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Integrating Energy Justice and SDGs in Solar Energy Transition: Analysis of the State Solar Policies of India

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Abstract

The transition to clean energy is not inherently positive or negative, and its impacts depend on the social context, power relations, and mechanisms to include marginalized voices. India, with its ambitious climate targets and commitment to the UN SDG Agenda, is a key country for ensuring an inclusive and sustainable transition. This paper aims to understand whether India's commitment to the SDG Agenda's overarching principle of 'leaving no one behind' is reflected in the design of its domestic solar policies. It analyzes how energy justice concerns are addressed in state-level solar policies. To that end, a pragmatic framework was developed to identify key justice dimensions and indicators, linked to the SDG targets, that are essential for an inclusive transition. This research conducted a qualitative interpretive content analysis of 29 solar energy policies, using the three identified framework dimensions—income growth, enhancing inclusion, and equal opportunities. We found that the themes around energy access, employment, and skill development are reflected in policies, while those around the inclusion of the poor, women, and community remain limited. The findings indicate that the policies have focused on low-impact justice concerns, lacking structural transformation. To address these gaps, the study proposes targeted subsidies, community ownership, and gender-inclusive mechanisms. The framework offers a pragmatic tool for the evaluation of clean energy policies in the Global South, and the empirical results provide insights for the synergistic implementation of the climate and sustainable development agenda.

Keywords: energy justice; Sustainable Development Goals (SDGs); renewable energy; solar policy; India; just transition



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1. Introduction

The transition to renewable energy offers a dual opportunity: climate mitigation while providing clean and affordable energy [1]. The United Nations' Sustainable Development Goals (SDGs) present this as a cross-cutting theme, explicitly articulated in SDGs 13 and 7. The SDGs are promoted as 'integrated and indivisible', and many studies have highlighted interlinkages between energy and non-energy SDGs [2–5]. The renewable energy expansion can provide electricity to remote areas (SDG 1), create jobs (SDG 8), and reduce GHG emissions (SDG 13) [2,3]. However, it can impact low-income households due to increased electricity costs (SDG 1) and threaten traditional jobs (SDG 8) [6]. Therefore, the renewable

energy transition is not inherently positive or negative, and without integrating justice concerns into policy, existing inequalities related to resource access, gender, and land ownership can be replicated or worsened [7,8]. The energy justice literature has progressed to explore the justice impacts of the low-carbon energy transition, but more knowledge is needed from developing countries.

India is an interesting and important case for studying the justice implications of solar energy transition. On the one hand, the country has ambitious international climate commitments and renewable energy targets. The total solar capacity has increased 29 times, from 2.82 GW in March 2014 to 100.3 GW in January 2025 [9]. On the other hand, as the world's most populous country, India has numerous developmental challenges. A synergistic approach to energy transition and the 2030 Agenda is essential for creating an equitable and inclusive society. Solar energy implementation broadly falls under the Concurrent List (electricity production, supply, and distribution) of the Indian Constitution. While states are crucial for solar transition through their independent policy formulation and implementation, there is limited understanding of whether these policies align with SDGs by addressing justice concerns. Therefore, reviewing state-level solar policies is crucial to identify current opportunities, gaps, and pathways towards a just and sustainable energy transition.

To understand if India's international commitment to the SDG Agenda's overarching principle to 'leave no one behind' is reflected in the design of domestic solar policies, this paper aims to assess if and how Indian solar policies address justice and sustainability concerns to improve the inclusivity and effectiveness of the solar transition. To fulfil this objective, an SDG-centric analytical framework was developed to identify key justice dimensions and indicators needed for an inclusive energy transition. These dimensions and indicators were used to examine 29 solar energy policies, representing 24 states and seven Union Territories (UTs), out of a total of 36 states and UTs (28 states and eight UTs). While a few policies were unavailable, the sample provides a representative picture of the state-level policy landscape. The findings reveal that policies have focused on promoting low-impact justice co-benefits rather than structural transformation, thus failing to unlock the real potential for SDG synergies.

The significance of this research is twofold. First, the framework developed is a novel methodological contribution, providing a pragmatic approach to analyze the overlooked and unintended justice impacts of energy policies. Second, this paper is among the first to critically analyze the Indian state's solar policies from a justice perspective. The empirical insights contribute to the knowledge of India's initiatives to address concerns of equity and justice within its energy transition. By focusing on India, the paper expands the geographical focus of justice-oriented policy analysis from the Global North to the Global South. The study highlights the innovative provisions that need to be scaled up and the gap areas that require attention, contributing to the energy justice literature. It also provides valuable insights for policymakers in the Global South, where energy transition must be both just and sustainable, to design synergistic renewable energy policies. The scope of the paper centers on justice dimensions linked to sustainability, prioritizing injustices against vulnerable and marginalized groups over those experienced by affluent groups. This research has a few limitations, which can be addressed in future research. First, the research focused only on solar policies and does not provide insights into the impacts of other renewable energy sources. Second, this research draws from policy documents, focusing on policy design, and does not cover implementation dynamics.

The paper is structured into seven sections. The Section 2 presents a literature review of concepts relevant to the research. The Section 3 describes the methodology used, which involves developing and applying an analytical framework to conduct interpretive content analysis of twenty-nine solar policies. The Section 4 outlines the analytical framework,

and the Section 5 covers the results of policy analysis. The Section 6 explores the findings, policy implications, and limitations. The Section 7 concludes the discussion, offers key recommendations, and suggests future directions.

2. Literature Review

2.1. Energy Transition, Justice, and SDGs

Energy transition involves moving from one dominant energy source to another. Historical examples include the shift from whale oil to wood in the 19th century and from wood to coal during the Industrial Revolution [10]. Low-carbon energy transition refers to moving from fossil fuels to renewable energy sources. This transition requires not only adding but also subtracting from the energy mix, following a different pathway than the historical transition [11]. The low-carbon transition meets the dual goals of climate action and providing access to clean energy. Both these goals are part of the SDG agenda, highlighting synergies between energy transition and other developmental goals.

The literature has explored the interlinkages between climate and development goals, highlighting both positive (synergies) and negative (trade-offs) interlinkages [12–14]. Table 1 presents a list of major synergies and trade-offs identified between the renewable energy transition and other SDGs. This set of the literature focuses more on the quantity of synergies and trade-offs and lacks empirical evidence.

Table 1. Synergies and trade-offs between the renewable energy transition and the SDGs.

SDG	Synergies	Trade-Offs
SDG 1: No Poverty	Access to modern energy services can alleviate poverty, and off-grid solar solutions can enhance energy access in remote areas.	New renewable energy policies can increase electricity prices, impacting the poor.
SDG 2: Zero Hunger	Modern energy services boost agricultural productivity, essential for food security.	Large-scale bioenergy and solar projects can compete for land resources, posing a threat to food security
SDG 5: Gender Equality	Improved lighting enhances women's security, while access to modern energy can create business opportunities for women.	Women may not have equal access to 'technical' opportunities created in renewable energy projects due to societal norms.
SDG 8: Decent Work and Economic Growth	Renewable energy expansion generates direct jobs in infrastructure and indirect employment by enhancing energy access and economic activity.	The transition to renewable energy may pose a threat to jobs for fossil fuel workers.
SDG 10: Reduced Inequalities	Small-scale renewable energy plants can facilitate community engagement and boost their income.	Developing renewable energy infrastructure can threaten communities and lead to their displacement.

Source: The authors' compilation, based on different sources [2–4].

Another body of literature on 'just transition' is important for the low-carbon transition. The concept originated in the 1990s when American labor unions fought for their workers' rights to protect against job losses due to increasing environmental regulations [15]. Initially, the concept centered on safeguarding the jobs of coal workers. However, it has evolved to represent a transition towards a fair and equitable post-carbon society, incorporating justice concerns related to income, gender, ethnicity, and more [16]. While this literature aligns with the SDGs, engagement remains limited, with only a few studies explicitly referencing these global goals [6,17]. Parallely, the literature on energy justice is also evolving. Energy justice is a conceptual approach that investigates the distribution of costs and benefits of energy transition (distributive justice); who is affected, ignored, or misrepresented

(recognition justice); and the fairness of procedures (procedural justice) [18,19]. This set of literature examines the energy transition through an energy justice lens, arguing that energy transition policies should incorporate the core principles of energy justice [1,20,21].

Just transition and energy justice are closely linked, both grounded in the principles of climate, environmental, and energy justice. Yet, the existing literature often overlooks their interconnections. Framing the discussion through the lens of inequality offers a valuable approach to integrating energy justice, just transition, and the SDGs into a more holistic perspective.

