De-mystifying Carbon Finance: A Primer for the Interested MBA Student

Centre for Development and Environment Policy

Carbon Finance is a subset of climate finance that deals with pricing of carbon, financial tools such as carbon emissions trading (carbon markets), and mechanisms to provide finance for activities that will reduce carbon emissions. Given the topicality of the issue and its complexity, the Centre for Development and Environment Policy (CDEP), IIM Calcutta, organised a one-day Carbon Finance Workshop under its BRIDGE initiative on January 13, 2023. Discussants at the workshop, Ms. Ekta Mehra, Senior Sector Specialist at KfW, Dr. Dhruba Purkayastha, India Director at Climate Policy Initiative, Dr. Dipak Dasgupta, Distinguished Fellow at TERI, Mr. Upendra Bhatt, Co-Founder and Managing Director at cKinetics, and Mr. Vinod Kala, Founder of Emergent Ventures, explored the subject as a conversation among themselves, while ensuring that the participants of the workshop were engaged in their exchanges. This white paper summarises the discussions, with the intent to help the informed reader get a better picture of the different facets of carbon finance without the associated jargon. An annotated bibliography of select literature is appended to the paper.

The genesis of climate finance comes from the notion of Climate Change, which the world acknowledged as a wicked, multilateral problem, around 35 years ago, quickly leading to the United Nations Framework Convention on Climate Change (UNFCCC) and the conference of parties (CoP). The understanding, that greenhouse gases (GHG) (including CO2) which were responsible for climate change, were a negative economic externality led to addressing climate change as a market failure. In fact, climate change creates presents a double market failure, as both real markets (those for goods and services) and financial markets are affected by it. Climate finance relates to funding for both mitigation (economic activities undertaken to reduce GHG emissions) and adaptation activities (investments to build capacity to adjust to changing ecological conditions as a result of climate change). Some of the terms used along with climate finance are green finance (climate finance plus addressing other environmental issues such as pollution) and sustainable finance (green finance plus actions addressing social [healthcare, education, inclusive growth] and governance issues).

Carbon finance is a more specific term, used as a subset of climate finance. When addressing market failures, we try and get the markets to work through public/government interventions, through taxes or creating a market where there is none. Or other policy measures This is the basic idea behind Carbon trading systems (markets) – If X has been granted permits limiting their emissions to a100 units, and they manage to limit it to 80, they get 20 credits. If Y, who also has been granted permits limiting their emissions to a100 units, emits 120 units, then both X and Y can trade for the 20 units. The money or the finance instruments that are created out of such systems is called carbon finance.

The way the world has been trying to solve the carbon problem – one is there to set a limit, any emission more than that you wither buy a credit from somewhere else or offset it. When we talk of pricing carbon dioxide emission using markets, it pays to bear in mind that there are broadly 3 types of carbon:

1. Compliance Carbon, where entities are allowed to emit certain amount of carbon below the specified limit (the permits), and trading of emissions occurs in 'cap and trade' markets. These come in force where you are obligated to reduce the emissions as per a country's decided NDCs. The Kyoto Protocol had country level targets only for the Annex – 1 countries, that is the developed countries. Developing countries like India and China had the option to set up the offset market (see below) and trade with the developed countries. This was one way of asking the Annex – 1 countries to pay for the historical emissions, a notion called Common but Differentiated Responsibilities.
   In the Indian context, examples of national compliance markets include the ESCerts – Energy Saving Certificates issued by the Bureau of Energy Efficiency and the Perform Achieve Trade (PAT) scheme. However, trading in these markets never really took off, and the inefficiency of the PAT framework is more or less mirrored in global markets as well.

Global compliance markets are somewhere about $150 billion today, and are expected to grow 3x over the next 3 years.

2. Offset Carbon, split into two, compliance offset carbon and voluntary offset carbon, which, as the name suggests, is about finding ways to counterbalance CO2 emissions, that is, something somebody is doing specially to reduce the carbon dioxide emissions from the atmosphere. The compliance offset carbon needs to be regulated (Article 6 of Kyoto Protocol) as it is related to compliance carbon, and Indian entities have no experience in this market. Voluntary offset carbon is something Indian firms are familiar with as these carbon credits are traded in voluntary carbon markets. The compliance offset market is relatively small today. The voluntary offset market is around $250 million, and is expected to grow to 3 billion by the end of this decade. California has been a leading market. There are four registries in the voluntary market, and the challenge is about how efficiently you do your verification and validation process. A lot of offsets with co-benefits are preferred. In the future, we may see tightening of standards in the verification and validation process, but we may continue to see opacity if there is no oversight.
3. Finally, we have non-market carbon which refers to reduction in CO2 emissions, through CSR initiatives, for example, that are not traded in the market at all.

