

## BOOK REVIEW

*Technology Transfer and Innovation for Low-Carbon Development* by Miria A. Pigato, Simon J. Black, Damien Dussaux, Zhimin Mao, Miles McKenna, Ryan Rafaty and Simon Touboul, published by the World Bank Group, Washington, DC, 2020, XXXIII+192 pages.

Over time, the evolution of human beings, technological advancement as well as environmental degradation went on hand in hand. However, to combat the injury which had already been done to the global climate, series of steps are now being taken. The sustainable development goals (SDGs) set by the United Nations General Assembly (UNGA) in 2015 (UN Resolution 70/1) include resorting to affordable and clean energy, ensuring responsible consumption and production, addressing climate action and securing the life below water and life on land. Similarly, several other international regulatory frameworks have been adopted which directly address the uneven volume of resources available in different parts of the world and highlight the necessity of technology transfer to make tenacious response to global climate change. The book *Technology Transfer and Innovation for Low-Carbon Development* intends to look into the prospects of the transfer of technology through a lens of optimism that can help the international community perceive and chalk out beneficial outcomes, particularly in the area of low-carbon development. Given how carbon emission has become a buzzword and concern, it is important to utilize the available technology pragmatically through appropriate policies. Hence, the book also sheds lights on the means and prospects of technologies transfer.

The book contains 192 pages along with a foreword and an executive summary. In the foreword, Ceyla Pazarbasioglu, Vice President, Equitable Growth, Finance and Institutions, World Bank Group has mentioned that the book looks forward to bringing ‘a ray of hope’ amid the pertinent pessimism about climate change. Throughout the book, this positive tone is found in a very tacit manner. The seven authors, in five distinct chapters, have tried to put forth the multiple dimensions of low-carbon technology transfers. The chapters, albeit not in a mutually exclusive manner, have taken into consideration of several key areas ranging from legal aspects like formulating a framework for transferring the technology, ins and outs of patent rights to economic and policy-oriented questions related to trade and foreign direct investments (FDIs) as well as potential leadership and measures which can turn the frameworks and policies into reality.

The book uses both qualitative and quantitative methods to illustrate the arguments through empirical and scientific validation. The executive summary perfectly justifies why the expansion of low-carbon technology (LCT) is necessary based on greenhouse gas (GHG) emissions abatement potential across four major

sectors—energy, industry, transportation and construction. Providing the inference, the book stands strong on its rationale by showcasing the complex intersection of multidimensional capabilities, i.e., human, organizational, financial, institutional, etc., which are often hard to be achieved by the developing or underdeveloped countries and may require technology transfer.

The five chapters of the book illustrates five different aspects of technology transfer and innovation in the field of low-carbon development. The first chapter highlights the integration of technology into the process of low-carbon transformation, the implication of technology transfer in the South as well as challenges of low-carbon technological innovation and diffusion. By explaining the legal dimensions, it also explores further avenues to develop a constructive framework for technology transfer, innovation and development. The second chapter evaluates different channels of low-carbon technology transfer, e.g., trade and foreign direct investments (FDIs) as well as movement of people. The third chapter focuses on patent transfer and the drivers that affect the innovations and their dispatch. With a focus on China, the fourth chapter traces the rise of the emerging economies as a leader in low-carbon innovation. The fifth and final chapter sketches out some policies to support transfer of low-carbon technology either inward through import and diffusion or outward through innovation, production and export.

The authors deserve a firm appreciation for the construction of language and literary art of the book. Even though the book has a general framework based on macroeconomics and International Political Economy (IPE), any enthusiast person from other field can go through the book without any exertion. For instance, the first chapter of the book begins with explanation of some key features of LCT like lower emissions intensity, complexity, multiplicity and heterogeneity, high up-front costs which make the reader familiar with the ins and outs of the problem the book is going to address. The analysis is easy to comprehend and each argument is backed by detailed information and precise evidences.

The division between the global North and South is clearly reflected in different chapters of the book. While talking about technological innovation and diffusion in the historical context, the authors have shown how the industrial revolutions since the mid-18<sup>th</sup> century have provided the North with a general privilege in innovation, adoption and transfer of technology. Even in the case of patent transfer, the authors have noted that around 91 per cent of LCT patent transfers would take place between high-income countries in between 1990 and 1995. On the other hand, the transfers from developing countries have depended more on the magnitude of the determinants than the high-income economies. With the establishment of the Clean Development Mechanism (CDM) in the Kyoto protocol of the United Nations

Framework Convention on Climate Change (UNFCCC) adopted in 1997, the North-South question had been addressed rigorously. The book refers to the article 10(c) of the protocol which states the necessity to bring about all practicable steps to promote, facilitate and finance the transfer of technology, specifically referring to the developing countries. However, the authors have not negated the contrasting argument stating that the asymmetrical distribution of state capacity and human capital between the two strata may affect the volume of innovation and deployment of technologies to a greater extent.

