

9 India's energy transition

Is China an inhibitor or a catalyst?

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1 Introduction

The Paris climate agreement has upheld India's commitment to climate mitigation and clean energy development. As part of its Nationally Determined Contributions, India has committed to reducing the emission intensity of its GDP by 30%–35% compared to the levels in 2005 and develop 40% of its electricity installed capacity from non-fossil fuel sources (Government of India, 2015). These commitments have given considerable momentum to the energy transition initiatives by the country.

Energy transition targets in India are multi-pronged and include both supply-side as well as demand-side measures. On the supply side, one of the most important areas is the development of renewable energy installed capacity in view of the country's long-term energy security as well as emission reduction goals. National targets on renewable energy development, which includes the development of 175 GW of installed capacity by 2022 and further expansion to 450 GW by 2030 (PIB, 2019), have emerged as key pillars. The renewable targets have also aimed to ensure that clean energy is affordable and accessible to all sections of the population. Regarding the demand-side measures for transition, India has been taking several initiatives that address the energy efficiency needs of industry, the residential sector, transport, and other key sectors responsible for major shares in energy consumption and emissions. This has not only generated larger public interest and acceptance toward renewable power sources but also contributed to dispelling inherent apprehension about the feasibility of non-traditional sources. As the government supported several renewable energy development programs and rural electrification programs, several households began renewable energy installation. The country's total potential for renewable installed capacity is estimated to be over 1000 GW as of March 2017 (NITI Aayog, 2015), which is a promising factor that catalyzes the energy transition initiatives. Additionally, India has a large energy efficiency program that focuses on the domestic industrial sector. The program is known as Perform Achieve and Trade (PAT) and aims to improve efficiency in various energy-intensive industries using a domestic market mechanism. Through

this program, India aims to enhance the energy efficiency of heavy industries and medium enterprises, which together constitute a major proportion of industrial energy consumption in the country.

One of the major challenges India has been facing with regard to expanding its renewable energy sector is the lack of adequate manufacturing facilities that could supply necessary machinery and equipment (Chaudhary et al., 2014; Behuria, 2020; Kumar and Majid, 2020). The demand for power generation facilities in terms of several critical components, including mounting systems, storage systems, solar panels, and charge controllers, indicates that it is imperative to have a cost-efficient supply channel that ensures adequate availability in the domestic market. Prior to setting the ambitious goal of renewable energy development, the supplies from domestic industry were sufficient to meet most of the sector's needs. However, the growing installed capacity targets and faster adoption of renewable energy for industrial as well as residential usage have led to a significant rise in demand for equipment and machinery. To fill the supply gap, the country eventually had to depend on external supply sources, mostly based in China (Bhattacharya and Jana, 2009). China's rapid emergence as the leading renewable energy equipment market (Wang et al., 2019) and its position as a major industry complemented India's search for external supply chains.

By the end of 2019, India imported approximately 85% of the renewable energy equipment and machinery (PTI, 2020) that is required domestically, with China being the major supplier. Similarly, other equipment and machinery needed to meet the energy efficiency improvement targets in the construction and residential sectors have also been sourced from the import market, conventionally dominated by Chinese suppliers. However, the supply chain was unfavorably affected by the economic lockdown brought about by the COVID-19 pandemic (Eroğlu, 2020; Pradhan et al., 2020), as well as by geopolitical tensions between the two countries originating from an ongoing border dispute. Interestingly, and surprisingly, despite historical hostility over border demarcation, India's dependency on China has been substantially increasing in all aspects of trade for several years. Two reasons can be attributed to this dependency: First, it was necessary to meet domestic demand for expanding the renewable energy target and cater to the energy transition, and second, support was required for India's larger global plan for renewable energy development in developing countries, which is widely known as the International Solar Alliance (Deo, 2018).

This chapter provides insights into how China has been both an inhibitor and catalyst for India's domestic energy transition, and it examines a possible change in the trajectory of India's collaboration with China on the renewable energy front. It also examines the extent to which a mutually beneficial approach toward technology ties can be developed between the two countries.

2 Role of China in India's energy transition: catalyst or inhibitor?

China's competitive advantage over other countries in the energy industry and equipment market has been one of the critical factors that help its industries dominate the overseas market. China has a positive trade balance with several leading world economies, indicating their dependency on China. In 2017, China's overall trade balance with the United States was US\$ 275 billion, and it was estimated to be US\$ 51 billion with India (World Bank, 2018). This also is reflective of the advantage China has in terms of trade with these partners. India's imports of renewable energy equipment and component supply from China were US\$ 2.81 billion and US\$ 3.41 billion in 2017 and 2018, respectively (ETEnergyWorld, 2020). It is often argued that imports from China are vital for India to meet its renewable energy development goals as the equipment and components are more cost-effective and efficient than those available in India or from other countries. By early 2020, over 80% of the total solar cells and modules used in India were from China (ETEnergyWorld, 2020).