While compliance carbon is about avoidance (of emissions of CO2), offset carbon is about its removal. For a Net-Zero world, there has to be a lot of focus on the removal aspect. Markets can be the means of bringing about the Low Carbon Transition, as they play a unique role in setting the price dimensions of energy.

Alternately, one could tax a negative externality, the carbon tax, the proceeds from which could be used to fund mitigation and adaptation activities. The carbon tax is basically putting a defined price on emitting carbon dioxide. With carbon tax in place, an industry should ideally reduce emissions to avoid paying extra cost. For example, the coal cess was one way adopted by the Govt of India, and Sweden has a carbon tax of around $100 per tonne. Unfortunately, carbon taxes generally don't work because of the political backlash that comes with enforcing an inelastic tax. In addition, a problem arises as to what is the right level of pricing for this carbon tax. Cross border carbon taxes, the carbon border adjustment tax (CBAM) are also a bone of contention in international trade. One must not see such taxes as a threat to exports, rather, a positive signal where the consumer is being made to pay for using a good, and therefore a negative externality being corrected. Since the concern of whether small manufacturers in Europe will be able to meet the high levels of requirements of CBAM is already being looked into, it is believed that the fear that CBAM would make exporters uncompetitive is somewhat misplaced.

The price of carbon in CO2 equivalent, varies from $4 to $5 dollars per tonne to $50 to $60 dollars at present depending on whether it is derived from carbon taxes, compliance markets or offset markets. This price would slowly ramp up in coming years to around $120 per tonne. Having a well-defined price of carbon is very important from the point of view of industry. If you have a market price defined for an upcoming technology, you can manage the technology at a much less cost. As technology evolves and matures, their costs fall. The cost of fighting Climate Change will, hence, come down in future. Good news!!!

Development banks have a critical role to play with respect to the provision of public goods such as measures to mitigate carbon. One such bank, which has done exemplary work in the area of energy transition in Germany and beyond is KfW, a German bank owned by the German Government. In India, KfW does development finance in India with special focus on climate finance which includes providing concessional finance for projects. Thus, every project is judged not just on its development potential but also on its potential to reduce CO_2 emissions. KfW then reports back this impact assessment to the German Government, and any transfer of funds are considered part of OECD assistance. The global transfer of funds happens under different heads such as development finance, with different country allocations varying based on its 'level of development'. Thus, African countries would get greater developmental assistance than a developing country like India. For development banks, the environmental and social aspects are always important consideration in every project that are

financed. Even for renewable energy projects, KfW focuses on aspects such as whether the water level would be affected due to these projects before choosing to fund the project.

The government's decentralized administration really needs to dramatically improve their adaptation capability. The problems created by climate change will have to be solved at the level of cities and villages and mechanisms by which public entities can access funding have to be centrally organized.

Another important consideration to keep in mind is that while the issue of concern, climate change, is caused by the stock or historical accumulation of GHGs in the atmosphere, measures to address it focus on containing and restraining the flow of GHGs, that is, the addition to the stock of GHG in the atmosphere. Carbon already emitted in the atmosphere is going to stay around for millions of years. The anthropogenic emissions have been so fast that they have been beyond Nature's ability of being absorbed. This is not ideal on two counts. First, this implies that the impact of mitigation measures undertaken would not be evident in the near future. In other words, the present generation would be taxed so as to reduce the impact of climate change for the future generations. Second, because the current impact of climate change is caused by the stock of CO_2 which was contributed to, largely, by the Global North[1], it would not be fair to restrain emissions of the Global South[2] as such restraint comes at the cost of economic development. Since this is a stock that has been created by the developed countries of the world, subsequent negotiations and international agreements cannot commit everyone equally to reducing the flow. Instead, solution will need a global transfer of funds from the developed to the developing countries.

