



## **Development of Renewable Energy and Its Current Situation in Nepal**

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Received: August 07, 2024; Revised & Accepted: November 10, 2024

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### **Abstract**

This article provides an overview of the current state of electrification in Nepal, highlighting the significant progress made and the challenges that remain. It also outlines future projections and targets for the energy sector, emphasizing the role of renewable energy and energy efficiency in achieving sustainable development goals. In Nepal, the field of renewable energy is expanding quickly. While solar and wind energy are viewed as crucial supplements to help Nepal overcome its energy crisis, the country currently mostly relies on burning biomass for its energy requirements. Hydroelectricity is the most widely used type of renewable energy in Nepal. Nepal has a great opportunity to promote renewable energy sources. In addition to offering subsidies, the GoN has prioritized promoting RETs for last-mile electrification. Due to their lack of ready funds to invest, rural poor people are unable to benefit from technology and government subsidies. These technologies can be considered practical, dependable, and sustainable for modern development due to their established technologies, quality control systems, economics of the many renewable energy technologies (RETs), and rural social elements. The sustainability of any development in Nepal's last-mile regions depends on the diversification of the systems and the services they provide. The secondary data has been used and descriptive methodology adopted. Compared to traditional energy technologies, renewable energy technologies are clean energy sources with significantly reduced environmental impact. Instead of expensive energy imports, the majority of investments in renewable energy go toward building and maintaining the facilities.

**Keywords:** renewable energy, sustainable development, policy, subsidy and RETs



## **Introduction**

Climate change presents one of the most important risks facing social, economic, environmental, and developmental dimensions in all parts of the world. Impacts are differential in local contexts. It is not only an environmental issue; at its core, it is a matter of justice. While being affected by climate change, it obviously will affect the distribution of its burdens inequitably, augmenting pre-existing systemic inequalities. Women, marginal groups, and minorities are particularly affected by climate change more than others (Nellemann, Verma, & Hislop, 2011). In most parts of the developing world, because of prevailing socio-economic, cultural, and environmental conditions, women bear a disproportionate share of the impacts of climate change (Dankelman, 2012; UN Women, 2022). Globally, women are more vulnerable to the effects of climate change due to existing gender inequalities. They often have less access to resources, education, and decision-making power, making them more susceptible to environmental changes (IPCC, 2021).

Nepal is a landlocked mountainous country nestled between the People's Republic of China to the north and the Democratic Republic of India to the south, east and west. The total area of the country is 147,516 square Kilometers (93<sup>th</sup> World rank) and land area is 92.94 percent and water area are only 7.06 percent. It is positioned in-between 80°4' to 88°12' eastern longitudes; and 26°22' to 30°27' northern latitudes. Nepal is 5:45 hours ahead of Greenwich Mean Time (GMT). It is popularly known as the birth place of Lord Buddha, Lumbini and also the land of Mt. Everest, the highest peak of the world. Nepal occupies 0.03% and 0.3% of land area of the World and the Asia respectively. It has a diverse topography and climate, including fertile plains, sub-alpine forest and eight peaks higher than 8,000 meters. It has an average length of 885 kilometers from east to west, and an average breadth of 193 kilometers from north to south (WECS, 2023).

Nepal is one of the least developed countries and its economic conditions are almost poor. It is the youngest federal democratic republic, has been passing through a protracted political transition for more than a decade. The constitution of Nepal has marked a political turn in the country's development process and introduced federalism and decentralized governance. It has introduced a three-tier structure of federal government (federal, province and local) and all three levels have the constitutional power to enact laws, prepare budgets and mobilize their resources. The Nepal Population and Housing Census (NPHC, 2021) estimates that approximately 29.10 million people live in Nepal. The country faces serious risks due to its pronounced vulnerability to natural calamities caused by climate change and global warming. Since renewable energy provides an alternative to conventional energy sources while reducing adverse environmental impacts, its promotion is essential for achieving sustainable development goals in this context.