It is widely noted that to defend and further its economic and political interests, China interferes with the political systems of developing economies (USCC, 2018; Shullman, 2019; Ferchen, 2020). While China seeks to ensure its presence in the domestic markets of other countries as well as the regional or global markets for renewable energy, it has often been perceived as pushing its economic interests. As China searches for renewable energy markets in the Asia-Pacific region, it has found itself at cross purposes with India on several occasions (Janardhanan, 2017).

This section discusses the perception of China as it engages with the Indian renewable energy market as a supplier of services and equipment or machinery. The specifics of the discussion highlighted the conflicting but often dominant strands of two sets of perceptions on China among Indian scholars. First, China's competitive advantage and its persisting market interest are perceived as a threat to the growth of domestic industries in India. This is further intensified by the historical animosity of the two that stems from the border conflict of 1962 as well as Beijing's political proximity to Pakistan. However, because of the gap between supply and demand of energy equipment and machinery needs for the expansion of the renewable energy industry, continued dependence on China seems inevitable. This section aims to examine this dialectics of China's role as a catalyst and an inhibitor to India's energy transition. The analysis is based on several studies as well as public statements and reports from the government and industry.

2.1 China as a catalyst in India's energy transition

China has played a significant role in India's energy transition by making available cost-effective equipment and machinery (Bhowmick, 2020;

ETEnergyWorld, 2020) needed for the installation of renewable energy facilities, thus leading to the perception by a section of Indian industry that China is a catalyst in India's energy transition. Collaboration with China has been important from different perspectives, namely, in terms of India's ambitious target, a cost-sensitive domestic market, and the ease of availability of equipment and machinery.

Indian commodity market (Kukarni and Anil, 2018; Rao and Charles, 2021) has undoubtedly been cost-sensitive, and this has been one of the many challenges faced by international firms and companies that intend to tap into the country's vast market and consumer base. Hence, subsidies have been essential in the promotion of the renewable energy sector as well as for energy efficiency equipment (Acharya and Sadathb, 2017; Shrimal et al., 2017). Price sensitivity plays a determining role for both large and small manufacturers. Costs have been highly competitive, which has also influenced the price of all equipment and machinery. Although India has seen a significant rise in demand for advanced technologies, many domestic and overseas companies in the renewable energy equipment industry have not been able to supply this advanced equipment at a sufficiently low cost. For this reason, Chinese companies have gained an advantage, as they have been able to produce and supply equipment and machinery at a lower cost to Indian consumers (Liming, 2007; Yang et al., 2016), and at a much more competitive level in comparison to other leading domestic or overseas players. Furthermore, China has a major market presence because of the aggressive marketing strategies of its companies, which have gained remarkable access in India due to lower costs, easy availability, and good after-sales service.

Another noticeable development is the role of the informal sector in promoting renewable energy equipment. Small and medium businesses have been involved in importing Chinese-manufactured industrial equipment and machinery, and these businesses have been able to benefit largely from the proactive policies and subsidies to promote renewable energy in India. Nevertheless, China's growing market presence in India's renewable energy equipment market was also unfavorably affecting the growth of the domestic industry.

2.2 China as an inhibitor to India's energy and strategic interests

Another point of view that drives the debate on China's role in India's energy transition is that Chinese companies do more harm than good for India's economy and long-term strategic interests. This view is largely founded on a mix of factors that include economic, political, and historic perceptions of China. India–China border disputes remain an unforgettable historical hindrance for both countries. This is also a reminder that there is an urgent need for both countries to work on their differences and find a feasible solution to amicably settle this dispute. Although bilateral cultural relations between India and China have been strong for centuries, recent

engagement has been largely shaped by the 1962 border conflict over a disputed geographical boundary. While the conflict did not turn into a full-scale war, this incident led to mistrust on the side of China as regards the Indian political perception (Hansen, 1967; Mansingh, 1994; Das, 2007). It is important to note that the persistent mistrust between the two countries has been undeniably affecting modern-day relations. Notably, the Indian media takes every opportunity to refer to the border conflict with China, bringing the topic into public focus, which also adds to intensified anti-China public sentiments. However, the root cause of the perception of China as an inhibitor to India's energy transition lies elsewhere. China's political proximity to Pakistan, which has been supporting cross-border terrorist activities, and a widespread opinion that China has been conducting direct and indirect espionage activities to limit India's strategic ambitions in the region, are also influencing India's perception of China. Considering India's import dependency on China, the Indian Minister for renewable energy stated that, "power systems are vulnerable to malware attacks, which can shut down our communications, databases and defense systems. Due to this vulnerability, all power sector imports need to be inspected and some countries need to be banned" (Singh, 2020). Against this backdrop, China is often seen as an unreliable partner in energy sector collaboration.

