From Policy to Practice- Barriers to Solar Energy Development in Nepal: A Systematic Literature Review

Abstract

Nepal holds immense solar energy potential, estimated at 432 gigawatts, yet its grid-connected capacity remains minimal at only about 107 megawatts as of mid-2024. To understand this disparity, this study conducted a systematic review aiming to comprehensively identify, categorize, and analyze the barriers hindering solar energy deployment in the country, synthesizing literature from 2010 to 2024. Adhering to PRISMA 2020 guidelines, the research methodically examined peer-reviewed and gray literature from major databases and institutional sources, employing the SPIDER framework for inclusion and conducting quality assessment with the Mixed Methods Appraisal Tool. Thematic synthesis of 89 studies revealed six primary barrier categories, with regulatory frameworks (91%), economic constraints (88%), and institutional capacity (85%) being the most prevalent, followed by complex permitting (79%), technical limitations (76%), and social factors (45%). The analysis further uncovered that institutional barriers intensified after Nepal's 2015 federal restructuring and that barrier profiles varied significantly across different ecological zones. The study concludes that overcoming these challenges requires integrated policy interventions focused on improving inter-governmental coordination, streamlining permits, and enhancing financing mechanisms. Nepal's impending graduation from Least Developed Country status in November 2026 is noted as a critical juncture presenting both challenges and a unique opportunity to accelerate its solar energy transition.

Keywords: Solar Energy, Nepal, Barriers, Systematic Review, Federal Transition

Introduction

Nepal, a landlocked country located between China and India, faces distinct energy challenges arising from its geographic constraints and developmental status. The country possesses noteciable solar energy resources, receiving average global solar radiation ranging from 3.6 to 6.2 kWh/m² per day across approximately 300 sunny days annually (Alternative Energy Promotion Centre & GIZ, 2024). This solar irradiation pattern establishes a theoretical generation potential of approximately 432 GW, representing nearly tenfold the technically and economically feasible hydropower potential of 42,000 MW (Investment Board Nepal, 2024). Despite these favorable conditions, Nepal's grid connected solar capacity reached only 107 MW by August 2024, representing less than 0.025% of its potential (Nepal Electricity Authority, 2024a).

The energy landscape in Nepal demonstrates significant evolution over recent decades. Total installed electricity capacity reached 3,157 MW by August 2024, with hydropower contributing approximately 95% of this capacity at 2,991 MW (Nepal Electricity Authority, 2024a). By July 2025, total installed capacity further increased to 3,878 MW as reported by Nepal's Energy Ministry (Ministry of Energy, Water Resources and Irrigation, 2025). Solar energy contribution remains at very nominal level despite the country having successfully eliminated scheduled load shedding since early 2018.

Nepal's classification as a Least Developed Country scheduled for graduation in November 2026 adds urgency to energy transition discussions (United Nations, 2024). The graduation will affect access to concessional financing mechanisms and preferential market access that have historically supported renewable energy development. Simultaneously, Nepal has committed to achieving net zero emissions by 2045 under the Paris Agreement, necessitating substantial expansion of renewable energy capacity (Government of Nepal, 2021).

Nepal's renewable energy policy framework has evolved considerably since the establishment of the Alternative Energy Promotion Centre in 1996. The Renewable Energy Policy of 2006 established initial targets for renewable energy development, while subsequent revisions in 2016 incorporated more ambitious goals aligned with international commitments. The 2015 Constitution of Nepal introduced federal governance structures, creating new institutional arrangements at provincial and local levels with significant implications for energy sector governance.

The regulatory framework for alternative electricity development enforced since January 2018 establishes power purchase agreement mechanisms through competitive bidding with maximum base prices of NPR 5.94 per unit for solar projects (Ministry of Energy, Water Resources and Irrigation, 2018). Recent tender announcements demonstrate evolving government priorities, with the November 2024 solar tender allocating 960 MW across 64 projects, achieving lowest bids of NPR 4.99 per kWh or approximately USD 0.037 per kWh (Nepal Electricity Authority, 2024b).

The substantial gap between Nepal's solar energy potential and actual deployment suggests the presence of significant barriers requiring systematic investigation. While individual studies have examined specific aspects of renewable energy development in Nepal, no comprehensive synthesis has analyzed the full spectrum of barriers impeding solar energy expansion. Understanding these barriers is the urgent need in the present context, considering the fact that Nepal is approaching to LDC graduation in 2026, the government has made net zero commitments, and solar energy pricing has been reduced to a noticeable level in recent tenders.

This systematic review pursues three primary objectives. First, to identify and categorize barriers to solar energy development in Nepal through a comprehensive synthesis of available evidences. Second, to analyze temporal trends in barrier across the study period from 2010 to 2024. Third, to develop evidence-based policy recommendations addressing identified barriers while considering the specific context of Nepal's federal governance structure and approaching LDC graduation.

Methods

Study Design and Registration

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) 2020 guidelines (Page et al., 2021). The review protocol was developed prior to conducting searches and followed established methodological standards for systematic reviews in energy policy research.

Search Strategy

Systematic searches were conducted across four electronic databases including Scopus, Web of Science, IEEE Xplore, and PubMed. The search strategy combined terms related to solar energy with Nepal specific terms and barrier related terminology. Boolean operators connected search terms as follows: ("solar energy" OR "solar power" OR "photovoltaic" OR "PV") AND ("Nepal" OR "Nepalese") AND ("barrier" OR "challenge*" OR "constraint" OR "obstacle" OR "impediment*"). Searches were limited to publications from January 2010 through October 2024.