This paper highlights on development of renewable energy and the current situation in Nepal. The primary goal of this paper, meanwhile, is to evaluate Nepali policies and contrast them with those of other countries with analogous policies. However, it will be useful to comprehend the upcoming development in renewable energy sector of Nepal. Energy plays



significant role in achieving the Sustainable Development Goals (SDGs) which are now a major development agenda for all developing countries like Nepal. Similarly, the climate change issue as consequence of using of fossils fuels is now become another development challenge.

Nepal has made remarkable strides in electrification, with 97.7% of the population having access to electricity as of 2024 (Economic Survey Report, 2024). However, 2.3% of the population, primarily in Karnali and Sudurpashchim Provinces, still lack access due to challenging geographical terrain and remoteness. According to the Energy Synopsis Report 2023 by the Water and Energy Commission Secretariat (WECS), residential consumption dominates Nepal's energy use, accounting for 60.59% of the total. The industrial sector follows with 22.17%, transportation with 10.49%, commercial activities with 4.79%, and agriculture with 0.94%. Around 2-3 percent of the Nepali rural population has currently no access to electricity. This hampers both economic development and access to information and education, particularly in rural areas. Among electrified households, 87 percent have access to electricity through the national grid, while the remaining seven percent have been electrified through off-grid energy technologies. The grid extension has reached approximately nine percent of the populations who were earlier provided with off-grid sources like micro/mini hydro and solar PV. In the Karnali Province and Sudurpashchim Province where building national grid infrastructure is a real challenge due to difficult geographical terrain and its remoteness.

This study attempts to offer a current perspective on Nepal's present energy dilemma in light of the country's constantly changing energy landscape and recent advancements in RE sector. Insufficient and outdated energy infrastructure, transmission and distribution losses, energy theft, ineffective energy management, a lack of energy conservation, delayed and expensive hydropower projects, low equipment efficiency, unsustainable energy pricing strategies, and unsatisfactory energy market regulations are some of the challenges for last-mile electrification. The lack of reliable electricity in rural areas of Nepal is a barrier to the economic growth of the nation. Nepal, being a developing country, gets foreign aid from different countries and international agencies. This study critically examines the economic and social issues underlying the development of rural electrification. The paper further explores the data on renewable energy technologies promotion and current situation in Nepal.

### **Purpose of the Study**

This paper has focused on the development of renewable energy and its current situation in Nepal. This is also going to critically evaluate the prevailing Renewable Energy Subsidy Policy in Nepal. The following are the research objectives:

- To identify the current situation of electrification in Nepal and explore the last mile areas to be electrified
- To critically analyze the subsidy policy and identify the gaps
- To provide recommendations in policies that can be helpful for the implementation of renewable energy projects in Nepal



## **Review of Literature**

This section of the study critically analyses the related literature on the selected topic. The Sustainable Development Goals 2030, also known as "Transforming Our World: The 2030 Agenda for Sustainable Development," was ratified by 193 UN members in September 2015. They consist of 17 goals and 169 targets. The MDGs didn't not address many of the concerns. SDG is unique because to its universality and purity. With a goal of achieving universal access to energy by 2030, Nepal has adopted the SDGs. The GoN has created numerous initiatives to increase the share of renewable energy and increase access to clean cooking by 2030 (NPC, 2020).

The majority of the world's important issues in the twenty-first century are energy-related. All of these challenges, such as decreasing poverty, combating climate change, managing ecosystems, preserving global health, and maintaining security, are impacted by energy, including its availability, cost, emissions, and other effects. Unfortunately, while being the greatest energy system in the world, it is unable to accomplish the majority of its goals. Significant changes in energy systems would need to be made in order to support countries achieve universal energy access by 2030, stabilize greenhouse gas emissions at levels specified by the United Nations Framework Convention on Climate Change (UNFCCC), and improve energy security.