The challenge, therefore, is how to make the financial system (the proverbial Bank of America, for instance,) start to invest seriously in Climate Change, and more specifically in low carbon transition? Recognizing the value of carbon is already enshrined in the Paris Agreement. What we are struggling with is persuading the sovereign entities to operationalize that into financial flows. For instance, how would the global south leverage the important legislative announcement of the Government of the USA, that they are going to spend USD 1 trillion for clean energy transition? The major problem is that whenever there is cross-border lending, the finance loses a degree of freedom. If you are a US pension fund and you are dealing with a US corporate entity, there is no risk of the exchange rate and you have the comfort of being bailed out in case of any major default. While there is need for the shift of capital to happen from OECD countries, where it is sitting in Oil and Gas, to non-OECD countries, that too, in renewable sector, it does not happen. This is because the expected rate of return in the non-OECD countries is 7 times higher than the OECD countries, and if the capital has to earn those rates of return, it does not see reason to shift from Oil and Gas in the OECD countries.

It is believed that more than 50-60% investments in low carbon projects that will be made are actually profitmaking. Hence, commercial capital will eventually find its way there. This is clearly demonstrated in the case of renewable energy like wind and solar energy, where the projects are making money in almost all countries. The need is to work on commercially attractive models of new technologies that can then be scaled up. Further, the newer technologies will eventually get cheaper. However, each new technology takes at least 25-30 years to become commercially successful. This is here the role of the public sector becomes crucial. For example, the first solar plant in India was set up in 1979 by BHEL. Today, most of the investments in solar energy may come from the private sector, but that was after a public sector firm took the plunge several decades ago.

Going forward, the role of public money would be to facilitate private investment into the renewable sector or towards any investments in climate technology. The start-ups in the Climate tech sector which have got the maximum capital were those working on big data, as the business models for these are unambiguous and returns are evident. For many other technologies, the outcomes are not as evident, which is where the development backs or other sources of public finance would have to play a role. For example, public procurement brings down the cost of any new technologies, and therefore economic

[1] The **Global North** encompasses the technically and socially well-developed regions such as North America, Europe, and Australia, who benefited most from the Industrial revolution in the 1900s

[2] The G**lobal South** refers to various countries around the world that are sometimes described as "developing," "less developed" or "underdeveloped, often used synonymously with the G77 countries

growth can be made green when public procurement is shifted towards cleaner technologies. Similarly, corporate entities can take advantage of the opportunities created by carbon markets, which are created by public interventions. One could also look towards the banking system to intermediate, although this may prove to be more challenging as the Indian banking system is not business focused, but collateral focused. Public sector banks need to be mainstreamed in the Carbon finance discourse. Development banks are doing their bit in nudging the public sector banks to move in that direction. There are now a very few capital-only venture capital funds in the country, which could allow new start-ups to crowd in. Moreover, conventional capital is also slowly moving towards funding energy transition related business ventures. These are not limited to just new technologies but also project execution and development in bio fuels, agricultural technologies and afforestation activities where the technologies are well developed and the challenge is to increase scale. EV financing is also a promising field.

For MBA students to contribute effectively in businesses related to carbon finance, they would need to equip themselves with basic analytical skills, economic modelling capabilities and an ability to 'do more than to say'. The knowledge of sustainability as a conceptual construct would be a prerequisite. As an exercise, students could think about how to transform state owned energy distribution companies, which are both commercial entities and socio-political tools. How would one integrate distributed energy generations such as rooftop solar energy generation into the grid? Not only would it act as a last mile reactive power compensation mechanism, it would be really cost-effective for the lowest paying consumer as They would get an in-built subsidy. There is also a lot of learning with respect to understanding and tracking scope 3 emissions, reporting which, as of now, is only voluntary as per the BRSR guidelines. As part of ESG due diligence, there is a lot of demand for analytics using data from scope 3 emissions.

Given that the largest country that would stand to face the disproportionate impacts of Climate Change is India, we need to pay attention and make change happen. India is critical to winning the Climate Change battle, and for this, a paradigm shift is needed where finance can be a force multiplier.

