



A STUDY ON AWARENESS OF RENEWABLE ENERGY SOURCES FOR TRANSPORTATION WITH SPECIAL REFERENCE TO BMRCL-NAMMA METRO.

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Abstract: Due to the rapid industrialization and life cycle changes, the amount of carbon dioxide (CO₂) in the earth's atmosphere is sharply increasing. The global economy has adopted a measure known as the Carbon Credit and Clean Development Mechanism (CDM), which enables a country with an emission-reduction or emission-limitation commitment under the 2005 Kyoto Protocol to carry out an emission-reduction project in developing nations.

India, a developing country, comes in second place globally in the development of CDM projects, behind China and Brazil. India participates in CDM projects at a rate of about 20% compared to China's 50%. In comparison to China, which has large-scale CDM projects, India produces fewer certified emission reduction (CER) credits due to its small-scale CDM initiatives. In order to reduce the impact of GHGs into the atmosphere, many renewable projects were introduced by The Ministry of New and Renewable Energy (MNRE). Recently, in the year 2017 Pradeep Singh Kharola, Managing Director of Namma Metro BMRCL have said that Namma Metro, under "Clean Development Mechanism" which reduce the greenhouse gas emissions will find the exact carbon ratings and sell the credits to other industries and projects.

The goal of the current study is to determine the general public's degree of knowledge regarding the usage of renewable energy sources for transportation and other uses. Quantitative data will be gathered for the study's purposes by utilising descriptive research and closed-ended questions through a standardised questionnaire.

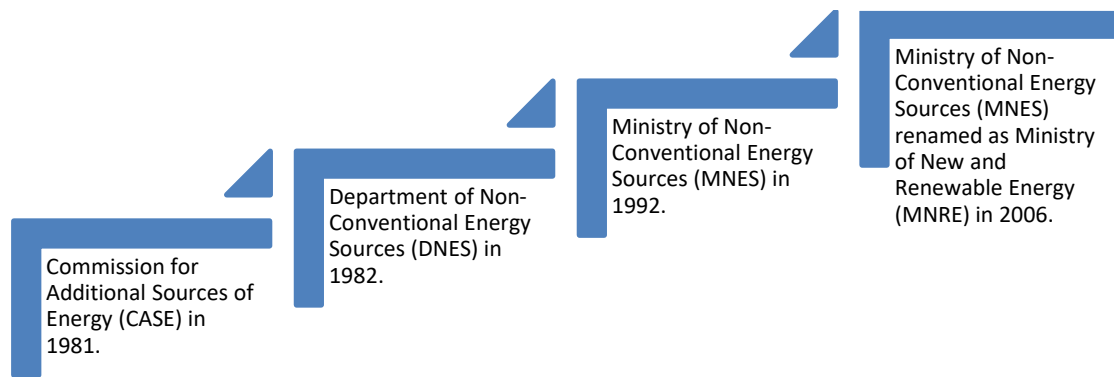
Key Words : Renewable energy, Green house gas agents, CDM

I. INTRODUCTION

Emissions of greenhouse gases into the atmosphere have resulted from the rapid revolution of industrialization and life cycle. Since the 1800s, industrialization has exploited and malfunctioned natural resources to generate the energies required for the industrial revolution. As a result, each season in the environment is at its most uncontrollable state, resulting in weather fluctuations, floods, earthquakes, and other problems. The consequences of these risks are already being felt, so world leaders have signed international conventions and treaties – such as the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol Treaty, the Paris Agreement, and others – to impose legally binding caps on greenhouse gas emissions by industries that produce more of them. To reduce and control the emission of GHG agents into the atmosphere by captive power industries, it is necessary to replace traditional fossil fuel based energy generation with renewable energy sources that are naturally available, replenish naturally, and help to reduce and control GHG agent emissions into the atmosphere.

Indian Scenario:

The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for all matters relating to new and renewable energy. The broad aim of the Ministry is to develop and deploy new and renewable energy to supplement the energy requirements of the country.

Milestones:

The role of new and renewable energy has been assuming increasing significance in recent times with the growing concern for the country's energy security. Energy self-sufficiency was identified as the major driver for new and renewable energy in the country in the wake of the two oil shocks of the 1970s. The sudden increase in the price of oil, uncertainties associated with its supply and the adverse impact on the balance of payments position led to the establishment of the Commission for Additional Sources of Energy in the Department of Science & Technology in March 1981. The Commission was charged with the responsibility of formulating policies and their implementation, programs for development of new and renewable energy apart from coordinating and intensifying R&D in the sector. In 1982, a new department, i.e., Department of Non-conventional Energy Sources (DNES), that incorporated CASE, was created in the then Ministry of Energy. In 1992, DNES became the Ministry of Non-conventional Energy Sources. In October 2006, the Ministry was re-christened as the Ministry of New and Renewable Energy.

