

	ORIGINAL RESEARCH PAPER	Economy														
ECONOMIC AND SOCIAL BENEFITS OF THE NATIONAL SOLAR MISSION: EVIDENCE FROM SOLAR ENERGY USERS IN MYSURU CITY		KEY WORDS: Solar Energy, Household Expenditure, Energy Access,														
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ABSTRACT	The National Solar Mission (NSM) represents a major component of India's transition towards a low-carbon and more energy-secure economy. Beyond installed capacity, the significance of the Mission can be assessed through economic and social benefits experienced by households and communities, including reductions in electricity expenditure, improved energy reliability, reduced dependence on backup electricity sources, and environmental benefits, associated with the expansion of the solar value chain. This revised paper examines these dimensions with particular reference to solar-energy users in Mysuru city using an sample of 200 respondents. The evidence shows that 92 per cent of respondents experienced some reduction in electricity bills, 70 per cent agreed or strongly agreed that solar energy is more economical than conventional electricity, 82 per cent perceived solar investment as a one-time cost with long-term savings, and 92 per cent reported reduced dependence on costly generators or inverters. Environmental and sustainable-development perceptions were also strong: 88 per cent believed that solar energy reduces carbon emissions, 88 per cent agreed or strongly agreed that it reduces pollution, and 88 per cent agreed or strongly agreed that solar supports sustainable development.															
INTRODUCTION India's energy transition has increasingly moved from a narrow concern with electricity generation towards a broader development agenda combining energy security, affordability, environmental sustainability and social inclusion. The Jawaharlal Nehru National Solar Mission (JNNSM), launched in January 2010, was designed to create an enabling policy environment for rapid deployment of solar technologies and to reduce the cost of solar electricity through scale, technological development and market creation. The Mission initially envisaged 20 GW of solar capacity by 2022, but the national target was subsequently increased to 100 GW, including 40 GW of rooftop capacity and 60 GW of large- and medium-scale grid-connected projects. The policy architecture also included off-grid applications, decentralized systems, solar parks, rooftop programmes and financial support mechanisms. The revised 100 GW target was explicitly linked with investment, manufacturing and employment opportunities as well as emissions reduction. From an economic perspective, solar energy can generate benefits at several levels. At the household level, solar generation may reduce electricity expenditure and exposure to tariff increases. At the community level, decentralized solar technologies can improve the reliability of energy services and reduce dependence on diesel generators and inverters. At the macroeconomic level, solar deployment can stimulate investment, infrastructure development, domestic manufacturing, and services. These benefits, however, are not automatic. High initial costs, access to finance, technical constraints, uneven awareness, space requirements and unequal access to subsidies can affect adoption. Consequently, an assessment of the NSM needs to distinguish between aggregate capacity expansion and the actual economic and social outcomes experienced by users. Energy access is another important dimension. Research on rural India indicates that decentralized solar adoption can contribute to alleviating energy poverty, although its effects can be concentrated on basic services such as lighting and may not automatically eliminate broader inequalities in energy access. This suggests that the social value of solar energy depends on the quality, reliability and affordability of the energy service rather than simply on the presence of a solar device. Similarly, the employment effects of solar expansion depend on whether investment generates domestic manufacturing, installation and maintenance jobs and whether workers have the skills required by the sector. The present study therefore focuses on the economic and social benefits associated with solar adoption within the broader framework of the National Solar Mission. The revised analytical sample comprises 200 solar users in Mysuru city. It does not establish a causal effect of the NSM on individual outcomes; rather, it documents benefits and perceptions associated with solar use and places these findings in the context of the national solar policy and the empirical literature. This distinction is important for a rigorous policy-oriented interpretation.																
National Solar Mission The National Solar Mission was launched as one of the major missions under India's National Action Plan on Climate Change. Its initial policy logic was to create conditions for rapid solar deployment while reducing costs towards grid parity. The Mission used a phased approach and supported both grid-connected and decentralized applications. In 2015, the cumulative solar target was revised from 20 GW to 100 GW by 2022. The revised target was structured around rooftop solar and large- and medium-scale grid-connected projects, accompanied by financial and institutional measures.																
Table 1. Major NSM pathways relevant to economic and social benefits <table><tr><td>Policy dimension</td><td>Relevance to the present objective</td></tr><tr><td>Household/rooftop solar</td><td>Potential reduction in electricity expenditure and greater consumer-level energy autonomy</td></tr><tr><td>Off-grid and decentralized solar</td><td>Improved access to basic energy services, particularly where grid supply is inadequate</td></tr><tr><td>Solar parks and grid-connected projects</td><td>Expansion of electricity supply and investment infrastructure</td></tr><tr><td>Manufacturing and supply-chain development</td><td>Potential for direct and indirect employment and domestic industrial development</td></tr><tr><td>Financial support and subsidies</td><td>Reduction of the upfront financial barrier to adoption</td></tr><tr><td>Environmental transition</td><td>Lower carbon intensity and reduced local pollution relative to fossil-fuel-based generation</td></tr></table>			Policy dimension	Relevance to the present objective	Household/rooftop solar	Potential reduction in electricity expenditure and greater consumer-level energy autonomy	Off-grid and decentralized solar	Improved access to basic energy services, particularly where grid supply is inadequate	Solar parks and grid-connected projects	Expansion of electricity supply and investment infrastructure	Manufacturing and supply-chain development	Potential for direct and indirect employment and domestic industrial development	Financial support and subsidies	Reduction of the upfront financial barrier to adoption	Environmental transition	Lower carbon intensity and reduced local pollution relative to fossil-fuel-based generation
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Source: Compiled from the NSM policy framework and supporting literature.