Gray Literature Sources

Recognizing the importance of policy documents and institutional reports in energy research, gray literature searches encompassed multiple sources. Government sources included publications from the Ministry of Energy, Water Resources and Irrigation, Nepal Electricity Authority, Alternative Energy Promotion Centre, and Water and Energy Commission Secretariat. International organization reports from the World Bank, Asian Development Bank, International Renewable Energy Agency, and bilateral development partners were systematically reviewed.

Eligibility Criteria

The SPIDER framework guided eligibility determination (Cooke et al., 2012). Sample criteria required focus on Nepal's energy sector with specific attention to solar energy or renewable energy more broadly. Phenomenon of Interest encompassed barriers, challenges, constraints, or obstacles to solar energy development. Design included qualitative, quantitative, and mixed methods studies as well as policy analyses and institutional assessments.

Quality Assessment

The Mixed Methods Appraisal Tool (MMAT) assessed study quality across quantitative, qualitative, and mixed methods designs (Hong et al., 2018). Studies were categorized as high quality with MMAT scores of 75% or above, medium quality with scores from 50% to 74%, and low quality with scores below 50%. Studies scoring below 25% were excluded from synthesis.

Data Extraction and Synthesis

Data extraction captured study characteristics including publication year, research design, geographic focus, and funding sources. Barrier identification recorded all barriers mentioned with supporting evidence, categorization, and contextual factors. Synthesis employed thematic analysis to develop barrier categories inductively from extracted data.

Results and Discussion

Database searches identified 1,580 records including 623 from Scopus, 412 from Web of Science, 298 from IEEE Xplore, and 247 from PubMed. Gray literature searches contributed 267 additional records for a total of 1,847 records. Following duplicate removal of 432 records, 1,415 records underwent title and abstract screening. Of these, 186 proceeded to full text assessment with 97 excluded for reasons including non Nepal focus at 35 studies, insufficient barrier analysis at 28 studies, publication before 2010 at 18 studies, and low quality scores at 16 studies. The final synthesis included 89 studies meeting all eligibility criteria. Figure 1 presents the complete PRISMA flow diagram.

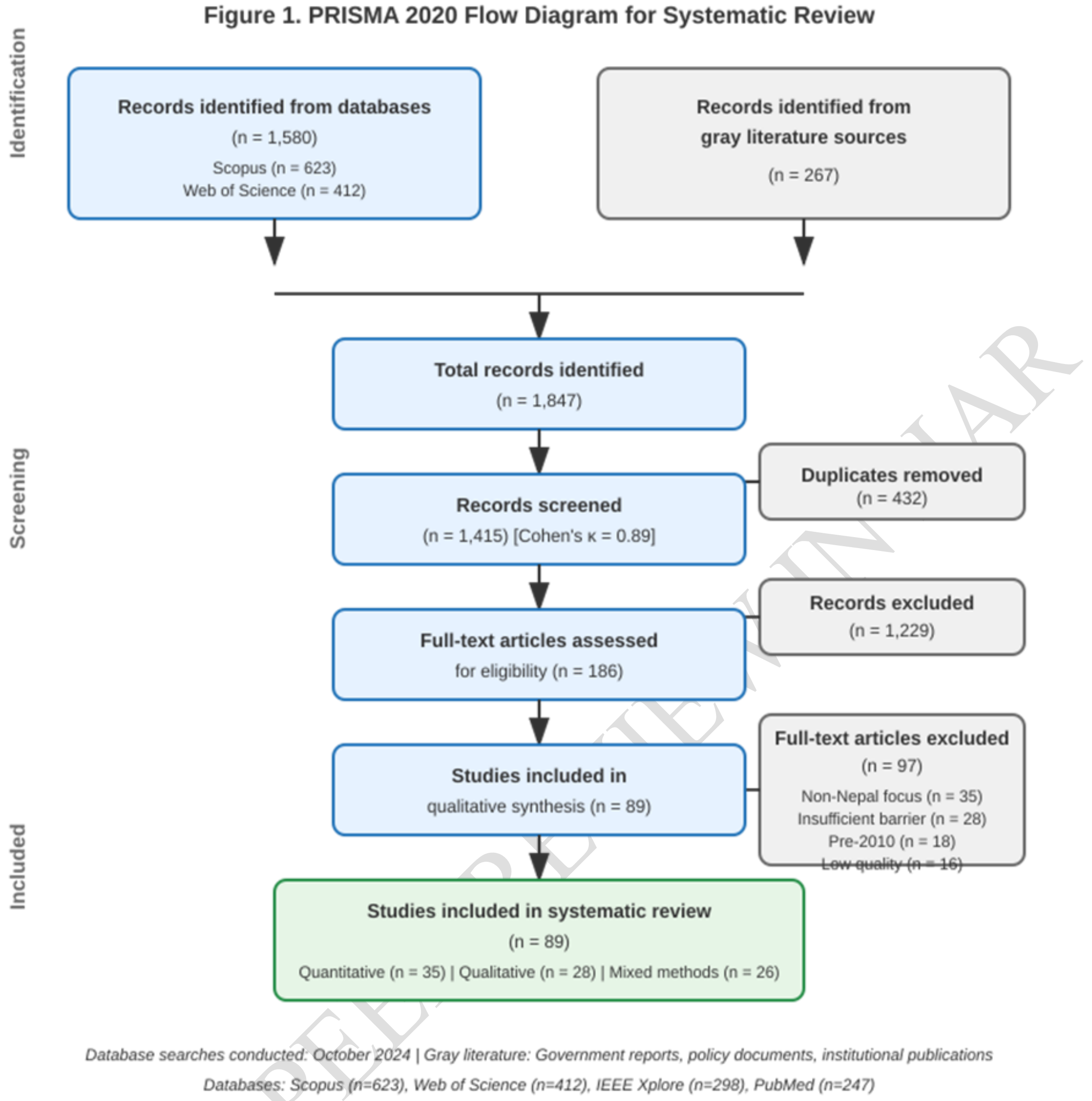

Figure 1. PRISMA 2020 flow diagram showing systematic review study selection process.

