The Synergy of Clean Energy

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Abstract

The consumption of energy will help improve the quality of life through a positive impact on many socio-economic variables. Energy encompasses a wide array of forms from providing basic needs such as the burning of wood for cooking to powering essential well-being requirements like education, health, and communication.

However, energy system failure threatens economic development. Hospitals cannot function, vaccines cannot be stored, children cannot get quality education, businesses cannot operate, and workers lose income and risk sliding into poverty. But, this consumption of energy also entails some risks., if it's not clean energy.

Clean Energy is that energy that comes from renewable, zero emission sources that do not pollute the atmosphere when used, as well as energy saved by energy efficiency measures. Consumption of clean energy may contribute to improvements in several domains of development, from sustaining the environment to improving health.

The objective of this paper is to study the composition and significance of clean household energy and to identify the problems in accessing Clean Energy. The Government has made huge efforts to make clean energy available to the people, which is also highlighted in this paper. This study is based on secondary information

Keywords: *Clean Energy, Renewables, Consumption*

Introduction

Energy has become a strategic commodity which is the most indispensable factor for economic growth and human wellbeing. Energy is crucial for sustaining the industrial, transportation, agricultural and household operations that drive economic growth. A consistent energy supply that meets all necessary demands is essential for a country's economic success.

The consumption of energy will help improve the quality of life through a positive impact on many socio-economic variables. Energy can have a substantial positive impact on livelihood. Energy encompasses a wide array of forms from providing basic needs such as the burning of wood for cooking to powering essential well-being requirements like education, health, and communication.

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Energy system failure can imperil development on every front. Hospitals cannot function, vaccines cannot be stored, children cannot get quality education, businesses cannot operate, and workers lose income and risk sliding into poverty. But, this consumption of energy also entails some risks., if it's not clean energy.

Concept of Clean Energy

India has a diverse power sector ranging from conventional sources like coal, natural gas, oil, hydro and nuclear energy to unconventional sources including wind, solar and bio waste. Clean Energy is that energy that comes from renewable, zero emission sources that do not pollute the atmosphere when used, as well as energy saved by energy efficiency measures. Clean fuels as defined by W H O (2014) are electricity, liquefied Petroleum gas, natural gas, biogas and solar. Clean technologies are those fueled by clean fuels, as well as alcohol- fuel stoves. Consumption of clean energy may contribute to improvements in several domains of development, from sustaining the environment to improving health.

Ren Pengue (2022), macroscopically, the use of clean energy can reduce carbon emissions to support national and regional economic upgrading, improve employment, and maintain energy economic security, which plays a crucial role in boosting social well-being. Consuming renewable energy considerably improves wellbeing and quality of life on a micro level. Using clean energy can minimises drudgery, shortens labour hours, and improves the health of women. Regular use of clean cooking fuels helps lessen air pollution, which is good for health. Residents' overall contentment rises dramatically when air pollution levels decline. At the same time, domestic power use can enhance subjective well-being, reduce gender disparities, and improves education levels.

Review of Literature

Nexus between clean household energy and wellbeing:

Rosenthal, J.; Quinn, A.; Grieshop, A.P.; Pillarisetti, A.; Glass, R.I (2017), One of the United Nations' (UN) goals for transforming the world is "ensuring access to affordable, reliable, and sustainable modern energy for all." In order to advance society and improve people's well-being, clean energy is crucial. A significant share of the world's total final energy consumption is consumed by households. To achieve the global Sustainable Development Goals, it is crucial to develop and promote domestic clean cooking technology. This will improve residents' health and well-being (SDCs).

Dil Bahadur Rahuta, Akhter Alib, Khondoker Abdul Mottaleba, Jeetendra Prakash Aryala (2019), education emerges as the critical factor which influences the choice of fuel for cooking purposes. The results showed that educated households are more likely to use clean fuel for cooking, while households with a lower level of education are more likely to use dirty fuel. With education, individuals are aware of the harmful effects of dirty fuel and tend to avoid its use. Educated households are more likely to have higher incomes; hence, they can afford to purchase clean fuel.

Soumen Rej and Barnali Nag (2019), This study looked at the linkage between India's energy consumption and human development and attempted to uncover if the exponentially increasing energy consumption of India, driven by its bourgeoning population and rapid in- dustrialization, is a necessary prerequisite for human development and vice-versa, i.e., if human development causes an increase in energy consumption or if the causation is bidirectional. The study, investigated the causal relationship between energy consumption per capita and the human development index in India using data for the period from 1990 to 2016. The findings from this study are expected to provide insights for policy readiness in terms of possible energy requirements arising from improvements in the HDI

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In the effort to review the past studies, it was noted that some of the studies focused on the factors determining choice of clean cooking fuel. Most of the studies focused on the impact of energy consumption on human development in general and not the benefits of clean energy in particular. It was also noted that no significant study has dedicated to evaluate the synergy of clean energy. Furthermore, the review could not trace from literature focusing the significance of clean household energy usage in the Indian context. This study is an effort to address these gaps.