Mechanism of Renewable Energy:

India has launched the Renewable Energy Certificate (REC) mechanism in November 2010 in compliance with United Nations Framework Convention on Climate Change (UNFCCC) which promote actions that address climate concerns, included in the India's intended Nationally Determined Contribution (INDC).

The mechanism is based on the REC Regulations notified by the Central Electricity Regulatory Commission (CERC) on January 14, 2010. Through the REC mechanism, a pan-India market instrument has been designed in a way to facilitate renewable purchase obligation (RPO) by the obligated entities, which, in turn, will promote renewable energy in the country by supplying the same to the captive users of power to reduce the greenhouse gas agents into the environment.

Under the REC, as a pan-India market instrument Renewable Energy (RE) sources are not uniformly located in India, and all states are not evenly endowed with RE resources, the REC mechanism was launched to enable obligated entities of less resourceful states to meet their Renewable Purchase Obligation (RPO) by purchasing RECs instead of directly procuring renewable energies all the way from projects located in different states.

Scenario in Karnataka:

In Karnataka, KREDL Karnataka Renewable Energy Development Ltd and Karnataka Power Corporation Limited (KPCL) are the major energy exchange sources in generating wind, solar, hydro, thermal, biomass and other renewable energies.

II. REVIEW OF LITERATURE:

1. Abdalla (1994), by the middle of the century, the world's population is predicted to have doubled, and practically every country on the planet will face rising energy consumption. Agriculture, manufacturing, commerce, transportation, and residential sectors all contribute to energy demand in a growing economy. As a result of rapid revolution of industrialization and life cycle usage of energies such as diesel, petrol another fossil fuels had contributed the emission of greenhouse gases into the atmosphere.
2. The clean development mechanism (CDM) of the Kyoto Protocol has been set up to assist developing countries in achieving sustainable development by promoting greenhouse gas emission reduction projects, that generate emission

credits (certified emissions reductions, CERs) for industrialized countries. A number of countries in the region are taking advantage of the CDM. This is a provision of the Kyoto Protocol which was devised originally as a bilateral mechanism through which entities in industrialized countries could gain certified emission reductions (CERs) by investing in clean technologies in developing countries.

3. Srikanth Subbarao and Bob loyd (2009), study on “Development Challenges under the Clean Development Mechanism (CDM) - can Renewable Energy initiatives be put in place before peak oil?” discuss the global concerns of developmental needs, energy and climate change, and their influence on the poor in the developing world. They say that, this mechanism to promote clean carbon-free energy for developing countries and modified CDM could deliver both reasonable quantity of costeffective emission reductions and increase the flow of technologies and finance to some developing country.
4. Sundar I and C.Venkatesan(2009) study on “Energy Economics” This book explained the economics of energy, energy theories and economic development, electricity demand forecasting and it is including econometric approach, time series methods, integration, end-use approach(pattern of electricity consumption), energy demand, forecasting new technologies, economics of depletable energy supply, capacity investment and capacity constraints, market failures, renewable energy sources and energy policy in India.
5. According to MNRE (2008), working paper on “Renewable Energy in India: Progress, Vision and Strategy” explained the renewable energy programmes, research and development, technology adoption, implementation, policy and budgetary support in India. The paper outlines the basic strategy and approach being followed for the growth of the renewable energy sector and emphasized the different important roles that can be played in the off-grid particularly in meeting the challenges of providing energy access to India's rural areas and reducing consumption of fossil fuels which is essential for future energy security of the country.
6. ToI (2021), reported that government enables replacing thermal power supply under signed contracts with renewable energy which aims at replacing of fossil fuel based energy companies by renewable energy to achieve emission less industrialisation. This step by the Central Government will lead to a faster energy transition and will be beneficial for both the Generators and the Distribution Companies, it added.
7. The Hindu- Business Line(2021), Central Issues revised guidelines to enable the replacement of fossil fuel-based energy by renewable energy, In a bid to enable the replacement of fossil fuel-based energy by renewable energy under the existing power purchase agreements (PPAs), the Centre has issued revised guidelines providing for thermal generation companies to set up renewable energy generation capacity either by themselves through developers by open bids and supplying it to the consumers under the existing PPAs. REC supported by government intervention and governance will further motivate the captive power users and private bodies to invest more in the renewable energy sectors.
8. Srikanth Subbarao and Bob loyd (2009), study on “Development Challenges under the Clean Development Mechanism (CDM) - can Renewable Energy initiatives be put in place before peak oil?” discuss the global concerns of developmental needs, energy and climate change, and their influence on the poor in the developing world. They say that, this mechanism to promote clean carbon-free energy for developing countries and modified CDM could deliver both reasonable quantity of costeffective emission reductions and increase the flow of technologies and finance to some developing country.