Similarly, the border standoff between the two countries has also been a critical hurdle in taking the diplomatic dialogue with regard to economic policies forward. Instances of border skirmishes escalated into political problems and also affected the economic ties drastically. Despite both sides making efforts to resolve these matters, complete disengagement from India–China geopolitical standoff cannot be envisioned.

One of the critical questions here is to what extent India and China can continue to collaborate on economic and trade relations. While bilateral trade relations are largely shaped by China's economic ambitions, the two countries need to work together to build a much more constructive collaboration. As the Indian market has been sensitive to any predatory economic approaches by China, there will be limited opportunities for both to collaborate using traditional pathways. However, China has made technological progress in the industrial and manufacturing sector as well as in energy efficiency, and these will be critical areas where India can collaborate. With regard to China's export of equipment and machinery damaging the Indian market, it is essential to explore ways to develop a mutually beneficial mechanism that is not founded in an exploitative or predatory approach. In this context, "co-innovation" can be seen to be highly relevant.

However, this perception does not explain why and how China plays the role of an inhibitor to India's energy transition. Conversely, the perception of China as an inhibitor is based primarily on three factors: the impact it creates on the domestic industry in terms of the threat it poses to local manufacturers (Álvarez and Claro, 2009; Chakraborty and Henry, 2019), the perception that Chinese products are unreliable (Narang, 2016), and a

lack of space for healthy competition (Srinivasan, 2004; Chakraborty and Henry, 2019) due to low-priced Chinese goods.

The growth of the domestic manufacturing sector focusing on the renewable energy industry has been severely affected due to low-priced Chinese equipment flooding the market. From being one of the major exporters of solar energy-related equipment and machinery to the global market between 2006 and 2011, India is now a major importer of equipment due to low-priced supplies from China. It is estimated that this has not only affected the industry economically but also resulted in a loss of approximately 200,000 jobs (TNN, 2018), as imports from China began dominating the Indian market. A Parliamentary Committee prepared a report on this issue noting that “the implementation of anti-dumping regulations have not been able to witness expected results as most imports from China have been misclassified under different product categories” (Parliament of India, 2018). The strongly worded report also states that “at a time when there is an urgent need to stimulate our manufacturing sector to at least 25 percent of country’s GDP, Chinese imports have been adversely affecting India’s manufacturing sector” (ET Now, 2018; Parliament of India, 2018).

While some believe that the influx of low-priced equipment and machinery required for the renewable energy sector has helped in clean energy development (Liming, 2007), there is also another prominent perception that the Chinese renewable manufacturing export-oriented industries were benefiting from subsidies handed out by the Indian government. It is estimated that in 2018–2019, India imported power equipment worth INR 710 billion, of which INR 210 billion was from China (ETEnergyWorld, 2020; Singh, 2020).

The influx of low-priced imports from China was also perceived by policymakers in India (Parliament of India, 2018) to have long-term impacts on the domestic renewable energy industry, thereby limiting opportunities for healthy market competition that is necessary for industry development and integration of advanced technology. This view highlights that the Chinese export market deliberately engages in a predatory strategy to sideline other industries in host countries. It is often noted that with state sponsorship, China’s state-owned enterprises not only blocked entry into China’s key industrial sectors by international business but also flooded the international markets with their inexpensive products and services, gaining a competitive edge over global companies (Oh, 2015). A statement by Rex Tillerson, former US Secretary of State, in 2017 in which he accused China of “financing schemes for large infrastructure projects that saddle recipient countries with unsustainable debt and could even compromise their sovereignty” (Goodman, 2017) echoed in China’s engagement with Sri Lanka (Wignaraja et al., 2020). These business practices have been seen as a wider strategy of the predatory business by China with the objective of dominating the host country market. Indian Parliamentary Standing Committee on Commerce

has submitted a report (India, 2018) to the government in 2018, highlighting the impact of Chinese goods import on domestic industry, and therefore supporting the view that the overdependence on Chinese imports is unfavorably affecting the domestic industry (Kondapalli, 2021).