Annotated Bibliography of Select Papers on Carbon Finance

Mobilizing private climate finance for sustainable energy access and climate change mitigation in Sub-Saharan Africa

Citation: Michaelowa, A., Hoch, S., Weber, A. K., Kassaye, R., & Hailu, T. (2021). Mobilizing private climate finance for sustainable energy access and climate change mitigation in Sub-Saharan Africa. Climate Policy, 21(1), 47-62. https://doi.org/10.1080/14693062.2020.1796568

Link: https://www.tandfonline.com/doi/full/10.1080/14693062.2020.1796568

Access to sustainable energy has a critical role in achieving sustainable development and climate change mitigation. This is crucial for Africa, a continent with historically low GHG emissions; however, Africa may cause a substantial increase in emissions if its development objectives are met. The implementation of all conditional elements included in Sub-Saharan African (SSA) Nationally Determined Contributions (NDCs) made under the Paris Agreement, such as international climate funds and government development assistance, is wholly dependent on their availability. To achieve both Sustainable Development Goal (SDG) 7, which calls for universal energy access, and the climate change mitigation goals of the Paris Agreement, it will be imperative to mobilize private capital in Sub-Saharan African (SSA) nations. In this context, Michaelowa *et al*., 2021 assessed how multilateral funding institutions, national and international climate policy instruments, foment private sectors to contribute to climate change mitigation activities in the energy sector in Sub-Saharan Africa(SSA). He also evaluated the role that private investment has played in SSA's energy-focused climate mitigation owing to UNFCCC-backed climate finance instruments. The article also talks about three case studies from Ethiopia, South Africa and Madagascar. Effective management of market processes is necessary to give the private sector the assurance it needs to make new investments. They also shed light on the main key policy insights as, according to Article 6 of the Paris Agreement, the subsequent generation of project-based market mechanisms should be anchored by a programmatic approach with established baseline and monitoring techniques. Furthermore, the paper underlines the importance of strengthening local financial markets and institutions to support sustainable energy projects. It suggests capacity-building efforts, knowledge-sharing platforms, and the involvement of local stakeholders to create a conducive investment environment. The study concludes with the remark that stronger synergies between international and national sources of money should be achieved, especially in the context of Nationally Determined Contribution (NDC), given the general need to enhance mitigation ambition and the major barrier of access to finance.

Nexus between green finance, non-fossil energy use, and carbon intensity: Empirical evidence from China based on a vector error correction model

Citation: Ren, X., Shao, Q., & Zhong, R. (2020). Nexus between green finance, non-fossil energy use, and carbon intensity: Empirical evidence from China based on a vector error correction model. Journal of Cleaner Production, 277, 122844. https://doi.org/10.1016/j.jclepro.2020.122844

Link: https://www.sciencedirect.com/science/article/pii/S0959652620328894

Numerous studies investigated the connection between financial development and CO2 emissions. However, a few studies have explored the role of green finance in carbon mitigation. In this regard, (Ren *et al*., 2020) studied empirical evidence from China from 2000 to 2018 based on a Vector Error Correction Model (VECM) and he identified the connection between green finance, non-fossil energy use, and carbon intensity. This study contributes to the literature by developing a green finance development index that comprises four financial indicators- green credit, green securities, green insurance, and green investment based on official documents, which is a novel attempt in this field. The paper indicates that significant fluctuations in green finance have a detrimental impact on the carbon intensity and the non-fossil energy industry. In order to encourage the reduction of emissions, it is essential that green financial policy be stable and sustainable. The second policy implication is the need for increased assistance for green financing in non-fossil energy industries. In order to incorporate green

financing goods and services into the development of non-fossil energy businesses, flexible and diverse service schemes need to be developed. The third policy implication is that the carbon market's application procedure for green financing should be streamlined. Utilizing financial derivatives to reduce carbon dioxide and other greenhouse gas emissions is how carbon trading is implemented in the financial sector. The findings emphasize the crucial role of green finance in facilitating the transition to a sustainable and low-carbon economy by promoting the use of non-fossil energy sources and reducing greenhouse gas emissions.

