



To cite this article: Dr. P. Santhi, Dr. P. Sasirekha and J. Anija (2025). RENEWABLE ENERGY AND CERTIFIED EMISSION REDUCTIONS: A STRATEGIC PATHWAY FOR INDIAN FIRMS TOWARDS NET ZERO, International Journal of Research in Commerce and Management Studies (IJRCMS) 7 (6): 431-438 Article No. 557 Sub Id 986

## RENEWABLE ENERGY AND CERTIFIED EMISSION REDUCTIONS: A STRATEGIC PATHWAY FOR INDIAN FIRMS TOWARDS NET ZERO

Dr. P. Santhi<sup>1</sup>, Dr. P. Sasirekha<sup>2</sup> and J. Anija<sup>3</sup>

<sup>1</sup>Professor, Department of Commerce,  
Avinashilingam Institute for Home Science and Higher Education for Women,  
Coimbatore – 641 043, Tamil Nadu  
Email id: shanthi\_comm@avinuty.ac.in  
ORCID id: 0000-0002-4910-5618

<sup>2</sup>Assistant Professor, Department of Commerce,  
Avinashilingam Institute for Home Science and Higher Education for Women,  
Coimbatore – 641 043, Tamil Nadu  
Email id: psasirekhaphd@gmail.com  
ORCID id: 0000-0002-2425-0966

<sup>3</sup>Ph.D- Research Scholar  
Avinashilingam Institute for Home Science and Higher Education for Women,  
Coimbatore – 641 043, Tamil Nadu  
Email id: anijajohnrose@gmail.com  
ORCID id: 0009-0003-8462-2922

DOI: <https://doi.org/10.38193/IJRCMS.2025.7634>

### ABSTRACT

Clean Development Mechanism (CDM) is driving low-carbon projects and transfer of technology by the corporate that aligns with the global shifts towards net-zero economy. The study intended to analyse Carbon emission reduction in achieving Certified Carbon Emission (CERs) through CDM by the Public and Private Limited Companies in India under UNFCCC. The secondary data on CERs derived from UNFCCC were used and analyzed descriptive statistics. The study found that wind energy, hydropower and solar energy were used in recognition of CERs by Private sector Firms and the Public Limited Companies have utilised primarily wind energy, energy from managing wastes, solar energy and hydro power. The number of sustainable projects has increased during the latter part of the study period. The study will be useful to wide range of audiences and stakeholders including investors, bankers, companies, Government, CER issuers and auditors to achieve Net Zero.

**KEYWORDS:** CDM, CERs, Carbon Credit, Content Analysis, Energy Source

### 1. INTRODUCTION

Impact of climate change across the globe warranted the United Nations Framework Convention on



Climate Change (UNFCCC) to bring out a agenda to stabilize Green House Gas emission by setting voluntary target on emission reduction (Hickmann et al., 2021). The Kyoto Protocol's (2005) Clean Development Mechanism (CDM) is an innovative approach for fetching developed and developing countries to get the mutual benefit to fight against climate change and promotes sustainability (Sabbaghi, & Sabbaghi, 2018). It facilitates developing countries to switch towards clean technology and energy efficiency through market-based mechanisms (Fernando & McWhinnie, 2025). It provides incentive to invest in schemes that diminish emissions in developing countries at costs lower than the inland measures of respective countries (Weitzel, 2015). These projects earn CERs, each equivalent to 1 ton of CO<sub>2</sub> equivalent (tCO<sub>2</sub>e) abatement. The companies can either use the CERs to meet their requirements or sell the CERs to an Annex I Party that can use those to meet their emission reduction target (Kaisto, 2024).

Keeping sustainable development as national priority, India created several opportunities to companies in India to focus more projects on renewable energy generation, energy and waste management (Gupta, 2014). Through these projects the companies can be able to generate CER credits under UNFCCC, which are tradable in international markets (Sarkar & Dash, 2011). Hence, the Indian companies considered CDM as a successful business strategy to support global environmental initiatives.

