

Brundtland Commission: A Comparative Analysis of the Energy Gap between India and China

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Abstract

Both the India and China have set renewable energy targets to be achieved by 2030 and 2060 respectively as India has refused the 2060 zero emission targets. The countries have adopted different initiatives such as implementation of targeted policies for enhancing investment in the development of renewable energy plants. However, India is still facing issues in achieving its desired energy targets due to the absence of a proper policy framework and other significant issues including financial constraints and a lack of manpower training and skills development. The literature review has provided clear details of the progress of India and China in achieving their targets as well as the challenges they are facing for the same. The methodology section looks at the effectiveness of selecting secondary data. This is followed by an analysis approach. This provides an overview of how these methods have been helpful for the collection of reliable information regarding green-energy initiatives in India and China. An analysis is also provided on how different renewable energy policies are guiding India and China to achieve their energy targets and the ways in which different issues are becoming obstacles to achieving desired growth. The conclusion provides suggestions for addressing the challenges faced by India and China in achieving their energy targets.

Keywords- Carbon Trading Scheme, Sustainable development, Energy efficiency, GDP (gross domestic product), fuel consumption, CAGR, NAPCC,

Introduction

Overview of the context

China and India are the largest polluters across the world as these countries account for a big portion of the total GHG emissions. India emits 7.1 percent of the global emissions and per capita emissions of India are about 2.47 Tco2e (Nandi, 2021). In the year 2019, the per capita emission of China reached 10.1 tons (Larsen et al., 2021). The huge population growth in these two countries is intensifying this issue (BBC, 2021).

This study is focused on determining the possibility of China and India achieving their renewable-energy targets. India has set a 2030 Renewable energy target for reducing GHG emissions to a huge extent by 45 percent. However, the Indian government’s continued investment in the development of the non-renewable energy sector has led to no significant improvement in achieving this target. As shown in the figure below, 138 GW of renewable energy has been generated in India in 2021, whereas the target is to achieve 175 GW (Energy.economictimes, 2021).

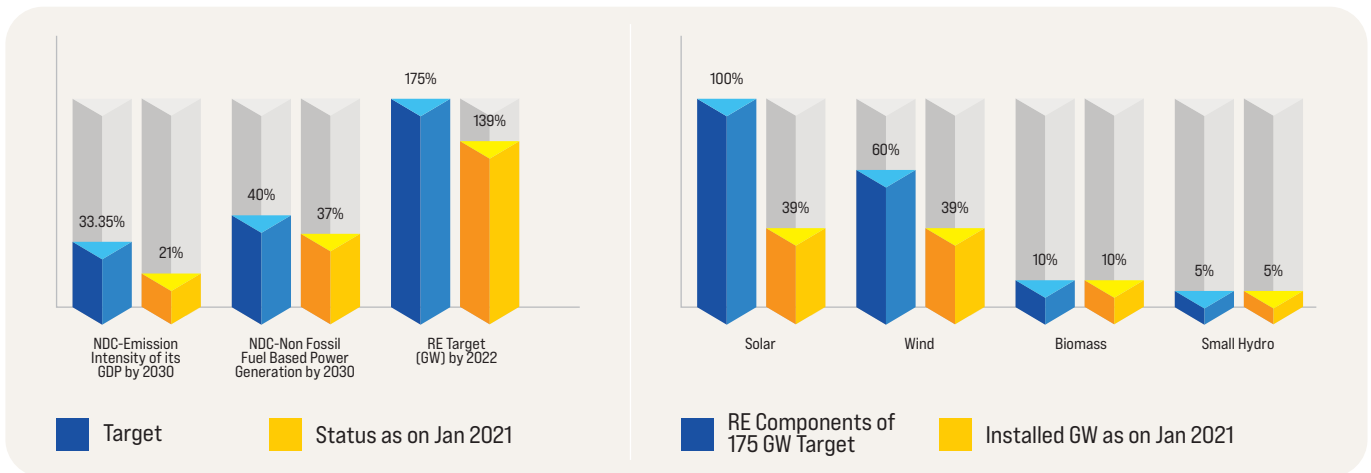


Figure 1: Renewable energy capacity (Source: Energy.economictimes, 2021)

Different strategies have been adopted in China for achieving renewable energy targets by reducing GHG emissions. It has set a net-zero emission target to be achieved by 2060. However, China too is facing significant issues in achieving its targets as a large portion of its energy comes from non-renewable sources. The Chinese government also continues to invest in the development of new coal plants to ensure economic development (Energy.economictimes, 2021). Figure 1.2 shows that the gaps between current and projected wind and solar energy targets in China are huge; hence, it will take considerable effort for China to achieve its projected target (Carbonbrief.org, 2020).

