

Research on the Development and Influence of CDM Projects in China

Zhixuan Zhang^{1,a,*}

¹*Department of Economics, University College London, London, UK, WC1E 6BT*
a. zhangzhixuan0731@126.com

**corresponding author*

Abstract: Environmental problem is becoming more severer day by day. China, as one of the largest carbon emission entities, has implemented CDM projects to help it reduce carbon emissions, and achieve sustainable growth. The CDM benefits both developing and developed countries by helping developed countries to reach emission reduction targets and providing subsidies for developing countries to build sustainable projects. The research paper shows that CDM is preferred by China to other projects due to its advantages, such as the CERs trading mechanism, the investment and subsidy from foreign countries, and the technology transfer. Meanwhile, after CDM adoption, the country has built some institutions and enacted appropriate regulations to construct CDM projects more efficiently. In the last part of the research, the influences of CDM on the domestic economy has been analysed, where both data and past paper from the official website and published articles show positive effects of building CDM, including job creation and decreasing worrying over the electric shortage. In conclusion, CDM projects and Chinese circumstances are compatible in several aspects which are presented in the paper. The compatibility contributes to Chinese sustainable development and provides other developing countries with a sample to learn from.

Keywords: Wind power, Environmental economics, Regional economics, CDM project, Sustainable development.

1. Introduction

Under the rapid development of cities and industries, climate change and more specifically, the global-warming problem, is getting worse day by day. One of the biggest causes of this worsening situation comes from greenhouse gas emission, which is produced from burning fossil fuels like coal, oil, and natural gas. Due to the severer environmental problem, there's a need for countries to seek renewable resources to replace fossil fuels. It's worth mentioning that different countries may have different resources, and to solve an environmental issue, they may have distinct solutions which are fitted in their circumstances. In this paper, we focus our attention on wind power projects, the Clean Development Mechanism (CDM), in China. The vast landscape and coastline provide China with plentiful wind energy resources: a 235 GW exploitable capacity in the Chinese mainland is estimated by China's Academy of Meteorological Sciences, and the eastern offshore area provides potential wind power even more [1]. In this case, China has already begun to develop wind power electricity from the first invention of the wind turbine in 1891. From 1991 to 2021, China

achieved significant development in wind power from 0 TWh to 614,18 TWh [2]. During this process, one undeniable contribution is from the CDM projects. In our paper, we draw attention to why CDM and Chinese energy development are compatible, and how the construction of this project influences China's economic activities. Existing studies covered the promotion effect of policies on technology change [3], the influences on economic activities from climate change [4] and so on. Whereas the research analyzes the benefits and influences of building CDM wind projects in China. The research is based on recent papers and data from the CDM official website. The research may be useful for developing countries and the corporations which are developing their pro-environment electricity generation through government policies and cooperation with advanced foreign institutions.

2. The beneficial traits of CDM support Chinese wind power development

The CDM helps developing countries to build emission-reduction projects and to trade certified emission reduction credits (CER) with developed countries. Under this mechanism, developed countries can earn extra emission permits to meet the target under the Kyoto Protocol, and developing countries can get the subsidy. China has embraced the CDM since 2002, and nearly half of the CDM projects were constructed in China. Why the CDM projects could be so widely accepted and constructed in China is a question that is solved in the following context.