Climate finance policy in practice: a review of the evidence

Citation: Bhandary, R. R., Gallagher, K. S., & Zhang, F. (2021). Climate finance policy in practice: A review of the evidence. Climate Policy, 21(4), 529-545. https://doi.org/10.1080/14693062.2020.1871313

Link: https://www.tandfonline.com/doi/full/10.1080/14693062.2020.1871313

The ability to transition to a low-carbon, climate-resilient economy depends heavily on finance. The Paris Agreement itself makes a commitment to coordinating financial flows with a strategy for achieving reduced greenhouse gas emissions and development that is climate resilient. Numerous studies have shown that there is a sizable budgetary gap to achieve these aims. Bhandary *et al*., (2021) evaluated how policy can mobilize climate finance in practice. On the basis of an extensive set of evaluation criteria, the paper analyzed the empirical effectiveness of climate financing initiatives. The paper also examines national climate financing policies and takes lessons from both successful and unsuccessful country cases.

Nine types of climate finance policies are being evaluated using multiple criteria, including mobilization effectiveness, economic efficiency, environmental integrity, and equity. The result shows that many climate finance strategies perform better than others depending on the standards being used to assess them and the specifics of their design. For each of these policy instruments, there are both strengths and limitations.

The paper proposes the possible policy implications. Effective climate finance mobilization may be hampered by a lack of government policy. Governments should be cautious when implementing measures that have shown to be financially costly in order to stretch limited resources farther. The paper came to the conclusion that the effects of climate financing policies on the integrity and fairness of the environment should be a concern for the government. Market disruption is a common result of technological change, which is fundamentally dynamic. In order to be effective, climate finance programs must foresee change and be prepared to adapt to it.

What do you think about climate finance?

Citation: Stroebel, J., & Wurgler, J. (2021). What do you think about climate finance? Journal of Financial Economics, 142(2), 487-498. https://doi.org/10.1016/j.jfineco.2021.08.004

Link: https://www.sciencedirect.com/science/article/pii/S0304405X21003494

There is a surge in financial studies resulting from the growing awareness of the risks associated with climate change. Stroebel & Wurgler (2021) surveyed 861 anonymous respondents from selected financial economists, finance professionals, and regulators and economists from public institutions to collect views about climate finance. The survey consists of five different types of questions viz i) Which climate risks are most important? ii) Are asset markets pricing climate risks correctly? iii) How should investors and governments discount climate Risks? iv) What are the biggest forces for change? v) What are the most important research topics? Are researchers working on them?

The majority of survey participants thought there was no connection between economic situations and realizations of climate risk. The survey results conclude that the greatest risk for investors and businesses in relation to the climate during the next five years, according to the respondents, is regulatory risk; however, the top risk over the next thirty years is physical risk. The assets markets are

underestimating climate risk and the most potent driver of change among financial mechanisms is thought to be institutional investor pressure. The most effective non-financial policies are thought to be carbon fees and government subsidies.

Do good intentions bring bad results? Climate finance and economic risks

Citation: Zhao, Jinsong, Boxu Zhou, and Xinrui Li. (2022) "Do good intentions bring bad results? Climate finance and economic risks." Finance Research Letters 48 :103003. https://doi.org/10.1016/j.frl.2022.103003

Link: https://www.sciencedirect.com/science/article/pii/S1544612322002446

Climate risk frequently has unforeseen consequences on the economy, as it creates uncertainty in the economic front and increases the probability that economic entities would experience financial losses when engaging in typical economic activity. Climate finance has become a critical tool for developing countries to address climate change. Zhao *et al*., (2022) identified climate finance, which offers financial support to developing countries to mitigate climate risk and draws lessons for the future allocation and implementation of climate finance. In order to determine whether climate finance has a negative effect on economic risks in developing countries, this study examines multilateral climate finance flows including mitigation and adaptation finance from 2000 to 2018. Finally, this study investigates whether the implementation of climate finance requires a stable political context in order for foreign aid to be used effectively. They estimated the diverse impact of two recipient countries: The Small Island Developing States (SIDS), which are more vulnerable among the developing countries, and the others. They used Fixed Effects (FE) and Generalized Method of Moments (GMM) models and found that climate finance significantly escalates the economic risks for recipient countries, with the impact of mitigation finance being more pronounced than that of adaptation finance. On the other hand, in SIDS or countries with greater political stability and lower levels of violence, the negative effects of climate finance on economic risk are less pronounced. The results do not prove that climate funding is ineffective, even while they show that it can increase economic risk. The outcomes, in fact, highlight the fact that delivering climate finance depends on recipient nations having good governance.