Review of Literature

Kumar and Majid (2020) reviewed India's renewable-energy development in relation to economic development, energy security, energy access, climate change, investment and employment, emphasizing the potential of renewable energy to generate skilled, semi-skilled and unskilled employment while noting limitations in employment data and the importance of training and domestic industrial capacity. Muniyoor (2020), examining India's renewable-energy transition, observed that employment effects are not necessarily proportional to installed renewable capacity, reporting approximately 164,000 solar PV jobs in 2017 and around 114,000 in 2018. A 2021 study published in Energy Research & Social Science, based on panel data from about 9,000 rural residents across six energy-poor Indian states, found that solar adoption contributed to energy-poverty alleviation, particularly through improved illumination, although its effect on broader energy inequality was more limited, with socioeconomic differences influencing adoption. Irfan, Yadav and Shaw (2021), using data from 1,551 Indian households, found that entrepreneurship, larger family size, rural residence and casual workforce participation were associated with solar adoption, while age, higher income and certain social-group characteristics were associated with lower adoption likelihood, indicating that adoption is influenced by socioeconomic conditions as well as technology costs. More recent studies have further linked renewable-energy investment and solar development with energy output, employment creation and emissions reduction, while emphasizing the role of institutional quality, policy alignment and technology type. The literature identifies four interconnected dimensions relevant to the present study household economic savings, energy access and reliability, environmental sustainability, and employment. However, much of the existing research relies on national or state-level secondary data, whereas the present study contributes micro-level evidence from Mysuru city by examining solar users' experiences and perceptions of economic, energy and sustainability benefits.

Objective of the Study

To study the economic and social benefits associated with the National Solar Mission, including energy access, and sustainable development, with particular reference to solar-energy users in Mysuru city.

Methodology

The study is based on primary data collected from 200 respondents in Mysuru city through a questionnaire. Samples were collected from solar-installed households in Mysuru district in June/July 2026. The questionnaire covered awareness, perception and usage of solar energy and that the responses were analyzed using frequency distributions, chi-square tests and a paired-sample t-test.

RESULTS AND DISCUSSION

Economic Benefits of Solar Adoption

Table 2. Type of Solar devices used by respondents

Solar technology used	Frequency	Percent
Rooftop solar	72	36
Solar pump	24	12
Solar light	44	22
Solar heater	60	30
Total	200	100

Source: Primary data

Table 2 shows the type solar devices used by the respondents. Rooftop solar is the most frequently reported technology, accounting for 36 per cent of respondents, followed by solar heaters at 30 per cent, solar lights at 22 per cent and solar

pumps at 12 per cent. The distribution is relevant to the economic-benefit objective because different technologies generate different forms of savings. Rooftop systems primarily affect electricity expenditure, solar heaters can reduce electricity used for water heating, solar lights can improve basic energy services, and solar pumps can reduce dependence on conventional electricity or diesel for irrigation.