Table 1 summarizes characteristics of included studies. Research designs comprised quantitative studies at 39% representing 35 studies, qualitative studies at 31% representing 28 studies, and mixed methods studies at 29% representing 26 studies.

Table 1. Characteristics of Included Studies (N = 89)

Characteristic	N	%
Study Design		
Quantitative	35	39
Qualitative	28	31

Characteristic	N	%
Mixed methods	26	29
Publication Period		
2010 to 2014	15	17
2015 to 2019	34	38
2020 to 2024	40	45
Geographic Focus		
Kathmandu Valley	45	51
Terai Region	28	31
Hill Districts	18	20
Mountain Region	12	13
National Level	24	27
Quality Assessment (MMAT)		
High (≥75%)	68	76
Medium (50 to 74%)	19	21
Low (25 to 49%)	2	2

Note. MMAT = Mixed Methods Appraisal Tool. Geographic categories are not mutually exclusive as some studies examined multiple regions.

Barrier Categories and Prevalence

Thematic synthesis identified six primary barrier categories with varying prevalence across reviewed studies. Table 2 presents detailed barrier categorization with sub barriers and identification frequencies. Figure 2 illustrates barrier prevalence with confidence intervals.

Table 2. Barrier Categories and Sub-Barriers Identified in Reviewed Studies (N = 89)

Barrier Category	Sub-Barrier	n	%
Regulatory (n=81, 91%)			
	Inconsistent policy frameworks	73	82
	Policy instability/frequent revisions	65	73
	Unclear regulatory requirements	59	66
	Net metering policy gaps	52	58
Economic (n=78, 88%)			
	High upfront capital costs	72	81
	Limited financing mechanisms	68	76
	Currency fluctuation risks	61	69
	Inadequate financial incentives	56	63
Institutional (n=76, 85%)			
	Coordination failures between agencies	71	80
	Technical capacity gaps	65	73
	Bureaucratic inefficiency	59	66
	Weak monitoring mechanisms	54	61
Permitting (n=70, 79%)			
	Multiple clearances required	66	74
	Extended processing timelines	62	70
	Absence of one-stop services	58	65

Barrier Category	Sub-Barrier	n	%
	Unclear documentation requirements	53	60
Technical (n=68, 76%)			
	Inadequate grid infrastructure	63	71
	No systematic grid planning	58	65
	Limited smart grid capabilities	54	61
	Voltage fluctuation issues	49	55
Social (n=40, 45%)			
	Limited awareness of benefits	36	40
	Gender exclusion in decisions	32	36
	Land use conflicts	28	31

Note. Percentages for sub-barriers calculated as proportion of total studies (N = 89). Multiple sub-barriers could be identified within each study.

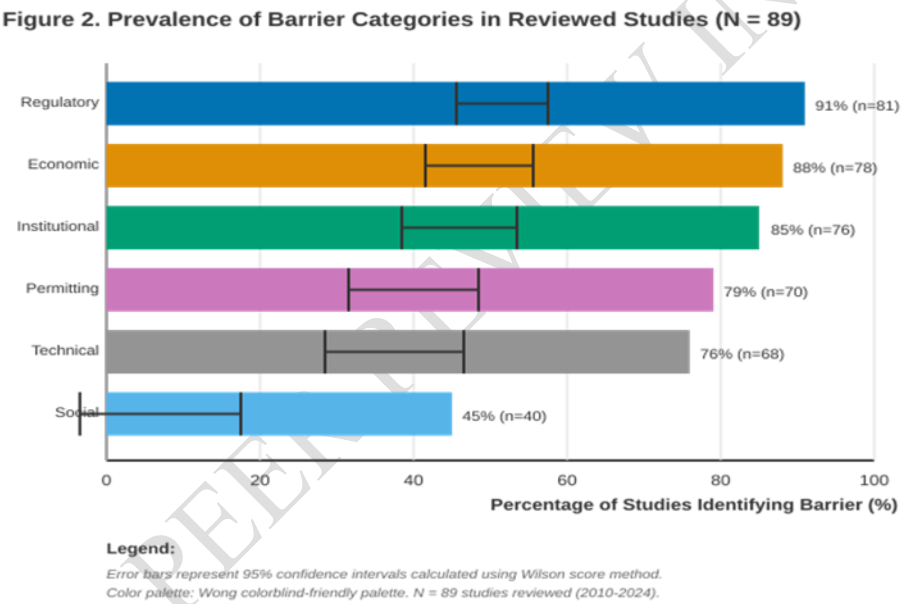

Figure 2. Prevalence of barrier categories in reviewed studies (N = 89). Error bars represent 95% confidence intervals calculated using Wilson score method.

Temporal Evolution of Barriers

Analysis across three time periods revealed significant evolution in barrier identification patterns as illustrated in Figure 3 and Table 3. The most notable change occurred in institutional barriers, which increased from 56% during 2010 to 2014, to 82% during 2015 to 2019, and further to 95% during 2020 to 2024. Chi square analysis confirmed statistical significance of this temporal trend at $\chi^2 = 11.47$ with p less than 0.01.