2.2. Existing Frameworks for Ensuring a Just Energy Transition

A range of ‘just transition’ frameworks has emerged across global, national, and local contexts, developed by governments, international organizations, and academic scholars. Owing to the origin of ‘just transition’, in the workers’ movement, the International Labour Organization (ILO) [22] has developed a just transition policy framework. It is centered on the ‘world of work’ and has identified nine key policy areas for a just transition to environmentally sustainable economies. Another framework by the International Renewable Energy Agency (IRENA) [23] includes deployment, integrating, and enabling policies for a just transition. Another just transition framework by the Climate Justice Alliance is rooted in environmental justice principles and defines just transition as a principle, process, and practice to shift from an extractive economy to a regenerative one [24]. There are also frameworks present in the scholarly literature. These include the ‘JUST’ framework, which unites the scholarship on Climate, Environment, and Energy justice (CEE) and argues its importance in reducing inequality and injustice [16]. A recent framework incorporates energy justice and socio-technical transitions using a political ecology framework to guide the adoption of low-carbon technologies in the Global South. It stresses the importance of local participation and managing power relations for a just transition [25]. Energy justice has also been used as an analytical and decision-making framework [19,26]. Few frameworks integrate energy justice principles with the SDG Agenda [1,6].

These frameworks contain elements and dimensions related to different SDGs and justice principles. The different frameworks and their linkages with SDGs and inequality are provided in Table 2.

The existing frameworks have many important dimensions, but there are gaps. First, the just transition discourse has evolved but still mostly revolves around the ‘world of work’, with most dimensions related to employment and workers. Second, the frameworks are primarily centered on the Global North, with less focus on the context of countries from the Global South. Third, while energy justice and SDG dimensions are aligned in all frameworks, the direct integration of relevant SDGs is limited.

Table 2. Review of the existing energy justice/just transition frameworks.

Existing Frameworks	Elements/Dimensions	Linkages with SDGs	Linkages with Justice/(In)Equality
ILO [22]	Nine policy areas: macroeconomic and growth, industrial and sectoral, enterprise, skill development, occupational safety and health, social protection, active labor market, social dialogue, and tripartism	Just transition is viewed in the context of sustainable development	The framework promotes social inclusion and reducing inequalities
Climate Justice Alliance Framework [24]	Extractive economy to regenerative economy. Caring and sacredness; ecological and social well-being; deep democracy; cooperation; regeneration	A regenerative economy is essentially a sustainable economy	Social equity and justice are aims of a just transition

Table 2. *Cont.*

Existing Frameworks	Elements/Dimensions	Linkages with SDGs	Linkages with Justice/(In)Equality
IRENA [23]	Three policy pillars: deployment; integration; enabling	The proposed policies related to livelihood, skill development, labor, and finance have linkages with different SDGs	Inclusion is a key element of the framework
World Economic Forum [27]	Key elements: minimizing impacts on workers, shifting to sustainable practices, maximizing benefits to the environment, providing access to affordable and clean energy, and creating green jobs	It argues that interactions between climate goals and well-being should be achieved	It recognizes the disproportionate impacts of climate disasters on developing countries
GIZ [28]	Seven key principles: no climate impact; leaving no one behind; inclusive and transparent decision-making; tailor-made solutions; access to multiple people; focus on affected regions; long-term and flexible services	‘Leaving no one behind’ is one of the key principles	Defines just transition as a ‘socially’ just strategy that improves living conditions equitably
Carbon Trust [29]	Three key principles: recognizing socio-economic inequalities; inclusive decision-making; equitable distribution of costs and benefits	The proposed policy solutions related to livelihood, skilling, and finance are related to different SDGs	Reducing inequalities and equitable distribution are core principles
Heffron and McCauley [16]	JUST: Justice (distributive, procedural, restorative); Universal (recognition, cosmopolitanism); Space; Time	Clean energy and climate action are important elements for a just transition and the SDGs	Just transition is defined in the context of inequality
Sovacool and Dworkin [19]	Nine energy justice principles: availability, affordability, due process, transparency, sustainability, intragenerational and intergenerational equity, responsibility	Sustainability is one of the principles, aligned with the SDG Agenda	Derived from energy justice tenets
Siciliano et al. [1]	Integrates low-carbon energy transition, energy justice, and SDGs	Explicitly links different SDGs to the impacts of low-carbon energy transition	Energy justice is used as an evaluative template
Haegele et al. [6]	Integrates energy justice tenets with ILO’s commitments and SDGs	Different SDGs are core of the framework	Inequality and justice principles are part of the framework
Boateng et al. [25]	Energy justice (distributive, procedural, recognition) and socio-technical innovations	The framework ensures a ‘sustainable’ energy transition	Inclusion is a key element of the framework

2.3. Justice-Oriented Analysis of Renewable Energy Policies and Projects

Energy justice has been used as an analytical tool to empirically study injustices associated with solar expansion. The findings highlight both positive and negative impacts of energy transition, which vary depending on the scale of implementation. Large-scale solar projects are implemented for rapid expansion and benefit investors, distributors, and large landowners, but they can reinforce caste and gender inequalities, specifically harming landless laborers dependent on land for their livelihood [30,31]. Decentralized and off-grid solutions provide affordable solutions to the rural population, providing access to basic services and reducing energy poverty [32]. However, they do not always reduce energy inequalities, as they are adopted more frequently by the educated and wealthy than by lower-caste and poor households [33]. Their adoption is also influenced by patriarchal roles and may exclude women and youth [34]. Furthermore, if solar energy leads to high electricity prices, energy poverty may worsen [35]. Mini-grids and community projects can

enable just outcomes, but can also exclude vulnerable communities [36,37]. To exercise the solar project's potential to alleviate energy poverty, the participation of the energy poor in its rollout is necessary [38].

Some studies have also conducted policy analysis to understand the extent of justice integration [39]. Empirical studies of Indian solar policies are limited, with state policy analysis remaining highly understudied. A few [40] have analyzed these policies using an energy justice and democracy lens, highlighting a lack of community ownership and public participation in the energy transition discourse. However, while they argue for integrating development goals, they do not fully incorporate the relevant SDGs.

2.4. Research Gaps and Question

Overall, the literature review points to three research gaps. First, while the literature on energy justice and just transition has progressed to include many dimensions, it is predominantly Global North-centric, with relatively less literature advancing knowledge on the Global South. Second, the frameworks reviewed are not sufficient on their own to assess the implications of the solar energy transition. There is a need for a practical framework for assessing the justice implications of solar expansion. Third, solar policy analysis from a justice lens remains highly understudied. There is a need to gather empirical data from the policies.

To address these research gaps, we ask the following research questions: To what extent are justice and sustainability concerns addressed by the solar energy policies of Indian states and Union Territories (UTs)?

The focus on solar policies stems from the critical role of solar energy in developing countries' energy transition. Among all renewable energy sources, solar expansion has been the most significant in recent years. The different solar technologies—grid-connected, mini-grids, and off-grid—provide a range of opportunities for sustainable development in the Global South [41]. Understanding the justice implications of solar energy is essential to ensure the equitable distribution of these opportunities. India was selected as the focus country due to its unique position as a climate leader amidst domestic challenges. The country is the third largest emitter of GHG emissions while being extremely vulnerable to climate change impacts. Globally, it has ambitious climate targets and is actively expanding renewable energy projects with a co-benefit strategy [42]. However, it faces significant developmental challenges rooted in social inequalities, in particular, gender bias in education, employment, and finance, which limits economic inclusion and thus impedes growth [43,44]. The country's ranking in gender-related indices remains low. The recent World Economic Forum's 'Gender Gap Index' ranked India 129 out of 148 countries, scoring on four dimensions, which include participation in the economy, literacy, health, survival, and political empowerment [45]. Without a targeted approach, the energy transition might perpetuate these inequities. These dynamics make India a compelling case to study the intersection of solar policy, justice, and sustainability.

Furthermore, India's unique position and experience in solar transition makes it a representative case for other developing countries, informing equitable transitions across the Global South.

3. Methodology

3.1. Developing an Analytical Framework

This paper developed a novel and pragmatic analytical framework, 'Energy Justice–SDG Framework', as a methodological tool to capture energy justice dimensions through the SDG lens. The framework is rooted in the argument that energy justice considerations must be integrated into the design and implementation of renewable energy policies to facilitate

a synergistic implementation of energy transition and the SDG agenda. For analytical purposes, we postulated that SDG 10 (Reduced Inequalities) provides an interesting link between energy justice, just transition, and the SDG agenda. While SDG 7 emphasizes renewable expansion, SDG 10 addresses justice concerns more directly, making it a more suitable bridge between energy justice and the SDGs. This direct integration of SDGs into the energy justice framework provides a pragmatic approach to synergistically implement the energy transition and sustainability agenda. Inequality/inequity, therefore, is defined in terms of SDG 10 (unfair distribution of resources, opportunities, and outcomes), which is a major source of injustices, operationalized as the three energy justice tenets (distributive, procedural, and recognition).

Therefore, taking SDG 10 as the focal point, three broad inequality dimensions were derived for the framework from three targets of Goal 10: Income Growth (T10.1), Enhancing Inclusion (T10.2), and Equality of Opportunity and Outcome (T10.3). These targets were selected based on the inclusion criteria: (a) relevant for inequality/justice, (b) relevant for solar energy transition, and (c) have local-level significance. Targets without direct relevance to the solar energy transition (T10.6, T10.7, T10.c) and those with an international scope (T10.5, T10.6, T10.a, T10.b) were excluded. To enhance the comprehensiveness of the framework, the sub-dimensions and indicators were identified from the existing energy justice frameworks and the literature on just transition, energy justice, and SDGs. The relevant SDG targets were mapped against these dimensions and sub-dimensions, based on the wording of the targets. Out of 169 SDG targets, 51 targets were mapped based on the inclusion criteria (See Tables A1 and A2 in the Appendix A for the included and excluded SDGs). The framework has three dimensions, nine sub-dimensions, and fifteen indicators. (The detailed framework and its dimensions are outlined in Section 4).