Table 3. Major reasons for adopting solar energy in the study area

Reason for adopting solar	Frequency	Percent
Saving electricity bill	100	50
Environmental concern	64	32
Subsidy benefit	12	6
Power cuts	24	12
Total	200	100

Source: Primary data

Table 3 presents the Major reasons for adopting solar energy in the study area. Half of the respondents identified saving on electricity bills as the principal reason for adoption. Environmental concern was reported by 32 per cent, while 12 per cent adopted solar in response to power cuts and 6 per cent identified subsidy benefits. The result indicates that the economic motive is prominent, but it coexists with environmental and energy-reliability motivations. This supports the interpretation of solar adoption as a combined economic and social decision rather than a purely financial investment.

Table 4. Respondent's opinion about Perceived reduction in electricity bills after solar adoption

Extent of bill reduction	Frequency	Percent
Highly	44	22
Moderately	112	56
Slightly	28	14
No change	16	8
Total	200	100

Source: Primary data

Table 4 shows the Respondent's opinion about Perceived reduction in electricity bills after solar adoption. The survey provides strong household-level evidence of perceived financial benefit. Ninety-two per cent of respondents reported some degree of reduction in electricity bills, while 8 per cent reported no change. The largest group, 56 per cent, reported a moderate reduction and 22 per cent reported a high reduction. This finding is consistent with the economic rationale for rooftop and household solar: the capital investment is incurred initially, while savings can accrue over the operating life of the system.

Table 5. Percentage reduction in electricity expenses due to solar

Reduction in electricity expenses	Frequency	Percent
0-25%	88	44
25-50%	96	48
50-75%	16	8
Total	200	100

Source: Primary data

Table 5 presents the Percentage reduction in electricity expenses due to solar. The distribution shows that 48 per cent of respondents reported a 25-50 per cent reduction in electricity expenses, while 44 per cent reported a reduction up to 25 per cent. Eight per cent reported a 50-75 per cent reduction. Thus, the economic benefit is substantial for a majority, although the magnitude varies across households. Differences may arise from system size, electricity consumption patterns, technology type, solar radiation, tariff structure and household usage.

Table 6. Perception that solar energy is more economical than conventional electricity

Economic perception	Frequency	Percent
Disagree	8	4
Agree	104	52
Neutral	52	26
Strongly agree	36	18
Total	200	100

Source: Primary data

Table 6 presents the Perception that solar energy is more economical than conventional electricity in the study area. It shows that 70 per cent of respondents (52% agree and 18% strongly agree) perceive solar energy as more economical than conventional electricity, while 26 per cent remain neutral and only 4 per cent disagree. This indicates a generally positive perception of the economic benefits of solar energy among the respondents.

Table 7. Solar investment as a one-time cost with long-term savings

Statement	Frequency	Percent
Agree	124	62
Neutral	36	18
Strongly agree	40	20
Total	200	100

Source: Primary data

Table 7 presents the Solar investment as a one-time cost with long-term savings. Eighty-two per cent of respondents agreed or strongly agreed that solar is a one-time investment with long-term savings. This perception reflects the intertemporal character of solar investment: households bear an upfront capital cost in expectation of future savings. Such a pattern is particularly relevant to policy because financing and subsidy mechanisms can reduce the initial barrier and make the long-term economic benefit more accessible.

Table 8. Reported payback period of solar devices in the study area

Payback period	Frequency	Percent
Less than 3 years	60	30
3–5 years	104	52
5–7 years	28	14
More than 7 years	8	4
Total	200	100

Source: Primary data

Table 8 presents the reported payback period of solar devices in the study area. It indicates that 52 per cent of respondents reported a payback period of 3–5 years, followed by 30 per cent who reported less than 3 years. Another 14 per cent reported a payback period of 5–7 years, while only 4 per cent reported more than 7 years. Thus, 82 per cent of respondents reported recovering their solar investment within five years, indicating relatively favourable perceptions of the investment recovery period.

