International Journal of Education, Modern Management, Applied Science & Social Science (IJEMMASSS)
ISSN :2581-9925(Online), Impact Factor: 7.555, Volume 07, No. 04(III), October - December, 2025, pp. 01-07

Government Budget Allocation and Solar Installed Capacity Growth: An Economic Analysis

Aman Bansal[1*] | Dr. G.L. Meena[2]

[1]Assistant Professor, Department of Economics, Government College Kaman, Deeg, Rajasthan, India.
[2]Assistant Professor, Department of Economics, University of Rajasthan, Jaipur, Rajasthan, India.

[*]Corresponding Author: ab.kherli@gmail.com

Citation: Bansal, A., & Meena, G.L. (2025). Government Budget Allocation and Solar Installed Capacity Growth: An Economic Analysis. International Journal of Education, Modern Management, Applied Science & Social Science, 07(04(III)), 1–7.

ABSTRACT

The expansion of solar energy has become a strategic priority for governments in order to achieve sustainable economic growth along with energy security, and environmental protection. Solar power adoption in many developing economies is heavily influenced by public policy support, particularly government budgetary allocations. From an economic perspective, budgetary support has crucial role in addressing market failures, reducing investment risks, and stimulating private sector participation in renewable energy projects. This study examines the relationship between government budget allocation for solar power and the growth of installed solar capacity with a specific focus, whether increased public expenditure leads to expansion in solar energy installed capacity. Using secondary data sourced from Union Budget documents, Ministry of New and Renewable Energy (MNRE) annual reports, and official installed capacity statistics, the study analyses trends in public spending on solar energy and corresponding capacity additions over time. The analysis employs descriptive statistics, trend analysis, and simple econometric techniques to assess the direction and strength of the relationship between budget allocation and solar installed capacity growth. The findings indicate a positive association between government budgetary support and the expansion of solar capacity, suggesting that public expenditure has been an effective policy instrument in promoting solar energy deployment. The study concludes that while budgetary allocations impose fiscal costs in the short run, their long-term economic, environmental, and developmental benefits justify continued and well-targeted government support.

***Keywords**: Solar Power, Government Budgetary Allocations, Market Failures, Installed Capacity, Public Expenditure.*

Introduction

Energy is a key driver of economic growth and structural transformation. A reliable and affordable energy supply supports industrial production, agricultural productivity, service sector expansion, and overall improvements in living standards. Historically, economic development has been closely linked with the use of traditional fossil fuel energy based sources importantly coal, oil, petroleum, and natural gas. While these sources have contributed significantly to economic growth, their extensive use has also resulted in adverse environmental impacts, such as air pollution, greenhouse gas mainly CO_2 emissions, and climate change. These challenges have motivated governments worldwide to reconsider their energy strategies and promote cleaner and more sustainable alternatives.

Solar energy has emerged as one of the most promising renewable energy sources because of its abundance, renewability, and declining cost of generation. Advances in photovoltaic technology, economies of scale, and competitive procurement mechanisms have significantly reduced the cost of solar power over the past decade. From an economic standpoint, solar energy offers several advantages,

including lower reliance on imported fuels, enhanced energy security, job creation, and positive environmental externalities. Despite these benefits, the increased adoption of solar energy has not been driven solely by market forces, particularly in developing economies.

Government budget allocation represents one of the most important fiscal instruments used to support solar energy development. Governments provide direct budgetary support to finance capital subsidies, viability gap funding, research and development, grid infrastructure, and various incentive schemes aimed at reducing the cost of solar power generation. From the policy perspective of public finance and energy economics, such budgetary allocations are intended to crowd in private investment, accelerate capacity addition, and facilitate the transition to a low-carbon economy.

In the Indian context, solar energy has received increasing policy attention due to rising energy demand and commitments to climate change mitigation. The government has allocated substantial budgetary resources to the solar sector under initiatives such as the National Solar Mission, PM-KUSUM and various MNRE-supported schemes. Consequently, India has witnessed a rapid increase in installed solar capacity over the past decade. However, the extent to which government budget allocation has directly influenced this growth remains an important empirical question.