3.2. Applying the Framework

The analytical framework developed was used to conduct a policy analysis of the solar policies of Indian states and Union Territories. The framework is operationalized through its indicators, which are used to gather empirical data from policy documents. The paper analyzed to what extent these justice indicators—practical measures aimed at promoting a just and sustainable transition—are present in the state solar policies, indicating the level of alignment and synergies with different SDGs. The data sources and method of analysis used for applying the framework are mentioned below.

3.2.1. Data Sources

The latest solar policies of states and Union Territories (UTs) are posted on the Ministry of New and Renewable Energy's (MNRE) website [46]. The Electricity Act of 2003 serves as the regulatory and legislative framework for these policies. Many provisions of this act, namely Section 86(1) (e), mandate the State Electricity Regulation Commission (SERC) to provide guidelines for promoting renewable energy sources. The solar policies are formulated to align with the national vision and targets and capitalize on the initiatives, including the Jawaharlal Nehru National Solar Mission (JNNSM), aimed at promoting solar power.

While some states have consolidated renewable energy policies covering multiple energy sources, others have separate policies for different technologies, such as solar, wind, and biomass. Out of the different renewable energy policies, only the latest solar policies were analyzed, with one policy analyzed for each state/UT. In cases where a separate solar policy was not available, we analyzed the solar section of the renewable energy policy. In the case where a formal policy was not available on the MNRE's website, other relevant policies were analyzed. For instance, for Meghalaya and Arunachal Pradesh, rooftop solar grid regulations were analyzed. For UTs, namely, Andaman and Nicobar

and Chandigarh, and Lakshadweep, a Joint Electricity Regulatory Commission for the State of Goa and Union Territories (Draft Solar PV Grid Interactive System based on Net Metering) Regulations, 2019, was analyzed. Four states and one UT were excluded from the analysis due to the unavailability of any relevant policies (Nagaland, Tripura, Ladakh) and the lack of policies in English (Chhattisgarh and Maharashtra). In total, 29 solar policies were analyzed, representing 24 states and 7 UTs. The detailed list of policies is provided in Table A3 in Appendix A. This list also provides an up-to-date overview of the different policies of Indian states, contributing to ongoing scholarly work to map climate policies in India.

3.2.2. Data Analysis

We conducted a qualitative content analysis of the policy documents. Content analysis can be defined as a technique to systematically analyze data using rules of coding [47].

This study employed an interpretive approach to content analysis, involving an interpretation of text to uncover contextual nuances [48]. A deductive coding strategy was used, guided by the dimensions and indicators of the framework. The framework dimensions were translated into themes, sub-dimensions into codes, and indicators into sub-codes. The list of themes, codes, and sub-codes used is provided in Table 3. The NVIVO software (Version 1.7.1) was used for coding the policy content. Each section of the state solar policy was paid close attention. This involved a meticulous reading process, examining the text through the lens of the defined framework. The focus was on identifying key sentences, objectives, regulatory measures, and incentive structures within the policies that relate, directly or indirectly, to the identified dimensions and indicators. These measures (provisions and mechanisms) were then coded and mapped to the relevant codes and sub-codes. In cases where some provisions point to more than one sub-code, it was noted but mapped to the most relevant sub-code. Through this detailed examination, the extent to which these policies integrate the broader justice and sustainability objectives was highlighted, thereby offering insights into their strengths and potential areas for improvement.

Table 3. List of themes, codes, and sub-codes derived from the framework for policy analysis.

Themes	Codes		Sub-Codes
Income Growth	1. Income	1.1	Measures for including low-income households
		1.2	Measures for diversifying farmers' income
		1.3	Targeted incentives for small farmers
Inclusion	2. Inclusion of the Vulnerable 3. Inclusive Governance 4. Inclusive Finance	2.1	Compensation mechanisms for landowners and the community
		3.1	Measures for inclusive decision-making
		3.2	Measures for promoting community-owned projects
		3.3	Measures to enhance inclusive participation
		4.1	Financial instruments for promoting inclusion
Equality of Opportunity and Outcomes	5. Employment and Skill Development 6. Gender 7. Resource Access 8. Environmental Conservation	5.1	Measures for promoting employment and entrepreneurship
		5.2	Provisions for the promotion of small-scale industries
		5.3	Measures for skill development and capacity building
		6.1	Measures for expanding opportunities for women
		7.1	Measures for rural development
		7.2	Recognition of land ownership inequalities and informal use
		8.1	Measures/provisions for environmental conservation
		8.2	Measures/provisions for waste management

4. Analytical Framework

To overcome the research gap of a lack of a pragmatic framework, we developed the ‘Energy Justice–SDG Framework’ to be used as a methodological tool for policy analysis. The framework draws from the existing frameworks and literature, highlighting the possible injustices of solar projects in the Global South. Its indicators serve as practical and tangible measures necessary for promoting justice and sustainability in the solar energy transition. The focus is on identifying injustices caused and mechanisms needed to reduce them, and mapping them against relevant SDG targets. The three dimensions are outlined below:

Income Growth: Solar energy projects, such as large-scale, rooftop, and off-grid, provide income opportunities. Direct opportunities come from selling electricity to the grid as project owners, selling/leasing land for solar projects, and new employment. Decentralized and off-grid projects can also open avenues for income growth by fostering productive activities [2,49,50]. However, the benefits of selling land for large solar projects have typically favored educated and wealthy landowners, while poor individuals have often sold their land at low prices due to a lack of information [51]. Furthermore, decentralized and off-grid solar projects, without subsidies, have been found to reinforce rural power structure and the energy poverty gap, primarily due to high upfront costs [33]. Similarly, solar-powered agricultural solutions create avenues for the diversification of farmers’ income by increasing agricultural productivity [52]. However, these opportunities are not equally accessible to small-scale farmers due to their limited land and financial resources [30,53]. The literature highlights promoting justice concerns through targeted mechanisms for low-income households and small-scale farmers to enhance accessibility and affordability [53,54].

Enhancing Inclusion: A ‘just’ solar energy transition should ultimately aim to enhance the inclusion of all stakeholders in the transition process, an important element of many frameworks [25,28,29]. An injustice linked to the large-scale solar projects is the loss of land access and livelihoods, along with inadequate compensation mechanisms for those lacking formal land titles [30,51]. Existing power relations also exclude the uneducated, poor, and women from decision-making processes [31,55,56]. Even in community-owned projects, community dialogues often involve the participation of the educated and wealthy [55]. Effective two-way information exchange, meaningful participation, and adequate representation of all groups, including the marginalized, are key elements of procedural justice that need to be incorporated into solar energy policies [56]. The barriers to including marginalized voices must be acknowledged, and inclusive financial mechanisms should be introduced for a sustainable transition.

Creating equal opportunities and ensuring just outcomes: This involves ensuring equal employment opportunities and providing necessary skills and capacity building. Ensuring equitable access to these opportunities would include creating long-term jobs and mechanisms for skilling and re-skilling [6,22,57]. The literature highlights that women are often excluded from these opportunities as energy-related jobs are often considered ‘masculine’ [58]. Furthermore, women do not enjoy similar opportunities as their male counterparts because they lack similar access to land, credit, and social networks [20,50,59]. Solar policies should act as instruments to enhance gender justice concerns [60]. Another indicator of a sustainable transition is increased energy access. While solar technologies support the goal of sustainable infrastructure, they may also contribute to infrastructural violence, which refers to the harm that disproportionately impacts marginalized communities [61]. The literature documents instances where the construction of large solar parks has adversely impacted nearby villagers because promised infrastructure improvements (roads, electricity, water, and schools) were not provided to them [61]. Recognizing the existing inequalities, especially in land ownership, is also crucial for creating equal opportunities and

just outcomes [29,31,51]. Although solar technologies are environmentally friendly, they can have negative impacts on the environment and biodiversity because of land clearing and waste generation [62,63]. A sustainable renewable energy policy would reduce GHG emissions, local pollution (air, water, noise), and maximize benefits to the environment.

The dimensions, sub-dimensions, and indicators of the framework are presented in Table 4.

Table 4. Analytical framework (energy justice–SDG framework).