Table 3. Temporal Evolution of Barrier Identification by Period

Barrier Category	2010-2014 (n=15)	2015-2019 (n=34)	2020-2024 (n=40)	χ^2 (p-value)
Regulatory	88%	88%	95%	1.82 (ns)
Economic	85%	85%	92%	6.89*
Institutional	56%	82%	95%	11.47**

Barrier Category	2010-2014 (n=15)	2015-2019 (n=34)	2020-2024 (n=40)	χ² (p-value)
Permitting	69%	76%	85%	3.24 (ns)
Technical	75%	74%	77%	0.45 (ns)
Social	38%	44%	49%	2.15 (ns)

*Note. *p < 0.05, **p < 0.01, ns = not significant. Values represent percentage of studies in each period identifying the barrier category.*

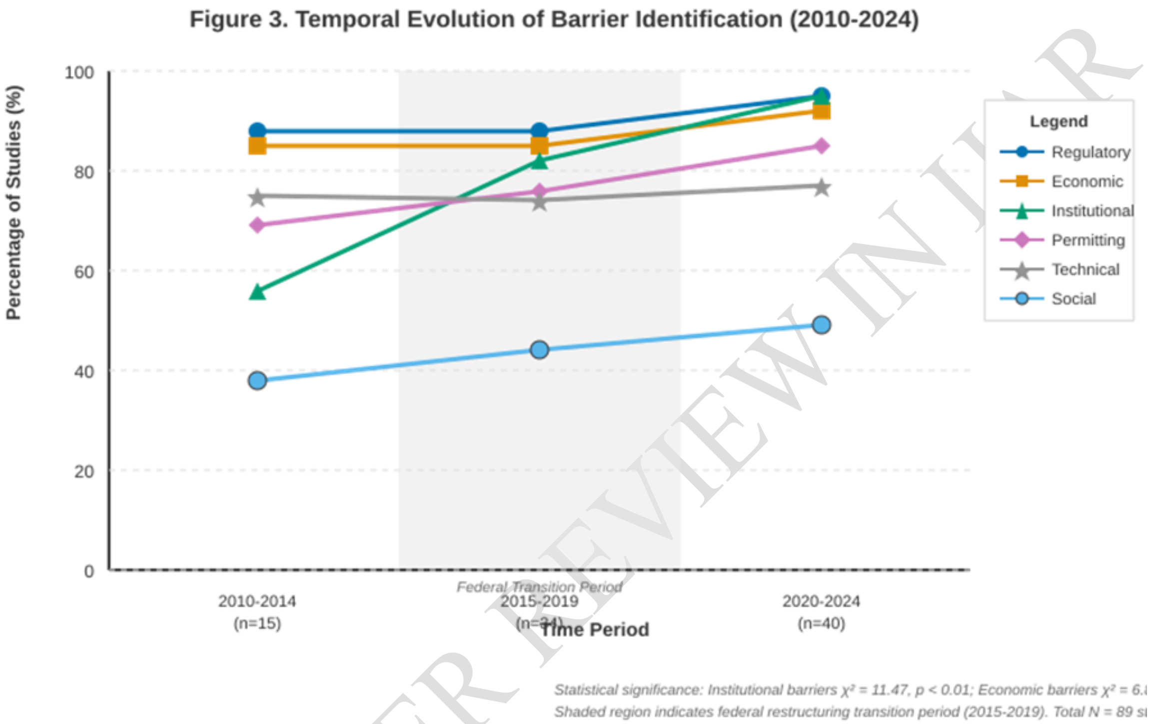

Figure 3. Temporal evolution of barrier identification across three periods (2010-2024). Shaded region indicates federal restructuring transition period.

Geographic Variation

Barrier prevalence demonstrated significant geographic variation reflecting Nepal's diverse ecological and administrative contexts. Table 4 presents barrier identification by geographic region.

Table 4. Geographic Distribution of Barrier Identification

Barrier Category	Mountain (n=12)	Hills (n=18)	Terai (n=28)	National (n=24)	Primary Focus
Regulatory	75%	78%	79%	96%	National
Economic	67%	83%	75%	88%	Hills
Institutional	58%	72%	71%	96%	National
Permitting	50%	67%	75%	83%	National
Technical	92%	78%	68%	79%	Mountain
Social	42%	50%	46%	42%	Hills

Note. Values represent percentage of studies within each geographic category identifying the barrier. Solar irradiation: Mountain 3.6-4.5 kWh/m²/day, Hills 4.0-5.0 kWh/m²/day, Terai 4.5-5.1 kWh/m²/day.

Discussion

Principal Findings

This systematic review synthesized evidence from 89 studies to identify six primary barrier categories impeding solar energy development in Nepal. Regulatory barriers emerged as most prevalent at 91%, followed by economic constraints at 88%, institutional limitations at 85%, permitting challenges at 79%, technical barriers at 76%, and social factors at 45%. The substantial increase in institutional barrier identification following federal restructuring represents a particularly significant finding with implications for policy intervention design.

The gap between Nepal's solar potential of 432 GW and installed capacity of 107 MW cannot be attributed to any single barrier category. Rather, these barriers operate interactively, creating cumulative impediments that exceed the sum of individual effects. Regulatory uncertainty compounds financing difficulties by increasing perceived investment risk. Institutional capacity gaps at provincial and local levels impede effective implementation of national policies.

Comparison with Regional Experience

Nepal's barrier profile shows both similarities and distinctions compared to regional experiences. India's solar energy expansion from 2,630 MW in 2014 to approximately 84,277 MW by 2024 demonstrates possibilities when regulatory frameworks align with market mechanisms and grid infrastructure investments (Ministry of New and Renewable Energy, India, 2024). Key enablers in India's experience included consistent policy signals, competitive auction mechanisms, grid infrastructure investments, and domestic manufacturing development.

Bangladesh's experience with solar home systems offers relevant lessons for Nepal's off grid applications, though utility scale grid connected development has faced similar institutional and regulatory barriers (Khan et al., 2024). Pakistan's renewable energy challenges highlight the consequences of policy inconsistency and institutional fragmentation that Nepal should actively avoid (Briera & Lefèvre, 2024).