While China continues to be the major exporter of renewable energy equipment to India, this has also had a significant adverse effect on domestic industrial production. Despite concerns by the Indian industry about the overdependence on equipment supplies from Chinese manufacturers, the clean energy development target has been forcing the country to continue its dependence on importing equipment from China. It is estimated that India imported (Chandrasekaran, 2017) almost 87% of the total number of solar panels required to meet its domestic demand in 2017, with the majority imported from China. This overseas dependence eventually turned domestic manufacturers into retailers of Chinese goods. While many see China's role as an inhibitor to India's energy industry growth as well as strategic ambitions, the import of low-priced energy equipment and machinery has substantially helped the development of the renewable energy sector. In this context, one of the critical questions that arise is how India and China can develop a possible pathway that respects mutual economic interest and strategic priorities.

2.3 India's energy transition and COVID-19 impacts

The COVID-19 economic lockdown revealed the vulnerable spot of India's energy transition. The over-reliance on external supply lines, especially the dependence on China, turned out to be detrimental for meeting renewable energy development targets. As India imported more than 85% of its solar cells and modules from overseas (PIB, 2020a), disruptions to supply have presented a long-term challenge. It is estimated that due to this impact, there will be a minimum 3 GW delay in the target planned for 2022 (Energy World, 2020). As indicated earlier, a significant share of the supplies for solar energy installation is from China (Economic Times, 2020). The current disruptions are opening up opportunities for domestic companies to consider manufacturing locally or diversifying their imports. The post-COVID policies of the Indian government will also be directed toward encouraging domestic industry (Chaudhary et al., 2020; PIB, 2020).

3 A possible framework for India–China collaboration on energy transition

In order to explore the possible future pathway for collaboration between India and China in the former's energy transition plans, this section presents a broader framework on the concept of co-innovation. The section also deals with the potential implementation of co-innovation identifying key areas that require policy attention.

3.1 A concept of co-innovation framework

India is estimated to have about 63.05 million micro industries, 0.33 million small enterprises, and approximately 5,000 medium enterprises (ET Rise, 2019). Hence, the pandemic-related stimulus package that has been offered by the government will be contributing to a revival of the industry. As supplies from China have been affected, domestic industries will slowly fill this gap. Notably, India could attract global companies as a destination for relocation, which will provide further support to ensure progress on the manufacturing of renewables (Inambar, 2020). However, the inability of the manufacturing sector to meet the domestic demand in the short term will continue to be a critical challenge, that is, the supply and demand gap with regard to renewable energy equipment and machinery.

This chapter proposes a renewed approach toward bilateral trade and technology collaboration between China and India, which is based on the concept of co-innovation. Co-innovation is “a collaborative and iterative approach by two or more partners for jointly innovating, manufacturing and scaling up technologies” (Janardhanan et al., 2020). This is also seen as “a shared work of generating innovative and exceptional design conducted by various actors from firms, customers, and collaborating partners” (Saragih and Tan, 2018). Co-innovation also reflects the continuous exchange of knowledge among all the stakeholders including scientists, manufacturers, and the end-users of technology, with the aim of improving the product. Co-innovation brings in profound changes in the industrial world’s operating rules (Maniak and Midler, 2008).

The framework shown in Figure 9.1 explains the phases of co-innovation as well as the role of each partner and the associated benefits to each stakeholder. To explain the process better, the framework is divided into three main phases: collaboration, co-innovation, and outcome. The first phase of the process includes both (or more than two) partners identifying the needs and benefits of cooperation. For the source country and the recipient country, there should be a mutual agreement to enter into a collaborative initiative. In this phase, partners may be able to identify the purpose of collaboration, benefits, and the required inputs in terms of soft skills and hard skills for designing a joint venture. One of the most critical elements here is the effort made by stakeholders in planning the financial resources or entering into agreements for securing adequate monetary means for the collaborative initiative. This phase also provides an opportunity for partners to design adequate legal boundaries that are necessary to carry forward the required collaborative work. In cases where both parties decide to institutionalize their collaboration, whereby their respective soft skills and hard skills need a common platform for fine-tuning, the stakeholders can consider the possibility of collaboration laboratories, or technology CoLabs.