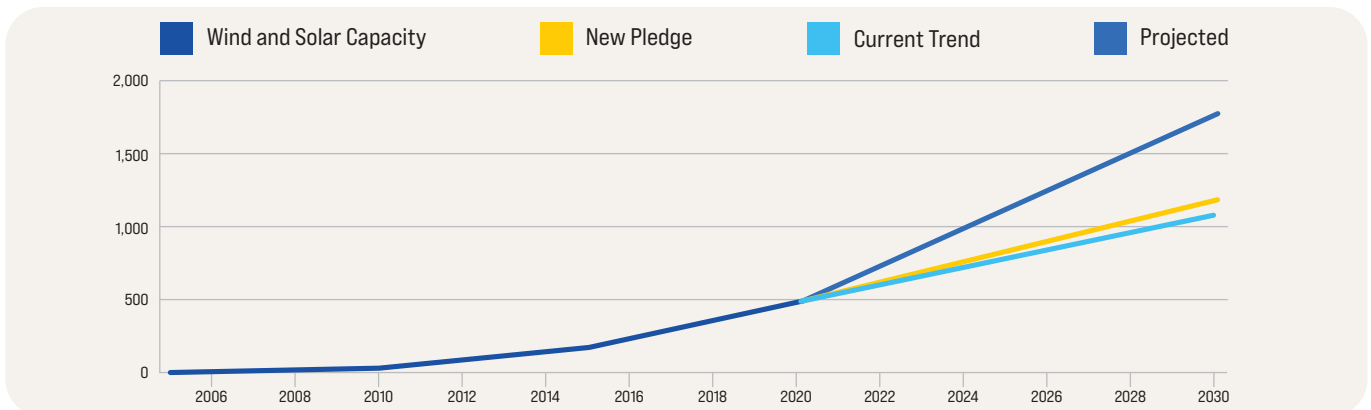


Figure 2: Differences in projected and current capacity-target in China (Source: Carbonbrief.org, 2020)

In India and China, the huge growth of industries and population are leading to a corresponding demand for energy that will increase significantly by 2025. Analyzing the manner in which the two countries are focusing on the renewable energy sector and attempting to reduce GHG emissions will prove useful.

The Brundtland Commission has been given the responsibility of proposing effective long-term solutions to enhance opportunities for countries to ensure sustainable development (Britannica, 2022). The report published by the commission on renewable energy has provided significant insight into the role of population and economy of countries such as China and India in the development of sustainable energy. By providing factual and numeric data, the report has helped in gaining a proper understanding of the ways in which both countries are trying to reduce their emissions and achieve the renewable energy targets set by them by signing the Paris Agreement.

2. Discussion with the alignment of literature

Concept of sustainable development through the use of renewable energy in China and India Low per capita income is fairly predominant in both India and China. Rising poverty as well as unemployment in these countries have further increased pressure on potential environmental resources, as economic activities in both countries rely directly upon those sources (Sustainabledevelopment.un.org, 2021), and the deepening environmental crisis can be a potential threat to the national securities because it can result in a humanitarian crisis, scarcity of water, political instability, and civil war in respective countries.

The three crises of environment, energy, and development are interlocked as one large global crisis (Sustainabledevelopment.un.org, 2021). The current global economy of 13 trillion USD is projected to grow 5-10 times its current size in the next 50 years. Industrial growth and production have further reflected as well as presaged a profound impact on the biosphere as global investment in transport, industries, houses as well as farms is increased (UNDP, 2010).

Initiatives adopted by India and China in achieving their energy targets and the challenges faced

India has set certain renewable energy targets and has aimed at the achievement of these targets through constant focus on generating a substantial portion of electricity from renewable sources including wind and solar energy. It is essential to note that out of India's 3119 different towns as well as cities, only 209 contain partial sewage treatment plants and only 8 of them contain full form of sewage treatment facilities. India's largest river, the Ganges, passes through 114 cities and 50,000 inhabitants' sewage or untreated sewage is dumped directly into its waters on a daily basis (Sustainabledevelopment.un.org, 2021). Additionally, coal and Dichloro-Diphenyl-Trichloroethane (DDT) which factories, paper mills, tanneries, fertilizer as well as petrochemical complexes and rubber industries depend upon the river to get rid of their potential wastes.

On the contrary, Chinese industries utilize coal in outdated boilers as well as furnaces, which are situated in nearly 20 cities in China. This contributes to a high level of air pollution and causes major diseases such as lung cancer. In this context, it is significant to note that mortality on account of lung cancer in Chinese cities increases the mortality rate of the country by 4 to 7 times. In general, urban growth in India has resulted in the development of a solid as well as a diversified economic base for supporting the building of housing, employment, as well as infrastructure (Sneddon et al. 2006).

As cited by Zhou et al. (2018), the demand for electricity in China has increased significantly due to the significant increase in the population and the GDP of the country. The population in the renewable energy sector of this country has increased rapidly in recent years and the considerable mobility of human resources in this sector has always been a huge contributor in the development of the renewable energy sector of China. India has signed the Paris Climate agreement as per which it has set an energy target of reducing the use of fossil fuels by a significant percentage within 2030 as it has refused the 2060 zero emission targets. By 2030, India aims to generate a substantial portion of its electricity from renewable energy sources such as wind and solar energy.

