Quest Journals
Journal of Research in Environmental and Earth Sciences
Volume 9 ~ Issue 1 (2023) pp: 73-76
ISSN(Online) :2348-2532
www.questjournals.org

Research Paper

Evaluating Sand Thermal Energy Storage Systems as a robust solution to India's regional coordination problem

Aadi Sehgal
[1](*Stanes School,India , ICSE))*

ABSTRACT: *India announced its ambitious goals to fight climate change at the COP26. Despite inadequate government support, renewable energy has augmented at a staggering pace due to its sinking cost. Fortunately, India's heterogeneous geography offers a solution: regional coordination. To enable efficient transmission of energy between states during surpluses and deficits, a robust infrastructure would need to be built, but this task would be challenging at best. Thermal Energy Storage systems are capable of storing thermal energy for months. Thermal Energy storage systems store heat or cold within a Phase Change Material (PCM), a Sand Thermal Energy Storage system is named after its phase change material and is extremely cost-effective with no adverse environmental impact. Our model involves a sand thermal energy storage system which can store energy from assorted sources. The model could allow the country to effectively store energy and utilise it during surpluses and deficits and hence eliminate or minimise the dependence on regional coordination.*

KEYWORDS: *COP26, heterogenous geography, regional coordination, phase change material, sand thermal energy storage system, surpluses, deficits*

Received 03 Jan., 2022; Revised 14 Jan., 2023; Accepted 16 Jan., 2023 © The author(s) 2023.
Published with open access at ***www.questjournals.org***

I. INTRODUCTION

The potential of renewable and Non renewable sources in India is enormous. In a report , the author outlined the advantages of using green energy in India, including how it can help with energy shortages, social and economic development, and environmental concerns including pollution and global warming. The rising popularity of renewable energy and emphasized the steps that the government would need to take to support its development. Improved infrastructure and a nation's energy sources are the primary factors in economic development. The expansion of energy consumption and economic development are directly correlated. A report also discussed the financial viability of development, the positive correlation between global per capita income and energy use, and employment benefits of green energy. It emphasized the considerable contribution of the private sector (47% of installed capacity) and argued that stronger private sector policies should be implemented by the government in order for the nation to fall within the sustainable category.[1] [2]

A study looks at the effects of using renewable and non-renewable energy on India's economic growth between 1971 and 2012 using an energy consumption-growth model. The study's findings showed that non-renewable energy use had a long-term, significant positive impact on India's economic development. In stark contrast, it is discovered that the long-term elasticity of economic growth with regard to usage of renewable energy is statistically insignificant. Additionally, it is demonstrated that there is a long-term and short-term causal relationship between the usage of non-renewable energy sources and economic growth. According to the findings, it is indicated that, if implemented without proper consideration for renewable energy sources, a nonrenewable energy conservation strategy could slow down India's economic growth. Renewable energy sources are becoming more and more relevant options as a result of technological advancements and the search for environmental sustainability. While these nations are taking part in the global transition to clean and low-carbon energy systems, renewable energy sources are still significantly underdeveloped in the majority of developing and rising economies. The question of whether a switch from non-renewable to renewable energy can support economic growth in underdeveloped nations is thus an emerging topic for empirical research in the literature on energy led economic growth.

- First of all, India is one of the nations with the highest rates of energy dependence. Indeed, with an energy consumption level of 872 million tonnes of oil equivalent in 2014, it ranked third in the world after China and the US in terms of energy consumption.

- Second, fossil fuels are taking a greater and greater share of the energy mix in India. For instance, a remarkable 36.59 percentage point growth in the proportion of fossil fuels in overall energy consumption from 37.05% in 1971 to 73.64% in 2012 can be noted.
- Thirdly, the phenomenal economic expansion that has increased the nation's prosperity and provided for its citizens on a social level has been intimately linked to this change in the mix of energy use.
- It should be mentioned that one third of India's overall energy demand is satisfied by imported fossil fuels when considering the country's current energy situation.

However, India's per-capita energy consumption remains to be much lower than that of affluent nations. As a result of recent programmes like Make in India, National Industrial Corridors, Digital India, and Startup India, as well as the desire for a better quality of life, it is anticipated that this trend would dramatically increase in the near future. Consequently, it is anticipated that the nation's dependency on energy imports would grow even more in the years to come. It is crucial to investigate the long-term and causative linkages between renewable and non-renewable energy consumption and economic growth in order to decide which type of energy use is more vital to maintain the pace of India's economic progress. The results of the Bayer and Hanck combination test and the autoregressive distributed lags (ARDL) bound testing technique to cointegration show that economic growth, non-renewable energy consumption, financial development, and trade openness all have long-run equilibrium relationships. This long-term connection shows that real GDP grows by 6.28% for every 10% rise in non-renewable energy consumption, but the elasticity of economic growth with regard to renewable energy consumption is determined to be statistically negligible. These results underline the significance of non-renewable energy sources in India's energy mix. Both renewable and non-renewable energy sources are important for economic growth, according to the short-term forecasts. The adoption of energy conservation laws may limit India's economic growth while also lowering demand for non-renewable energy because there is a feedback effect between the consumption of non-renewable energy and economic growth. This result shows that the Indian government should maintain its pursuit of non-renewable energy exploration strategies. We discover a one-way causal relationship between the consumption of renewable energy and short-term economic growth in this example.[3] [4]

