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Impact of Solar Energy in Environment and Economic Development

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Abstract

The present study examines the role of solar energy in influencing economic well-being. The world at present is entangled with the hostile environmental changes and climate conditions that pose great threat to the wellbeing of future mankind. In addition, the diminishing resources that are the vital part of today's economy and businesses, all around the world, also found a major threat to long term sustainability. The contribution of energy in developing a country's economy is known to play a crucial part in economic development either straightforwardly or as a complement to different variables of production. In compliance, the role of solar energy are debated for being the beatification that endures the ability to fulfil economic needs and at the same time exert minimal or no damage to the environment. At the same time, growing concerns over climate change are prompting governments worldwide to seek ways to supply energy while minimizing greenhouse gas emissions and other environmental impacts. Decisions made today on energy sector investments and infrastructure lock in associated costs and benefits for at least a few decades. They also strongly influence how effectively the solar energy sector supports growth across the economy.

Keywords: Renewable Energy, Solar Energy Products, Solar Energy Deployment, Economic Well-being, Environmental Impact.

I. INTRODUCTION

The correlation between economic growth and solar energy consumption has constituted a considerable field of research. Particularly, examining the significance of connection direction between the two variables is of high significance, since it may provide valuable insights for policy-makers. Keeping in mind the rising environmental deterioration and adverse climate effects, the extensive energy dependent economies are considered as the most potential victim of the deteriorating atmosphere and thus lead the risk of futuristic economic setbacks.

Nowadays, multiple challenges in relation to energy exist, but in particular two hot issues drive energy discussions. First, fossil fuels are a finite resource. Although there are still large supplies of coal, oil and natural gas, given the increasing demand and limited supply it is inevitable that one day supplies will run out. Thus, it is important to search for alternative energy sources. Second, is the issue of climate change? The prevailing threat of global warming and climate change has brought the attention on the relationship between economic

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growth, energy consumption and environmental pollution to a new level.

II. OBJECTIVES OF THE STUDY

a) To capture and measure the effects of solar energy utilization on the basis of a holistic macroeconomic framework. It provides quantitative evidence of the macroeconomic impacts of solar deployment at a global level.
b) The study brings the insights to the existing facts on the socio-economic benefits of solar energy positioning at the national level.
c) To protect the environment from CO2 emissions.

III. SIGNIFICANCE OF THE STUDY

The production of solar energy is a topic of great importance nowadays. The solar energy landscape of the twenty-first century is dominated by values necessitating critically low carbon emissions and efficient utilization of solar energy sources. Therefore, in order to support the transition to the solar energy era a myriad of policies is drafted and implemented.

Solar energy is now becoming more and more popular due to several reasons. It is an alternative to the traditional energy wherein the bi-product of the traditional energy will cause pollution to the environment. But renewable energy is not contributing to pollution. Hence it is called green energy. The most popular renewable energy is solar energy.

IV. GROWTH OF SOLAR ENERGY IN INDIA

India's government has begun to acknowledge the importance of solar energy to the country's economic growth. Prime Minister Manmohan Singh, who has said solar energy will transform rural India, launched a National Solar Mission (NSM) in 2010. Initial growth has been dramatic, albeit from a tiny base. From less than 12 MW in 2009, solar-power generation in the country grew to 190 MW in 2011. On March 1st, 2014, the then Chief Minister of Gujarat, Narendra Modi, inaugurated at Diken in Neemuch district of Madhya Pradesh, India's biggest solar power plant. By March 2013, it is expected to grow fivefold to 1,000 MW, but the country has a long way to go to reach its goal of increasing solar-power generation to 20 gigawatts by 2020. Across India, there are still thousands of villages with plenty of sun but not enough power [1].

Table 1: Electricity Generation from the Solar Resources

Countries	Electricity Generation from Solar Resources (bkwt)	Countries	Electricity Generation from Solar Resources (bkwt)
China	800	India	160
United States	527	Germany	126
Brazil	459	Norway	121
Canada	398	Japan	116
Russia	168	Spain	87

Source: International Energy Agency, 2015 [2].

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Table 1 depicts that the consumption of solar energy for electricity generation by various countries and also indicates the position of India.

A. PRESENT STATUS AND INSTALLED CAPACITY OF SOLAR ENERGY IN INDIA

Solar power has so far played an almost non-existent role in the Indian energy mix. The grid-connected capacity (all PV) in India now stands at 481.48 MW as of 31st January 2012. However, the market is set to grow significantly in the next ten years, driven mainly by rising power demand and prices for fossil fuels, the ambitious National Solar Mission (NSM), various state level initiatives, renewable energy quotas including solar energy quotas for utilities as well as by falling international technology costs. Encouraging the spread of solar power generation (both CSP and PV) and aiming for grid-parity (currently at around RS.5/kWh) by 2022 and parity with coal power generation (currently at around RS.4/kWh) by 2030, is a key element in India's comprehensive, long term energy supply strategy. Keeping in view the solar annual insolation, solar power could therefore easily address India's long-term power requirements. However, it has to be cost-competitive. As of December 2011, solar power generation in India costs around RS.10/kWh, or over 2.5 times as much as power from coal [3]. Importantly, it is crucial that the industry receives the right policy support to ensure that projects are executed and performed up to the mark.