2.1. CERs trading mechanism

Carbon emission in China is a severe environmental problem that needs to be solved. The Chinese energy system is dominated by coal consumption and its energy generation is ranked the second largest just below the United States. According to the National Bureau Statistics of China, the country's coal assumption is 56% of the overall energy consumption [5]. Comparing CDM over Joint Implementation (JI), and Emission Trading (ET), CDM has some advantages over the others that made it a better choice for China. Specifically, China began its emission reduction in the 2000s and CDM provides the country with a special CER trading mechanism, and an opportunity to achieve utility maximization from wind resources. The related Articles are about regulations on the energy related issues. For example, Article 5 states that any attempt engagement in manipulating energy market on wholesale markets shouldn't exist, and Article 6 defines JI that the activities, including trade of emission reduction units, can only occur between Annex I parties. Similarly, ET in Article 17 also faces limitations on emission trading, which defines trade between Annex I and other economic transitions. The parties primarily include the OECD's industrialized countries, the Russian Federation, and several European countries [6]. In this case, the limitation on activities decreases the potential for country to improve energy construction while providing economic revenue. The market for trading credits, specifically CERs, is small. Therefore, joining JI cannot provide China economic benefits as much as CDM can. As a developing country, China is trying to become a greater economic entity, but carbon reduction would relatively hinder its development. CDM, on the other hand, reduces the opportunity cost for China. Moreover, under CDM projects, China could accumulate its reduction credits from 2000s while accumulation was allowed under JI from 2008. The country could earn revenue from selling the emission units and restore some amount of it for the country's later use. According to the data illustrated in introduction, the volume of wind power generation was growing tremendously from CDM, which means not all of the emission credits are sold in market since this large supply would pull the price down and reduce the revenue. As Chinese economic volume grows larger, the saved CER credits can be used by the country itself, and thus the accumulated credits could save extra costs.

2.2. Foreign investment and technology transfer

Another important merit of CDM is that it provides incentives for developed countries to invest in building renewable projects in developing countries [7]. The logic is similar to the analysis presented above: the developed countries could buy CER credits to reach the target of emission reduction with the lowest cost. China has great wind-generated electricity potential, which makes China especially proper for implementing CDM projects. The efficiency of generating wind power is high since it avoids both emissions from fossil fuels and external costs [8]. Additionally, the investment flow would bring technology transfer to China. This can be accomplished through the establishment of R&D networks, licensing, and foreign direct investment [9]. China could enjoy backward advantages since its energy related technologies are not advanced as the technologies from developed countries. From those considerations, planting CDM projects could enhance Chinese development in emission reduction and build a good basement for its sustainable growth.

Nevertheless, as Kazunari Kainou has illustrated in his article, the CDM projects experienced a collapse when the credit price jumped tremendously from €25 per tonne of carbon-dioxide in 2008 to €0.5 in 2012 [10]. This was caused by prohibitions of offsets trading from the European Commission and from the Japanese government. Though this collapse uncovered some potential danger and fragility of CDM, the mechanism's advantages are out-weighted its disadvantages. CDM is still a better choice for China to achieve emission reduction and build wind energy projects.

3. The promotion on CDM given by Chinese advanced regulations

3.1. Coordination between MOST and NDRC

From another perspective, China has some prior experiences from constructing CDM projects, including both institutions and regulations. The country is aware of the severeness of climate change and have established the National Coordination Committee on Climate Change (NCCCC) at the beginning of 21th century [11]. The membership of NCCC involves a whole range of agencies related to the environment and energy, including the Ministry of Water Resources and the State Environmental Protection Administration. To be more specifically, the prominent coordination role played by the National Development and Reform Commission (NDRC) and the Ministry of Science and Technology (MOST) enhances the efficiency in supervising the progress of the projects and provides local government incentive to promote wind project building. When one institution is taking control of all the CDM projects, the efficiency would be low since there's no division of supervision on different stages. This rule could be derived from the division of labor, in which each type of labor maximizes their professional skills on the production and efficiency will be maximized without a doubt. With two powerful agencies work together, for example, the revenues collected from selling CERs could be more wisely divided into project building. Besides that, the subordination of NDRC and MOST to NCCC and the National CDM Board (NCDMB) ensures that the decisions related to projects would be double checked. Therefore the progresses and any detailed aspects of the projects would be perfectly balanced.