## 2. REVIEW OF LITERATURE

1. Shailendra Sharma (2012). Carbon credits are certifications given to nations which lower their greenhouse gas emissions through CDM projects. The sale of CERs helps to recoup the investment and operational costs of CDM projects, which are pertinent method used in India to reduce carbon emissions.
2. Kumar and Agarwala (2018) stated that for the promotion of generation and use of renewable energy, Ministry of New and Renewable Energy (MNRE) had envisaged various schemes with outcomes of tradable Renewable Energy Certificate (REC) with Perform, Achieve and Trade (PAT) as the market-based mechanism. In India, wind energy is being harnessed at the fastest rate due to regional resource potential, as opposed to solar energy technology diffusion, which is faster worldwide.
3. Policy Paper for Indian Carbon Market (2022), envisaged well-defined registry for ETS System, active tracking of demand and supply and benchmarking-based approach is used for allocation. The proposed unified domestic carbon market mechanism will subsume the existing PAT and REC mechanisms
4. Bharat and Amirthiyan(2024) emphasized the global leadership of India with the transition to clean energy through the Government of India's Initiatives like Lifestyle for Environment (LiFE), National Hydrogen Mission and National Solar Mission, FAME and PAT Schemes.

**Objectives of the Study**

- To identify the Energy Source –wise number and value of CERs gained by the firms in India and
- To analyse the CO<sub>2</sub> Emission Reduction in recognition of CERs by the firms in India

**3. RESEARCH METHODOLOGY**

The study adopted descriptive method to analyse the CERs. The required secondary data on issuance of CERs from the financial year 2017-2018 to 2022-2023 were fetched from the official website of UNFCCC. Totally, 595 carbon credit announcements made during the period. Of which 323 projects belong to 253 Private Limited Companies and 272 projects are associated with 128 Public Sector Companies, consisting of both listed and non-listed companies in India. The collected CER data were organized, tabulated and analysed using descriptive statistics.

**4. EMPIRICAL FINDINGS**

This section provides a detailed analysis the CER<sub>s</sub> recognized by the select Indian firms during study period.

Table 1 presents the number of CERs and Table 2 value of CERs generated by the Indian Public sector companies and Private sector firms. The firms have implemented CDM projects according to their agenda on carbon emission reduction. The Private sector firms in India adopted on a on voluntary basis and the public sector companies, compulsorily at a volume that would stop harmful anthropogenic interaction with the eco system.

**Table 1 Energy source –wise number of CER Projects implemented by the Firms in India**

Sources	Sector	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	Total
Biogas	Public	2	3	0	1	1	3	0	10
	Private	4	1	3	3	7	1	0	19
Biomass	Public	4	3	1	5	2	7	1	23
	Private	1	0	3	0	1	5	2	12
Energy Efficiency	Public	5	1	1	0	0	1	4	12
	Private	0	5	0	1	2	1	0	9
Forestry	Public	1	0	1	0	0	0	0	2
	Private	0	1	2	0	0	0	0	3
Hydro Power	Public	3	4	2	4	9	14	3	39
	Private	4	1	0	0	9	21	4	39
Solar	Public	3	4	3	6	4	5	2	27
	Private	8	5	0	7	5	22	6	53
Waste Management	Public	4	1	1	2	2	1	3	14
	Private	0	2	0	2	2	2	0	8

Wind	Public	15	9	12	7	37	54	11	<b>145</b>
	Private	26	20	0	8	42	60	24	<b>180</b>
Total	Public	<b>37</b>	<b>25</b>	<b>21</b>	<b>25</b>	<b>55</b>	<b>85</b>	<b>24</b>	<b>272</b>
	Private	<b>43</b>	<b>35</b>	<b>8</b>	<b>21</b>	<b>68</b>	<b>112</b>	<b>36</b>	<b>323</b>

Source: Compiled data

Wind energy is the prime source utilized by public and private sector firms driven by beneficial policy support that has promoted both Independent Power Producers (IPP) and non- IPPs, followed by hydro power which is well suited to balance wind and solar unlike coal.

India’s solar sector is a sunshine opportunity with incentives which prompted private sector companies to leap forward than public sector companies. A quite a few projects on the biomass energy with technology transfer were implemented and considerable number of projects on waste-to-energy was implemented by the public sector companies in India.

Private sector companies are ahead in executing biogas projects. Replacing lighting system and manufacturing process with energy efficient equipment and bulbs led to recognition of CERs by both in public and private sector companies as well as adopted forestry projects.

The Energy Source-wise CO<sub>2</sub> Emission Reduction in recognition of CERs by the firms in India (Table 2) indicates that wind energy is predominantly used by both Private and Public sector companies. The Public sector companies have relied much on biogas, hydropower, energy efficient products and solar energy which yielded CERs. The private sector companies generated CERs out of hydropower, use of energy efficient products, solar power, biomass and forestry.