The impact of China's economic transition on sustainable development of the economy of this country

The economic development and transition of the economy of China have influenced the growth of renewable energy sectors. China has been making significant progress in terms of reaching its climate goals and targets. While India has been on track towards exceeding its renewable energy goals for 2022, with the acceleration of solar as well as wind installations, China has been efficient in terms of advancing its 2030 targets along with goals. China has been effective in terms of making more than 40 percent progress towards its potential emission intensity as well as clean energy targets and forest stock-volume (Mabel and Fernandez, 2008). India has been maintaining an annual rate of economic development of nearly 6.8 percent while on the other hand China has been efficient in terms of illustrating a 7.1 percent rate of annual economic growth as well as development, which is responsible for sustaining the largest population in the global context.

Literature gap

It is important to note that this research has aligned suitable literature towards enhancing the research outcomes. However, due to the unavailability of proper sources on this research topic, a potential gap emerges while implementing the literature in the research context. This allows for upcoming research on similar contexts to identify any prevailing literature gap and work towards bridging the gap for ensuring better context delivery to the research audience.

Philosophy of the study

An optimal research philosophy helps in the proper identification of the nature of the research by developing research assumptions. Interpretivism philosophy has been employed in this study as it has aided in the interpretation of different information regarding the paths taken by China and India to their renewable energy targets and their current positions regarding the same.

This study has employed a deductive approach for designing proper hypotheses based upon information gathered from various sources. Different variables of population growth, the use of non-renewable energy, and the use of renewable energy have been considered for developing the hypotheses.

Design

A research design provides researchers with an effective framework for identifying proper research methods to ensure error-free results; an exploratory design was chosen for this study. As cited by Camargo et al. (2020), this design can help explore and identify new ideas or concepts that in turn help add new dimensions to a study. This problem has never been studied with this specific research design, and hence, this study has supported proper investigation.

Sampling

The sampling method selection should be suitable for collecting the requisite information in the desired manner. The purposive sampling method has been chosen for this study. As cited by Herawati and Putra (2018), purposive sampling allows researchers to select information sources based upon different criteria. In the present study, the sample was selected based upon criteria such as current trends in renewable energy development and so on.

Collection of data

Secondary data-collection has been considered in this research for collecting authentic data on the current trends of renewable energy development in India and China. Secondary data has been helpful for reducing significant time in collecting valuable information. Data has been collected from different secondary sources including journal articles, websites, and newspapers online articles and so on. This information has been beneficial for the collection of evidence-based reliable information that has ensured the authenticity of the research outcomes.



Figure 3: Research Paradigm

Data Analysis

Thematic data analysis in the current research has been appropriate for framing different themes based upon various concepts regarding opportunities and challenges for India and China in sustainable renewable energy development. It supports the reporting and analysis of different themes for generating meaningful results (Chen et al. 2020). It helped in developing proper arguments in a convenient manner by comparing existing theories with collected information for ensuring the development of proper outcomes. In this research, it has helped in the identification of descriptive themes for effectively analyzing collected information for ensuring the reliability of research outcomes. From the information collected from various

sources, the themes have been extracted in the results section for establishing proper relations amongst the variables including the achievement of sustainable energy targets, steps taken by both countries, political aspects and so on.

Results and Discussion

Results

China has set its net-zero targets for reducing its dependence on coal and increasing the use of renewable energy by 2060 and has taken numerous steps to significantly curb CO₂ and other greenhouse gas emissions by 2060. However, India has not set its net-zero targets yet in spite of taking many initiatives for ensuring sustainable and renewable energy development activities (Kiesecker et al. 2020).

India and China are facing significant challenges in ensuring the achievement of their sustainable energy targets within a given timespan as their energy mix is inefficient. Apart from this, the absence of proper funding and planning, and a lack of social acceptance are other challenges too. Therefore, proper planning at the political level is necessary for addressing these challenges to achieve the net-zero target of China and other renewable-energy targets of India.

It is highly difficult for a largely coal-dependent country such as India to achieve its renewable energy target. However, strategic actions such as the creation of social demand, development of proper infrastructure and so on can be beneficial for ensuring the achievement of India's renewable energy target by 2022 and 2030. However, the achievement of net-zero would require India to stop the development of coal plants or reduce coal-energy production to a significant extent.

Development of robust policies can aid in the achievement of China's renewable energy target. As cited by Shao et al. (2019), the Chinese government needs to take proper action for reinforcing its coal energy-saving and renewable energy development policies by introducing market-oriented policies for meeting energy demands at an industrial level.

In-depth analysis and discussion

Theme 1: India and China's initiatives to achieve sustainable energy targets

India has started investing in renewable energy-sources for meeting the demands of its huge population while ensuring sustainability. For instance, it invests in wind energy as an alternative energy source for satisfying its energy demand. The Indian government is supporting the wind-energy sector by developing innovative schemes and contributing to this industry through financial incentives. For example, the Indian government has come up with the Solar Energy Subsidy scheme and the Development of Solar Park Scheme for encouraging the efficient use of solar energy. The Solar Park Scheme has been launched with the aim of enhancing solar energy production by facilitating the development of standardized infrastructure (Chawla et al. 2020). The Indian government has started providing a subsidy of 30 percent for installing solar panels as per its MNRE Solar subsidy scheme⁵⁰.