Inequality Dimensions	Sub-Dimensions	Indicators	Relevant SDG Targets
Income Growth (T10.1)	Increasing the income of the poor and eradicating poverty	Mechanisms to provide new income opportunities	1.1, 1.2, 1.3
		Mechanisms for low-income households	
	Increasing the income of farmers	Mechanisms to increase and diversify farmers' income	2.3
		Targeted subsidies for small-scale farmers	
Enhancing Inclusion (T10.2)	Inclusion of the poor and vulnerable	Compensation mechanisms for owners and communities (landless and pastoralists) dependent on land	2.3
	Inclusive governance	Inclusive decision-making, community ownership, and effective participation of women/marginalized, and mechanisms to remove barriers of inclusion	16.6, 16.7, 16.10, 5.5
		Inclusive finance	
	Equality of Opportunity and Outcomes (T10.3)	Equitable employment and entrepreneurship opportunities; Skill development and capacity building	Creation of quality, safe, long-term, skilled, and unskilled jobs and entrepreneurship opportunities
Mechanisms for skilling, re-skilling of workers			4.3, 4.4, 4.5, 8.6, 8.8 (4.7)
Mechanisms for promoting small-scale industries			8.3, 9.2, 9.3, 9.4
Equal opportunities for women and promoting gender justice		Mechanisms to create equal opportunities for women and promote gender justice	5.5, 5.c (1.b, 5.4, 5.b)
Ensuring resource access, recognition of resource inequalities		Increased energy access and affordability, and promotion of infrastructure for rural development	7.1, 9.1, 17.17
		Recognition of land-ownership-based inequalities	1.4, 2.3, 5.a
Environmental and resource conservation		Mechanisms to reduce local pollution (air, water, land, noise) and GHG emissions	3.9, 6.3, 11.6, 12.4, 13.2, 14.1 (1.5, 11.b)
		Mechanisms to conserve natural resources, biodiversity, and waste management	6.6, 12.2, 12.5, 12.a, 14.5, 15.1, 15.3, 15.4 (15.2, 15.9)

There are many overlaps between the different dimensions and indicators. We also acknowledge that there may be additional relevant dimensions and SDG targets that are not included. However, the framework aims to provide a pragmatic approach rather than trying to address all SDG dimensions comprehensively.

5. Results—How Do India’s Solar Policies Promote Justice?

This section presents the findings from the policy analysis, structured around the three thematic dimensions of the framework—income growth, inclusion, and equality of opportunities.

The results within each dimension are organized based on sub-codes that were generated deductively from the framework. To enhance clarity, some results are grouped into broader sub-themes. We present the measures (mechanisms and provisions) found in solar policies that align with the identified dimensions of justice and sustainability.

5.1. Income Growth

Most policies include solar projects that could potentially enhance the income of developers, prosumers, and landowners. Still, only a few policies have mechanisms in place to protect the interests of low-income households. Similarly, mechanisms to help small and marginal farmers diversify their income were found to be limited.

5.1.1. Measures for Increasing the Income of Poor Households

Various solar projects, such as parks, rooftop systems, and off-grid applications, offer opportunities for developers, landowners, and consumers to boost their income. Through its model solar villages, Jharkhand’s solar policy promotes ‘citizen-led initiatives for income generation activities’ [64] (p. 24). The justice implications of solar policies are hinged on their accessibility and affordability for all households. Special mechanisms for low-income households were found in four states’ policies. Jharkhand’s solar policy provides an additional state subsidy for setting up residential rooftops to households with an annual income lower than 0.3 million (60% up to 3 kW and 80% for 3 kW–10 kW). In addition, it provides standalone solar home systems to the Economically Weaker Sections—those holding Ration Cards (Ration Cards are documents issued by the state government, under the National Food Security Act (NFSA), to households eligible to purchase subsidized grains from the Public Distribution System) and Below Poverty Line (BPL) cards [64]. Similarly, Uttar Pradesh’s solar policy provides standalone solar pack systems to unelectrified households; eligible Antyodaya card (ration cards issued to the ‘poorest of poor’ households) and BPL card holders are selected by the district-level committee, as per budget availability [65]. Bihar’s renewable energy policy exempts the Below Poverty Line (BPL) and agricultural consumers from the renewable energy development cess, collected from consumers towards development funds [66]. In contrast, other policies lack direct incentives, though few incorporate business models, such as third-party involvement and virtual net metering, aiding the participation of low-income households and those without a rooftop space.

5.1.2. Measures for Increasing the Income of Farmers

Many state solar policies support agricultural solar solutions that may boost productivity and farmers’ income. Four states (Rajasthan, Tamil Nadu, Uttar Pradesh, and Uttarakhand) specifically mention diversifying or increasing farmers’ income as a goal. Other policies have not explicitly mentioned income increase as an outcome, but have mechanisms contributing to the same ($n = 15$). These include the provision to sell surplus energy from grid-connected solar pumps or setting up solar plants on barren/uncultivable/agricultural land by farmers and selling generated electricity. Even without the provision to sell surplus energy, solar irrigation pumps provide daytime power, offering a cost-effective alternative to electricity or diesel pumps, which can help increase farmers’ total income. Many states provide subsidies for farmers, but targeted support for small-scale or marginalized farmers is limited. Uttar Pradesh stands out with its solar policy, offering a 70% additional subsidy

under the PM-KUSUM Scheme for Scheduled Tribe (ST), Vantangia, and Musahar farmers (marginalized communities), while other farmers receive a 60% state subsidy [65].

5.2. Enhancing Inclusion

While policies have measures for promoting inclusion, more efforts are needed toward the active inclusion of the marginalized. The relevant measures for each indicator are highlighted below.

5.2.1. Compensation Mechanisms for Landowners and the Community

The land for solar plants is acquired under the ‘Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation, and Resettlement Act, 2013’. Four states mandate that project developers pay for community development and rehabilitation. Telangana’s policy requires development charges of INR 25,000 per acre to be paid to the respective Gram Panchayat (Village Council) [67]. In Uttarakhand and Himachal Pradesh, when leasing government land with community rights, 1% of the project cost must be paid for community development to the Local Area Development Fund (LADF) [68,69]. Similarly, in West Bengal, developers/government shall acquire land by paying an amount (not exceeding 1% of the project cost) for the rehabilitation and resettlement of displaced persons [70]. In Kerala’s solar policy, in addition to lease rentals, a revenue-sharing model is included for tribal lands. Further, the ‘willingness of the land owner is mandatory’ and the land ownership rights remain with the landowner [71]. Himachal Pradesh’s policy extends beyond monetary compensation and offers preference for employment to private landowners or right holders who transfer land for solar projects [69].

5.2.2. Measures for Promoting Inclusive Decision-Making, Community Ownership, and Effective Participation

Inclusive participation is facilitated by inclusive governance structures, found in a few policies. Jharkhand’s policy highlights the role of a ‘Screening and Empowered Committee’ with representatives from relevant departments. The process of model solar villages involves coordination with many departments, including the ‘Department of Scheduled Tribe, Scheduled Class, Minority, and Backward Class Welfare’ [64]. However, most involve only the relevant departments. Regarding community participation and ownership, eight states permit groups of persons/farmer(s)/Panchayat/Associations to set up solar plants, promoting community ownership. Virtual net metering also falls under this category as it allows the participation of people with a shared or without a rooftop space. The solar villages and green cities/villages, promoted by some states, also have a component for community solar installations. To promote women’s participation, Jharkhand’s policy involves engaging women in model solar villages by working with women’s self-help groups and gathering information from village leaders about new business opportunities for women [64]. Uttarakhand’s policy mandates women’s representation in village-level committees (VLCs) for model solar villages [68].

5.2.3. Inclusive Financial Mechanisms

Many policies mention creating an enabling environment for businesses as one of the objectives. The financial models in these policies naturally favor private developers more than community ownership. The majority of states incentivize developers by offering deemed industry status, as per MNRE and industrial policy, such as exemption from transmission and distribution wheeling charges, open access clearance, etc. The most common financial mechanism among states to enhance financial viability is the RESCO/third-party owned model or virtual net metering for rooftop solar. Some policies have incentives catered to the needs of the different stakeholders. For example, Kerala’s policy has a

separate section on financing with models for different categories, including incentives for panchayats to promote solar installations. It also offers a special feed-in tariff scheme for consumers with monthly consumption lower than 30 units [71]. Goa's solar policy provides interest-free loans, up to 50% of the project cost, to small prosumers for setting up small projects (up to 100 kW). Additionally, it provides a 30% state subsidy for small standalone systems [72]. Jharkhand's policy provides easy access to end-user finance for model solar villages through the National Bank for Agriculture and Rural Development (NABARD), regional rural banks, etc. It offers both financial assistance and innovative business models, including community solar subscription, pay-as-you-go, etc., for promoting solar for rural development [64]. Some other states have additional state subsidies for rooftop solar, solar pumps, and community projects.

5.3. *Equal Opportunities and Outcomes*

Employment and skill development are the most dominant themes in the policies, revealing a gap in safeguarding women's needs and recognizing land-ownership-based inequalities. The relevant measures for each indicator are highlighted below.