**Table 2 Energy Source-wise CO<sub>2</sub> Emission Reduction in recognition of CERs by the firms in India**

**(In tonnes)**

Sources	Sector	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	Total
Biogas	Public	2230634	5081978	0	391411	131233	7299666	0	<b>15134922</b>
	Private	135762	28700	117757	58637	815454	52294	0	<b>1208604</b>
Biomass	Public	157873	201838	48042	296500	155149	913215	71430	<b>1844047</b>
	Private	36024	0	64312	0	249471	1083796	137173	<b>1570776</b>
Energy Efficiency	Public	1424269	44353	1349097	0	0	59343	2014322	<b>4891384</b>
	Private	0	47754	0	22459	51895	64239	0	<b>128532</b>

			4		1	4			8
Forestry	Public	5464	0	9201	0	0	0	0	14665
	Private	0	9157	225508	0	0	0	0	234665
Hydro Power	Public	3702564	94820	71945	1435049	4135961	1780825	998809	12219973
	Private	924344	39849	0	0	1387219	2175648	818869	5345929
Solar	Public	131143	279997	150638	453288	332708	1073127	181154	2602055
	Private	429795	416954	0	496032	558104	1915453	752357	4568695
Waste Management	Public	240084	88264	58841	156376	611630	49533	288137	1492865
	Private	0	83842	0	133273	204683	88613	0	510411
Wind	Public	1434170	1132482	865045	739362	3057991	6211751	1831466	15272267
	Private	3028437	1622747	0	1010029	4259188	7546757	1853103	19320261
Total	Public	9326201	6923732	2552809	3471986	8424672	17387460	5385318	53472178
	Private	4554362	2678793	407577	1922562	7993073	12926800	3561502	34044669

Source: Compiled data

**Table 3 Descriptive Analysis on Energy Source-wise CO<sub>2</sub> Emission Reduction in recognition of CERs by the Public Sector Companies in India**

Category	Mean	Std. Deviation	Skewness	Kurtosis	Variance	t	Significance
Biogas	2162131.7143	2930701.90591	1.171	-.087	8589013661294.240	1.952	.099
Biomass	263435.2857	298113.73421	2.243	5.357	88871798524.571	2.338	.058
Energy Efficiency	698769.1429	865413.06078	.615	-1.840	748939765774.476	2.136	.077
Forestry	2095.0000	3736.98903	1.570	1.240	13965087.000	1.483	.189

Hydro Power	1745710.4286	1618904.40893	.633	-1.126	2620851485264.620	2.853	.029
Solar	371722.1429	329552.75428	2.041	4.460	108605017853.810	2.984	.025
Waste Management	213266.4286	197710.35055	1.614	2.772	39089382712.952	2.854	.029
Wind	2181752.4286	1941023.76864	1.890	3.583	3767573270414.950	2.974	.025

Source: Computed data

Table 3 presents the source wise CER resulted for the public sector companies in India. The average CO<sub>2</sub> cancelled revealed that wind energy is the prime source followed by biogas and hydropower.

All the source-wise data on CO<sub>2</sub> cancelled towards CER have positively skewed (long right tail). The kurtosis computed is mesokurtic for wind energy, platykurtic for biogas, energy efficiency, hydro power, forestry and waste management and leptokurtic for biomass, and solar energy. The variance resulted are higher with the utilisation of various energy sources in recognition of CERs.

The result of one sample t-test showed a significant mean difference in case of CERs recognized from hydropower, solar power, waste management and wind energy whereas no statistically significant mean difference in case of biogas, biomass, energy efficiency and forestry among public sectors companies.

**Table 4 Descriptive Analysis on Energy Source-wise CO<sub>2</sub> Emission Reduction in recognition of CERs by the Private Sector Companies in India**

Sources	Mean	Std. Deviation	Skewness	Kurtosis	Variance	t	Significance
Biogas	172657.7143	287397.83805	2.497	6.395	82597517316.238	1.589	.163
Biomass	224396.5714	389149.28464	2.378	5.843	151437165737.286	1.526	.178
Energy Efficiency	183618.2857	229462.98486	.828	-1.406	52653261418.905	2.117	.079
Forestry	33523.5714	84725.93053	2.637	6.963	7178483303.952	1.047	.335
Hydro Power	763704.1429	826806.99697	.740	-.326	683609810240.476	2.444	.050
Solar	652670.71	601283.352	1.833	4.349	361541670272.	2.872	.028