China is the top environmental pollutant in the world (BBC, 2021). However, the declining population growth is projected to positively influence climate, as there is a chance of a significant reduction in energy demand and hence, a significant reduction in the use of non-renewable energy. However, increasing industrialization and agricultural development are resulting in a huge demand for fossil-fuel energy and other non-renewable energy in China

⁵⁰According to the MNRE-Solar subsidy-scheme, India wants to increase solar power capacity of the country in order to increase the generation capacity of eco-friendly energy resources and reduce the overall GHG emission percentage in the near future.

(Sustainabledevelopment.org, 2021). The Chinese government lacks a fully-developed subsidy scheme for renewable energy unlike India; moreover, it has developed a five-year plan to pay special attention to climate change and the scarcity of non-renewable energy due to its high demand.

China's Thirteenth Five Year Plan aims to reduce the consumption of coal significantly by setting renewable energy goals. After the enactment of the renewable energy law in China, several incentive schemes have been introduced for the promotion of renewable-energy development (Li et al. 2019). The plan is meant to ensure that a major portion of the country's electricity would come from renewable non-fossil fuel sources by 2030 for satisfying energy demands in a sustainable way.

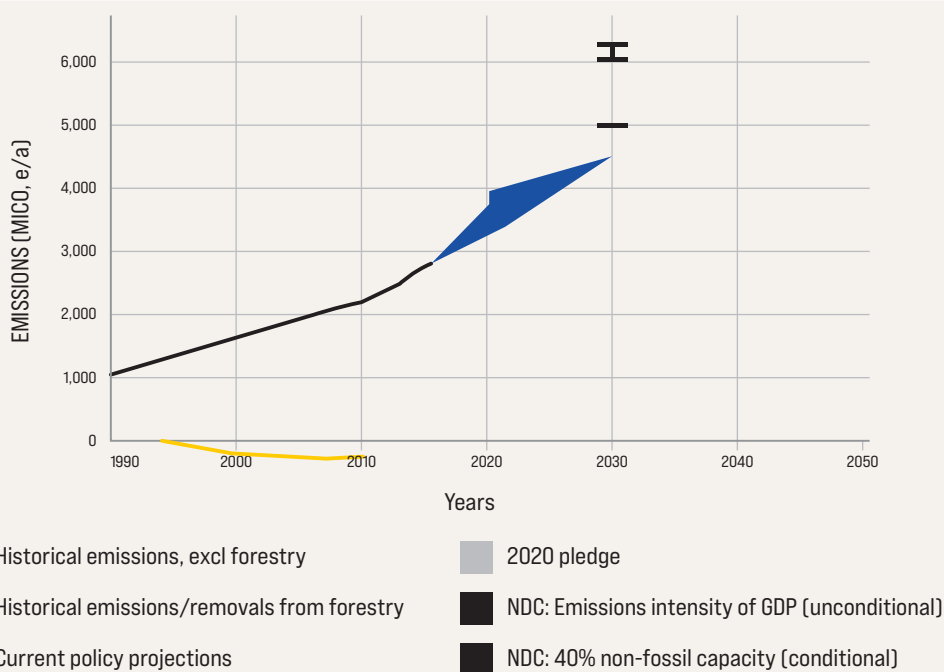


Figure 4: India's inclining graph of emission and its projected target till 2030 (Source: Nrdc.org, 2019)

The Indian government has set a wind-capacity target of 60 GW. It is aiming to achieve this target by 2022 (Majid, 2019). India has already added approximately 86 GW in 2019. It has further set a renewable energy target of 450 GW approximately by 2030. Therefore, based on the data, it can be said that India is not too far from sustainably achieving its energy target. The government of China has set a target of reducing dependence on coal significantly by 2030. Besides that, it has set a net-zero target that has been projected to be achieved by 2060. China has also set an energy target of enhancing renewable energy production capacity significantly by 2025 to support its emission goals. As per the recommendations of the Brundtland Commission, to bring energy use of developing countries such as India and China up to the industrialized nation levels by 2025, there will be a requirement for the enhanced use of energy. If this increase is based entirely upon non-renewable energy sources, the world ecosystem will be unable to withstand it (Sustainabledevelopment.org, 2021).

Theme 2: Net-zero target and achievement of renewable energy targets

As mentioned previously, India has aimed at achieving 227 GW of sustainable energy capacity

by 2022. Based on the desired progress being achieved, the Indian government has further set another target of reducing non-renewable energy dependence by 2027 (Gielen et al. 2019). During the pandemic, policy initiatives taken by the Indian government such as making solar-energy plants' Operations and Maintenance (O&M) an essential service and removal of tariff caps on the tenders of solar as well as wind energy generation capacities clearly indicate enhanced support by the Indian government for meeting the enhanced energy demand by intensifying green energy efforts (EconomicTimes, 2021). Considerable investment in the development of hydro, solar and wind energy has set the goal of 175GW renewable energy capacity.