3.2. Financial fund and transparency insurance

Another special institution increases the efficiency even more, and provides incentives for provincial governments to improve energy generation and environmental protection. The CDM fund, which was initiated by the Ministry of Finance, manages the inflows of hard currencies. By implementing this fund, the financial sector is divided into complicated mechanism and can be managed separately. Unlike banks which manage money over different directions of outflows, the CDM fund would only be used on CDM projects, such as stimulating technical innovation,

lowering production cost, and providing additional support on projects construction. In other words, liquidity of financial flows is ensured and corruption with governmental agencies is minimized. Research and development (R&D) is promoted by the fund and this learning-by-searching process will contribute to lowering the production costs [12]. Technological advancements, such as increased turbine efficiency, lower depreciation rates, and reduced conversion loss, could lower the cost of wind-generated electricity and thus increase demand for clean energy.

Moreover, China specified the Interim Measures for Operation and Management of Clean Development Mechanism Projects, which includes the rules that both domestic and foreign institutions need to follow under CDM construction [11]. Under those measures, the transparency of CDM projects is promised, the role of the project developer is limited to domestic or joint-venture enterprises, and the technology transfer is ensured. The transparency could enhance the responsibility of institutions since their behavior is under supervision by not only the government but also the public. Meanwhile, transparency could increase people's trusts toward the projects and attract foreign investment. The foreign investment would increase the effect of technical spillover since domestic production could learn superior experience from advanced technologies. Also, the transparency could make this effect even larger when project developers learn from each other by sharing information about energy generation and operation. Secondly, when all project developers are domestic, the projects are conducting in favor of domestic interests. If a project developer is from a foreign country, it may only focus on reducing carbon emission and earning as many CER credits as possible. This would definitely harm the efficiency of the project and hinder domestic sustainable development.

3.3. CERs regulations

Since CER plays a pivotal role in CDM projects, China has the following regulations over it to ensure domestic interests: limitation on CER selling volume, a floor price on CER, and taxation on CER revenue [13]. Since the larger volume of CERs, the lower price it will be in the market, revenues for selling CERs to developed countries are shrinking as China constructed more wind-electricity projects. The first two restrictions work together to ensure the profit which project developers can get. Thus, their incentives on developing wind power projects would not be diminished when more and more projects were established.

Taxation, in another aspect, promising the shares the government can get from building emission reduction projects. This regulation can also limit the CER selling volume and the revenue collected from levy is transferred to state-controlled CDM fund [6]. For example, a lowest levy of 2% on projects with high productivity and relatively low production cost. If a destruction project (e.g. hydrofluorocarbon) is over-efficient and it could generate a large number of CERs with little sustainable benefit, a relatively higher tax on this project could limit its production, controlling CER prices, and distributing fund money on other less developed projects. To be more precise, this regulation could balance the production between projects in different efficiency level, and thus promote the rationality in resources sharing.

4. The influences of CDM on Chinese economic activities

The above context includes how CDM fits into Chinese development status and how wisely the regulations from the Chinese government have magnified the benefits of applying CDM. But more importantly, whether CDM contributes to sustainable development is arguable. To investigate this aspect, the CDM needs to be connected with Chinese economic development. The following paragraphs analyze how CDM may have modified or influenced the economic activities from job creation and employment, improvement of living standards, and production and aggregate demand

perspectives.

4.1. Supply of electricity meets the growing demand

As China has high efficiency regulations over CDM projects, and the characteristics of CDM fit into Chinese circumstances, wind energy projects develop fast in China, which induces a rapid increase in wind power electricity and an influence on electric price. Since the beginning of 2000s, 1452 wind projects has been completed by 2012, and electric capacity from wind power has reached 17,630 MW by 2011 [16]. We can forecast a higher growth of wind energy capacity as workers have more professional skills on projects, and generation efficiency increases with more technical innovations. According to a data analysis conducted by Michaelowa and Zhao, electricity consumption in Yinzhou grows continuously from 1437 GWh to 2096 GWh within two years, corresponding to a rapid improvement in GDP per capita [17]. The consumption comes from all sectors, including households, factories, and housing construction. The result shows that as economic growth hasn't stopped, the need for electricity will grow. According to Our World in Data, the electricity demand in China developed from around 1346 TWh in 2000 to around 8443 TWh in 2021. The slope of the growth curve shows a rapid increase trend in demand, which indicates a need for further developing renewable projects like CDM, and to maintain sustainable development [18]. By building the CDM projects, the sustainable increase in wind energy projects can provide a relative safe insurance for emission reduction, and become a solution for electric shortage.