A study looked at the effects of petroleum and natural gas consumption per person on economic growth and per-person carbon emissions among the major oil-producing nations in Africa between 1980 and 2015. For a comparison of the countries, the paper used the non-linear autoregressive distributed lag (NARDL) method (Algeria, Angola, Egypt, Gabon and Nigeria). In all save Algeria, the analysis finds evidence of an asymmetric relationship between per capita use of both petroleum and natural gas and economic development and carbon emissions. Results showed that different countries have significantly different effects on carbon emissions when using energy resources for economic expansion. The author advocates using rewards and sanctions to encourage adherence to environmental laws. [5]

Possible quantitative things we can include:

- Percentage change in natural gas consumption in India
- Percentage change in non-renewable energy consumption in India
- Percentage change in carbon emission per capita in India

A study done examined the numerous challenges the renewable sector faces, including institutional, financial and fiscal, market, technological, and environmental challenges. Based on the findings of the review, the author produced recommendations that give helpful data to decision-makers, innovators, project developers, etc. According to the author, the renewable energy industry faces significant challenges. Some of them are a natural part of every renewable technology, while others are the result of an unbalanced regulatory system and market. The author draws attention to the lack of thorough regulations and regulatory frameworks that hinder the adoption of renewable technology, the requirement for manufacturing renewable products, and unreliable grid connectivity. This makes it less appealing for investors to fund renewable energy technologies. Consumer confidence is reduced by inadequate facility care and maintenance as well as by the unreliability of technology. Communities should be encouraged to become aware of renewable energy sources. The document offered numerous recommendations aimed specifically at the government.[6]

II. SOLAR ENERGY

A paper examines advances in thermal solar electricity technology. The paper examined single axis tracking technologies - parabolic trough, linear fresnel electric technology, solar roof, etc - two axis tracking technologies - SG3, ANU Dish, Boeing SES Dish, Single tower - low temperature technologies - evacuated tubes and ORC turbines, solar chimneys. The paper also studied technological trends and incentives [7].A paper examined cultural constraints on renewable-energies particularly Wind and Solar energy. The paper talked about how the problem lay within policy risks and not policy goals. The paper highlighted certain costs that communities would have to bear, for example, wind energy presented at least 3 costs: noise and visual pollution, and concerns about avian mortality. Solar Energy also presented costs which were harder to address. [8]. A study done examined thermal solar energy systems in a more technical way. The paper talked about thermal diffusivity in stratified storage tanks, energy management, Advanced control strategies to maximize ROI, etc. [9].A group of scientists talked about India's speedy overall development followed by an introduction to renewable energy and how they could be used to overcome energy shortages. The paper examined different renewable sources — Wind, Hydro, Biomass, Solar. Although Wind Power has the largest installed renewable energy power generation capacity (in GW), the paper indicated that Solar energy has the highest potential in the country. The country has about 300 clear sunny days in a year and receives on average 4-7 Kwh of solar radiation per square meter per day. The paper further indulged in Wind Energy and Biomass & Biogas Energy. [10]. A research group began by introducing the significance of Solar Energy. The paper even indicated that theoretically a small fraction of the total incident solar energy, given that it is captured effectively, could meet the entire country's power requirements. The paper then talked about how Solar Energy has impacted lives: reduction in drudgery among rural women and girls to fetch fuel wood. The paper then talked about government initiatives such as the National Solar mission and other schemes such as the Solar park scheme, Bundling schemes, Defense Scheme, etc.[11].

III. DISCUSSION AND CONCLUSION

The above model receives electricity from different renewable and non-renewable energy sources. The electricity is first passed through a refractory heating element with high resistance, like tungsten or graphite, to generate heat; heat here is a byproduct of collisions of electrons within the resistor. A heat transfer fluid, like tin, then transfers the heat to the sand thermal energy storage system. Whenever electricity needs to be reproduced it is achieved by transferring the heat from the sand thermal energy storage system to a heat engine, like thermophotovoltaics, via the heat transfer fluid.