The book rigorously describes the international legal framework for LCT transfer. It starts from the Intergovernmental Panel on Climate Change (IPCC) special report published in 2000 which provided a comprehensive and holistic definition of technology transfer. A sheer importance has been given to the legal provisions adopted by the UNFCCC. Moreover, the Kyoto Protocol and the Paris Agreement (2016) have been referred to a number of times as both of these initiatives have contributed in the pursuit of technology transfer dedicated to the reduction of worldwide carbon emission.

After conceptualizing the legal framework, the vital area that needs to be addressed is the implementation and financing of the schemes. The authors have successfully undertaken both of these issues. In this respect, FDI, trade and patent transfers have been identified as the most common channels. Presenting effective quantitative data, the authors identify the current situation as well as future possibilities, possible channels and determinants. Data derived from World Bank's 1988/92 Harmonized Commodity Description and Coding System classification have shown that in between 1990 and 2016, LCT exports have increased at a compound annual rate of 11.1 per cent which outrun the rate of both total exports (9.7 per cent) and merchandise exports (6.0 per cent). The book also takes into account the slowdown in year-on-year growth in trade values while arguing that it is a part of the general slowdown in global trade which makes the situation less alarming. Nevertheless, the values of North-North, North-South, South-South and South-North exports have been described and analyzed respectively to assess the reality of trade and transaction through different channels.

So far as the FDIs are concerned, the authors have looked at the renewable energy (RE) investments with a specific focus on the Renewables Global Status Report (GSR). It has been reported in the book that among the US\$332.1 worth of clean energy investment at the global scale in 2018, one-third came from the South. China can be credited with its record in the RE investment, consisting 45 per cent of total RE investment globally. However, it would be intriguing to have further discussion on why the North has not been investing much in the RE

sector. The authors have also identified areas of investment (i.e., biomass power, geothermal electric power, hydroelectric power, solar electric power, etc.) as well as the economic determinants (i.e., market size, per capita income, access to regional/global markets, access to raw materials, etc.) for renewable energy. Nevertheless, a definitive correlation between the motive, determinants and how their relations with the discrepancies in investment could have made the discussion all-encompassing. A similar analysis in case of patent transfer could have added a new dimension to the book.

The book clearly addresses the driving forces behind patent transfer including trade and FDI policies, local capacity on technological absorption, national environmental policies and Intellectual Property Right (IPR) protection. It uses a gravity model to identify the impacts of the driving factors. But the focus has been primarily given to the global trend in patent sharing as well as the South-South transfer. Skimming through the pages, one can easily find out that the names of China and Russia have been pronounced more than any other country. While tracing the effects of relaxing FDI controls and lowering tariffs, the authors mention that the impact of relaxing FDI controls is 50 per cent higher than that of lowering tariffs. But the example has been given based on simulations from Brazil, China and Russia.

The analysis of the book is strong in its methodology. But it becomes parsimonious due to its sole focus on the South-South and not on the North-South transfer. Different other researches may bring different result. Yanmin Shao's article titled "Does FDI affect carbon intensity? New evidence from dynamic panel analysis?" (2018) published in *International Journal of Climate Change Strategies and Management* has provided an argument that FDI has a significant negative impact on carbon intensity of the host country, be it a high-income, middle-income or low-income country. Shao's analysis has been based on worldwide samples. Therefore, a critique can always be enunciated referring to the limited scope and focus of the book.

The book also considers different relevant industries and their contribution to the reduction of carbon emission. In this regard, the rise of wind industry, ethanol and solar industries as well as a global electric vehicle market have been discussed. However, the fourth chapter of the book titled "The Rise of Emerging Economies as Leaders in Low-Carbon Innovation", which dedicates itself to the analysis of these kind of new industries has gone beyond the previously mentioned constraints. Hence, industries in both the Northern and Southern parts have been brought up to substantiate particular contexts. It incorporates diverse fields and sufficient examples to complement the discussion. It brings up how the European firms have helped China to develop its wind power industry, how India and South Africa joined the

voyage and how Brazil strengthened itself with the success of sugarcane ethanol industry. Most importantly, this chapter also dedicates a portion to elaborate the United States (US) electric vehicle policies and another section to discuss non-state or private enterprises like BYD and Tesla. Moreover, while discussing the estimated world solar photovoltaic cell production under the broad architecture of the solar industries, the authors have counted the data of China, Taiwan, Europe, Japan, Malaysia, the US and the rest of the world. This gives a strong cognition of holistic analysis which has been missing in rest of the chapters.

However, with regard to the question of energy, the breadth of deliberation has to be stretched to the issue of consumption and energy regulation. For example, Frauke Urban's book titled *Low Carbon Transitions for Developing Countries (2014)* published as a part of Routledge Studies in Low Carbon Development has brought up some analytical models (i.e., the Energy Ladder in the Special Report on Emissions Scenarios (SRES) Models, the Environmental Kuznet's Curve in the SRES models, the Long-range Energy Alternatives Planning (LEAP) model for final energy demand analysis, etc.) and also addressed some relevant areas including fossil energy resource depletion or urban air pollution. In comparison to this kind of monographs, the book and particularly the chapter mentioned above lacks depth and sound structural modelling.