B. ASSESSING ECONOMIC IMPACTS OF INCREASED SOLAR ENERGY DEPLOYMENT

The solar energy sector donates to economic activity in two ways. Firstly, solar energy is an important economic sector that creates jobs and value by extracting, transforming and distributing energy goods and services throughout the economy (World Economic Forum, 2012). Secondly, the solar energy sector's impact flows through the rest of the economy. Solar energy is an input to nearly every product and service in the economy and strengthens the economic activity across each of its sectors. Faced with the identical challenges of sluggish economic growth and the mounting imperative to decarbonize economies, countries are looking for solutions to improve their economic performance while minimizing further greenhouse gas emissions. Given this context, solar energy is emerging not only as a solution to meet growing energy demand while sharply reducing carbon emissions but also as a potential engine for economic growth and diversification [4].

This resonates strongly with the objective of green growth, which is probably the only way to satisfy the needs of a growing population and drive development and well-being, while reducing greenhouse gas emissions and increasing solar resource productivity. Advancements in technology and growing cost competitiveness has meant that renewables now over governments the option to pursue such a vision for the energy sector and reduce the traditional trade of between economic growth and environmental conservation. The implicit relationship between the solar energy sector and the economy raises questions on the economy-wide impacts of the ongoing energy sector transformation. However, analytical work and empirical evidence on this important subject remains relatively limited, especially at the global level.

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V. SOCIO-ECONOMIC BENEFITS OF SOLAR ENERGY

The following are the socio-economic benefits of solar energy [5]:

A. SOLAR CONTROLS ENERGY COSTS

(*i*). Solar can mean lower utility bills

Local utility ratesare probably higher. Unfortunately, saving money by turning off the lights and easing back the AC may only go so far. When we choose to install a home solar system and a battery, we can better control our average electricity costs over a year. Households with the highest electricity rates from their local utilities are the ones who stand to save the most when they convert to power from the sun.

(*ii*). Say goodbye to unit rates

For states with unit rates going solar with a home battery allow us to run our solar appliances according to our convenience. With solar and a home battery, we are in control. Excess energy is stored in our home battery and we can use it when we need it the most.

(*iii*). Net Energy Metering (NEM) can work

Net Energy Metering allows customers who generate their own electricity from solar panels to sell the excess electricity generated back to the grid. However, not all states have NEM policies, and these policies vary by state. A reputable solar company can explain the NEM in our location.

(*iv*). Federal and state incentives are available for going solar

Currently, deduct 30% of the cost of our purchased home solar system from our federal income taxes. Many state and local governments that offer property and sales tax exemptions too. Cash rebates can also help us reduce our costs by about 10% to 20%.

(*v*). Home value may increase with the purchase of a home solar system

Another reason to go solar is an increase in the value of home. This makes solar a safe and wise investment. The right size purchased solar installation may increase home value.

B. SOLAR SAVES LIVES

(*i*). Renewable energy helps others in times of need

We need energy to live our daily lives, but we also need energy to help those less fortunate. People all over the world are using solar energy to push through power outages caused by storms and other natural disasters that can lead to loss of life and property. Events like floods, wildfires, hurricanes, rising sea levels and hunger related to environmental damage have caused devastation around the world. The costs associated with climate change are growing and include rising health care costs, destruction of property, increased food prices and more. Wide scale adoption of solar and other renewable energy must continue so we can address the negative societal and economic impacts of dirty fossil fuels.

(*ii*). Solar energy means healthier air

We all need clean air for survival. But ground-level ozone and other pollutants from cars, power plants, industrial boilers, refineries and chemical plants can kill. The damage extends to crops, trees and other vegetation and the toll on human life is significant. Pollution is so bad in some parts of the world that people are instructed to stay indoors. The Environmental Defense Fund (EDF) states that pollution is responsible for the deaths of 6.4 million people per year. In contrast, solar energy supports a planet that is clean and green. By eliminating harmful toxic emissions from fossil fuels, solar lets us breathe easier and provide healthy air

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for future generations.

(*iii*). Solar creates jobs and supports families

When our community is gainfully employed, everybody benefits. The solar workforce increased 168% in the past seven years. In 2010, the industry hired 93,000 people. In 2018, the number of solar jobs increased to over 2, 42,000, and further growth is expected. These solar jobs cannot be outsourced so they are a significant contributor to our economy.

C. SOLAR SAVES ON GAS AND FUEL

(*i*). Price of sunlight is zero

The sun is a renewable resource. Unlike fossil fuels, sunlight is never going away. We can count on it every day. Coal and natural gas are not free, and they are expensive and dirty. Their price is volatile too and has increased systematically over the past decade. But there is no fuel cost for sunlight. With Sun run's residential solar, we will know our annual energy expenses for at least the next two decades.