The next phase assumes the central role in the process. This phase explains the broad steps involved in the co-innovation process. The first step of

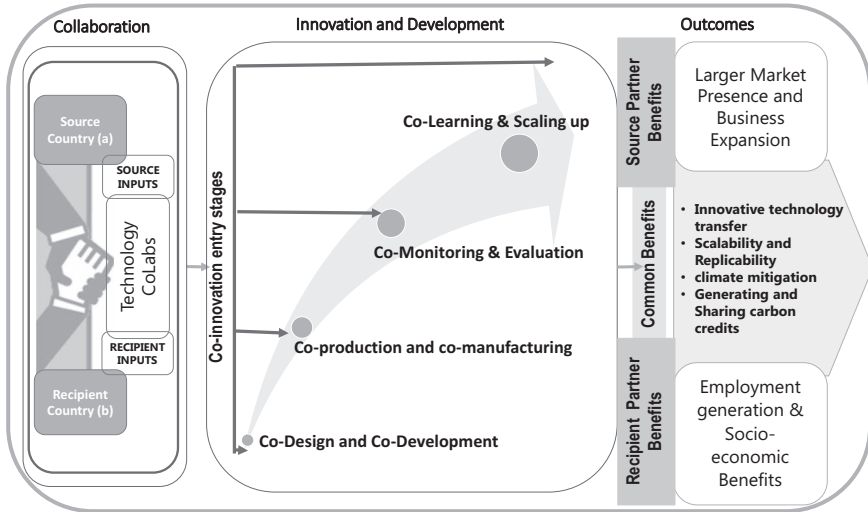


Figure 9.1 Co-innovation framework

Source: Janardhanan, et al. (2021)

this phase is co-design and co-development. This step explains the process that includes ideation, conceptualization, and developing a product design based on mutual agreement among stakeholders. Translating the concept into designing a particular piece of machinery or equipment demands significant joint efforts. The next important step involves co-production or co-manufacturing, which broadly indicates the industrial-level joint production of the machinery or equipment by the stakeholders. The third important step for co-innovation is co-monitoring and evaluation, which are critical processes that include preliminary field testing as well as operational product revision up to and including final product revision, based on co-monitoring activities. This step also can involve processes ranging from product testing to marketing and sale on a commercial scale. The last phase in the process is about co-learning and scaling-up, which involves product revision based on market knowledge, capacity building, as well as further scaling-up of the product for other potential markets. Although there are four possible phases, it is important to point out that co-innovation does not necessarily have exactly all these four steps; rather, co-innovation can be initiated at any stage depending on the agreement between the collaborators.

3.2 Implementation of co-innovation in India–China engagement

Co-innovation has often been discussed in the context of technology collaboration with the aim of overcoming traditional barriers. However, in

the India–China context, this is also one of the possible models where both countries can explore developing a collaborative framework for more constructive engagement. While China offers promising benefits in terms of easy availability of raw materials and smaller components, India cannot keep its manufacturing sector away from industrial production activities. For both countries, it may be worth exploring collaboration to strengthen bilateral trade while offering notable mutual benefits.

Three border steps are recommended by experts (Jacob, 2021; Mohan, 2021; Varghese, 2021) as possible avenues for engagement, and they are contingent upon how these proposed options are valued in the context of mutual economic as well as strategic interests. These options are proposed assuming that China’s export of equipment and machinery may be accepted in India if the latter’s security and strategic interests are not threatened. However, Chinese companies will benefit significantly from access to the huge Indian market. The phased collaboration should be in three steps.

3.2.1 First step: encouraging a material supply for production in India

One of the most important areas of collaboration between India and China pertaining to clean energy is material supply. Critical raw materials including tellurium, gallium, indium, and the rare earths neodymium and dysprosium (Rabe et al., 2017) needed for the clean energy industry have been tightly controlled by state-owned enterprises in China, which is partly due to the environmental and health problems associated with extracting these materials and also to ensure a domestic supply for its own, growing renewable energy industries (Rabe et al., 2017). Considering the long-term plans for clean energy development, this constitutes a potential area for bilateral cooperation.

3.2.2 Second step: engaging the Indian manufacturing sector

It is important for India to consider the development of its domestic industry, which is critical for employment generation as well as for strengthening local economies. This has been an important consideration for the country and has often played a significant role in deciding against overdependence on importing finished equipment and machinery. This area opens up avenues for both countries to engage in joint production and manufacturing utilizing co-innovation in industry.

3.2.3 Third step: promoting joint ventures in host countries

India–China joint production and manufacture of equipment and machinery seems to be a bare possibility in the current geopolitical circumstances. However, if the two countries are able to overcome their challenging border issues, there is every potential for an India–China co-innovation framework

to flourish. This will not only help meet the demand for renewable energy equipment and machinery in India but can also play a critical role in meeting the growing demand for renewable sector development in countries where India has been promoting the International Solar Alliance (ISA). Over 50 countries are involved in this alliance and most of the developing countries in the network will be beneficiaries of renewable energy development programs by the India-led initiative. China's closer collaboration with the network as a joint producer and supplier of renewable energy equipment and machinery could be a remarkable contribution to the developing economies.