4.2. Job creation

The data and relevant analysis show that CDM construction does bring some job losses, but the job position created by CDM greatly exceeds the loss. By collecting data before 2011, Wang and Zhang did the analysis and find that most of the wind power projects are concentrated in the North and Northwest section of China, in which the carbon-dioxide emission reduction is 47.3 million tonnes in the North China grid, and that of Northwest China grid is 36.9 million tonnes [14]. The reduction generated from wind projects is 86.8% and 41.2% respectively. According to the Job and Economic Development Impact model, the employment effects of CDM construction can be divided into three parts, which are direct employment, indirect employment, and induced employment. The direct employment comes from CDM itself, which may include building wind turbine, hiring employees for supervision, and mundane workers. The indirect employment comes from other job positions related to CDM construction, which mainly includes the horizontal production chain of wind energy generation. The induced employment, on the other hand, comes from aggregate demand, which is demand accumulation from all employees of CDM on good and services. The data analysis shows that wind projects generate 378 direct job employments per GW, and 45.6 indirect employments per GW [14]. Compared with the job creation from other renewable resources projects, small thermal power has the highest direct job creation, which is 10570 Jobs/GW, and solar power creates indirect jobs most. The differences may be due to wind projects may need more highly skilled workers to handle more technical equipment, and the need for innovation is greater in wind electricity generation. The implicit reason for those differences are needed for future investigation. The job creation and higher demand for employment provide an opportunity for an increase in income per capita and living standard, which may contribute to higher GDP per capita as well.

Nevertheless, the construction of CDM projects would decrease the need for coal consumption, which may induce job losses. But it is worth noticing that coal resources still rely heavily on the electricity generation sector. The coal supply for energy production is expected to decrease to 70%, which shows that the loss of job positions in coal production would not be reduced a lot [15].

Therefore, the job creation from CDM is greater than job loss from coal production, which satisfies one key determinant of sustainable development.

5. Conclusion

In general, CDM implementation contributes to Chinese sustainable development a lot. China has provided a proper environment for CDM to construct, including distinguishing different tasks among institutions, building funds for investment development, and attracting foreign liquidity through wise control of CER volume. On the other hand, the merits of CDM projects have been responded with technology transfer, a solid foundation for sustainable growth, and strong incentives for future development. For other developing countries who's currently treating climate change as a challenge, building energy projects similar to CDM, or learning resemble regulations from China is an efficient way in dealing with pollution and financial challenge. From a speech given by one of the leading governors, China has reached its target of carbon reduction and kept an increase in economic growth, which is meaningful and proves the efficient use of CDM. However, the paper's focus is mainly on CDM wind projects, which the positive effects of other types of projects, like hydro and solar energy, are not presented. Those effects are also unignorable since they occupy an enormous volume in Chinese CDM project. So in order to have a full view of CDM projects, those renewable resources are worth consideration. Moreover, the paper and data are concentrated between 2002 to 2010, during which CDM projects are completed intensively. To focus on the present problem, more contemporary literature may be needed. People nowadays are borrowing natural resources from siblings in later generations. It's all people's responsibility to begin developing sustainably and planning the future better later than ever.