Conclusions

This systematic review synthesized evidence from 89 studies to provide comprehensive understanding of barriers impeding solar energy development in Nepal. Four principal conclusions emerge from this analysis.

First, regulatory and institutional barriers have become increasingly prominent following federal restructuring, requiring coordinated policy responses across all three tiers of government. The increase in institutional barrier identification from 56% to 95% represents a fundamental shift in the barrier landscape requiring targeted intervention.

Second, the gap between Nepal's 432 GW solar potential and 107 MW installed capacity reflects interactive effects among multiple barrier categories that compound individual impediments. Effective intervention requires integrated approaches addressing regulatory, institutional, and technical dimensions simultaneously.

Third, recent tender results achieving solar tariffs of NPR 4.99 per kWh demonstrate fundamental economic viability, shifting policy emphasis from subsidy provision toward addressing non-economic barriers including permitting processes and grid infrastructure.

Fourth, Nepal's approaching LDC graduation in November 2026 creates urgency for establishing robust policy frameworks and institutional mechanisms that can attract commercial financing as concessional sources being a LCD member may diminish after graduation. Timely action on recommended policy interventions can position Nepal to accelerate solar deployment while meeting international climate commitments.

Future research should examine implementation experiences from initial large scale solar projects, effectiveness of emerging coordination mechanisms, and evolving barrier profiles as policy interventions take effect.

References

Raihan, A., Joarder, S. A., & Sarker, T. (2024). Renewable energy in Nepal: Current state and future outlook. International Journal of Energy Economics and Policy, 14(3), 147-163. https://doi.org/10.32479/ijeep.16500

Lohani, S. P., Gurung, P., Gautam, B., Kafle, S., & Paudel, U. (2023). Current status, prospects, and implications of renewable energy for achieving sustainable development in Nepal. Sustainable Development, 31(4), 2319-2342. https://doi.org/10.1002/sd.2392

Adhikari, D. R., Techato, K., & Jariyaboon, R. (2024). A systematic literature review on renewable energy technologies for energy sustainability in Nepal. International Journal of Renewable Energy Development, 13(4), 729-748. https://doi.org/10.61435/ijred.2024.60032

International Centre for Integrated Mountain Development (2019). Renewable energy in Nepal: Key findings and policy recommendations. ICIMOD. https://doi.org/10.53055/icimod.1023

Shrestha, J. N. (1996). Solar PV water pumping system for rural development in Nepal: Problems and prospects. Proceedings of the 31st Intersociety Energy Conversion Engineering Conference, 3, 1968-1973. https://doi.org/10.1109/IECEC.1996.553350

Weiss, W., Moschik, R., & Malla, A. (2019). Solar thermal roadmap and implementation plan for Nepal. ICIMOD Working Paper. https://doi.org/10.53055/icimod.1083

Bharadwaj, B., Pattanayak, S. K., & Ashworth, P. (2022). Space matters: Reducing energy disparity in Nepal through spatially equitable renewable energy development. Environmental Research Communications, 4(10), Article 105001. https://doi.org/10.1088/2515-7620/ac9458

Gulagi, A., Pathak, S., Bogdanov, D., & Breyer, C. (2021). Renewable energy transition for the Himalayan countries Nepal and Bhutan: Pathways towards reliable, affordable and sustainable energy. IEEE Access, 9, 84520-84544. https://doi.org/10.1109/ACCESS.2021.3087204

Anam, M. Z., & Siraj, M. T. (2023). Exploring the barriers to implementing solar energy in an emerging economy: Implications for sustainable development. Proceedings of the International Conference on Industrial Engineering and Operations Management. https://doi.org/10.46254/an13.20230584

Saraswat, N., Pandeya, M., & Pareek, R. K. (2024). Solar energy in developing countries: Challenges and opportunities for smart cities. E3S Web of Conferences, 540, Article 04003. https://doi.org/10.1051/e3sconf/202454004003

Jha, A. K. (2021). Together we have more power: Status, challenges, and the potential for regional renewable energy cooperation. ICIMOD Working Paper. https://doi.org/10.53055/icimod.1090

Yaqoot, M., Diwan, P., & Kandpal, T. C. (2016). Review of barriers to the dissemination of decentralized renewable energy systems. Renewable and Sustainable Energy Reviews, 58, 477-490. https://doi.org/10.1016/j.rser.2015.12.224

Dhakal, S. P., Mahmood, M. N., & Bogati, R. (2018). Bridging the energy access divide for sustainable development in South Asia: Policies and prospects in Nepal. International Journal of Public Policy, 14(1-2), 123-147. https://doi.org/10.1504/IJPP.2018.090704

Ghimire, L. P. (2016). Analysis on barriers of renewable energy development: Context of Nepal. Master's Thesis, Seoul National University.

Surendra, K. C., Khanal, S. K., & Shrestha, P. (2011). Current status of renewable energy in Nepal: Opportunities and challenges. Renewable and Sustainable Energy Reviews, 15(8), 4107-4117. https://doi.org/10.1016/j.rser.2011.07.022

Karki, N. R., Jha, D. K., & Verma, A. K. (2010). Rural energy security utilizing renewable energy sources: Challenges and opportunities. IEEE TENCON 2010. https://doi.org/10.1109/TENCON.2010.5686743

Karki, S. K. (2021). Solar energy potential in Nepal: A meta-analytic review. International Journal of Scientific Research and Publications, 11(5), 350-356. https://doi.org/10.29322/ijsrp.11.05.2021.p11350

Zahnd, A., & McKay, K. H. (2007). Solar PV systems in Himalayan villages: Problems and possible solutions. Proceedings of the 45th Annual Conference of the Australian and New Zealand Solar Energy Society.