III. RESEARCH OBJECTIVES:

1. To know the concept renewable energy projects and its application in transportation at bengaluru city.
2. To understand the importance sustainable transportation
3. To study the awareness of general public towards the sources of renewable energy for transportation.
4. To offer suggestions based on the study.

IV. RESEARCH METHODOLOGY:

Data Collection:

- ✚ Primary Data:- Structured Questionnaire :The study was conducted by collecting primary data through administering a well-designed questionnaire to analyse the impact of usage of renewable energy sources towards sustainable development.
- ✚ Secondary data: Research papers and websites.

Sample Selection:

- ✚ Tool and Technique : Convenience Sampling.
- ✚ Sample Size:
 - Questionnaire Distributed : 150 respondents
 - Questionnaire Collected : 128 respondents.

Scope: The study was conducted in Bengaluru city.

Limitation of the study:

- ✚ It is purely based on the responses given by the respondents.
- ✚ The study is limited to Bengaluru city.

V. FINDINGS AND INTERPRETATION:

OBJECTIVE: 1 THE CONCEPT OF CDM PROJECTS AND APPLICATION IN TRANSPORTATION AT BENGALURU CITY.

Emission-reduction initiatives in developing nations are eligible to get certified emission reduction credits under the clean development mechanism. Industrialized nations can use these marketable credits to partially achieve their Kyoto Protocol emission reduction goals.

The United Nations had suggested a cap on annual emissions by businesses and industries and further established carbon credits in order to encourage less carbon that pollutes the environment. Selling extra carbon credits is one method to earn extra money while being ecologically conscientious. The idea of "carbon credit trading" has not acquired much traction in India and is merely a suggestion given by the UN Framework Convention on Climate Change.

The metro project belongs to the category of "clean development mechanism" (CDM) initiatives that lower greenhouse gas emissions.

The plus side is that Bengaluru is progressing by cutting carbon emissions and putting money into public transportation like the metro. Also benefiting from non-fare revenue collecting is BMRC.

As for metro, it has a significant carbon footprint because it consumes a lot of electricity. Additionally, the number of cars that individuals leave behind in order to take the train is counted when determining the carbon ratings for the metro. The biggest polluters are vehicles. There are not many places to park a car and board the metro in Bengaluru's metro stations.

OBJECTIVE : 2 IMPORTANCE of SUSTAINABLE TRANSPORTATION.

Humans require transportation as a basic need. Our reliance on transportation rises as our cities develop and expand. Of all the sectors in the country, the transport industry uses 24% of the total energy (TEDDY, 2018). It also has one of the fastest rates of growth. The need for transportation is expected to rise along with our economy's growth and income levels. It's crucial that a supply of clean, sustainable transportation can meet this rising demand. The correct policy interventions can aid in developing a transportation industry that can meet customer needs while being environmentally sustainable.

Low- and zero-emission, cost-effective, energy-efficient forms of transportation, including electric and alternative-fuel cars, as well as domestic fuels, are referred to as sustainable transportation.

BENEFITS OF SUSTAINBLE TRANSPORTATION:

Numerous social and economic advantages of sustainable transportation can hasten local sustainable development. Investing in bicycle lanes, pedestrian pathways, and non-pedestrian pathways can improve commuter safety, help create jobs, and make it easier and more affordable to access opportunities for employment and social interaction, according to a number of serious reports published by the Low Emission Development Strategies Global Partnership (LEDS GP). Additionally, it provides a useful chance to save people's time, money from their homes, and government budgets, making an investment in sustainable transport a "win-win" opportunity.

The weight of vehicles can be decreased, sustainable driving practises can be adopted, tyre friction can be decreased, electric and hybrid vehicles can be encouraged, the walking and cycling environment in cities can be improved, and the role of public transportation, particularly electric rail, can be expanded.

OBJECTIVE: 3 - AWARENESS OF GENERAL PUBLIC TOWARDS THE SOURCES OF RENEWABLE ENERGY FOR TRANSPORTATION.