Reference

- [1] Ku, J. (n.d.). [online] Available at: <https://www.nrel.gov/docs/fy04osti/35789.pdf>.
- [2] BP (2021). *Statistical Review of World Energy* | Home | BP. [online] BP global. Available at: <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>.
- [3] Tang, T. and Popp, D.C. (2014). *The Learning Process and Technological Change in Wind Power: Evidence from China's CDM Wind Projects*. SSRN Electronic Journal. doi:10.2139/ssrn.2425508.
- [4] Kalkuhl, M. and Wenz, L. (2020). *The impact of climate conditions on economic production. Evidence from a global panel of regions*. *Journal of Environmental Economics and Management*, 103, p.102360. doi:10.1016/j.jeem.2020.102360.
- [5] www.stats.gov.cn. (n.d.). *Statistical Communiqué of the People's Republic of China on the 2021 National Economic and Social Development*. [online] Available at: http://www.stats.gov.cn/english/PressRelease/202202/t0220227_1827963.html.
- [6] Unfccc.int. (2020). [online] Available at: <https://unfccc.int/parties-observers#:~:text=Annex%20I%20Parties%20include%20the>.
- [7] Purohit, P. and Michaelowa, A. (2007). *Potential of wind power projects under the Clean Development Mechanism in India*. *Carbon Balance and Management*, [online] 2(1). doi:10.1186/1750-0680-2-8.
- [8] www.wind-energy-the-facts.org. (n.d.). *Benefits of Wind Energy under the Consideration of External Cost*. [online] Available at: <https://www.wind-energy-the-facts.org/benefits-of-wind-energy-under-the-consideration-of-external-cost.html> [Accessed 12 Jul. 2022].
- [9] Jin, Y., Liu, X. and Yang, W. (2000). *PROSPECTS OF CDM FOR PROMOTING SUSTAINABLE DEVELOPMENT IN CHINA ---Accelerating Foreign Investment and Technology Transfer Prepared for The Working Group on Trade and Environment China Council for International Cooperation on Environment and Development*. [online] Available at: <https://www.iisd.org/system/files/publications/prospects-cdm-sustainable-development-china.pdf>
- [10] Kainou, K. (2022). *Collapse of the Clean Development Mechanism scheme under the Kyoto Protocol and its spillover: Consequences of 'carbon panic'*. [online] VoxEU.org. Available at: <https://voxeu.org/article/collapse-clean-development-mechanism>.

- [11] Maosheng, D. and Haites, E. (2006). *International Review for Environmental Strategies Implementing the Clean Development Mechanism in China*. [online] 6(1), pp.153–168. Available at: https://www.iges.or.jp/en/publication_documents/pub/peer/en/1194/IRES_Vol.6-1_153.pdf
- [12] Qiu, Y. and Anadon, L.D. (2012). *The price of wind power in China during its expansion: Technology adoption, learning-by-doing, economies of scale, and manufacturing localization*. *Energy Economics*, 34(3), pp.772–785. doi:10.1016/j.eneco.2011.06.008.
- [13] INsIDE stoRIEs on climate compatible development Key messages. (n.d.). [online] Available at: https://cdkn.org/sites/default/files/files/China-InsideStory_final_WEB.pdf
- [14] Wang, C., Zhang, W., Cai, W. and Xie, X. (2013). *Employment impacts of CDM projects in China's power sector*. *Energy Policy*, 59, pp.481–491. doi:10.1016/j.enpol.2013.04.010.
- [15] Michaelowa, A., Jusen, A., Krause, K., Grimm, B. and Koch, T. (2000). *CDM projects in China's energy supply and demand sectors – Opportunities and barriers*. [online] www.econstor.eu. Available at: <https://www.econstor.eu/handle/10419/19461>
- [16] Zhao, Zhen-Yu & Li, Zhi-Wei & Xia, Bo. (2014). *The impact of the CDM (clean development mechanism) on the cost price of wind power electricity: A China study*. *Energy*. 69. 10.1016/j.energy.2013.10.050.
- [17] Zhao, X. and Michaelowa, A. (2004). *CDM Potential for Rural Transition in China Case Study: Options in Yinzhou District, Zhejiang Province*. SSRN Electronic Journal. doi:10.2139/ssrn.576921.
- [18] Our World in Data. (n.d.). *Electricity demand*. [online] Available at: <https://ourworldindata.org/grapher/electricity-demand?tab=chart&country=~CHN>.