Although India has rejected net-zero targets, it is making good progress in achieving its short-term energy targets. Strong domestic action largely supports the renewable energy ambition of this country. For example, in 2019, Rajasthan introduced a new solar-policy with the intention to build approximately 50 GW of solar-capacity within the next 5 years. Apart from this, Gujarat, has taken an initiative to enhance its renewable energy-capacity significantly by 2022 through which the state government has agreed not to give new permission to develop new coal-plants (Nrdc.org, 2019). It therefore appears that India is not too far from achieving its energy targets.

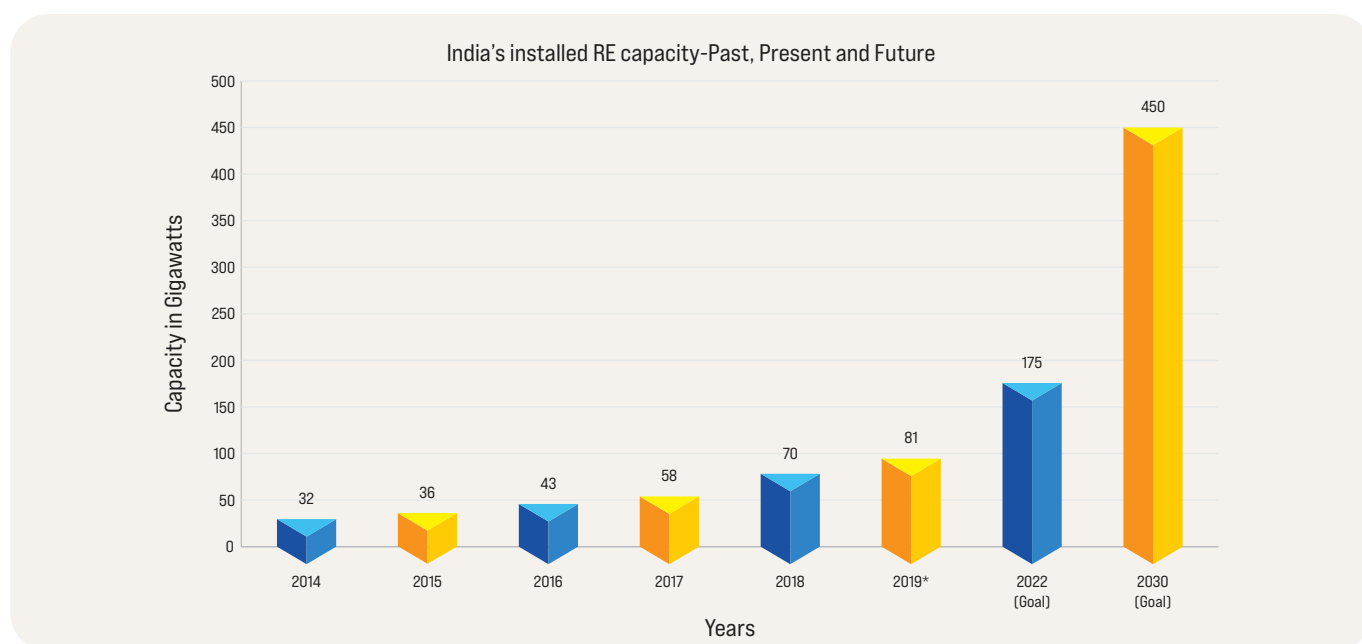


Figure 5: India's renewable energy targets (Source: Nrdc.org, 2019)

On the other hand, China has set a clear pathway for building a secure and sustainable energy future. It has aimed to reduce CO₂ emissions significantly by 2030 and achieve carbon-neutrality by 2060. Micro-grid technologies, wind-power consumption-technologies, and low-wind power-generation technologies have made huge progress in recent years (Liu, 2019). China already has a solid foundation for growing its renewable energy sector as it has been one of leading developers of renewable energy in the past decades. Total installed renewable energy capacity in China had reached 184 GW in 2018 as it had strengthened both local and national planning systems for facilitating utilisation and development of renewable energy. China has made a considerable investment in the renewable energy sector development by depositing 0.9 percent of its GDP in it. Currently, approximately 23 percent of energy in China

comes from different renewable energy sources. Hence, from this data, it is evident that China has also made significant progress in achieving its energy target until date.

However, it is projected that India would be able to achieve only a certain portion of its 2022 renewable energy target due to several challenges. Even if it were to achieve the 2060 target, it would not achieve the 2022 target as well. According to the Brundtland Commission's recommendations, developing a sustainable and safe energy pathway is vital for ensuring sustainable development. For pursuing sustainable development, population growth and size need to be in symmetry with changes in the productive potential of the ecosystem (Sustainabledevelopment.org, 2021). In India, the population is growing at a rapid pace due to high birth rate and low mortality rate.