4 Conclusion

In the past several years, China has been playing an active role in India's energy transition as a supplier of equipment and machinery needed for renewable energy sector as well as for energy efficiency improvement. However, recent months have seen the role of China in India's energy transition rapidly diminish as a result of the pandemic-induced break in bilateral trade and the persisting political volatility between the two countries.

This chapter aims to take stock of the three specific aspects regarding China's role in India's energy transition. First, the factors that give leverage to China in gaining dominance over the overseas market; second, the role China plays as a catalyst and inhibitor to India's energy transition; and third, a potential roadmap for India–China bilateral engagement in the clean energy equipment and machinery sector. Two specific elements are most noticeable throughout the discussions. First, the engagement of India and China in the clean energy domain can be beneficial to both. China's advantage in terms of its ability to supply cheaper equipment and machinery is important for India's stricter target for renewable energy development. However, the political differences founded in geopolitical issues and historical border clashes continue to unfavorably affect bilateral relations, and this is reflected in the energy sector collaboration as well.

The chapter presents a possible conceptual framework for future collaboration based on an innovative approach to co-innovation. The approach facilitates greater involvement of both countries in the manufacturing and production of equipment and machinery, rather than completely depending on imports from one to the other. The conceptual framework indicates that co-innovation can be mutually beneficial given that China's access to the Indian market enables the latter to engage its manufacturing sector to jointly develop and produce equipment and machinery with its Chinese counterparts. Although this proposed approach may appear to lack viability, this addresses one of the most critical and contentious perceptions of Chinese businesses in India as predatory and overly mercantilist. The relevance of co-innovation is also emphasized because strengthening bilateral trade ties will be one of the critical approaches that can build confidence among the two countries and bring about appeasement in their political interactions. This chapter is

an attempt to examine China's contribution in India's energy transition and what role it can potentially continue to play in the coming years.

References

- Acharya, R. H. & Sadathb, A. C., 2017. Implications of energy subsidy reform in India. *Energy Policy*, 102, pp. 453–462.
- Álvarez, R. & Claro, S., 2009. David Versus Goliath: The Impact of Chinese Competition on Developing Countries. *World Development*, 37(3), pp. 560–571.
- Behuria, P., 2020. The politics of late late development in renewable energy sectors: Dependency and contradictory tensions in India's National Solar Mission. *World Development*, 126, p. 104726.
- Bhattacharya, S. C. & Jana, C., 2009. Renewable energy in India: Historical developments and prospects. *Energy*, 34(8), pp. 981–991.
- Bhowmick, S., 2020. *Sino-Indian transitions in the energy sector*. [Online] Available at: <https://www.orfonline.org/expert-speak/sino-indian-transitions-energy-sector-64894/> [Accessed 14 January 2021].
- Chakraborty, P. & Henry, M., 2019. Chinese competition and product variety of Indian firms. *Journal of Comparative Economics*, 47(2), pp. 367–395.
- Chandrasekaran, K., 2017. *China is biggest exporter of solar equipment to India with 87 per cent market share*. [Online] Available at: <https://economictimes.indiatimes.com/news/economy/foreign-trade/china-is-biggest-exporter-of-solar-equipment-to-india-with-87-per-cent-market-share/articleshow/58450137.cms?from=mdr> [Accessed 20 March 2020].
- Chaudhary, A., Krishna, C. & Sagar, A., 2014. Policy making for renewable energy in India: lessons from wind and solar power sectors. *Climate Policy*, 15(1), pp. 58–87.
- Chaudhary, M., Sodani, P. R. & Das, S., 2020. Effect of COVID-19 on Economy in India: Some Reflections for Policy and Programme. *Journal of Health Management*, 22(2), pp. 169–180.
- Das, D. K., 2007. *China and India: A Tale of Two Economies*. 1st ed. London: Routledge.
- Deo, A., 2018. *The International Solar Alliance's China conundrum*. New Delhi: Observer Research Foundation.
- Economic Times, 2020. *India imported solar power equipment worth \$1,180 mn from China in Apr-Dec FY20*. [Online] Available at: <https://energy.economictimes.indiatimes.com/news/renewable/india-imported-solar-power-equipment-worth-1180-mn-from-china-in-apr-dec-fy20/74493914> [Accessed 12 April 2020].
- Energy World, 2020. *India's renewables installation could fall by a fifth due to lockdown: Wood Mackenzie*. [Online] Available at: <https://energy.economictimes.indiatimes.com/news/renewable/indias-renewables-installation-could-fall-by-a-fifth-due-to-lockdown-wood-mackenzie/75027294> [Accessed 12 August 2020].
- Eroğlu, H., 2020. Effects of Covid-19 outbreak on environment and renewable energy sector. *Environment, Development and Sustainability*, June 2020, pp. 1–9.
- ETEnergyWorld, 2020. *India imported solar power equipment worth \$1,180 mn from China in Apr-Dec FY20*. [Online] Available at: <https://energy.economictimes.indiatimes.com/news/renewable/india-imported-solar-power-equipment-worth-1180-mn-from-china-in-apr-dec-fy20/74493914> [Accessed 18 December 2020].