Green bonds as an instrument to finance low carbon transition

Citation: Sartzetakis, E.S. (2021) Green bonds as an instrument to finance low carbon transition. Econ Change Restruct 54, 755–779. https://doi.org/10.1007/s10644-020-09266-9

Link: https://link.springer.com/article/10.1007/s10644-020-09266-9#citeas

The significance of the financial risk linked to climate change is becoming more widely acknowledged. Central banks have recognized in recent years the potential risk that climate change and the phasing out of fossil fuels could pose to the financial system. The study conducted by (Sartzetakis, 2021) analyzed how green bonds can help finance the shift to a low-carbon economy. The paper also focuses on main characteristics of green bonds with a special focus on those that pose challenges in further developing the market, and the major reasons for promoting the use of green bonds. They present two arguments - one theoretical and one practical, in favor of using bonds to finance the shift to a low-carbon economy. The first argument is that green bonds, as debt financing tools, could aid in equitable and effective cost distribution over generations. The second one is; transition financing is the practical requirement for significant long-term investments.

It is evident from the paper that despite the green bond market and its rapid expansion, it is still far from attaining the level of investments to support the low carbon transition. The paper came to the conclusion that in order to reach its potential, providing a viable instrument for substantial financial support for the transition to the low carbon economy, the green bonds market needs to address the important challenge of widening the scope of low carbon investments that have access to the green bonds market. By effectively mobilizing private capital towards sustainable projects, green bonds can play a crucial role in accelerating the transition to a more environmentally sustainable future.

The Impact of Financial Development on Carbon Emissions: A Global Perspective
Citation: Jiang, C., & Ma, X. (2019). The impact of financial development on carbon emissions: a global perspective. Sustainability, 11(19), 5241. https://doi.org/10.3390/su11195241

Link: https://www.mdpi.com/2071-1050/11/19/5241

The financial development has been recognized to be an important factor influencing carbon emissions, however, the specific effect generated by financial development is still debatable. In this regard, (Jiang & Ma, 2019) analyzed the impact of financial development on carbon emissions from a global perspective on panel data of 155 countries. In order to detect the national differences in a coherent framework, the study area is divided into: developed countries and emerging market and developing countries.

The empirical findings led to the general conclusion that financial development can raise carbon emissions, and this conclusion is still true for the subgroup of emerging markets and developing countries. However, the empirical findings showed that, for developed countries, financial development has no discernible impact on carbon emissions. In addition, the development of financial institutions has a considerably higher impact on carbon emissions than the development of the stock market. The robustness tests also demonstrated the reliability of the aforementioned empirical findings.

Additionally, from a macro viewpoint, the empirical findings of the sub-groups suggested that the impact of financial development on carbon emissions might concur with the law of short-term pain, long-term gain. In order to create a long-term plan for the domestic development of the financial sector, authorities in emerging markets and developing countries could take into account the whole positive impact of financial development. It also suggests that a well-developed financial sector can serve as a catalyst for sustainable development by enabling investments in clean technologies and fostering environmentally responsible practices. The findings underscore the importance of aligning financial policies and practices with climate goals to achieve a more sustainable and low-carbon future.

A bibliometric analysis on green finance: Current status, development, and future directions
Citation: Zhang, D., Zhang, Z., & Managi, S. (2019). A bibliometric analysis on green finance: Current status, development, and future directions. Finance Research Letters, 29, 425-430. https://doi.org/10.1016/j.frl.2019.02.003

Link: https://www.sciencedirect.com/science/article/pii/S1544612319300765

Sustainability and climate change have received significant international attention. Green finance has had paramount policy importance, among international organizations and national governments since its emergence. Zhang *et al*., (2019) did a bibliometric analysis to understand the current status, development, and future directions on green finance. Considering the analysis, green finance should be viewed as an interdisciplinary research topic that covers and deals with policies, investment, and governance on financing and investment in climate adaptation.