Bhandari, A., & Sharma, T. P. P. (2024). Suitability analysis of PV solar power plant sites in Gandaki province: Application of GIS and AHP method. Journal of Environmental Sciences, 2(1), 44-58. https://doi.org/10.3126/jes2.v2i1.60395

Parajuli, C. (2024). Energy security strategy for Nepal. Prashasan: Nepalese Journal of Public Administration, 56(1), 1-18. https://doi.org/10.3126/prashasan.v56i1.67332

Malla, S. (2021). Household transitions to clean energy from traditional biomass in Nepal: Challenges and opportunities. Nepal Public Policy Review, 1, 95-124.

Sarangi, G. K., Pugazenthi, D., & Mishra, A. (2015). Poverty amidst plenty: Renewable energy-based mini-grid electrification in Nepal. In Low Carbon Pathways for Growth in India. https://doi.org/10.1007/978-3-319-04816-1_13

Bhandari, R., & Stadler, I. (2011). Electrification using solar photovoltaic systems in Nepal. Applied Energy, 88(2), 458-465. https://doi.org/10.1016/j.apenergy.2009.11.029

Pokhrel, H. (2020). Techno-economic feasibility study of net-metering implementation in rooftop solar PV in Nepal. Journal of The Institute of Engineering, 15(3), 204-213. https://doi.org/10.3126/jie.v15i3.32188

Khanal, R. C., Shakya, S. R., & Bajracharya, T. R. (2020). Contribution of renewable energy technologies in climate resilient approach and SDGs in Nepal. Journal of The Institute of Engineering, 15(3), 286-295. https://doi.org/10.3126/jie.v15i3.32230

Ito, Y., Ito, T., & Komatsu, S. (2012). Does the institutional failure undermine the physical design performances of the solar water heater in Nepal?. Hiroshima University Repository. https://doi.org/10.15027/35323

Pant, M., Ghosh, A., & Ojha, S. (2024). Integration of renewable energy in smart infrastructure development in Nepal: A policy and regulatory framework. International Journal of Environmental Sciences, 15(2), 89-105. https://doi.org/10.64252/z626zk62

Poudyal, R., Loskot, P., Nepal, R., & Parajuli, R. (2019). Mitigating the current energy crisis in Nepal with renewable energy sources. Renewable and Sustainable Energy Reviews, 116, Article 109388. https://doi.org/10.1016/j.rser.2019.109388

Sovacool, B. K., Dhakal, S., Gippner, O., & Bambawale, M. J. (2013). Peeling the energy pickle: Expert perceptions on overcoming Nepal's electricity crisis. South Asia: Journal of South Asian Studies, 36(4), 496-519. https://doi.org/10.1080/00856401.2013.788469

Zahnd, A., McKay, K. H., & Komp, R. (2009). Renewable energy village power systems for remote and impoverished Himalayan villages in Nepal. Proceedings of the World Renewable Energy Congress.

Silveira, S., Mainali, B., & Khatiwada, D. (2011). Green energy for development in Nepal. In Energy for Development: Resources, Technologies, Environment.

Suman, A. (2021). Role of renewable energy technologies in climate change adaptation and mitigation: A brief review from Nepal. Renewable and Sustainable Energy Reviews, 151, Article 111524. https://doi.org/10.1016/j.rser.2021.111524

Sedai, A. K., Dhakal, R., Koirala, P., & Sharma, A. (2023). Renewable energy resource assessment for rural electrification: A case study in Nepal. International Journal of Low-Carbon Technologies, 18, 1011-1024. https://doi.org/10.1093/ijlct/ctad089

Sharma, C. K. (1991). Energy and environment in Nepal. Ambio, 20(3-4), 120-123.

Pokharel, T. R., & Rijal, H. B. (2021). Energy transition toward cleaner energy resources in Nepal. Sustainability, 13(8), Article 4243. https://doi.org/10.3390/su13084243

Karna, S. K., & Singh, R. R. (2021). A framework for assessing the viability of solar PV in Province-2 of Nepal using system dynamics modeling. In Advances in Smart Grid Technology. https://doi.org/10.1007/978-981-15-8025-3_78

Bhatt, P. K. (2022). Solar energy integration and potential challenges in distribution network: A comprehensive review. Journal of Energy Research and Reviews, 10(3), 33-47. https://doi.org/10.9734/jenrr/2022/v10i330259

Mainali, B., & Dhital, R. P. (2015). Isolated and mini-grid solar PV systems: An alternative solution for providing electricity access in rural areas of Nepal. In Low Carbon Energy Supply Technologies and Systems. https://doi.org/10.1016/B978-0-12-409540-3.00015-3

Pandey, R. K., Zahnd, A., & Thakuri, S. (2015). Identification and evaluation of the losses occurring in a solar PV system under real field conditions in Nepal. Conference Proceedings.

Best, R., & Nepal, R. (2022). Savings and subsidies for solar panel adoption in Nepal. Applied Economics, 54(52), 6011-6024. https://doi.org/10.1080/00036846.2022.2083570

Balakrishnan, P. (2024). Global renewable energy transition challenges and strategic solutions. In Advances in Environmental Engineering and Green Technologies. https://doi.org/10.4018/979-8-3693-8814-3.ch003

Sagar, V. (2020). Studies of future prospects of solar energy and its potential. Energy Research Journal.