- ET Now, 2018. *Parliamentary panel expresses concern over Chinese imports*. [Online] Available at: <https://economictimes.indiatimes.com/news/economy/foreign-trade/covid-drugs-india-south-africa-seek-waiver-of-ipr-patents/videoshow/78463117.cms> [Accessed 12 July 2020].
- ET Rise, 2019. *How structured trade finance solutions help MSME exporters & importers*. [Online] Available at: <https://economictimes.indiatimes.com/small-biz/trade/exports/insights/how-structured-trade-finance-solutions-help-msme-exporters-importers/articleshow/70153295.cms?from=mdr> [Accessed 2 May 2020].
- Ferchen, M., 2020. *How China is reshaping international development*. [Online] Available at: <https://carnegieendowment.org/2020/01/08/how-china-is-reshaping-international-development-pub-80703> [Accessed 20 July 2020].
- Goodman, M. P., 2017. Predatory economics and the China challenge. *Global Economics Monthly*, VI(II), pp. 1–2.
- Government of India, 2015. *India's intended nationally determined contribution*. [Online] Available at: <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/India%20First/INDIA%20INDC%20TO%20UNFCCC.pdf> [Accessed 15 January 2021].
- Hansen, G. E., 1967. The impact of the Border War on Indian perceptions of China. *Pacific Affairs*, 40(3/4), pp. 235–249.
- Inambar, N., 2020. *Coronavirus: Can India replace China as world's factory?*. [Online] Available at: <https://www.bbc.com/news/world-asia-india-52672510> [Accessed 21 May 2020].
- India, P. o., 2018. *Impact of Chinese Goods on Indian Industry*. [Online] Available at: http://164.100.47.5/committee_web/ReportFile/13/97/145_2018_7_13.pdf [Accessed 20 December 2020].
- Jacob, J. T., 2021. *India China Engagement on Clean Energy Trade* [Interview] (25 January 2021).
- Janardhanan, N., 2017. India–China energy geopolitics: Dominating alternative energy market in Pacific Asia. *International Studies*, 52(1–4), pp. 66–85.
- Janardhanan, N., Ikeda, E., Zusman, E. & Tamura, K., 2020. *Co-innovation for Low Carbon Technologies: The Case of Japan-India Collaboration*, Hayama: Institute for Global Environmental Strategies.
- Kumar, C.R.J., & Majid, M. A., 2020. Renewable energy for sustainable development in India: current status, future prospects, challenges, employment, and investment opportunities. *Energy, Sustainability and Society*, 10(1), pp. 1–36.
- Kondapalli, S., 2021. *Prof. Srikanth Kondapalli's assessment about the prominent perception of India's overdependence on China* [Interview] (27 January 2021).
- Kukarni, S. H. & Anil, T. R., 2018. Renewable energy in India—Barriers to wind energy. *Strategic Planning for Energy and the Environment*, 38(2), pp. 40–69.
- Liming, H., 2007. A study of China–India cooperation in renewable energy field. *Renewable and Sustainable Energy Reviews*, 11(8), pp. 1739–1757.
- Maniak, R. & Midler, C., 2008. Shifting from co-development to co-innovation. *International Journal of Automotive Technology and Management*, 8(4), pp. 449–468.
- Mansingh, S., 1994. India-China relations in the Post Cold War era. *Asian Survey*, 34(3), pp. 285–300.
- Mohan, M. P. R., 2021. *Indian China Clean Energy Trade* [Interview] (22 January 2021).
- Narang, R., 2016. Understanding purchase intention towards Chinese products: Role of ethnocentrism, animosity, status and self-esteem. *Journal of Retailing and Consumer Services*, 32, pp. 253–261.