5.3.1. Measures for Promoting Employment Opportunities, Skill Development, and Promotion of Small-Scale Industries

The focus on employment varies from a broad reference to specific measures. Only two states have quantified goals for job creation and skill training. Madhya Pradesh has a target to 'generate more than 10,000 new jobs in the renewable energy sector by 2024 and 50,000 new jobs by 2030', and Uttar Pradesh aims to 'train 30,000 youth' [65,73]. Seventeen states mention employment generation/and or skill development as one of the objectives. Out of these, Uttarakhand's policy focuses on employment generation and skill development of vulnerable communities [68]. Additionally, Assam's policy supports local entrepreneurs for off-grid applications, while Himachal Pradesh's policy promotes small projects for unemployed youth and local entrepreneurs [69,74]. Himachal Pradesh and Uttarakhand have taken an innovative step and mandate 80% and 50% of their employment potential to 'bona fide residents', respectively [68,69]. Similarly, Jammu and Kashmir's policy mandates developers to have a minimum of 50% employees from 'state subjects' [75]. Skill enhancement is another mechanism that promotes job creation for the local population. Seven states have a separate section on skill and capacity building, offering training related to solar manufacturing, installation, Operation and Maintenance (O&M), etc., through diplomas and certified courses. The inclusion of marginalized and vulnerable groups can be seen to some extent in the form of the reskilling of mine workers, in Jharkhand [64] and providing skill training to jail inmates, in Uttar Pradesh [65]. For promoting small-scale industries, most policies provide incentives to manufacturers under the industrial policy. Three states (Andhra Pradesh, Jharkhand, and Telangana) provide incentives, such as waiving off electricity duty, stamp duty, and customs duty, to new manufacturing industries [64,67,76]. Three states (Rajasthan, Uttarakhand, and Uttar Pradesh) provide incentives under the micro-, small, and medium enterprise (MSME) policy. Himachal Pradesh's policy promotes domestic manufacturers under the 'Make in India' initiative [69].

5.3.2. Measures for Expanding Opportunities for Women

The references to opportunities for women in the solar policies analyzed are missing, with three exceptions. The Jharkhand solar policy is the only one that mentions gender inclusiveness in its objectives, in the context of skilling and livelihood applications [64]. The solar policy of Bihar also aims to explore other rural livelihood programs (like JEEViKA) to reach out to women to support entrepreneurship [66]. The solar policy of Uttarakhand has referred to gender through its vision of creating livelihood opportunities for women. To

materialize the vision, it has a separate section on capacity building that mentions ‘gender inclusiveness’ in training sessions [68]. There are also measures to facilitate women’s participation, already discussed in Section 5.2.2.

5.3.3. Measures for Increasing Energy Access, Rural Development, and Recognition of Land Ownership Inequalities

While all policies focus on the goals of clean energy access, only a few explicitly refer to the SDGs. Assam’s solar policy refers to ‘fulfilling commitments under the Sustainable Development Goals by promoting clean, accessible, affordable, and equitable solar energy availability to ensure energy security for its citizens’ [74] (p. 5). Similarly, Gujarat’s policy vision refers to ‘achieve the State’s Sustainable Development Goals by a rapid transition to clean energy sources’ [77] (p. 2). Furthermore, the state policies of Jharkhand and Uttarakhand explicitly refer to SDG 7, in the context of ‘Energy Compacts’ (Energy Compacts are commitments by state and non-state actors to advance SDG 7) [64,68].

For increased energy access in rural areas, most state policies promote off-grid solutions to provide clean and affordable energy to remote areas. Jharkhand’s policy aims to solarize 1000 villages through new solar installations and scaling up existing initiatives [64]. Uttarakhand’s policy, in addition to solar villages, has community solar installations for rural development [68]. Land ownership inequalities are recognized to some extent by the policies of Goa and Kerala by having special provisions for ‘comunidade’ land and tribal land, respectively. As discussed, a few policies have compensation funds for the communities. However, no policy explicitly recognizes the existing ownership-based inequalities.

The different solar projects and the promotion of smart grids contribute to the development of reliable infrastructure. Most policies mention the responsibility of implementing agencies to facilitate the development of supporting infrastructure, such as roads, water facilities, etc., needed for large solar projects. While this is important, the infrastructure should be accessible to the local population. Only the policy of Himachal Pradesh aims to make project-related infrastructure, roads, healthcare, and educational facilities, available to the local population [69]. Rajasthan’s policy puts the responsibility on the state to develop local infrastructure, such as health and educational facilities [78]. The model solar villages of Jharkhand aim to solarize infrastructure to provide basic amenities (street lights, community hall, schools, etc.) to the village residents. No other policies have explicitly mentioned providing infrastructural access to the local population [64]. Fifteen states promote decentralized solutions for rural communities. These solutions have community benefits, including livelihood generation, community cooking, powering computers in schools, and refrigeration in hospitals, etc.

5.3.4. Measures for Environmental and Resource Conservation

Most policies mention the role of solar energy in fighting climate change. Many policies have exempted solar projects from pollution and forest clearances. Few policies require clearances from the forest department, whereas Jammu and Kashmir’s policy requires compensation for afforestation from developers in the case of forest land. Few measures are present for promoting resource conservation [75]. For instance, the promotion of floating solar by many states helps in reducing evaporation and increasing water availability. Jharkhand’s solar policy has included additional incentives for solar producers that use robotic methods and low-water technologies for cleaning solar modules [64]. Further, three policies (Bihar, Jharkhand, and Uttarakhand) have included undertaking Research and Development for the end-of-life management of solar PV modules.

A summary of different measures to promote justice present in state solar policies is provided in Figure 1 (A detailed list of measures in respective states and UTs is presented

in Appendix A). A comprehensive list of measures for each indicator by state is provided in the Supplementary Materials (Tables S1–S3).

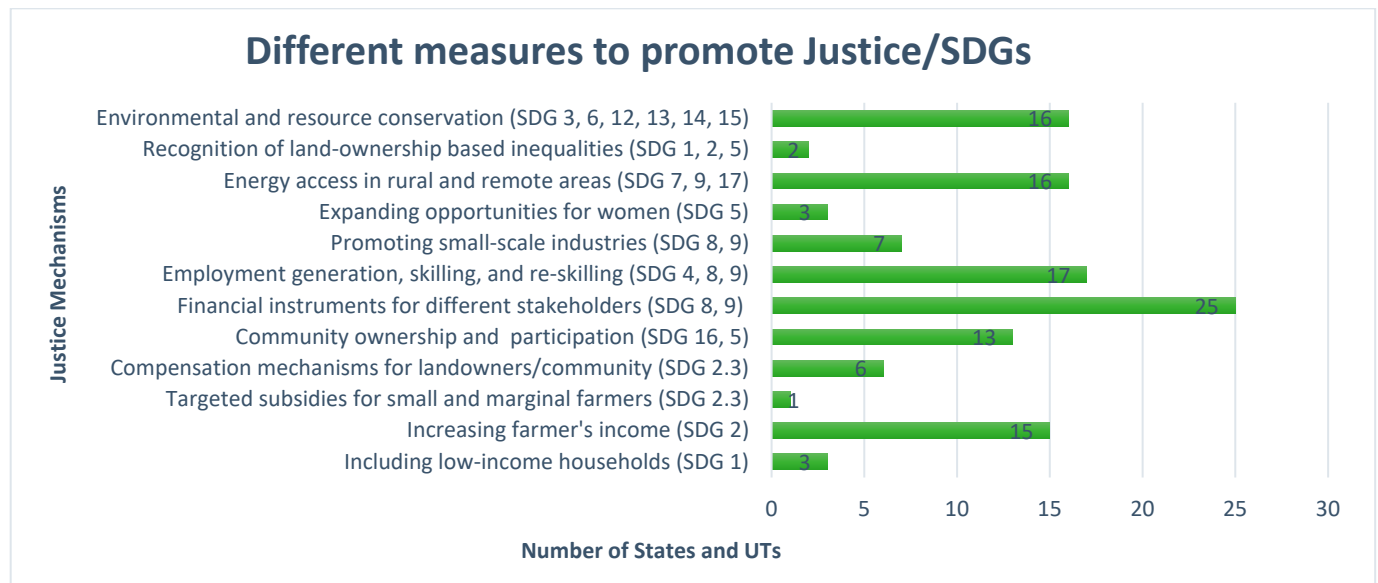


Figure 1. Distribution of justice measures in Indian solar energy policies.

6. Discussion

This paper analyzed Indian solar policies to answer the following research question: To what extent are justice and sustainability concerns addressed in the policies?

The analysis reveals that, while policies address energy access, employment, and skills development, they ignore structural inequalities (gender and poverty), prioritizing low-impact justice measures over transformative change. This stems from a lack of integration of procedural and recognitional justice principles in solar policies. Furthermore, while all states include sustainability dimensions indirectly, only four states (Assam, Gujarat, Jharkhand, and Uttarakhand) explicitly mention the SDGs in the policy's vision or preamble. The absence of a clear alignment with the SDGs limits policy coherence and accountability, revealing a critical gap between global discourse and national implementation.

In terms of income growth, there are some incentives for low-income households, but more efforts are required to aid their participation in the decentralized solar segment. Some policies recognize farmers as solar power generators, which is a step towards including them in the transition process. However, what seems to be missing is the recognition of land-based inequalities and targeted subsidies for small-scale farmers to prevent the reproduction of existing inequalities. Some states with special provisions for tribal land (Kerala) and additional subsidies for marginalized farmers (Uttar Pradesh) are a step towards fulfilling multiple SDGs through energy policies. A lack of mechanisms to equitably distribute income opportunities related to solar energy may perpetuate existing inequities between wealthy and low-income households, as well as between small and large farmers [33].