Objectives

1. To study the energy composition and significance of clean household energy in India
2. To analyse the status of clean energy consumption
3. To know the programs for Clean Energy
4. To identify the problems in accessing the Clean Energy and suggestions for policy making

Methodology

The study is based on secondary sources. The data included in this article is taken from the annual reports of the Ministry of Power, Government of India, Special reports by India Energy Outlook and Newsletter of Ministry of New and Renewable Energy, Government of India, Special reports by International Renewable Energy Agency and Reports of World Health Organisation.

Analysis

1. Composition of energy in India

With conventional energy sources including coal, natural gas, oil, hydropower, and nuclear power as well as unconventional ones like wind, solar, and bio-waste, India's energy sector is diversified. It comprises both renewables and nonrenewable. India is blessed with a variety of renewable energy sources, like biomass, solar, wind, geothermal and small hydropower. These renewables are the main source of clean energy.

Table 1 : Installed generation capacity (comparative of renewables and non-renewables) as on 2022:

Energy type	Installed generation capacity(MW)	% Share in total
Non-renewables		
Coal	204,080	50.3%
Lignite	6.620	1.6%
Gas	24,856	6.1%
Diesel	0.510	0.1%
Total Non-Renewables	2,36,065	58.2%
Renewables		

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Energy type	Installed generation capacity(MW)	% Share in total
Hydro	46850	11.5%
Wind	41205	10.2%
Solar	59303	14.6%
Waste to Energy & others	10211	3.9%
Nuclear	6780	1.7%
Total renewables	169708	41.8%

Power at a Glance, Ministry of Power, India

The share of non-renewables is 58.2% and renewables is 41.8% in the total installed generation capacity of energy. Moreover, the share of Coal, a polluting fuel, is 50.3 % of the total energy share, which is alarming.

A comparison of growth trends of non-renewables to non- renewables shows an equal increasing ratio. The total energy supply from 2014 to 2019 showed an increasing trend with 20% growth. The percentage of energy supplied from renewables increased from 7432326 TJ to 8856378, in terms of growth and it is just 19.2%. This needs to be improved to increase the access to clean energy in the future.

Table 2 : Growth of renewables in the total energy composition in India from 2014-2019:

Total Energy Supply (TES)	2014	2019	Growth in TES
Non-Renewable (TJ)	26245320	31716684	20.8%
Renewable (TJ)	7432326	8856378	19.2%
Total (TJ)	33677646	40573062	20%

Source: IRENA, Energy Profile 2022

* TES= Total Energy Supply ** TJ= Terajoule

The Significance of Clean Household Energy

Households relying on electricity, biogas, solar, alcohol fuels, natural gas, and liquefied petroleum gas (LPG) for household cooking and other activities are considered to be clean energy households. This consumption of clean energy impacts household welfare, human health and economic development through a vast range of channels and mechanisms. Availability of electricity and other clean energy sources means the opportunity to purchase electric appliances, such as lights, refrigerator, TV, heating and cooling appliances, improved stoves, other kitchen equipment and electric machinery for household activities and for small business. These electronic appliances increase the comforts of life and energy services reduce the time spent by women and children, especially girls, on basic survival activities such as gathering firewood, hauling water and cooking so that more time can be devoted to income generating activities and study purposes.