The importance and advancing relevance of green finance have also been demonstrated in the paper. Since mainstream economics and finance journals have not been paying much attention to current material, there is a gap that presents opportunities for future research in at least three different paths. First, since green finance is fundamentally a financial subject, it is imperative to analyze green finance challenges from a financial perspective and using financial methods. Green governance, risk management, and bonds should all be of interest to mainstream financial journals. Second, additional research on green finance concerns from the viewpoint of developing nations would help regulators and policy makers align various policy goals and establish clear policy objectives.

Scholars from developing nations will be provided greater opportunities with evident information advantages, and increased international collaboration between developing and developed countries is anticipated. Third, it is important to note that one notable distinction between green finance and

conventional finance subjects is that the former is mostly driven by policy. As a result of the swiftly shifting global economic and political settings, new difficulties in this area are expected to arise. This paper emphasizes the importance of interdisciplinary collaboration, knowledge sharing, and research that addresses practical challenges and policy implications. The author concluded with the note that a thorough evaluation of pertinent literature is currently lacking. The paper also suggests the need for further exploration of emerging topics and the integration of innovative methodologies, such as machine learning and data analytics, to advance green finance research.

Carbon finance and carbon market in China: Progress and challenges

Citation: Zhou, K., & Li, Y. (2019). Carbon finance and carbon market in China: Progress and challenges. Journal of Cleaner Production, 214, 536-549. https://doi.org/10.1016/j.jclepro.2018.12.298

Link: https://www.sciencedirect.com/science/article/pii/S0959652618340290#abs0010

The majority of current research on the carbon market is currently focused on the European carbon market. However, efforts to do research on the carbon market are comparatively limited in China and several other nations/regions, particularly for an in-depth analysis. Based on the procedures of some other foreign carbon market development, (Zhou & Li, 2019) proposed a thorough evaluation of carbon financing and market under China's setting to close this gap. The chapter first provides a survey on the growth and experiences of previous international carbon markets. They integrate Chinese context with global practices and also identified several issues that the carbon markets in China and across the world share. In this study, the author specifically reviewed and summarized the background information and associated topics, such as carbon finance markets, carbon financial instruments, and the function of financial institutions in carbon finance. The main obstacles to the establishment and growth of China's carbon finance market were also highlighted, which included a lack of knowledge of carbon finance, a lack of professionals with the necessary expertise, a lack of sound policies, regulations, and legal frameworks, a lack of innovation in carbon financial products, and an absence of a national unified carbon trading platform. Finally, the authors provided pertinent advice on how to improve carbon finance understanding, train experts who will be involved, boost product innovation, and improve applicable laws and regulations. Additionally, taking into consideration the global context, this study identified several shared difficulties and proposed pertinent policy implications for the global carbon market.

Developing Low Carbon Finance Index: Evidence from Developed and Developing Economies

Citation: Mohsin, M., Taghizadeh-Hesary, F., Panthamit, N., Anwar, S., Abbas, Q., & Vo, X. V. (2021). Developing low carbon finance index: evidence from developed and developing economies. Finance Research Letters, 43, 101520. https://doi.org/10.1016/j.frl.2020.101520

https://www.sciencedirect.com/science/article/pii/S1544612320300234?casa_token=0Wf3qrFOvQcAAAAA:-ysAOsQANWss_AUKyZKJ_WMawmnmTSeqTAXz0cNXWhXTVpiyA_-Ou_7qETbpRM2LvQt6nb7h6zk

Mohsin *et al*., (2021) delves into the critical issue of transitioning towards a low-carbon economy and the role of finance in driving this shift. With the escalating threats posed by climate change, the need to mobilize capital for sustainable and environmentally responsible projects has become paramount. This study focuses on constructing a novel Low Carbon Finance Index (LCFI) to assess the performance and progress of economies in this transformative journey.

To address the gap of emphasizing the lack of a standardized measurement tool to gauge the extent of low-carbon financial activities across economies, the author proposes the LCFI as an innovative metric to track and compare low-carbon financial development worldwide. Constructing LCFI, involves gathering data on various low-carbon financial indicators from both developed and developing economies. The selected indicators encompass a broad spectrum of activities, such as green bonds, renewable energy investments, carbon pricing mechanisms, and sustainable lending practices. By combining these indicators, the author creates a comprehensive index that quantifies the degree of low-carbon financial engagement in each economy. The research then presents empirical evidence from a

sample of developed and developing countries, offering a comparative analysis of their low-carbon finance performance. The findings highlight the variations in low-carbon finance development across regions and income levels, with some economies showcasing remarkable progress while others lag behind.