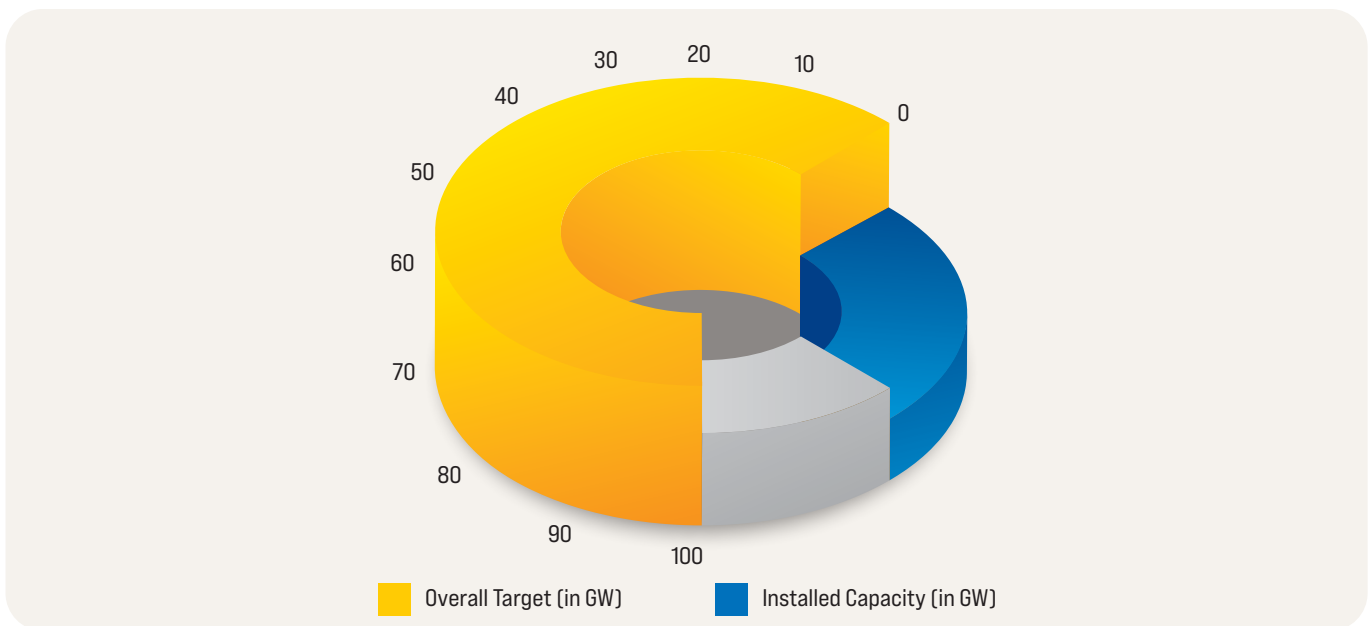


Figure 6: Proportion of installed capacity and overall target in India (Source: Mnre.gov, 2021)

Thus, with constant growth in population, the demand for energy is also rising rapidly. With the rise in middle-class economy and urbanization, it is estimated that there will be a 25 percent rise in the total energy demand by the year 2040. Consumption of fossil fuel has also increased in recent years that has further presented significant challenges for achieving sustainable energy targets. Hence, the revolutionization of the energy mix of this country is essential for estimating if it will be able to achieve its renewable energy target. In India, there also exists a lack of social acceptance of renewable energy, presenting a significant challenge towards achieving India's short-term energy goals. Social acceptance of sustainable energy systems is not encouraging in India despite the government's effort in providing huge subsidies for installing solar power in power plants. 7 percent of the urban population is not in favor of implementing renewable energy plants for power generation (Patel et al. 2016). They have opined that this will not provide any major benefit to them. This lack of acceptance is due to poor facilities, poor manpower training, and lack of upgradation of skills, skill shortage, and low level of efficiency in operating these systems. In comparison to China the situation is also not promising. Therefore China is likely to miss its target regarding improvement in renewable energy building capacity. If China reduces the development activities of new coal plants, then the Chinese government will be able to achieve renewable-energy target by 2065-2070 (Yang

et al. 2021). China also faces significant difficulties in ensuring desired growth in renewable energy development that is also making it challenging to achieve its net-zero targets.

China is one of the biggest coal consumers in world and many people would lose their jobs in case of closure of non-renewable energy plants. Hence, it presents a significant challenge for the Chinese government which continues to invest in coal energy plants. Besides that, China's GDP is largely dependent upon fossil fuel for which the Chinese government is still investing a huge amount for building new coal plants (The Guardian, 2020). However, as it contributes approximately 28 percent of the total GHG emissions worldwide, it needs to reduce its non-renewable energy use by 90 percent or more to be successful in achieving its net-zero targets by 2060.