While a growing body of literature examines renewable energy policies and subsidy mechanisms, relatively few studies focus specifically on the relationship between government budget allocation and solar installed capacity growth. This study aims to analyse the relationship between government budget allocation for solar power and the growth of installed solar capacity. The study seeks to examine trends in public expenditure on solar energy and assess the impact of budgetary support on capacity expansion.

Review of Literature

Several studies indicate that feed-in tariffs and capital subsidies significantly increase renewable energy investments. Research in developing countries shows that subsidies reduce investment risks and encourage private sector participation. Reports on India's Union Budgets in recent years show that solar energy received enhanced fiscal priority, with substantial increases in budget allocations for flagship schemes such as PM Surya Ghar Muft Bijli Yojana and PM-KUSUM, alongside grid-connected solar project support. These allocations aimed to reduce the cost barriers faced by households and agricultural users while promoting utility-scale investment, resulting in accelerated capacity addition and broader distribution of solar installations across socio-economic segments(Palit, 2025).Additionally, analysis by the Center on Global Energy Policy confirm that budget doubling for grid-connected solar and expanded support for agricultural solar under PM-KUSUM have strengthened sector growth by enhancing financial viability and investor confidence(Shastry et.al., 2024).

Despite these positive findings, the literature also highlights challenges. Studies on Indian subsidy programs have pointed to issues such as funding delays, regional disparities in uptake, and implementation inefficiencies, suggesting that the mere presence of subsidies does not guarantee uniform capacity growth without effective execution and monitoring. (John et.al., 2024). Other studies highlight concerns regarding fiscal burden and inefficiency in subsidy allocation.

Overall, existing literature supports the positive role of subsidies but emphasizes the need for well-designed and targeted policies. However, limited studies focus specifically on the economic linkage between budgetary allocation and solar installed capacity growth in India, which this study aims to address.

Theoretical Framework

The economic justification for government budget allocations towards promoting solar energy is majorly based on the theories of market failure and externalities. Solar energy generates positive externalities such as reduced pollution and improved public health. Private markets tend to underinvest in such technologies, justifying government intervention. An important reason of market failure in solar energy is the existence of positive externalities. Solar power generation reduces greenhouse gas emissions, air pollution, and dependence on traditional energy sources. In addition to environmental externalities, solar energy contributes to public health improvements by reducing air pollutants such as particulate matter and sulphur dioxide, which are associated with respiratory and cardiovascular diseases. These environmental and health benefits accrue to society at large rather than solely to the producer or consumer of solar energy. Since private investors are unable to capture these social-benefits

in the form of market revenues, private markets tend to supply less solar energy than is socially desirable.

Another key aspect of market failure in solar energy development is the high upfront capital cost associated with solar power projects. Solar installations require significant initial investment, while returns are realised over a long period. Financial markets in developing economies often fail to provide low cost and long-term financing for such projects. Since, solar energy industries exhibits characteristics of an infant industry, it often face higher production costs and limited market access in the early stages. Without temporary government support, such industries may fail to achieve economies of scale and technological learning that would allow them to compete with established fossil fuel-based energy sources.

Thus, government intervention through budgetary allocation, subsidies, and policy support becomes economically justified. By providing financial incentives and reducing investment risks, government intervention helps bridge the gap between private and social returns, thereby promoting efficient resource allocation and accelerating solar installed capacity growth.

- **Conceptual Link:** The conceptual framework of this study explains the economic mechanism through which government budget allocation for solar power influences solar installed capacity growth and generates broader economic and environmental benefits. The framework establishes a sequential link between public expenditure, market incentives, investment behaviour, and long-term development outcomes.

Government Budget Allocation for Solar Power → Government Subsidies → Reduced Cost of Solar Power → Increased Adoption and Installed Capacity Growth → Economic & Environmental Benefits

This conceptual framework demonstrates how government budget allocation acts as a catalyst for solar energy development by initiating a chain of economic effects that ultimately result in capacity growth and broader societal benefits. The framework provides a clear analytical structure for examining the relationship between public expenditure and solar installed capacity growth, and it guides the empirical analysis conducted in this study.