In terms of inclusion, only a few policies promote mechanisms to enhance inclusive participation and remove exclusion barriers. The representation of only a few departments stems from a narrow approach of treating solar expansion separately from other development concerns, hindering effective integration. The innovative step by a few states to mandate payment by developers towards community development can help benefit the local population. However, most policies have focused on compensation mechanisms for landowners, which can create a cycle of exclusion for the landless and pastoralists. Similar findings have been found during the construction of large-scale solar parks in

India [30,51]. Furthermore, policies have focused on creating an enabling environment for business and attracting private participation. This shows that large businesses are treated as ‘developers’ for large solar projects, while the communities are treated as mere beneficiaries of decentralized solar projects. The concept of model solar villages by a few states seems to be a good start toward this aim. However, the literature highlights that community-owned projects are also not free of injustices, as community dialogues can be influenced by the educated and affluent, with high social and cultural capital (e.g., caste, networks, community governance positions) [31,50,55]. Mechanisms for trust-building and effective participation are missing in the policy design, which might lead to the exclusion of vulnerable communities. The underrepresentation of vulnerable consumers in Renewable Energy Communities (RECs) has also been found in the European context [37]. There also seems to be a significant gap in terms of gender indicators, and it is still seen as a separate agenda to be undertaken by separate policies. While a few policies require women’s representation in village committees, this alone does not guarantee gender justice. True progress requires addressing structural inequalities and removing barriers to inclusion [50,60].

In terms of equal opportunities, while most policies have focused on employment generation and skill development, only a few measures stand out for promoting equitable opportunities. These include re-skilling of mine workers, employing ‘bona fide residents’, and gender-inclusive skill training. A lack of such measures can lead to the exclusion of the unskilled and uneducated. Many state policies have decentralized and off-grid solar projects, which are important infrastructures for communities, but the benefits of these projects are not explicitly highlighted. Most policies view solar as an environmentally friendly solution, and there is a gap in terms of recognizing the environmental externalities.

Overall, the findings from the three dimensions of the framework reveal that, while Indian states have addressed some justice concerns related to energy access, rural development, and employment, they lack explicit mechanisms to include the marginalized populations. Through policy analysis and the existing literature, we find that integrating the dimensions of the SDGs explicitly can provide a transformative pathway to enhance inclusivity by addressing structural injustices, thus leading to the synergistic implementation of the energy transition and sustainable development agenda. These findings advance the literature on energy justice, especially those that argue for integrating justice dimensions in the solar energy transition [21,79,80].

There are both similarities and differences between different states’ approaches to promoting solar. Most states have a similar vision to utilize solar technologies to meet energy needs and attract private investment. The differences across states exist in the extent of integrating different justice dimensions. Overall, the states of Himachal Pradesh, Jharkhand, Uttarakhand, and Uttar Pradesh have the most comprehensive policies. All these policies are relatively new and have been formulated after 2020. Furthermore, Jharkhand’s latest policy of 2022 has significant improvements from its earlier policy of 2018, highlighting a learning curve influenced by current needs and changing narratives around energy transition.

There are also opportunities for interstate learning. The various provisions and mechanisms included by some states can provide valuable insights for those who do not have similar systems in place. For instance, the practice of charging developers for community development in certain states could encourage others to adopt similar measures. Additionally, targeted subsidies for solar pumps aimed at marginalized farmers could be implemented in other states facing comparable structural injustices. Likewise, innovative approaches for managing tribal lands and enhancing women’s participation can be expanded and applied in other regions.

This paper makes both theoretical and policy contributions through the development of a pragmatic framework as well as comprehensive policy analysis. By linking justice principles to specific targets of all 17 SDGs, the framework contributes to a pragmatic and nuanced understanding of multiple opportunities for solar transition and the real potential of SDG synergies. It addresses the research gap regarding the lack of a practical framework and contributes to the literature while integrating scholarship on energy justice, just transition, and the SDGs. The integration of SDGs through a justice lens also contributes to the literature that highlights the limitations of the 2030 agenda and argues for the incorporation of justice principles in SDG targets as a prerequisite for sustainability [81]. The framework's indicators provide practical mechanisms for an inclusive energy transition, serving as a resource for researchers and policymakers in India and the Global South to develop just and sustainable energy systems. The comprehensive policy analysis provides evidence from real-world policy design, an underexplored area in the energy justice literature. It also provides actionable insights to policymakers, highlighting opportunities, gaps, and the potential for inter-state learning.

The research's scope and design pose a few limitations. First, the research has focused exclusively on solar policies and provides insights into the justice concerns of solar projects. The justice concerns of other renewable energy sources—wind, hydropower, bioenergy—may differ due to differences in technological design, ownership, and environmental implications. Future research should extend the framework to examine other renewable energy policies. Additionally, the overall framework can be enhanced through a mixed-methods approach that integrates insights from the literature, quantitative indicators, and stakeholder interviews to provide a comprehensive understanding. Second, this research is limited to analyzing the impact through the design of the policies, which may differ from the actual impact after implementation. This can be addressed in future research by conducting field visits in a few states to collect empirical data on how the policy mechanisms are implemented on the ground. The data collection and analysis can be enhanced by including quantitative data and primary data from stakeholder interviews. Third, the scope of the research focuses on the justice concerns related to the expansion of solar energy. It does not consider the potential injustices that could arise from not expanding solar energy, such as ongoing dependence on fossil fuels or unequal access to clean energy. Future studies could investigate these alternative scenarios to provide a more comprehensive understanding of the trade-offs involved in energy justice. Future studies can also expand the framework by a mixed-methods approach.

7. Conclusions

This paper aimed to examine whether and how Indian solar energy policies address justice concerns. The analysis indicates that justice and SDG lenses are missing from the policy design. While themes such as energy access, employment, and skill development are present in the solar policies, there is a noticeable lack of emphasis on the inclusion of marginalized groups, including the poor, women, and communities. Furthermore, while policies are aligned with sustainability dimensions, direct alignment with SDGs is limited. We argue that an SDG-centric approach is needed to drive a structural transformation instead of addressing surface-level concerns.

This paper addresses the research gap in energy policy analysis from the perspective of the SDGs. This framework, although applied in the Indian and solar context, has its application for other countries and renewable sources as well. It provides an SDG-centric approach to analyze clean energy policies and further help in developing more 'just' and 'sustainable' energy transition policies, enabling a synergistic implementation of the climate and sustainable development agenda. The findings from different solar policies

highlight innovative mechanisms and limitations, contributing to knowledge on India's energy transition strategy. We propose key recommendations, such as targeted subsidies, community ownership, gender-inclusive mechanisms, and inclusive decision-making, to be incorporated into future solar policies. Some specific provisions, such as revenue sharing for tribal land in Kerala and solar villages in Jharkhand and Uttarakhand, should be extended nationwide. Future research should concentrate on empirical studies within various states to uncover the reasons and mechanisms behind the level of integration and to further explore the differences between states. Additionally, researchers should apply this framework to other renewable energy sources and other countries of the Global South. The limitations of the research can be addressed by mixed-methods research, combining policy analysis with semi-structured interviews with relevant stakeholders.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/en18153952/s1>, Table S1: State-wise mechanisms for Income Growth; Table S2: State-wise mechanisms for Enhancing Inclusion; Table S3: State-wise Mechanisms for Equality of Opportunity and Outcome.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. Included SDG targets. Inclusion criteria: all SDG targets relevant for (a) inequality, (b) solar energy transition, and (c) the local level.

Dimension	Selected SDGs
Income Growth 10.1: By 2030, progressively achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average	1.1: By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than USD 1.25 a day 1.2: By 2030, reduce at least by half the proportion of men, women, and children of all ages living in poverty in all its dimensions according to national definitions 1.3: Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030, achieve substantial coverage of the poor and the vulnerable 2.3: By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists, and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets, and opportunities for value addition and non-farm employment

Table A1. Cont.

Dimension	Selected SDGs
Enhancing Inclusion 10.2: By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion, or economic or other status	2.3: By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists, and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets, and opportunities for value addition and non-farm employment
	5.5: Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic, and public life 16.6: Develop effective, accountable and transparent institutions at all levels
	16.7: Ensure responsive, inclusive, participatory, and representative decision-making at all levels Other targets
	16.10: Ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements
	8.10: Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance, and financial services for all 9.3: Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets 10.4: Adopt policies, especially fiscal, wage, and social protection policies, and progressively achieve greater equality
Equality of Opportunity and Outcome 10.3: Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies, and practices and promoting appropriate legislation, policies and action in this regard	8.3: Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity, and innovation, and encourage the formalization and growth of micro-, small-, and medium-sized enterprises, including through access to financial services
	8.5: By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value
	8.6: By 2020, substantially reduce the proportion of youth not in employment, education, or training
	8.8: Protect labor rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment
	9.2: Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries
	9.3: Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets 9.4: By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and a greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities

Table A1. *Cont.*

Dimension	Selected SDGs
Equality of Opportunity and Outcome 10.3: Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies, and practices and promoting appropriate legislation, policies and action in this regard	4.3: By 2030, ensure equal access for all women and men to affordable and quality technical, vocational, and tertiary education, including university 4.4: By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs, and entrepreneurship 4.5: By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples, and children in vulnerable situations Other targets: 4.7: By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship, and appreciation of cultural diversity and of culture's contribution to sustainable development 8.6, 8.8
	5.5: Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic, and public life 5.c: Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels Other targets: 1.b: Create sound policy frameworks at the national, regional, and international levels, based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions 5.4: Recognize and value unpaid care and domestic work through the provision of public services, infrastructure, and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate 5.b: Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women
	7.1: By 2030, ensure universal access to affordable, reliable, and modern energy services 9.1: Develop quality, reliable, sustainable, and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all 17.17: Encourage and promote effective public, public–private, and civil society partnerships, building on the experience and resourcing strategies of partnerships
	1.4: By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology, and financial services, including microfinance 2.3: By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists, and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets, and opportunities for value addition and non-farm employment 5.a: Undertake reforms to provide women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance, and natural resources, in accordance with national laws

Table A1. Cont.