Year	India's Target	China's Target
2022	175 GW of energy generation from wind and solar energy sources	58 percent of energy generation from renewable energy sources
2030	450 GW of energy generation from wind and solar energy sources	40 percent of energy generation from nuclear sources
2040	50 percent of power generation from solar energy sources	40 percent of electricity capacity development from non-fossil renewable energy sources
2060	Rejected 2060 renewable energy target	Zero emission

Table 1: Countries' targets in different years

Theme 3: Ways in which India and China can meet their energy goals

India is facing challenges in achieving its renewable energy target as it lacks proper planning for making non-renewable energy sources popular amongst society and industries. The government needs to focus on the effective promotion of renewable energy for creating social demand by investing significantly in promoting the use of renewable energy. India should also focus on implementing a green growth strategy for promoting sustainable growth of renewable energy to reduce depletion of natural resources and environmental degradation as China has (Economic times, 2020). China has adopted a green finance strategy for the development of its renewable energy as per the Brundtland commission report. Most importantly, China needs to develop a proper sustainable path for renewable energy development for enhancing social acceptance for renewable energy. Apart from this, companies have an issue of non-acceptance depending largely upon non-renewable energy. As shown in above figure, there have been 1.55 increases in GHG even during COVID-19, indicating the Chinese Indian government's efforts to continue with non-renewable energy-production.

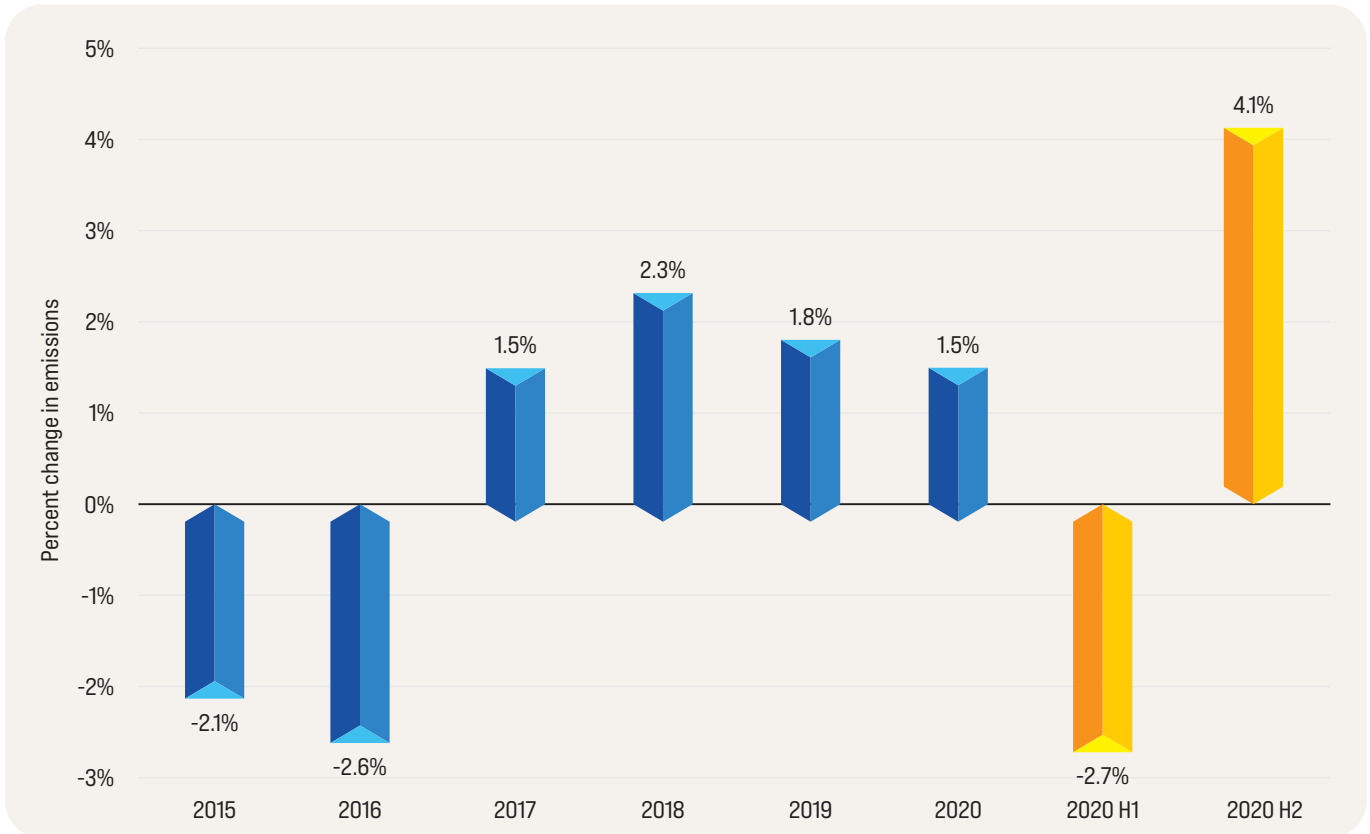


Figure 7: CHINA: Increase in CO2 emissions by 1.5 percent after recovery of non-renewable energy industries- (Source: Statista, 2021)

As many people would lose their jobs in case of closure of non-renewable energy production plants, they are reluctant to accept the use of renewable energy sources for meeting energy demands. Hence, the Indian government needs to focus on creating jobs in the renewable energy-sector for ensuring the acceptance of renewable energy amongst society and energy plants (Al-Falahi et al. 2017). However, it is also important to note that the inadequate skills of workers in operating renewable energy-systems are also becoming barriers in the achievement of renewable energy targets by India . Therefore, the fundamental focus needs to be on providing proper training to the workers, who are currently working at non-renewable energy plants, while making them aware of the long-term benefits of renewable energy.