The field where the writing holds an outstanding expanse is the connection between perceived frameworks and substantial policies. In every case, where there is a determined legal or conceptual framework, the authors have tried to furnish them with significant policy schemes. To actualize the policies, the book also comes up with the rationale behind formulating them. From knowledge spillovers, network externalities, imperfect information and inattention to incomplete property rights, financial market frictions and mismatches—all areas have been touched with necessary policy responses. Moreover, the book essentially goes deeper into the politics where implementation of policies is taken into account. For example, while discussing the question of state-intervention, the authors have clearly mentioned how market failures can be exploited as a justification for intervention of the government. It also argues that this kind of insufficiency of existing interventions proves that policy is currently located in a place of unsustainability. Hence, the authors must be praised for spelling out the reality and acknowledging the complexities. Once the dilemma is addressed, it is undoubtedly easier to comprehend the necessities. In the book, LCT transfer policies have been distinguished based on two dimensions named as the instrument mechanism and the type of national capability. It also acknowledges that typology is not mutually exclusive or collectively exhaustive.

The book refers to the United Nations Environment Programme (UNEP)'s goal to containing global warming to 1.5°C and the requirement that limits annual global GHG emissions to 24 gigatons till 2030. The objective is elaborated with the necessity of rapid increase in the global stock of low-carbon capital goods and a technology-transfer hierarchy model that includes adoption, diffusion, limitation, collaborative innovation and indigenous invention.

The book provides with specific recommendations to the policymaker like being consistent, coherent, credible, comprehensive and strategic; getting systemic policies right; making a comprehensive mixture of demand-pull and technology-push policies (for deployment) and focusing on longer temporal expanse and tech-push policies (for production). Nonetheless, the policy recommendations, at some points, may seem vague as they lack specification of stakeholders on any country in particular. The recommendations are also made focusing on the national policymaking platforms, which overlook the significance of international and regional top-down approaches. However, the examples of Tesla and BYD do indirectly suggest some policy options for the private organizations and new entrepreneurs. Building alliances and partnerships, envisioning new and innovative technologies, shaping the patents as per the needs are key advices to be endorsed by the organizations. Bringing in more actors and focusing on their diversified objectives as well as international strategic and political interests could give the recommendations more robust and stringent footholds.

The book lacks in delivering proper weight to the SDGs. In a 192-page book, the discussion of SDGs has come only twice and it only mentions several SDG goals including the impacts of air pollution (SDG 3), ensuring universal energy access (SDG 7) and reducing and mitigating climate change (SDG 13). Nevertheless, the book does not provide any recommendation that may accelerate the SDGs. Even, the issues of air pollution or pollution in general also never discusses in detail. In another World Bank publication titled *Low-Carbon Development for Mexico (2010)*, authors Todd M. Johnson, Claudio Alatorre, Zayra Romo, Feng Liu have not only brought in the issues of energy end-use, electric power or the usage of oil and gas, they have also addressed the connection of low-carbon development with the transportation industry, agriculture and forestry. Although this book takes into account just one case study, these sectors could have been studied as well.

Overall, the book has been organized in a meticulous way with eloquent analysis and strong arguments. The empirical depositions are fresh, cohesive and derived from authentic sources. The authors have managed to make an intriguing mixture of quantitative and qualitative analysis which makes the reading experience more enjoyable. Each of the chapters is equipped with methodological or analytical

exordiums and apt layouts. On the one hand, the book articulates comprehensive enunciation of the past and the present. On the other hand, it addresses the probable future and required policies to make it climate-friendly. In one word, the book is a new literature and guide to the scientific optimism complemented by the technology transfer in low-carbon development.

Albeit the book is precise, compact and rigorous on its own, it is not completely free of criticism. Apart from the issue of limited scope and linear focus discussed above, it also lacks ample reference to other secondary literature and researches. At times, the discussions in different chapters may seem repetitive and incoherent. It is understandable that the five chapters focus on five different dominions, the exposition lacks literary harmony. The book is befitting in the way it is intended to be—in search of a ray of hope amid the pessimism. However, it cannot be completely ignored that some of these pessimistic overtures are indeed important and factual and they need to be addressed with prerequisite significance. In this regard, the book has not been able to vigorously address the challenges lying within the frameworks, policies and developments in the field. Another point that can be illustrated is the feasibility of building up the entire analysis on the division of the global North and the global South. Putting countries like China, India or Brazil on the same scale as Nepal or Guyana even though being considered as a part of the global South may seem unfeasible.

In conclusion, it can be said that *Technology Transfer and Innovation for Low-Carbon Development* is definitely a significant contribution to the existing literature on climate change, carbon-emission and mitigation strategies. With its multidisciplinary approach, it sketches out some considerable frameworks and policies as well as the earlier development in the correlated areas. It can, hence, be identified as a point of departure for further researches and a paramount reference portraying the legal and practical advancements initiated to combat the adverse impacts of climate change and carbon intensity.

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