Policy Background

The Government of India allocates budgetary resources to promote solar energy growth, which then trickles down through several policy and financial mechanisms. These measures are primarily implemented through the Ministry of New and Renewable Energy (MNRE) and supported by budgetary allocations under various national programs. These mechanisms include capital subsidies, feed-in tariffs, tax incentives, and viability gap funding, which collectively reduce investment costs and encourage capacity expansion.

- **Capital Subsidies:** Capital subsidies provide upfront financial support to reduce the initial investment cost of solar power installations, particularly for rooftop and small-scale solar projects. These subsidies are especially important for households, small businesses, and institutional users who may face financial constraints or limited access to credit. By lowering the capital cost, capital subsidies shorten the payback period and increase attractiveness of solar installations.
- **Feed-in Tariffs (FiTs):** Feed-in tariffs offer guaranteed prices for electricity produced from solar power over a fixed period. Under this mechanism, solar power producers are assured a stable and predictable revenue stream, reducing market and price risks. Feed-in tariffs were particularly important during the early stages of India's solar sector development when solar power costs were high and market confidence was low.
- **Viability Gap Funding (VGF):** Viability Gap Funding is designed to support large-scale solar projects that are economically desirable but financially unviable under prevailing market conditions. Under the VGF mechanism, the government provides financial support to bridge the gap between project costs and expected revenues. VGF has been widely used in solar parks and large grid-connected projects.
- **National Solar Mission:** The National Solar Mission (NSM) is the cornerstone of India's solar energy policy. Launched as part of the National Action Plan on Climate Change, the mission aims to achieve large-scale solar deployment, reduce the cost of solar power, and promote

domestic manufacturing. The mission emphasizes a phased approach, combining policy support, fiscal incentives, and regulatory reforms to scale up solar capacity. A key objective of the NSM is to minimise dependence on fossil fuels, and act as a contributor to India's climate commitments.

- **PM-KUSUM Scheme:** The Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM) scheme emphasizes on integrating solar energy into the agriculture. This scheme promotes the installation of solar-powered irrigation pumps, decentralised ground-mounted solar plants, and grid-connected solar pumps. PM-KUSUM aims to reduce farmers' dependence on diesel and grid electricity, lower energy subsidies, and provide an additional source of income to farmers through surplus power generation. From an economic perspective, the scheme addresses both energy and agricultural sustainability while supporting rural income enhancement.
- **Overall, Policy Significance:** Together, these subsidy mechanisms and policy initiatives form a comprehensive framework aimed at overcoming market failures, reducing investment risks, and accelerating solar capacity growth in India. These policies not only support capacity expansion but also contribute to broader economic objectives such as energy security, fiscal efficiency, rural development, and environmental sustainability.

Objectives of the Study

- To examine the role of government budget allocation in promoting solar installed capacity growth.
- To analyse trends in budget allocation for solar power and solar capacity expansion.
- To assess the economic effectiveness of solar energy government expenditure.

Research Question: Do government budgetary allocations significantly influence the growth of solar energy capacity?

Methodology

Data Sources: This study is based on secondary data collected from:

- Ministry of New and Renewable Energy (MNRE)
- Government budget documents

Variables: The study uses two variables.

- Dependent Variable :Solar installed capacity (GW)
- Independent Variable: GOI Budget Allocation for Solar Power (₹ crore)

Analytical Tools

- Trend analysis
- Descriptive statistics
- Linear Regression analysis

Solar Installed Capacity = $\beta 0 + \beta 1$ (GOI Budget Allocation) $+\varepsilon$

Hypothesis Statement:

H_0: $\beta_1=0$; No significant impact of budget allocation on solar power installed capacity.

H_1: $\beta_1 \neq 0$;Significant impact of budget allocation on solar power installed capacity.