China is facing challenges due to the absence of a robust policy framework for achieving sustainable energy targets. Hence, it is essential to reinforce its existing policies through the development of a robust sustainable strategy framework. It should further focus on designing an effective investment framework for making planned investment in development and research activities, employee training and infrastructure development for promoting its sustainable energy initiatives and implementing them successfully. It should prompt the use of renewable energy not only at the industrial level but also at the domestic level. China has started using nuclear energy, as it is a clean energy source.

However, as per the recommendations of the Brundtland Commission, the use of nuclear energy would only be justifiable if proper solutions for mitigating unresolved risks associated with this are implemented (Sustainabledevelopment.org, 2021). The fundamental objective should be to invest in alternative renewable sources to meet growing demands in a safe and sustainable manner. In order to mitigate financial challenges, the Chinese government will have to facilitate and attract a flow of international capital that would require China to encourage participation of foreign investors in different events (Ft, 2020). This way it will be possible to

achieve energy targets in a sustainable manner while reducing the risks associated with the use of nuclear sources for energy production.

Conclusion

Finally, it can be concluded that India and China are in challenging positions in achieving their energy targets by 2060. The Indian government has adopted various initiatives for sustainably achieving energy targets. In the introduction section, it has been found that India and China have set ambitious goals for developing renewable energy and reducing dependence upon non-renewable energy. However, they are still facing issues in achieving energy-targets. In the literature review of this study, different concepts and theoretical frameworks have been provided to analyse ways in which renewable energy development is challenging and beneficial for reducing detrimental environmental impact while facing various economic challenges. This section has provided a proper understanding of the ways in which renewable energy targets can be achieved to ensure proper reduction of GHG emissions in the environment for addressing climate change issues. India has made significant progress in terms of reducing GHG emissions through the launch of different schemes such as the solar park scheme; however, India also invests significantly in the non-renewable energy sector for economic development.

In the methodology section of this study, ways of generating proper assumptions have been analysed through the selection of proper data-collection and analysis methods. This section has also analysed ways in which interpretivism philosophy has been beneficial for ensuring proper interpretation of data regarding renewable energy development challenges and progress in China and India. Secondary data collection has aided in understanding challenges such as the absence of proper policies, lack of social acceptance and so on that are hindering the development of renewable energy in India and China and the ways in which they are addressing these challenges. It has also been found that India has set short-term targets for reducing its GHG emissions and developing renewable energy. On the other hand, China has set a five-year plan to achieve its long-term renewable energy development targets by 2060. India and China are striving for renewable energy development; however, they are simultaneously developing non-renewable energy plants to meet their huge energy demands. As per the guidelines of the Brundtland Commission's report, inappropriate industrialization should be stopped for curbing excessive demand for developing the economy of India in a sustainable way and achieving its zero-emission target.

Limitations, recommendations and future research

The outcomes of this study will help future researchers to study how renewable energy is being developed for achieving China and India's targets. Researchers will not have to make considerable effort in the collection of authentic information. However, thematic data analysis often raises questions regarding the reliability of research outcomes. Hence, a different data-analysis technique could have been selected.

Renewable energy development in China and India to reduce GHG emissions to a zero target is challenging as both of these countries depend largely upon non-renewable energy to meet their huge demands and develop their economies. Hence, to achieve their sustainable energy targets, the governments of both countries should take proper steps. For instance, the Indian government should focus on implementing its solar-energy schemes effectively through proper promotion of its schemes and benefits. It should also promote household installation of solar plants for reducing GHG emissions as the use of this energy at an industrial level alone might not be beneficial for reducing GHG emissions to zero.

Investment in development and research activities should be considered for determining the

best ways of installing renewable energy systems in a cost-effective manner. Besides that, proper funds for the same should be maintained. The governments of both India and China can collaborate with international investors and local energy plants for ensuring support for promoting renewable energy effectively. It allows upcoming research to bridge any identified research gaps and continue research for ensuring better outcomes of the research contexts.

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I would like to express my gratitude to my mentor Prof. (Dr). Mohan Kumar for guiding me and assisting me on this topic “Brundtland Commission: A comparative analysis of energy gap between India and China”. This study has provided me with an in-depth knowledge of the importance of enhancing reliance upon renewable energy sources for ensuring a green world by reducing GHG emissions to a significant extent. I got the opportunity to study China and India’s initiatives for reducing GHG emissions, which helped me gain new knowledge regarding the significance of focusing on renewable-energy production for reducing the negative impact on the environment. This study will help me in future to conduct further research on this topic or a topic related to this.

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