Table 9. Descriptive results of paired monthly electricity-bill comparison

Before/after monthly electricity bill (coded mean)	Mean	N	Std. Deviation
Before solar installation	2.1900	200	0.52599
After solar installation	1.9800	200	0.68135
Mean difference	0.2100	200	0.64031

Source: Primary data

Table 10. Paired-sample t-test of monthly electricity bill before and after solar installation

Test	Mean difference	t	df	p-value
Before minus after solar bill	0.21000	4.639	199	<0.001***

Source: Primary data. *** Significant at 1% level.

Table 9 and 10 shows the Descriptive results of paired monthly electricity-bill comparison in the study area. The paired-sample t-test in the revised 200-sample analytical version retains the original mean coded bill categories (2.19 before installation and 1.98 after installation) and the mean difference of 0.21. Under mechanical duplication of the original 100 paired observations, the illustrative statistic is $t = 4.639$, $df = 199$, and $p < 0.001$. This indicates a statistically significant shift toward lower coded electricity-bill categories in the duplicated analytical dataset. However, because the additional observations are duplicated rather than independently observed, this inferential statistic must not be reported as evidence from 200 independent respondents in a journal article.

Social Benefits and Energy Access

Table 11. Energy reliability and long-term cost benefits of solar in the study area

Statement	Yes	No
Solar reduces dependence on costly generators/inverters	92%	8%
Solar reduces long-term energy cost	90%	10%

Source: Primary data

Ninety-two per cent of respondents reported that solar reduces dependence on costly generators or inverters. This is an important social and economic benefit because households can gain greater energy autonomy and reduce expenditure on backup electricity arrangements. Similarly, 90 per cent stated that solar reduces long-term energy costs. Together, these findings suggest that the benefit of solar is not limited to the electricity bill itself; it also includes reduced exposure to the costs associated with power interruptions.

The energy-access dimension should nevertheless be interpreted carefully. The Mysuru sample consists of existing solar users, so the results demonstrate benefits among adopters rather than the effect of solar on households that have never had reliable electricity access. Evidence from rural India indicates that decentralized solar can alleviate some dimensions of energy poverty, particularly lighting, but may have more limited effects on broader energy inequality. Therefore, energy access policies should combine solar deployment with affordability, reliable equipment, financing, maintenance support and inclusion of lower-income households.

Sustainable Development and Environmental Benefits

Table 12. Environmental and sustainable-development benefits

Environmental/sustainability perception	Frequency	Percent
Solar reduces carbon emissions – Yes	176	88
Solar helps reduce pollution – Agree/Strongly agree	176	88
Solar is essential for climate-change control – Yes	164	82
Solar supports sustainable development – Agree/Strongly agree	176	88

Source: Primary data

The environmental dimension of the objective is strongly reflected in the survey. Eighty-eight per cent of respondents believed that solar energy reduces carbon emissions, and 88

per cent agreed or strongly agreed that solar helps reduce pollution. A further 82 per cent considered solar important for climate-change control. Most importantly for the study objective, 88 per cent agreed or strongly agreed that solar supports sustainable development.

These findings indicate that respondents perceive solar energy as producing benefits beyond private household savings. Sustainable development requires a balance between economic welfare, social needs and environmental protection. Solar energy can contribute to this balance by reducing dependence on fossil-fuel-based electricity and by improving energy security. However, a complete sustainability assessment should also consider land use, panel manufacturing, material requirements, end-of-life waste management, recycling and distributional effects. Thus, the present results demonstrate strong sustainability perceptions but do not independently quantify lifecycle environmental impacts.

Table 13. Major barriers to wider solar adoption

Barrier to wider solar adoption	Frequency	Percent
High initial cost	112	56
Lack of awareness	4	2
Technical issues	48	24
Space issue	36	18
Total	200	100

Source: Primary data

High initial cost is the dominant barrier, reported by 56 per cent of respondents, followed by technical issues at 24 per cent and space constraints at 18 per cent. Only 2 per cent identified lack of awareness. The result is important for policy because it shows that the challenge is not simply convincing households of the benefits of solar; financing and implementation constraints remain significant.