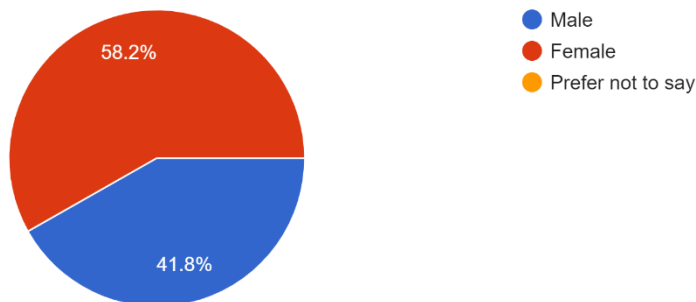
To understand the awareness of general public towards the sources of renewable energy towards transportation primary data was collected. The details of the same includes the following:

i. Gender category:

Table:1 Distribution of respondents based on the gender.

Sl.No.	Gender	Percentage
01	Female	58.2%
02	Male	41.8%
03	Prefer not to say	-

Chart showing the distribution of respondents based on gender



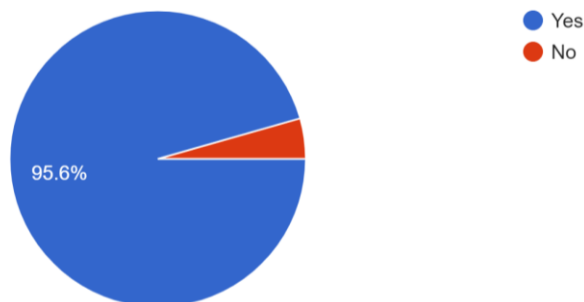
Inference: The above chart exhibits that 58.2% of female and 41.8% of male respondents responded to the questionnaire.

ii. Status of Residence in Bengaluru city:

Table :2 Status of residence in Bengaluru city.

Sl.No.	Residents of Bengaluru City	Percentage
01	Yes	95.6%
02	No	4.4%

Chart showing the resident status of respondents in Bengaluru city



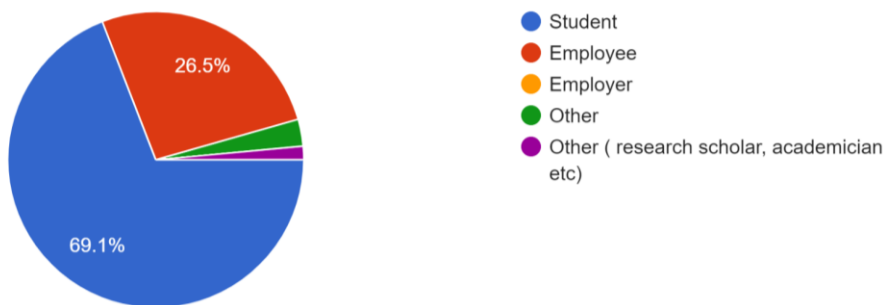
Inference: The above explains that 95.6% of the respondents were residents of Bengaluru city and the remaining 4.4% of the respondents were the non-residents of the Bengaluru city.

iii. Status of Designation of the respondents:

Table: 3 Table showing the status of the respondents

Sl No.	Status of Respondents	Percentage
01	Students	69.1%
02	Employees	26.5%
03	Research scholars	1.5%
04	Not like to reveal	2.9%

Chart showing the status of respondent



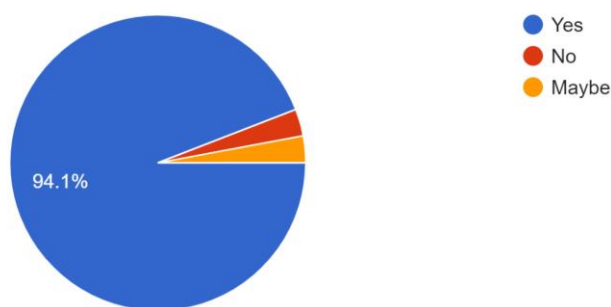
The chart reveals that the majority of 69.1% of the respondents are students, 26.5% of the respondents are employees, 1.5% were research scholars and academicians and the remaining 2.9% are others who does not like to disclose the status.

iv. Level of awareness on renewable energy sources.

Table:4 Table showing the level of awareness of the respondents on renewable energy sources.