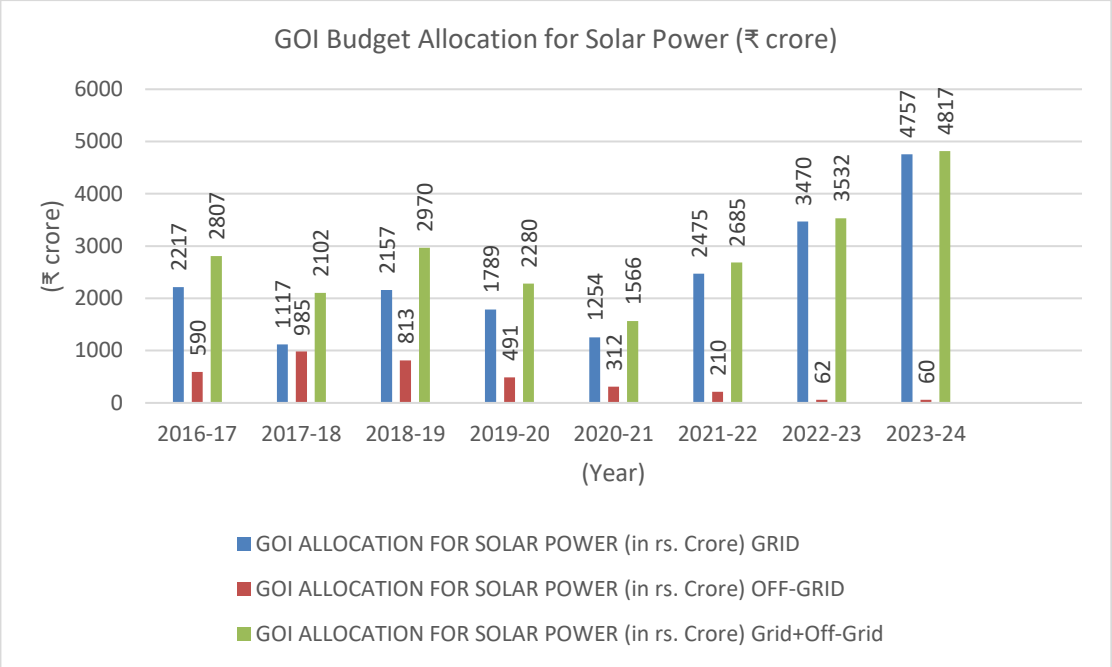
Results and Analysis

To analyse the relationship between GOI budget allocation for solar power and solar installed capacity, this study uses data from the Union Expenditure Budget documents of the Ministry of New and Renewable Energy (MNRE) for grid and off-grid solar power allocations covering the period from FY 2016–17 to FY 2023–24, along with data from MNRE's Renewable Energy Statistics 2024–25.

In Figure 1, we have shown the revised estimates data from FY 2016-17 to FY 2023-24 considered for the study. The total GOI budget allocation for solar power shows a clear long-term upward trend, rising from ₹2,807 crore in 2016–17 to ₹4,817 crore in 2023–24. Although there is a temporary decline during 2019–20 and 2020–21,the allocations increase sharply thereafter, indicating renewed and