Obuseh, E., Eyenubo, O. J., & Alele, J. (2024). A systematic review of barriers to renewable energy integration and adoption. Journal of Asian Energy Studies, 9, 1-22. https://doi.org/10.24112/jaes.090002

Ajayi, A. O., Agupugo, C. P., & Nwanevu, C. (2024). Review of penetration and impact of utility solar installation in developing countries: Policy and technical considerations. International Journal of Frontiers in Engineering and Technology Research, 7(2), 68-89. https://doi.org/10.53294/ijfetr.2024.7.2.0046

Dhonju, H. K., Uprety, B., & Xiao, W. F. (2022). Geo-enabled sustainable municipal energy planning for comprehensive accessibility: A case study in Nepal. ISPRS International Journal of Geo-Information, 11(5), Article 304. https://doi.org/10.3390/ijgi11050304

Shakya, S. R. (2009). Application of renewable energy technology for greenhouse gas emission reduction in Nepalese context. Nepalese Journal of Engineering, 1(1), 32-40. https://doi.org/10.3126/njoe.v1i1.32

Shrestha, A., Rajbhandari, Y., Khadka, N., Bista, A., Marahatta, A., & Pandit, R. (2020). Status of micro/mini-grid systems in a Himalayan nation: A comprehensive review. IEEE Access, 8, 120983-121013. https://doi.org/10.1109/ACCESS.2020.3006912

Chapagai, D. P., Sharma, N., & Roy, A. K. (2024). A fuzzy approach to environmental scanning of multi-factor bottlenecks to renewable resource implementation in Nepal. Energy Sources, Part B: Economics, Planning, and Policy, 19(1), Article 2384544. https://doi.org/10.1080/15567249.2024.2384544

Adhikari, M., Munankami, R., & Pokharel, G. R. (2008). Solar PV as a viable alternative to remote and rural electricity: A case study of Nepalese experience. In Solar Energy and Energy Efficiency. https://doi.org/10.1007/978-3-540-75997-3_28

Islam, M. A., Rahman, K., & Ali, M. M. N. (2024). Overcoming hurdles: A comprehensive analysis of renewable energy in Bangladesh. IEEE ICCIGST Conference Proceedings. https://doi.org/10.1109/iccigst60741.2024.10717611

Amin, S. B., Chowdhury, M. I., & Ehsan, S. M. A. (2022). Solar energy sustainability in Bangladesh: Tackling the management challenges. In Managing Distributed Energy Resources. https://doi.org/10.1016/B978-0-12-824555-2.00015-0

Mahajan, S., & Garud, S. (2011). Photovoltaic for rural development: A study of policy impact and scope of market development in India and Nepal. World Renewable Energy Congress Proceedings. https://doi.org/10.3384/ECP110572883

Mittal, A. (2022). Assessment of SAARC nations' solar energy potential for sustainable development. Energy & Environment, 34(6), 2045-2068. https://doi.org/10.1177/0958305x221120935

Mehmood, U. (2021). Renewable-nonrenewable energy: Institutional quality and environment nexus in South Asian countries. Environmental Science and Pollution Research, 28(21), 26529-26536. https://doi.org/10.1007/s11356-021-12554-0

Asif, M., Khan, M. I., & Pandey, A. K. (2024). Navigating the inclusive and sustainable energy transitions in South Asia: Progress, priorities and policy implications. Energy Conversion and Management, 309, Article 118589. https://doi.org/10.1016/j.enconman.2024.118589

Ul-Haq, A., Jalal, M., & Sindi, H. (2020). Energy scenario in South Asia: Analytical assessment and policy implications. IEEE Access, 8, 152380-152398. https://doi.org/10.1109/ACCESS.2020.3019648

Khare, V., Khare, C., & Nema, S. (2022). Path towards sustainable energy development: Status of renewable energy in Indian subcontinent. Cleaner Energy Systems, 3, Article 100020. https://doi.org/10.1016/j.cles.2022.100020

Thapa, L., & Bhandari, R. (2022). A review of domestic socio-economic barriers on hydroelectricity trading in Nepal. International Journal of Innovative Research in Engineering, 10(1), 1-12. https://doi.org/10.37082/ijirmps.2022.v10i01.001

Gippner, O. (2014). Energy cooperation in South Asia: Prospects and challenges. Asia Foundation Working Paper.

Bhat, K. S., Bachhiesl, U., & Feichtinger, G. (2019). A techno-economic model-based analysis of the renewable energy transition in the Indian subcontinent. Elektrotechnik und Informationstechnik, 136(8), 351-360. https://doi.org/10.1007/s00502-019-00773-w

Mustafa, M., Malik, M. O. F., & Maqsoom, A. (2024). Barriers to solar PV adoption in developing countries: Multiple regression and analytical hierarchy process approach. Sustainability, 16(3), Article 1032. https://doi.org/10.3390/su16031032

Murshed, M., Chadni, M. H., & Ferdaus, J. (2020). Does ICT trade facilitate renewable energy transition and environmental sustainability? Evidence from Bangladesh. Energy, Ecology and Environment, 5(6), 424-439. https://doi.org/10.1007/s40974-020-00190-2

Chakraborty, S., Sadhu, P. K., & Goswami, U. (2018). Barriers in the advancement of solar energy in developing countries like India. SSRN Working Paper.