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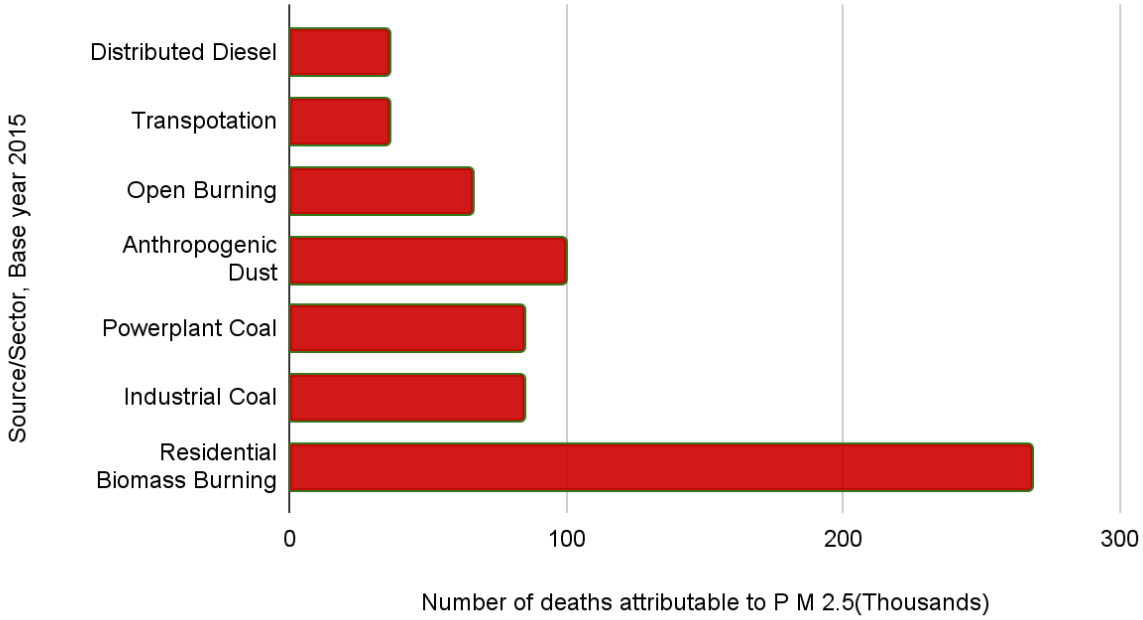
Availability of clean energy facilitates economic growth by enabling the establishment of micro enterprises and locally owned businesses that create employment, enabling livelihood activities beyond daylight hours as well as by helping to bridge the digital divide by supporting telecommunications.

Switching to clean cooking using modern stoves and fuels transforms lives by improving health. The World Health Organisation estimates that the use of traditional cooking methods, through wood and biomass combustion, has severe consequences on the health of households, due to indoor air pollution. The recent Global Burden Disease study estimates that almost four million people die every year from indoor air pollution due to the use of polluting fuels. The premature death of around 8 lakh Indians every year are attributable to household air pollution, much of which is caused by the traditional use of biomass for cooking. The damaging health effects are felt proportionately by women and children and the time and effort involved in collecting biomass impose an additional cost that is again overwhelmingly borne by women. Transition to clean energy removes all these negative health impacts.

Fig. 1. Number of deaths attributable to each major source of air pollution in India 2015



Source: Health Effects Institute Special Report 2021 GBD India

As per the special report of Health Effects Institute Residential Biomass fuel burning is the major contributor to pollution and deaths in India. Indoor air pollution contributed to 268000 deaths in 2015, coal combustion from both thermal electric power plants and industry contributed to 169000 deaths, anthropogenic dusts caused 1 lakh deaths, agricultural burning caused 66000 and transport diesel contributed to over 65 thousand deaths in India in 2015. India: Health of the Nation's States, 2017 report identified household air pollution and ambient air pollution as the second most serious risk factor for public health in India, contributing to 6.4 % of all healthy years of life lost in 2016 and also heart disease, stroke, pneumonia, chronic obstructive pulmonary disease, and cancers were caused by household air pollution with the largest burden falling on women, children and low income households.

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Status of Clean Energy Consumption in India

The global quest is to achieve universal access to affordable, reliable, sustainable clean energy by 2030. Accordingly, globally, the number of people without access to clean cooking fell in recent years. This decline reflects efforts to reduce the reliance of vulnerable populations on biomass, with the aim of improving indoor air quality, reducing the amount of time spent gathering fuel, and curbing deforestation and emissions from the incomplete combustion of biomass.

Table 3 : Sector Wise consumption of renewable energy in India

Consumption by sector	2014	2019
Industry (TJ)	2082508	2965542
Transport (TJ)	9165	12405
Households (TJ)	4337288	4357745
Other (TJ)	262536	369807

Source: IRENA, India Asia RE SP 2022

The share of renewable energy in the total energy consumed is shown in the table. The industry sector accounted for the highest share of renewable energy consumption across India followed by the domestic sector. The industry demand for energy in 2019 stood at 2965542 TJ and household consumption of energy is 4357745 TJ. Out of the total energy consumed by the household sector, 57% is from renewable, clean sources as per the available reports.

Percentage of Population Having Access to Clean Energy In India

Year	Access to clean energy(% of Population)	Access to clean cooking(% of population)	Renewable energy(% TFEC)
2014	81	50	26
2015	83	52	28
2016	84	54	29
2017	88	57	30
2018	92	60	31
2019	95	65	32
2020	99	68	33

Source: India-Asia-RE-SP, IRENA special report 2022, Energy Profile

Universal access to modern energy services, in terms of access to electricity and to modern cooking facilities, has been recognized as a fundamental challenge for development. India has made tremendous progress in providing access to electricity, clean cooking and generating renewables. As per the data, from

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2014-2020, 99% of the population has access to electricity, 68% of the population has access to clean cooking and 33% of the total final energy consumed (TFEC) is from renewables.