Sl. No.	Awareness on Renewable energy	Percentage
01	Yes	94.1%
02	No	2.9%
03	May be	2.9%

Chart showing the level of awareness of respondents on renewable energy



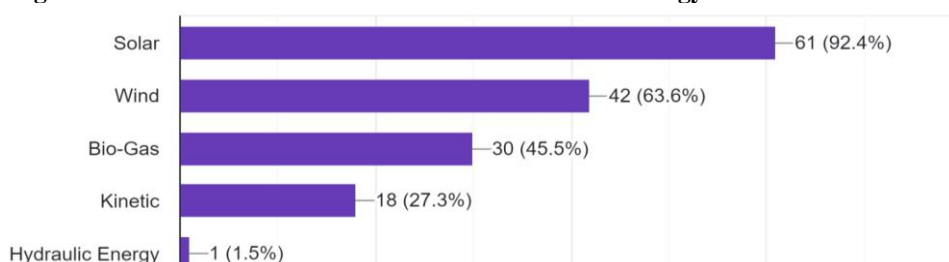
Inference: The above diagram reveals that majority of 94.1% respondents are aware of the renewable energy, 2.9% are not aware of the renewable energy and the remaining 2.9% not sure about the renewable energy sources.

v. Level of awareness on the sources of renewable energy

Table:5 Table showing the level of awareness on sources of renewable energy.

Sl. No.	Source of Energy	Percentage
01	Solar	92.4%
02	Wind	63.6%
03	Bio- gas	45.5%
04	Kinetic Energy	27.3%
05	Hydraulic energy	1.5%

Chart showing the the level of awareness on sources of renewable energy



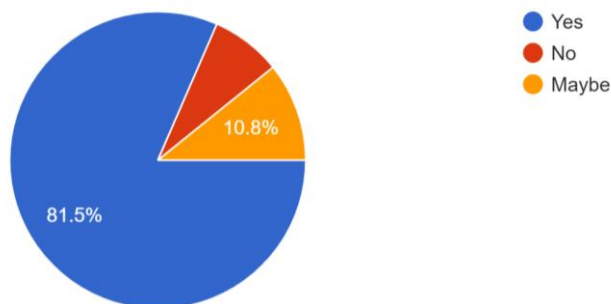
Inference: The above diagram reveals that 92.4% of the respondents are aware of solar energy, 63.6% of the respondents are aware of wind energy, 45.5% of the respondents of the bio-gas energy, 27.3% of the respondents of the kinetic energy and 1.5% of the respondents of the hydraulic energy as source of renewable energy.

vi. Level of preference to use renewable energy products for transportation and other purpose.

Table:6 Table showing the level of preference of the respondents on usage of renewable energy products .

Sl. No.	Level of preference	Percentage
01	Yes	81.5%
02	No	7.7%
03	May be	10.8%

Diagram showing the level of preference of the respondents on usage of renewable energy products.



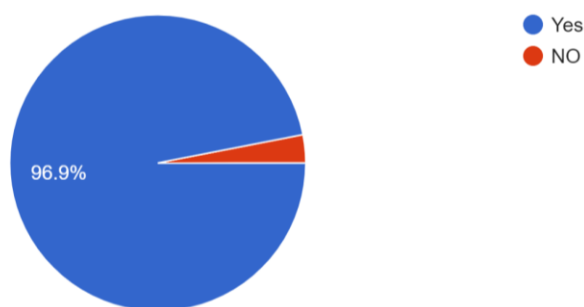
Inference: The diagram shows that 81.5% of the respondents prefer to use renewable energy products, 7.7% of the respondents do not prefer to use and the remaining 10.8% of the respondents are not sure of using renewable energy products for transportation and other purposes.

vii. **Travel experinece in Namma Metro- BMRCL:**

Table 7: Table showing the travel experience of the respondents in Metro.

Sl. No.	Travel experience	Percentage
01	Yes	96.9%
02	No	3.1%

Chart showing the travel experience of the respondents in namma Metro- BMRCL.



The above diagram shows that 96.9% of the respondents have experienced the travel in Namma metro- BMRCL and remaining 3.1% of the respondents have no experience of travel in Namma metro- BMRCL.

VI. SUGGESTIONS:

Due to rapid industrialization, it is now impossible to supply all of the demands for products and services by just depending on fossil fuel-based energy. It is necessary to use renewable energy sources, such as solar, wind, biogas, kinetic, and other sources, to replace the current energy supply. According to the study, the government should vigorously support Clean Development Mechanism projects like Namma Metro and others like Suzlon Energy, a pioneer in wind and solar energy, Tata BP Solar, Gujarat Fluoro Chemicals Ltd., Torrent Power Ltd., Jindal Steel Works Ltd., Bhoruka Power Corporation Ltd., Steel Authority of India Ltd., etc. to improve the quality of life and protect resources for future generations.

VII. CONCLUSION:

Based on the aforementioned study, it is evident that the respondents are fully aware of the benefits of using renewable energy sources for a variety of tasks, including transportation, and how they support sustainable development. Additionally, it is seen that the respondents are delighted to accept new CDM projects that will support initiatives which will reduce emissions and improve quality of life.

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