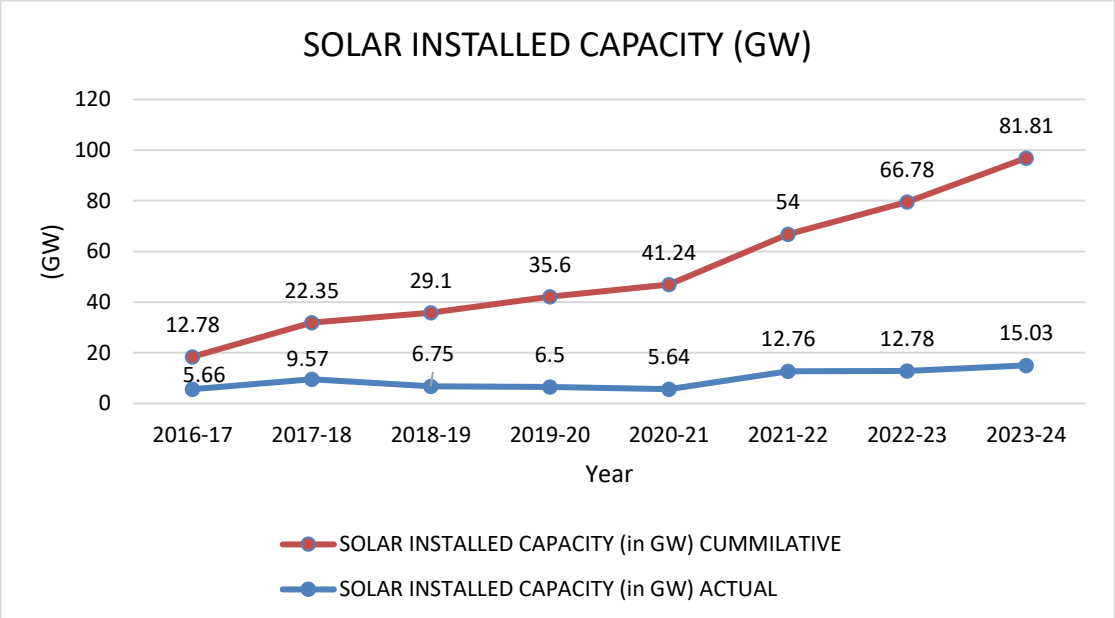
strengthened policy support for solar energy.This sharp rise reflects the government's renewed commitment to achieving national solar and renewable energy targets.

Figure 1: GOI Budget Allocation for Solar Power (Grid and Off-Grid)



Source : Union Expenditure Budget, MNRE, FY17-18 to FY 24-25 ; (figures are revised estimates)

Figure 2: Trend in Solar Energy Cumulative and Actual Installed Capacity



Source : Ministry of New and Renewable Energy, Renewable Energy Statistics, 2024–25.

Note- Figures are based on RES 2024-25 (Table 2.1): Cumulative Installed Capacity under RES since2014-15.

In figure 2, we have shown the cumulative solar installed capacity since 2014-15 based on the RES annual report 2024-25 (Table 2.1).The actual annual solar capacity installed was calculated by subtracting the cumulative installed capacity of the previous year from the cumulative installed capacity of the current year. The cumulative solar installed capacity shows a strong and consistent upward trend throughout the period of study. India has achieved substantial and sustained growth in solar installed capacity, reinforcing the effectiveness of government initiatives and long-term renewable energy planning. The two figures clearly demonstrate that GOI budget allocation plays a crucial enabling role in expanding solar installed capacity in India. Periods of increased funding coincide with accelerated capacity additions, while budgetary contraction corresponds with slower growth.

Table 1: Test of normality for the GOI budget allocation and solar capacity installed data from year 2016-17 to 2023-24.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
GOI Budget Allocation (In Rs. Crore)	.200	8	.200*	.939	8	.599
Solar Capacity Installed (In GW)	.255	8	.133	.862	8	.126

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Normality of the data was assessed using the Shapiro–Wilk test. Table 1 indicates the result for the normality test. In both cases, $p > 0.05$, indicating no significant deviation from normality. Both GOI Budget Allocation($p = 0.599$) and Solar Capacity Installed ($p = 0.126$)are normally distributed. Therefore, the assumption of normality is satisfied. Hence, use of parametric tests (t-test, Pearson correlation, linear regression) is appropriate.

Table 2: Linear regression analysis of GOI budget allocation on solar power installed capacity

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1.507	3.139		.480	.648	-6.175	9.188
	GOI Budget Allocation (In Rs. Crore)	.003	.001	.731	2.624	.039	.000	.005

a. Dependent Variable: Solar Capacity Installed (In GW)

Regression Equation

Solar Capacity Installed (GW) = 1.507 + 0.003× (GOI Budget Allocation)

Unstandardised coefficient (B) = 0.003

The unstandardised coefficient shows the unit-based change in the dependent variable corresponding to a one-unit change in the independent variable, expressed in their original units. In this study, B = 0.003 means that for every ₹1 crore increase in GOI budget allocation, solar capacity installed increases by 0.003 GW.