(*ii*). Solar reduces dangerous greenhouse gases from cars

The Environmental Protection Agency (EPA) reported that new motor vehicles contribute significantly to greenhouse gases, which endanger our public health and welfare. The good news is that an electric vehicle can be powered by our residential solar system. We can use clean power from the sun to fuel our car, and run our home. The switch from fossil fuels to solar energy contributes to healthy communities and a healthy planet.

VI. GOVERNMENT SUPPORT TO SOLAR ENERGY

The government of India is promoting the use of solar energy through various strategies. In the budget proposal for 2010-11, the government has announced an allocation of Rs.10 billion towards the Jawaharlal Nehru National Solar Mission (JNNSM) and the establishment of a Clean Energy Fund. It's an increase of Rs.3.8 billion from the previous budget. Also budget has also encouraged private solar companies by reducing customs duty on solar panels by 5 percent and exempting excise duty on solar photovoltaic panels. This is expected to reduce the roof-top solar panel installation by 15- 20 percent [6].

VII. ACHIEVEMENTS IN THE SOLAR ENERGY SECTOR

- Solar capacity has increased by eight times between FY14-18. India added record 11,788 MW of renewable energy capacity in 2017-18.
- A total of 47 solar parks with generation capacity of 26,694 MW have been approved in India up to November 2018, out of capacity of 4,195 MW has been commissioned.
- Power generation from renewable energy sources (excluding large hydro) in India reached record 101.84 billion units in FY18 and have reached 107.22 billion units between April 2018 - January 2019.

VIII. FUTURE GROWTH OF SOLAR POWER IN INDIA

In solar energy sector of India, so many projects have been proposed as mentioned below[7].

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- Thar Desert has some of India's best solar power projects, estimated to generate 700 to 2,100 GW.
- The Jawaharlal Nehru National Solar Mission (JNNSM) launched by the Centre is targeting 20,000 MW of solar energy power by 2022.
- Gujarat's pioneering solar power policy aims at 1,000 MW of solar energy generation.
- In July 2009, Rs.19 billion solar power plan was unveiled, which projected to produce 20 GW of solar power by 2020.
- About 66 MW is installed for various applications in the rural area, amounting to be used in solar lanterns, street lighting systems and solar water pumps, etc.
- In July 2019 Union finance minister Nirmala Sitharaman said the government will use the approach of Mission LED bulb to promote the use of solar stoves and battery chargers in the country and Rs 30 billion for solar power (both grid and off grid).
- Sitharaman said the government will support private entrepreneurship to encourage farmers to produce energy from solar installations in fields.

Considering all these facts, we do have a bright picture in front of us as India's potential to be a solar power driven country of the world.

IX. RESULTS ANALYSIS

The effective adoption of solar energy is an indispensable solution to protect the earth from environmental pollutions (CO2 emissions). Simultaneously to enhance the economic condition by reducing the import of non-renewable energy resources like crude oil, petroleum, diesel, and so on.

Table 2: Top 10 States of India in Solar Installation (Capacity in MW as on 31.03.2019)

S. No.	Name of the State	Solar Capacity in MW
1	Karnataka	6095.55
2	Telungana	3592.09
3	Rajasthan	3226.76
4	Andhra Pradesh	3085.68
5	Tamil Nadu	2575.22
6	Gujarat	2440.13
7	Madhya Pradesh	1840.16
8	Maharashtra	1633.54
9	Uttar Pradesh	960.10
10	Punjab	905.62

Source: Annual Report 2019, The Renewable Energy Resolution [8].

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Table 3: The World's Top 15 CO2 Emissions and Generating Countries

Rank	Name of the country	CO2 Emission in 2017 (Mt)	% of Global Emission
1	China	9,839	27.2%
2	United States	5,269	14.6%
3	India	2,467	6.8%
4	Russia	1,693	4.7%
5	Japan	1,205	3.3%
6	Germany	799	2.2%
7	Iran	672	1.9%
8	South Arabia	635	1.8%
9	South Korea	616	1.7%
10	Canada	573	1.6%
11	Mexico	490	1.4%
12	Indonesia	487	1.3%
13	Brazil	476	1.3%
14	South Africa	456	1.3%
15	Turkey	448	1.2%

Source: World Economic Forum – Agenda 2017 [9].

Table 2 exhibit the position of top 10 states in the generation of solar power installation. Generation of electricity from solar energy and its consumption is very much high, when compare to 33 states.

Table 3 indicates the position of our country in CO2 emissions. Heavy utilization of solar power is an alternative way to go back from the current position.

X. CONCLUSION

This current paper investigates the role of solar energy consumption in effecting economic well-being of India by using the annual data over the time from 1993 to 2018. The study uses solar energy consumption (% of solar energy consumption to total energy consumption) and economic growth as a proxy of economic well-being to inspect the long-run connection among solar energy consumption and economic well-being. The positive impacts of doubling the share of solar energy by 2030 on economic growth, welfare, employment and international trade. Solar Power Generation (SEG) alone can cater more than 60-65% of our entire need of power. Investors are keen enough toward this sector in our country thereby contributing to the development of economy via three fold return (i.e. economically, socially & environmentally). The step of Indian government to increases the target is a very good to become India as one of the most solar powered countries in the world. Such types of steps will be required in the future.

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