Dimension	Selected SDGs
Equality of Opportunity and Outcome 10.3: Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies, and practices and promoting appropriate legislation, policies and action in this regard	3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management 12.4: By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water, and soil in order to minimize their adverse impacts on human health and the environment 13.2: Integrate climate change measures into national policies, strategies, and planning 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution Other targets: 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social, and environmental shocks and disasters 11.b: By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation, and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, holistic disaster risk management at all levels
	6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers, and lakes 12.2: By 2030, achieve the sustainable management and efficient use of natural resources 12.5: By 2030, substantially reduce waste generation through prevention, reduction, recycling, and reuse 12.a: Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production 14.5: By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information 15.1: By 2020, ensure the conservation, restoration, and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains, and drylands, in line with obligations under international agreements 15.3: By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought, and floods, and strive to achieve a land degradation-neutral world 15.4: Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity, and, by 2020, protect and prevent the extinction of threatened species Other targets: 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests, and substantially increase afforestation and reforestation globally 15.9: By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies, and accounts

Table A2. Excluded SDG targets. Exclusion criteria: all SDG targets not relevant for 1. inequality, 2. solar energy transition, and 3. the local level.

Criteria	Excluded SDG Targets
Not directly relevant to inequality	2.2, 2.4, 2.a, 2.b, 3.1–3.6, 3.a, 6.3, 6.5, 7.2, 8.2, 8.9, 9.4, 11.4, 12.1, 12.3, 12.6, 12.7, 12.b, 13.1, 13.3, 14.2, 14.3, 14.4, 14.c, 16.4, 16.5
Not relevant for solar energy transition	2.1, 2.2, 2.5, 2.b, 2.c, 3.1–3.8, 3.a–3.d, 4.1, 4.2, 4.6, 4.a, 4.c, 5.1, 5.2, 5.3, 5.6, 6.2, 6.4, 6.5, 6.b, 8.7, 8.9, 9.c, 10.5, 10.6, 10.7, 10.c, 11.1, 11.2, 11.3, 11.4, 11.5, 11.7, 11.a, 11.c, 12.3, 12.6, 12.7, 12.8, 12.b, 13.3, 14.2, 14.4, 14.6, 14.7, 14.b, 15.4, 15.7, 15.8, 15.c, 16.1, 16.2, 16.3, 16.4, 16.8, 16.9, 16.a, 16.b, 17.10, 17.11, 17.12, 17.13, 17.14, 17.15, 17.18, 17.19
Not relevant at the local level	1.a, 2.a, 2.b, 3.a–3.d, 4.b, 4.c, 6.a, 7.3, 7.a, 7.b, 8.1, 8.4, 8.a, 8.b, 9.a, 9.b, 10.5, 10.6, 10.a, 10.b, 12.c, 13.a, 13.b, 14.3, 14.6, 14.a, 14.c, 15.a, 15.b, 16.8, 17.1–17.12, 17.13, 17.18, 17.19

Table A3. State-wise solar policies and categories.

State/UT and Title of Policy	Operative Period	Solar Categories	Previous Policies	Other Policies
Andhra Pradesh Andhra Pradesh Solar Power Policy-2018	2019–2024	Solar power projects for sale to DISCOMs, captive use/third-party sale; solar parks; solar rooftop; solar pumps	Andhra Pradesh Solar Power Policy- 2015	Wind Power Policy-2018; Wind-Solar Hybrid Power Policy-2018; Renewable Energy Export Policy-2020; Pumped Storage Power Promotion Policy-2022; Green Hydrogen and Green Ammonia Policy-2023
Arunachal Pradesh Arunachal Pradesh State Electricity Regulatory Commission Draft Regulation for Rooftop Solar Grid Interactive systems based on Net Metering	2016	Grid-interactive rooftop solar	-	-
Assam Assam Renewable Energy Policy-2022	2022–2027	Grid-connected solar (solar park, solar power plants for sale to DISCOM, for REC mechanism; solar plant in agriculture, captive solar power plant); rooftop (Industrial, residential, state government installations); off-grid (Solar pump, mini/microgrid, SHS, etc.); EV-charging infrastructure		
Bihar Bihar Policy for Promotion of New and Renewable Energy Sources-2017	2017–2022	Grid-connected solar (solar power plants for sale to DISCOM, for REC mechanism; sale to captive consumers/third party); grid-connected rooftop solar; solar parks; mini-grid projects; canal solar/floating solar; decentralized (street light, solar pumps, water heater, etc.)	Bihar Policy for Promotion of New and Renewable Energy Sources-2011	
Chhattisgarh Chhattisgarh State Solar Energy Policy (only in regional language)	2017–2027			Wind Energy Policy-2006; Small Hydro Policy-2012
Goa Goa State Solar Policy-2017	2017–2024	Solar projects, ground-mounted and rooftop (prosumer, producer); solar power plants under REC; third-party sale; rooftop solar through RESCO		

Table A3. Cont.

State/UT and Title of Policy	Operative Period	Solar Categories	Previous Policies	Other Policies
Gujarat Gujarat Renewable Energy Policy-2023	2023–2028	Ground-mounted solar (solar park or outside), rooftop solar, floating/canal-based solar, wind–solar hybrid, RE projects under REC mechanism,	Gujarat Solar Power Policy 2021; Gujarat Wind Power Policy 2016; Gujarat Wind Solar Hybrid Power Policy-2018	Small Hydel Policy-2016; Waste to Energy Policy-2022
Haryana Haryana Solar Power Policy-2016	2016–until new policy	Ground-mounted solar (megawatt scale, capacity reservation, solar parks, canal-based); rooftop solar; solar pumps; decentralized and off-grid solar	Haryana Solar Power Policy-2014	
Himachal Pradesh Himachal Energy Policy-2021	2021	Grid-connected rooftop (net-metering and captive use), ground-mounted solar (small and large capacity, floating solar), wind-solar hybrid	Solar Power Policy-2016	
Jharkhand Jharkhand State Solar Policy-2022	2022–2027	Utility scale solar projects (solar park, non-park solar, floating solar, canal top); distributed solar projects (rooftop solar, captive and group captive, solar agriculture—solar plants, solar pumps); off-grid solar (model solar villages-min/microgrid, SHS, solar for livelihood, solar pump); integrated solar (EV-charging stations, hybrid RE)	Jharkhand State Solar Policy-2015	
Karnataka Karnataka Renewable Energy Policy-2022–2027	2022–2027	Grid-connected solar; rooftop solar; distributed solar (solarization of agriculture feeders and solar pumps); EV-charging station		
Kerala Kerala Solar Energy Policy-2013	2013–until new policy	Grid-connected solar, off-grid, solar thermal		Renewable energy policy-2002
Madhya Pradesh Madhya Pradesh Renewable Energy Policy-2022	2022–2027	Ground-mounted, floating solar, canal top; grid-connected RE projects (like Comp. A of PM-KUSUM scheme)		Policy for Decentralized RE Systems-2016
Maharashtra Transmission Linked/Non-Transmission Integrated Renewable Energy Strategy- 2020 (only in regional language)	2020			Non-Conventional Energy Generation Policy-2020
Manipur Manipur Grid-Interactive Rooftop Solar Photo-Voltaic (SPV) Power Policy-2014	2015	Grid-interactive rooftop solar		
Meghalaya Meghalaya State Electricity Regulatory Commission (Rooftop Solar Grid Interactive systems based on Net metering) Regulations-2015	2015	Grid-interactive rooftop solar		
Mizoram Solar Power Policy of Mizoram-2017	2017–until further order	Grid-connected projects (under central govt., state govt., REC mechanism, captive generation, third-party sale); grid-connected rooftop; off-grid projects (SHS, solar lanterns, solar pack, solar pumps)		
Nagaland	-		-	-
Odisha Odisha Renewable Energy Policy-2022	2022–2030	Land-based solar (solar park, non-park solar); rooftop solar, floating solar; canal top solar; distributed solar (grid-connected solar pumps, solar cookers, solar dryer, etc.); EV-charging stations; solar cities		

Table A3. Cont.