Ghosh, A., & Ghosh, D. (2018). Investments in clean energy in South Asia: Visiting barriers and gaps from the perspective of financial institutions. In Sustainable Energy and Transportation. https://doi.org/10.1007/978-981-10-7509-4_7

Irfan, M., Mahapatra, B., & Ojha, R. K. (2021). Examining the effectiveness of low-carbon strategies in South Asian countries: The case of India and Nepal. Environment, Development and Sustainability, 23(3), 4181-4197. https://doi.org/10.1007/s10668-020-01150-w

Peimani, H. (2018). Financial barriers to development of renewable and green energy projects in Asia. In Handbook of Clean Energy Systems. https://doi.org/10.1007/978-981-13-0227-5_14

Qureshi, M. I. (2021). Renewable energy technologies: Barriers and policy implications. In Energy Policy Advancements. https://doi.org/10.1007/978-3-030-76221-6_60

Salam, R. A., Amber, K. P., & Ratyal, N. I. (2020). An overview on energy and development of energy integration in major South Asian countries. Energies, 13(21), Article 5776. https://doi.org/10.3390/en13215776

Woodman, B., Ragwitz, M., & Ordonez, J. A. (2015). Economic and non-economic barriers and drivers for the uptake of renewables. EU Research Report.

Millison, D., George, L., & Acharya, J. S. (2022). Enabling policy and regulatory environment for solar power development: Lessons in Asia-Pacific. Solar Compass, 3, Article 100023. https://doi.org/10.1016/j.solcom.2022.100023

Shrestha, S., & Bajracharya, S. (2022). Climate change mitigation and adaptation in Nepal and South Asia: Challenges, progress, and policy implications. Journal of Sustainable Energy and Environment Management, 2(2), 86-101. https://doi.org/10.3126/josem.v2i2.55206

Kumar, S., Bhattacharya, S. C., & Anisuzzaman, M. (2003). Role of a regional programme for promotion of photovoltaic based rural electrification in South Asia. International

Journal of Global Energy Issues, 20(3), 234-254. https://doi.org/10.1504/IJGEI.2003.005299

Dhungel, K. R. (2007). Regional energy trade in South Asia: Problems and prospects. South Asia Economic Journal, 9(1), 173-193. https://doi.org/10.1177/139156140700900108

Qazi, T. F., Basit, A., & Niazi, A. A. K. (2023). What stops to switch on to solar energy? An empirical evidence from Pakistan. Bulletin of Business and Economics, 12(4), 45-59. https://doi.org/10.61506/01.00120

Sudan, F. K. (2016). Addressing climate change and energy security through energy cooperation: Challenges and opportunities for South Asia. SAARC Workshop Paper.

Bhandari, M. P. (2019). The climate change induced problems in South Asia: A case study of Bangladesh, India, Nepal, Pakistan and Sri Lanka. Annals of Agricultural and Environmental Sciences, 4(1), Article 00009. https://doi.org/10.30881/aaeoa.00009

Dongjun, D., Shahzad, M. A., & Jaskani, S. A. (2020). An empirical review of barriers in development of renewable energy in Pakistan: A case of solar energy. IEEE ICOMET Conference Proceedings. https://doi.org/10.1109/ICOMET48670.2020.9073902

Bhusal, S., Dangol, M., & Bhatta, M. (2024). Pathways towards net zero: Assessment of enablers and barriers in Nepal. Research in Globalization, 8, Article 100226. https://doi.org/10.1016/j.resglo.2024.100226

Neupane, B. K., & Parajuli, C. (2024). Development of renewable energy and its current situation in Nepal. NPRC Journal of Multidisciplinary Research, 1(6), 124-138. https://doi.org/10.3126/nprcjmr.v1i6.71744

Bhattarai, U., Maraseni, T. K., & Devkota, L. P. (2024). Evaluating four decades of energy policy evolution for sustainable development of a South Asian nation: Nepal. Sustainable Development, 32(1), 687-707. https://doi.org/10.1002/sd.3053

Sharma, R., & Gupta, S. (2021). En route for the accomplishment of SDG-7 in South Asian countries: A retrospective study. Strategic Planning for Energy and the Environment, 40(3), 89-118. https://doi.org/10.13052/spee1048-4236.4031

Pranti, A. S., Iqubal, M. S., & Saifullah, A. Z. A. (2019). Current energy situation and comparative solar power possibility analysis for obtaining sustainable development. International Journal of Scientific and Technology Research, 8(10), 178-186.

Sapkota, A., Yang, H., & Wang, J. (2013). Role of renewable energy technologies for rural electrification in achieving the millennium development goals. Environmental Science & Technology, 47(3), 1184-1185. https://doi.org/10.1021/es305307t

Nakarmi, A. M., Mishra, T., & Banerjee, R. (2014). Integrated MAED–MARKAL-based analysis of future energy scenarios of Nepal. International Journal of Sustainable Energy, 33(6), 1165-1185. https://doi.org/10.1080/14786451.2014.966712

Shamnani, H., Pandey, S., & Sinha, A. K. (2024). Analytical examination of sustainable development goals: Defining a better living environment through renewable energy in Nepal. ShodhKosh: Journal of Visual and Performing Arts, 5(Special Issue), Article 1308. https://doi.org/10.29121/shodhkosh.v5.iicetda24.2024.1308

Lohani, S. P., & Blakers, A. (2021). 100% renewable energy with pumped-hydro-energy storage in Nepal. Clean Energy, 5(2), 243-253. https://doi.org/10.1093/ce/zkab011

Khatri, B. B., & Neupane, B. K. (2024). Does renewable energy contribute to rural livelihood? Evidence from Nepal. NPRC Journal of Multidisciplinary Research, 1(3), 78-92. https://doi.org/10.3126/nprcjmr.v1i3.70058

Suwal, R. K. (2020). The downward trend in cost of solar PV: An opportunity to synergy of hydro and solar power in Nepal. Hydro Nepal Journal.

Butkar, U. D., Pokale, N. B., & Thosar, D. S. (2024). The journey to sustainable development via solar energy: A recap. ShodhKosh: Journal of Visual and Performing Arts, 5(2), Article 2544. https://doi.org/10.29121/shodhkosh.v5.i2.2024.2544