Programs for Clean Energy

Government has made huge efforts to expand the availability of clean cooking energy through the Pradhan Mantri Ujjwala Yojana scheme (PMUY) and Pratyaksh Hastantarit Labh (PAHAL). This scheme aims to safeguard the health of women and children by providing them with a clean cooking fuel LPG. The release of 8 crore LPG connections under the scheme has helped in increasing the LPG coverage from 62 % in 2016 to 99.8% in 2021.

To provide uninterrupted clean energy to all homes, the government is focusing on renewable energy production. India is now at fourth Global Position for overall installed renewable energy capacity. Renewable energy installed capacity increased 286% in the last 7.5 years. Renewable energy has a share of 26.53 % in the total installed generation capacity in the country.

The National Solar Mission launched in 2010, with a target of developing solar power to 100 GW. Roof-top Solar Energy, PM KUSUM, Solar City, Solar Park, Green Energy Corridors, Renewable Energy Obligation (RPO) and AJAY are some other schemes. With all these solar schemes, capacity increased in the last 7.5 years from around 2.6 GW to more than 46 GW. India also achieved a record low solar tariff of rupees 1.99 / unit. Government initiated Integrated Power development scheme IPDS, Deen Dayal Upadhyay gram Jyoti Yojana for improving transmission, distribution and uninterrupted supply of power.

The Ministry of New and Renewable Energy along with the National Institute of Wind Energy (NIWE) has initiated India's Offshore Wind Policy. India's wind energy sector is led by indigenous wind power industry and has shown consistent progress. The country currently has the fourth highest wind installed capacity in the world with total installed capacity of 39.25 GW (as on 31st March 2021) and has generated around 60.149 Billion Units during 2020-21. Among all renewables, wind energy contributes 40.8% as per MNRE report 2021.

Problems in Accessing Clean Energy:

As per The Energy Progress Report 2022, 733 million people in the world are without access to electricity and 2.4 billion people are without access to clean cooking. The share of total final energy consumption from renewables is just 17.7 %.

According to the World Bank Report 2022, the number of people without access to electricity in India is 14 million and the country ranks in the top 20 access deficit countries. 60 million India remain without access to modern clean cooking fuels or technologies as per records of India energy Outlook 2021.

Despite the domestic sector representing roughly one-quarter of India's electricity consumption, around 2.4 percent of Indian households have no access to electricity, according to a survey conducted in 2020, many people use traditional fuels such as wood or agricultural residues for cooking and heating purposes. Nevertheless, burning these fuels releases several air pollutants such as nitrogen oxides, carbon monoxide, and particulate matter, which are detrimental to the environment and public health. (* Statista 2022)

Lack of technical knowledge and awareness in the population about clean energy technology is a major barrier to adoption. Householders fear that LPG cylinders might explode and that electric stoves might cause fire are deterrents to adoption of clean energy according to WHO reports. The lack of address proof, initial investment cost, lack of awareness are also the barriers. The rural poor may not accept electricity as the primary energy source because of the lack of affordability and reliability.

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The necessity to buy LPG in bulk is the major challenge because despite government subsidies other fuels are more affordable and also available in smaller quantities which suits most households with less income.

Households, sometimes may not accept electricity as the primary energy source because of the lack of affordability and reliability. Affordability and reliability are the key concerns for Indian consumers. Unreliable power is a major problem. Urban households receive about 22 hours of electricity a day on average and rural households receive about 20 hours. In rural areas 53% of household's experience multiple power cuts in a day compared with 30% of their urban counterparts. Hence households that collect solid fuels themselves are less likely to switch to cleaner fuels. (World Energy Outlook 2021)

Suggestions

1. Enhancing international cooperation is necessary in the production of renewable energy. Collaboration with and learning from other nations are necessary, but India-centric innovation and particular goals for the spread of clean energy should be promoted instead.
2. Need to ramp up finance for investment in Clean Energy research and development.
3. It's also a good idea to use private sector investment and public-private partnerships.
4. With low cost funding, the government can encourage the production and purchase of electricity from locally available renewable energy sources.
5. Increasing capability for certain skill requirements with more vigor
6. Setting up of Technology platforms led by industry for Clean Energy Technologies

Conclusion

Clean energy provides enormous benefits and has the potential to provide solutions to the problems of polluting energy sources and ensure a more sustainable future. India is increasingly adopting Clean Energy techniques and taking positive steps towards zero carbon emissions. To maximise the advantages of clean energy, it is necessary to hasten the transition to and adoption of clean energy as well as to encourage more people to do so. In order to increase the personal willingness of residents to use clean energy, greater consideration should be given to both the physical and psychological experiences of consumers during the promotion of clean energy. In order to preserve gender equality, the government should make greater measures to safeguard the rights and interests of female users and free them as quickly as possible from the harms of traditional energy. Still there is a long way to go to boost the efforts for further development and promotion of clean energy sources in the context of sustainability.

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