	43	73			571		
Waste Management	72915.8571	78868.57442	.642	-.580	6220252031.810	2.446	.050
Wind	2760037.2857	2517554.06116	1.235	1.568	6338078450848.240	2.901	.027

Source: Computed data

The Table 4 shows the mean value of CO<sub>2</sub> cancelled in recognition of CERs revealed that wind energy is the prime source of energy followed by hydropower and solar energy in Private Sector companies. The data were positively skewed. The kurtosis value indicates that CERs data generated are platykurtic for forestry, biogas, biomass and solar energy and leptokurtic for hydro power, energy efficiency and waste management. The data variance is high in all the sources. The one sample T-test resulted statistically significant for CERs recognition on wind energy and solar energy, indicating the firms in private sector working towards achieving carbon neutrality.

**5. CONCLUSION**

The study focused the extent to which Indian firms have participated in the global carbon market under CDM framework. Both the private and public sector firms showed an increasing trend in implementation of CDM projects. Private firms are ahead of public sector companies in CDM projects implementation. Wind energy is most effectively used source by firms in generating CERs. The study proved the contribution of Indian firms on emission reduction as well as their role in leveraging environmental initiatives for sustainable development.

**FUNDING ACKNOWLEDGEMENT**

We acknowledge the Indian Council of Social Science Research (ICSSR), New Delhi for funding support.

**REFERENCE**

1. Bharat A, S. and Amirthiyan B (2024). India’s Energy Management Solutions: Conquering Challenges, Guiding the Globe. *The Management Accountant Journal*, 59(11), 27–30. <https://doi.org/10.33516/maj.v59i11.27-30>
2. Fernando, L., & McWhinnie, S. (2025). Kyoto's Clean Development Mechanism for emissions reduction in developing economies. *Australian Journal of Agricultural and Resource Economics*, 69(2), 281–297 <https://doi.org/10.1111/2F1467-8489.12615>.
3. Gupta, A. (2014). Clean development mechanism of Kyoto Protocol: Contribution of India in climate change mitigation and expectations of Indian project proponents. *International Journal of Climate Change Strategies and Management*, 6(2), 116–130. <https://doi.org/10.1108/IJCCSM-09-2012-0051>
4. Hickmann, T., Widerberg, O., Lederer, M., & Pattberg, P. (2021). The United Nations Framework Convention on Climate Change Secretariat as an orchestrator in global climate policymaking.



- International Review of Administrative Sciences*, 87(1), 21–38.  
<https://doi.org/10.1177/0020852319840425>
5. Kaisto, J. (2024). Emission allowances and carbon credits as property: A Finnish perspective. *European Property Law Journal*, 12(2–3), 148–210. <https://doi.org/10.1515/eplj-2023-0006>
  6. Kumar, R., & Agarwala, A. (2013). Energy certificates REC and PAT sustenance to energy model for India. *Renewable and Sustainable Energy Reviews*, 21, 315–323. <https://doi.org/10.1016/j.rser.2013.01.003>
  7. Bureau of Energy Efficiency. (2022). *Policy paper for Indian carbon market*. Ministry of Environment, Forest and Climate Change, Government of India. <https://beeindia.gov.in/carbon-market.php>
  8. Sabbaghi, O., Li, J., & Sabbaghi, N. (2018). Certified emission reduction credits and the role of investments: Evidence from wind CDM projects in China. *International Journal of Energy Sector Management*, 12(3), 386–407. <https://doi.org/10.1108/IJESM-06-2017-0005>
  9. Sarkar, A. N., & Dash, S. (2011). Emissions trading and carbon credit accounting for sustainable energy development with focus on India. *Asia Pacific Business Review*, 7(1), 50–80. <https://doi.org/10.1177/097324701100700104>
  10. Sharma, S. (2012, August). Carbon credits – A growing opportunity with boon to environment *EPC&I*, Anniversary Issue. [https://ijiset.com/vol2/v2s9/IJSET\\_V2\\_I9\\_122](https://ijiset.com/vol2/v2s9/IJSET_V2_I9_122).
  11. Weitzel, M., Liu, W. H., & Vaona, A. (2015). Determinants of technology transfer through the CDM: A within-country analysis for China. *Climate Policy*, 15(5), 626–646. <https://doi.org/10.1080/14693062.2014.954095>