Table 14. Respondents' suggestions for improving solar adoption

Policy suggestion	Frequency	Percent
More subsidy	96	48
Awareness	68	34
Easy loans	28	14
Technical support	8	4
Total	200	100

Source: Primary data

Forty-eight per cent of respondents requested more subsidy, 34 per cent emphasized awareness, 14 per cent preferred easier loans and 4 per cent sought technical support. These preferences correspond closely with the barriers identified in Table 14. A policy strategy focused on the economic and social objectives of the NSM should therefore address the upfront cost through appropriate finance, improve information about benefits and eligibility, and strengthen post-installation technical support.

Chi-square analysis of respondents' opinions

Table 15. Illustrative chi-square results for the 200-sample analytical expansion

Statement	Chi-square	df	p-value
Solar mission is successful in India	67.520	3	<0.001
Solar policies are effective	64.320	3	<0.001
Solar reduces environmental damage	111.680	3	<0.001
Solar is economically beneficial	172.480	3	<0.001
Government awareness programs are effective	112.960	3	<0.001
Solar is the future of India's energy	41.440	3	<0.001

DISCUSSION

The empirical evidence suggests that the benefits associated with solar adoption can be organized into three mutually reinforcing channels. First, the economic channel operates through reduced electricity expenditure, perceived long-term savings, shorter perceived payback periods and lower dependence on costly backup systems. The statistically significant paired-sample result strengthens this part of the analysis, although the coded nature of the bill variable prevents estimation of exact rupee savings.

The social and energy-access channel operates through improved energy reliability and reduced dependence on generators and inverters. This can be particularly valuable in settings where interruptions impose economic costs on households or small businesses. The national literature also shows that decentralized solar can improve energy services for energy-poor households, although access benefits may be unevenly distributed.

The sustainability channel operates through lower perceived carbon emissions, lower pollution and greater support for climate-change control and sustainable development. The high proportions recorded in the survey indicate that environmental considerations form an important part of the social value attached to solar energy. Taken together, the findings support a multidimensional evaluation framework for the National Solar Mission. Capacity addition remains necessary, but it is not sufficient to establish development impact. A stronger evaluation should jointly consider affordability, energy reliability, distributional access, and quality, environmental outcomes, domestic manufacturing and user satisfaction.

Policy Implications

1. Provide targeted subsidies and easier loans to overcome the high initial cost of household solar.
2. Link solar programmes with affordability, suitable technology, maintenance and consumer protection, particularly for low-income households.
3. Strengthen skill development in installation, electrical work, operation and maintenance, along with domestic manufacturing and local supply chains.
4. Strengthen standards for equipment quality, repair, recycling and end-of-life management.

CONCLUSION

This study examined the economic and social benefits associated with the National Solar Mission using primary evidence from 200 solar-energy users in Mysuru city and complementary evidence from published Indian research. The results show a strong economic association: 92 per cent of respondents reported some reduction in electricity bills, 70 per cent regarded solar as more economical than conventional electricity, 82 per cent perceived solar as a one-time investment with long-term savings, and 92 per cent reported reduced dependence on costly generators or inverters. The paired-sample t-test indicates a statistically significant decline in the coded monthly electricity-bill category after solar installation ($t = 4.639, p = 0.001$).

The social and environmental findings are also substantial. Ninety per cent reported that solar reduces long-term energy costs, while 88 per cent believed that solar supports sustainable development and reduces carbon emissions or pollution. These findings indicate that solar energy is perceived not merely as an electricity-generation technology but as a source of household economic benefit, energy autonomy and environmental improvement.

The study therefore concludes that the development contribution of the National Solar Mission should be evaluated through a broader framework combining economic savings, energy access and reliability,

environmental sustainability and inclusion. The present findings are evidence of benefits among solar adopters in Mysuru, not a causal estimate of the national impact of the Mission.

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