State/UT and Title of Policy	Operative Period	Solar Categories	Previous Policies	Other Policies
Punjab New and Renewable Energy Sources of Energy (NRSE) Policy-2012	2012–until new policy	Rooftop solar; decentralized and off-grid (solar thermal, solar PV lighting system, SPV pumps)	New and Renewable Energy Sources of Energy (NRSE) Policy-2006	
Rajasthan Rajasthan Renewable Energy Policy-2023	2023–until new policy	Grid-connected utility-scale (solar parks, sale to DISCOM, captive use, third party sale); rooftop solar, floating/canal solar; decentralized grid-connected; off-grid solar (pumps, stand-alone solar system)		Green Hydrogen Policy-2023; Biomass and Waste to Energy Policy-2023
Sikkim Grid Connected Rooftop Solar Photovoltaic System Policy for Sikkim-2019	2019–2022	Grid-connected rooftop solar		
Tamil Nadu Tamil Nadu Solar Energy Policy-2019	2019–until new policy	Grid feed-in (gross feed-in, consumer net feed-in); EVs; solar–thermal	Tamil Nadu Solar Energy Policy-2012	
Telangana Telangana Solar Power Policy-2015	2015–2020	Solar parks; Solar power projects (grid-connected for sale to DISCOMs, third-party sale, captive generation, solar thermal); rooftop solar (grid and off-grid); solar pump sets; off-grid		
Tripura	-		-	-
Uttarakhand Uttarakhand State Solar Policy-2023	2023–until new policy	Utility-scale solar, distributed solar (residential rooftop solar, community solar, solar villages, mini/micro-grids, solar for livelihood, commercial rooftop, captive and third party, institutional, agricultural grid and off-grid solar installations, and solar pumps)	Uttarakhand Solar Energy Policy, 2013	
Uttar Pradesh Uttar Pradesh Solar Energy Policy-2022	2022–2027 (or till new policy, whichever is earlier)	Utility-scale solar projects; rooftop solar (residential, non-residential), distributed solar (solar pumps, feeder solarization); floating/canal solar; off-grid solar (solar plants, solar lights, solar pack system, solar pump, etc.)		
West Bengal West Bengal Policy on Co-Generation and Generation of Electricity from Renewable Sources of Energy-2012	2012–2022	Grid-connected utility scale; rooftop solar and small projects; distributed solar		
Andaman and Nicobar Islands Joint Electricity Regulatory Commission for the State of Goa and Union Territories (Draft Solar PV Grid Interactive System based on Net Metering) Regulations-2019	2019	Grid-connected land/rooftop solar		
Chandigarh Joint Electricity Regulatory Commission for the State of Goa and Union Territories (Draft Solar PV Grid Interactive System based on Net Metering) Regulations-2019	2019	Grid-connected land/rooftop solar		

Table A3. *Cont.*

State/UT and Title of Policy	Operative Period	Solar Categories	Previous Policies	Other Policies
Dadra and Nagar Haveli and Daman and Diu Renewable Energy Policy-2024 for U.T. of Dadra and Nagar Haveli and Daman and Diu	2024–until new policy	Solar PV rooftop, ground-mounted, floating		
The Government of NCT of Delhi Delhi Solar Policy, 2016	2016–2020	Grid-connected rooftop solar		
Jammu and Kashmir Solar Power Policy for Jammu and Kashmir-2013	2013–until new policy	Solar power plants		Policy for Grid Connected Rooftop Solar Photovoltaic Power Plant-2016 (Net-Metering Based); Policy for Development of Micro/Mini-Hydro Power Project-2011
Ladakh	N/A			
Lakshadweep Joint Electricity Regulatory Commission for the State of Goa and Union Territories (Draft Solar PV Grid Interactive System based on Net Metering) Regulations-2019	2019	Grid-connected land/rooftop solar		
Puducherry Solar Energy Policy-2015	2015–until new policy	Grid-connected solar PV (rooftop, solar parks), solar–wind hybrid, solar thermal, solar pumps		

Table A4. Different measures to promote justice present in state solar policies.

Sub-Dimension/Indicator	Specific Mechanisms/Provision	States/UT
Mechanisms for low-income households	Subsidies for low-income households Standalone solar home systems for BPL households Exemption of BPL and agricultural consumers from tax	Jharkhand Jharkhand, Uttar Pradesh Bihar
Mechanisms for increasing and diversifying farmer's income	Promotion of solar pumps, sale of surplus energy through grid-connected solar pumps Setting up small solar projects by farmers	Andhra Pradesh, Assam, Bihar, Haryana, Jharkhand, Karnataka, Mizoram, Odisha, Punjab, Puducherry, Rajasthan, Telangana, Uttarakhand, Uttar Pradesh Assam, Bihar, Himachal Pradesh, Jharkhand, Rajasthan
Targeted subsidies for small and marginal farmers	Additional subsidy to ST and marginalized farmers for solar pumps	Uttar Pradesh
Compensation mechanisms for landowners and community	Payment of development charges to support rehabilitation and community development Revenue sharing model for tribal land Special provisions for comunidade and tribal land	Telangana, Himachal Pradesh, Uttarakhand, West Bengal Kerala Goa, Kerala

Table A4. Cont.

Sub-Dimension/Indicator	Specific Mechanisms/Provision	States/UT
Inclusive decision-making, community ownership and participation	Involvement of different ministries, departments, and organizations Allowing projects to be installed by groups of individuals/farmers/cooperatives (collective generation) Promotion of community-owned projects Representation of women in model solar villages	Jharkhand, Mizoram, Punjab, Uttarakhand, Uttar Pradesh Andhra Pradesh, Assam, Bihar, Jharkhand, Uttarakhand Andaman and Nicobar Islands, Chandigarh, Lakshadweep Bihar, Jharkhand, Kerala, Madhya Pradesh, Uttarakhand Jharkhand, Uttarakhand
Financial instruments as per needs of different stakeholders	Additional state subsidies for solar projects (small, rooftop, solar pumps) Interest-free loan for small prosumers; subsidy for standalone systems Generation-based incentive Virtual-net metering for rooftop solar RESCO Model/Third-party owned Other incentives for the promotion of solar (Panchayat, farmers) Innovative business models for decentralized solar (community subscription, pay-as-you-go)	Andhra Pradesh, Assam, Bihar, Goa, Haryana, Jharkhand, Uttarakhand, Uttar Pradesh Goa Delhi, Sikkim, West Bengal Dadra and Nagar Haveli and Daman and Diu, Delhi, Jharkhand, Puducherry, Sikkim, Uttar Pradesh, Uttarakhand Arunachal Pradesh, Assam, Bihar, Goa, Haryana, Jharkhand, Manipur, Meghalaya, Mizoram, Rajasthan, Odisha, Sikkim, Uttar Pradesh, Uttarakhand, Dadra and Nagar Haveli and Daman and Diu, Delhi, Puducherry, Andaman and Nicobar Islands, Chandigarh, Lakshadweep Kerala, Tamil Nadu, Madhya Pradesh, Rajasthan Jharkhand
Employment opportunities and skill development	Employment generation and/or skill development as one of the objectives Reserving employment opportunities for 'bona fide residents', state subjects Separate section on skill and capacity building (capacity building and training sessions) Re-skilling of mine workers Skilling of jail inmates	Andhra Pradesh, Bihar, Dadra and Nagar Haveli and Daman and Diu, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Kerala, Madhya Pradesh, Mizoram, Odisha, Rajasthan, Sikkim, Uttarakhand, Uttar Pradesh Himachal Pradesh, Uttarakhand, Jammu and Kashmir Bihar, Himachal Pradesh, Jharkhand, Madhya Pradesh, Uttarakhand, Uttar Pradesh, Jharkhand Uttar Pradesh
Promotion of small-scale industries	Incentives to new or domestic manufacturing industries Incentives under the Micro-, Small, and Medium Enterprise (MSME) policy	Andhra Pradesh, Jharkhand, Telangana, Himachal Pradesh Rajasthan, Uttarakhand, Uttar Pradesh
Equal Opportunities for Women	Creating livelihood opportunities for women Gender-inclusive skill training	Bihar, Jharkhand, Uttarakhand Jharkhand, Uttarakhand

Table A4. Cont.

Sub-Dimension/Indicator	Specific Mechanisms/Provision	States/UT
Increased energy access and infrastructure for rural development	Promotion of decentralized solar applications in remote areas Non-electricity applications (solar cooker, heater, desalination, dryer) Prioritizing tribal areas for off-grid applications Special consideration for rural targets Provision to provide access to infrastructure (roads, water) to the local population	Assam, Bihar, Haryana, Himachal Pradesh, Jharkhand, Kerala, Madhya Pradesh, Mizoram, Odisha, Punjab, Rajasthan, Uttarakhand, Uttar Pradesh, West Bengal, Dadra and Nagar Haveli and Daman and Diu Bihar, Haryana, Himachal, Jharkhand, Kerala, Odisha, Punjab, Uttar Pradesh, West Bengal Uttar Pradesh Sikkim Himachal Pradesh
Recognition of land ownership inequalities	Special mechanisms for comunidade and tribal land	Goa, Kerala
Environmental and resource conservation	Promotion of floating solar for preventing water loss Promotion and incentivization of technologies for water conservation R&D for the end-of-life management of solar PV modules	Assam, Bihar, Delhi, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Madhya Pradesh, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh, Andaman and Nicobar Islands, Chandigarh, Lakshadweep Jharkhand Bihar, Jharkhand, Uttarakhand

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