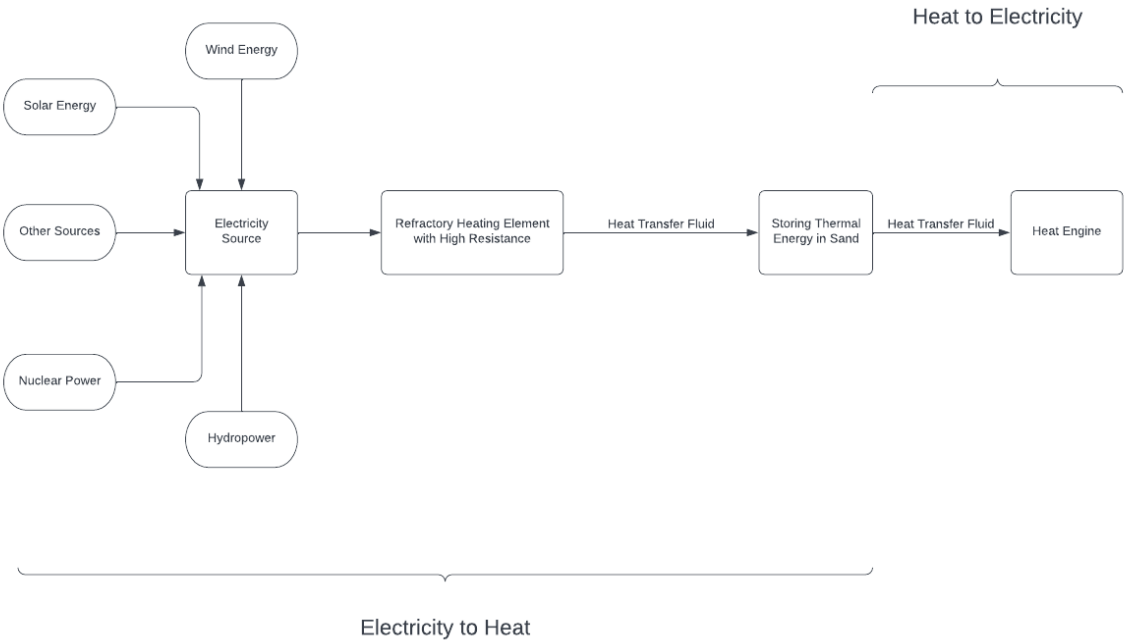

Figure 1

The model's efficiency can be improved by modifying the energy sources. For example, the heat created from nuclear power plants could be directly stored in the sand thermal energy storage system, and this would be a more efficient storage of energy because of the lack of conversion losses. The model is extremely cost effective not only because sand is readily available, but also because in large quantities the cost of an insulator would be minimal because sand itself would act as an insulator. The sand thermal energy storage system could be used to optimise compressed air storage systems and this would intern further grid scale storage.

REFERENCES

[1]. Pachar, S. (2020). Renewable & Non-Renewable Energy Sources in India: A Study on Future Prospects. ResearchGate, 8952–8958.
[2]. Pachar, S., Singh, R., & Wahid, M. A. (2021). Implication of Renewable Energy in Sustainable Development in India: Future Strategy. IOP Conf. Ser.: Mater. Sci. Eng., 1149(1), 012020. doi: 10.1088/1757-899X/1149/1/012020
[3]. Ohlan, R. (2016). Renewable and non-renewable energy consumption and economic growth in India. Energy Sources Part B, 11(11). doi: 10.1080/15567249.2016.1190801
[4]. Mahmoodi, M. and Mahmoodi E. (2011) Renewable Energy Consumption and Economic Growth: The Case of 7 Asian Developing Countries. American Journal of Scientific Research, 35:146–152
[5]. Awodumi, O. B., & Adewuyi, A. O. (2020). The role of non-renewable energy consumption in economic growth and carbon emission: Evidence from oil producing economies in Africa. Energy Strategy Reviews, 27, 100434. doi: 10.1016/j.esr.2019.100434
[6]. Shahbaz, M., Hye, Q. M. A., Tiwari, A. K., & Leitão, N. C. (2013). Economic growth, energy consumption, financial development, international trade and CO2 emissions in Indonesia. Renewable Sustainable Energy Rev., 25, 109–121. doi: 10.1016/j.rser.2013.04.009
[7]. Mills, D. (2004). Advances in solar thermal electricity technology. Sol. Energy, 76(1), 19–31. doi: 10.1016/S0038-092X(03)00102-
[8]. Simon, C. A. (2009). Cultural Constraints on Wind and Solar Energy in the U.S. Context. Comparative Technology Transfer and Society, 7(3), 251–269. doi: 10.1353/ctt.0.0046
[9]. Thermal Solar Energy Systems - an overview | ScienceDirect Topics. (2022, October 02). doi: 10.1016/B978-0-12-809597-3.00543-5
[10]. IJASEAT Current Status And The Future Potentials Of Renewable Energy In India - A Review. (2022, October 03). Retrieved from http://iraj.in/journal/IJASEAT/paper_detail.php?paper_id=2422&name=Current_Status_And_The_Future_Potentials_Of_Renewable_Energy_In_India_-_A_Review
[11]. Current Status | Ministry of New and Renewable Energy, Government of India. (2022, October 03). Retrieved from https://mnre.gov.in/solar/current-status