Furthermore, the paper explores the potential drivers and barriers that influence the adoption of low-carbon financial practices in different economies. Policy frameworks, institutional support, market maturity, and public awareness are identified as key factors that influence the transition to a low-carbon financial system.

In conclusion, the development of the Low Carbon Finance Index serves as a crucial step toward promoting sustainable finance practices globally. By providing a standardized measure, policymakers, investors, and stakeholders can assess progress, identify best practices, and formulate strategies to accelerate the shift toward a low-carbon economy.

Does climate finance reduce vulnerability in Small Island Developing States? An empirical investigation

Citation: Scandurra, G., Thomas, A., Passaro, R., Bencini, J., & Carfora, A. (2020). Does climate finance reduce vulnerability in Small Island Developing States? An empirical investigation. Journal of Cleaner Production, 256, 120330. https://doi.org/10.1016/j.jclepro.2020.120330

Link: https://www.sciencedirect.com/science/article/pii/S0959652620303772?pes=vor

Scandurra *et al*., (2020) studied climate finance as a measure to reduce the vulnerability in Small Island Developing States (SIDS). The study focused on examining the effectiveness of climate finance in reducing vulnerability and enhancing resilience in these vulnerable regions.

To assess the impact of climate finance on vulnerability reduction, the author adopts an empirical approach, analyzing data from a sample of SIDS over a specific period. He gathers information on climate finance inflows, such as grants, concessional loans, and climate-related aid, and examines their allocation towards climate adaptation and mitigation projects.

Furthermore, the study evaluates the effectiveness of these climate finance investments by measuring changes in vulnerability indicators over time. These indicators include metrics related to climate resilience, disaster preparedness, GDP stability, and human development. The empirical investigation reveals insights into the relationship between climate finance and vulnerability reduction in SIDS. The findings indicate that targeted climate finance interventions have a positive association with increased resilience and reduced vulnerability in these nations. When invested in appropriate adaptation and mitigation strategies, climate finance can bolster infrastructure, enhance capacity-building efforts, and facilitate the adoption of sustainable practices, all of which contribute to reduced vulnerability. The paper also discusses the challenges and opportunities that SIDS encounter in accessing and utilizing climate finance effectively. It emphasizes the importance of strengthening institutional capacities, improving financial management, and promoting transparent governance to ensure optimal utilization of climate finance resources. By providing empirical evidence of the positive impact of climate finance on vulnerability reduction, this study contributes to the ongoing efforts of policymakers, international organizations, and stakeholders in formulating targeted strategies to enhance resilience and sustainable development in SIDS. It underscores the urgency of scaling up climate finance commitments to protect these vulnerable nations from the escalating impacts of climate change.

The impact of climate funds on economic growth and their role in substituting fossil energy sources

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The climate funds have established themselves as a resource for supporting adaptation to combat climate change and its effects on the environment in recent years. Additionally, they serve as a tool for advancing policies that aid developing nations in achieving sustainability. In this regard, (Carfora & Scandurra 2019) studied the impact of climate funds on economic growth and their role in substituting fossil energy sources. This aim of the paper is to assess the efficacy of policies governing the use of climate funding. To accomplish this, they assessed how the climate funds given out by donor countries have affected environmental and economic issues by analyzing the flow of funds among countries and conducting a counterfactual analysis. The findings of this study offer clear evidence of how effectively climate funds operate to encourage green growth. The findings demonstrate that funds were allocated to improve energy efficiency and sustainability: in fact, recipient countries reduced their GHG emissions in comparison to their similar counterparts. The research paper also discusses the challenges and limitations of climate funds in achieving a complete substitution of fossil energy sources. It recognizes the need for supportive policies, regulatory frameworks, and technological advancements to facilitate the transition to a low-carbon economy.

In conclusion, the research paper demonstrates the positive impact of climate funds on economic growth and their potential role in substituting fossil energy sources. It highlights the importance of targeted investments in renewable energy and the need for continued financial support to accelerate the transition away from fossil fuels. The findings provide insights for policymakers and stakeholders involved in climate finance, emphasizing the importance of aligning financial resources with sustainable development goals and climate objectives.