Standardised coefficient (Beta) = 0.731

The standardised coefficient measures the strength of the relationship between variables after converting them into standard deviation units. A Beta value of 0.731 indicates a strong positive influence of GOI budget allocation on solar capacity installed.

t = 2.624, Sig. = 0.039

The t-value (2.624) and significance level ($p = 0.039 < 0.05$) indicate that this relationship is statistically significant at the 5% level. Overall, the result suggests that higher government budget allocation significantly contributes to increased solar capacity installation in India.

Conclusion

This study examined the relationship between government budget allocation for solar energy and the growth of solar installed capacity in India. The analysis was motivated by the need to understand whether public financial support has been conducive in accelerating the expansion of renewable energy in a developing economy, characterised by market imperfections and high initial investment costs. Using secondary data and regression analysis, the study provides empirical evidence that government spending on solar energy has a significant positive influence on growth of solar capacity. The findings confirm that increased budgetary allocation by the Government of India contributes to the expansion of solar installed capacity by reducing capital costs, lowering investment risks, and improving the viability of solar projects.

The study also highlights the importance of India's broader solar policy framework, particularly initiatives under the National Solar Mission and PM-KUSUM scheme, which have played a crucial role in scaling up solar installations. Greater emphasis on rooftop and decentralised solar systems can enhance energy access, reduce transmission losses, and promote inclusive growth, particularly in rural areas. Overall, the study concludes that government budget allocation has been a key driver of solar energy growth in India. Well-designed fiscal support, combined with effective policy implementation and long-term planning, can ensure sustainable expansion of solar capacity while maintaining fiscal discipline. These findings reinforce the importance of continued but strategically managed government intervention in achieving India's renewable energy, energy security, and climate objectives.

References

1. Bhattacharyya, S. C. (2013). Financing energy access and off-grid electrification: A review of status, options and challenges. *Renewable and Sustainable Energy Reviews, 20*, 462–472. https://doi.org/10.1016/j.rser.2012.12.008
2. Carley, S. (2009). State renewable energy electricity policies: An empirical evaluation of effectiveness. *Energy Policy, 37*(8), 3071–3081. https://doi.org/10.1016/j.enpol.2009.03.062
3. Government of India, (2024). Union Expenditure Budget. Available online at: https://www.indiabudget.gov.in/budget2024-25(I)/doc/Budget_Speech.pdf
4. IEA. (2022). Renewables 2022: Analysis and forecast to 2027. *International Energy Agency*. https://www.iea.org/reports/renewables-2022
5. John Koshy et.al. (2024). Challenges and opportunities in residential solar power susidies: a case study of India. *Educational Administration theory and practices*, 2024, vol 30(7), pages 412-419. Doi: 10.53555/kuey.v3oi7.6029
6. Ministry of New and Renewable Energy (2024). Renewable energy statistics 2024–25. Government ofindia.https://cdnbbsr.s3waas.gov.in/s3716e1b8c6cd17b771da77391355749f3/uploads/2025/04/20250416715431493.pdf
7. Palit Debajit (2025). Fuelling Green Growth: Union Budget 2025-26 gives renewables their due. *Icon Solar-En Power Technologies Pvt. Ltd*, 2025.
8. Pandey, S. and Kapur, A., (2024), Trends in Finances for the Ministry of Renewable Energy, Budget Insights 2024-25, Volume 1, Issue 4, Foundation for Responsive Governance, New Delhi. 2 August 2024.
9. Pfeiffer, B., Mulder, P., & Pacheco, P. (2016). Innovation in solar power: A comparative study of subsidy regimes. Energy Policy, 95, 372–384. https://doi.org/10.1016/j.enpol.2016.05.005
10. Shastry Vivek (2024). India's Latest Budget Reveals New Details for National Energy Transition. *Finance & Economics,august* 2024.
11. Shrimali, G., & Jenner, S. (2013). The impact of state policy on deployment and cost of solar photovoltaic technology. U.S. Energy Policy, 46, 538–547. https://doi.org/10.1016/j.enpol.2012.04.020.

❑❑❑