- NITI Aayog, 2015. *Report of the Expert Group on 175GW RE by 2022*, New Delhi: NITI Aayog.
- Oh, S.-Y., 2015. How China outsmarts WTO rulings in the wind industry. *Asian Survey*, 55(6), pp. 1116–1145.
- Parliament of India, 2018. *Impact of Chinese Goods on Indian Industry*. [Online] Available at: http://164.100.47.5/committee_web/ReportFile/13/97/145_2018_7_13.pdf [Accessed 12 August 2020].
- PIB, 2019. *PM Modi addresses Climate Action Summit*. [Online] Available at: <https://pib.gov.in/PressReleasePage.aspx?PRID=1585979> [Accessed 12 July 2020].
- PIB, 2020. *Finance Minister announces Aatma Nirbhar Bharat 3.0 Stimulus worth ₹ 2.65 Lakh Crore*. [Online] Available at: <https://pib.gov.in/PressReleaseDetail.aspx?PRID=1672529> [Accessed 12 January 2021].
- PIB, 2020a. *MNRE gives major push towards setting up RE Equipment Manufacturing Parks in India*. [Online] Available at: <https://pib.gov.in/PressReleasePage.aspx?PRID=1615611> [Accessed 10 May 2020].
- Pradhan, S., Ghose, D. & Shabbiruddin, 2020. Present and future impact of COVID-19 in the renewable energy sector: a case study on India. *Energy Sources*, August 2020, pp. 1–11.
- PTI, 2020. *Covid-19: Need to focus on improving domestic solar manufacturing, says official*. [Online] Available at: [Accessed 12 February 2021].
- Rabe, W., Kostka, G. & Stegen, K. S., 2017. China's supply of critical raw materials: Risks for Europe's solar and wind industries?. *Energy Policy*, 101(2017), pp. 692–699.
- Rao, U. & Charles, V., 2021. An empirical examination of the efficiency of commodity markets in India. *International Journal of Banking, Accounting and Finance*, 12(1), pp. 1–15.
- Saragih, H. S. & Tan, J. D., 2018. Co-innovation: a review and conceptual framework. *International Journal of Business Innovation and Research*, 17(3), pp. 361–377.
- Shrimali, G., Srinivasan, S., Goel, S. & Nelson, D., 2017. The effectiveness of federal renewable policies in India. *Renewable and Sustainable Energy Reviews*, 70, pp. 538–550.
- Shullman, D.O., 2019. *Protect the Party: China's growing influence in the developing world*. [Online] Available at: <https://www.brookings.edu/articles/protect-the-party-chinas-growing-influence-in-the-developing-world/> [Accessed 13 July 2020].
- Singh, S.C., 2020. *Ban on power equipment imports from China, Pak; Can't give jobs to country that transgresses into India: R K Singh*. [Online] Available at: <https://energy.economictimes.indiatimes.com/news/power/ban-on-power-equipment-imports-from-china-pak-cant-give-jobs-to-country-that-transgresses-into-india-r-k-singh/76765596> [Accessed 23 August 2020].
- Srinivasan, T.N., 2004. China and India: economic performance, competition and cooperation: An update. *Journal of Asian Economics*, 15(4), pp. 613–636.
- TNN, 2018. *Chinese imports shut MSMEs down, lead to job losses: Parliamentary panel*. [Online] Available at: <https://timesofindia.indiatimes.com/business/india-business/chinese-imports-shut-msmes-down-panel/articleshow/65157017.cms> [Accessed 27 December 2019].
- USCC, 2018. *USCC 2018 Annual Report*, Washington: USCC.
- Varghese, S., 2021. *India-China engagement on clean energy equipment trade* [Interview] (28 January 2021).

- Wang, Q. et al., 2019. A study on the spatial distribution of the renewable energy industries in China and their driving factors. *Renewable Energy*, 139, pp. 161–175.
- White House, 2018. *How China's Economic Aggression Threatens the Technologies and Intellectual Property of the United States and the World*, Washington D.C.: White House Office of Trade and Manufacturing Policy.
- Wignaraja, G., Panditaratne, D., Kannangara, P. & Hundlani, D., 2020. *Chinese Investment and the BRI in Sri Lanka*, London: Chatham House.
- World Bank, 2018. *China trade balance, exports and imports by country 2017*. [Online] Available at: <https://wits.worldbank.org/CountryProfile/en/Country/CHN/Year/2018/TradeFlow/EXPIMP/Partner/by-country> [Accessed 12 July 2020].
- Yang, X. J., Hua, H., Tan, T. & Li, J., 2016. China's renewable energy goals by 2050. *Environmental Development*, 20, pp. 83–90.