigate greenhouse gas emissions. This study delves into the nuanced social and economic repercussions of carbon trading programmes within these nations, offering insights gleaned from a comprehensive analysis of existing literature and empirical data. The literature review underscores the intricate interplay between social and economic factors in the context of carbon trading. It highlights specific challenges faced by each country, such as carbon leakage, economic competitiveness, and social equity concerns. Moreover, it elucidates the

unique policy frameworks and implementation hurdles encountered in China, South Korea, and Japan, underscoring the need for tailored approaches to address diverse socio-economic landscapes.

Through comparative analysis, this study reveals the distinct experiences of carbon trading implementation in East Asia. In South Korea, the Emissions Trading System (ETS), initiated in 2015, has been instrumental in incentivizing emissions reduction across various sectors of the economy. The analysis delves into the impact of carbon pricing on industrial competitiveness and innovation, shedding light on South Korea's trajectory towards a low-carbon future. Similarly, Japan's phased carbon pricing scheme, aimed at achieving carbon neutrality by 2050, presents unique challenges and opportunities. The study explores the implications of Japan's heavy reliance on fossil fuels and the potential for economic transformation through emissions reduction initiatives. Insights gleaned from Japan's approach shed light on the complexities of balancing economic growth with environmental sustainability. In China, the establishment of a national carbon emissions trading market marks a significant milestone in the country's climate policy agenda. The study delves into China's market-oriented approach to carbon trading, examining its effectiveness in reducing emissions and fostering economic growth. It also analyses the challenges of integrating regional carbon markets and the role of consumers in shaping energy consumption patterns.

Policy implications derived from these insights offer actionable recommendations for policymakers in those three East Asian countries. These recommendations include the harmonisation of carbon trading policies, the prioritisation of social equity, and the establishment of robust monitoring mechanisms. Furthermore, the study outlines avenues for future research, including longitudinal studies and cross-sectoral analyses, to deepen our understanding of the social and economic impacts of carbon trading in East Asia. By delineating specific challenges and opportunities unique to each country, it seeks to inform evidence-based policymaking and foster international collaboration towards a sustainable, low-carbon future.

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