In Nepal, the seventh plan (1985-1990) included alternative energy in the framework for national planning and enacted a policy to support alternative energy sources. The plan developed a working policy of using the private sector and giving customers grants or loans for efficient marketing of such technologies in order to achieve the policy aims. The subsidy was first introduced for RE technology. Following the restoration of democracy in Nepal in 1990, the eighth plan (1992-1997) serves as the first program of the country's democratic government. The plan maintained the alternative energy agenda set forth in the preceding plan and recognized the necessity of establishing an alternative energy agency to carry out and coordinate various projects linked to energy

The development of rural energy was acknowledged by the Ninth Plan (1997-2002) as a way to improve employment opportunities with the goal of building economic foundations, improving rural living standards, and maintaining environmental sustainability. To collect and maintain information on renewable technology, the plan established the Alternative Energy Promotion Centre (AEPC). In the interim, the plan also adopted a policy to institutionalize AEPC as the focal agency for development of alternative energy in Nepal and envisioned decentralized energy planning. The tenth plan (2002-2007) embraced a long-term vision of speeding economic development, expanding employment possibilities, and maintaining environmental sustainability.

The renewable energy sector had acquired the required institutional, organizational, and execution foundation for its implementation in Nepal by the time the Three-Year Interim Plan (2007-2010) was developed. Sectoral targets for various forms of renewable energy were established. More significantly, the Central Renewable Energy Fund (CREF) was designed to



be established for the efficient and long-term development of rural energy. The three-year plan (2010-2013) set a long-term objective to ensure that 10 percent of the energy mix would come from renewable sources so that 30 percent of the population would have access to power. The research, development, and management of energy efficiency measures in renewable energy technologies were all part of the Thirteenth Plan (2013-2016). The goal of the 14th periodic plan (2016-2019) was to provide electricity from solar, hydro (small and micro), and wind resources to an additional 9% of the population. The 14th plan also sought to promote 1.065 million units of upgraded cooking stoves and 0.2 million units of biogas digesters. The GoN has decided to implement the fifteenth plan during FY 2019/20 and through FY 2023/2024. The plan aimed for a 12 percent contribution of renewable energy in the total energy.

The Constitution of Nepal ensures that the government will take the policies relating to protection, promotion and use of natural resources (Part 4, Article 51 g). The constitution directed that the government will take the policy to ensure reliable supply of energy in an affordable and easy manner, and make proper use of energy, for the fulfillment of the basic needs of citizens, by generating and developing renewable energy. This has mandated the government to develop and implement the policies and strategies related to renewable energy promotion in the country. The state powers related to energy services are distributed among the federal, provincial, and local levels, as outlined in the constitutional mandates under clauses 57 and 58 and schedules 5 to 9 of the constitution. This framework emphasizes the need for collaboration, coordination, and cooperation among all three levels of government to ensure the effective development of the energy sector.

Because of its extreme poverty, high rate of illiteracy, social inequality, and reliance on natural resources for existence, Nepal is particularly vulnerable to the consequences of climate change. Nepal, a party to the Paris Agreement on Climate Change, has already submitted the schedule for its Nationally Determined Contributions (NDC). At a time when Nepal has ratified the Paris Agreement, Sustainable Development Goals, and Sendai Framework for disaster management, the National Climate Change Policy 2019 was envisioned to make the most of the opportunities for financial, technical, and other types of assistance through the framework of conventions for the purpose of managing climate change in line with the national priority and local needs while adhering to international obligations. The RE Promotion in rural parts of the country is a national priority.

## **Methodology**

The study based on secondary sources came from contemporary, comprehensive journals and papers. The GoN publications and reports on RE sector, as well as a number of papers connected to the topic, as well as a few additional reports, and publications, have been analyzed and arranged analytically. To accomplish the purpose of the study, the descriptive methodology has been used. Majority of the information was obtained from the AEPC reports, National Statistics Office (NSO) data book and relevant website materials.



## **Discussion**

The electrification of rural communities in developing economies and the promotion of sustainable development both benefit greatly from renewable energy. However, in order to fully utilize renewable energy, both the associated supply-side and demand-side constraints must be addressed. The key elements in developing green technologies in nations like Nepal are creative subsidies and tax incentives, proper entrepreneurial assistance, strengthened institutional arrangements, and the promotion of regional community-based groups like cooperatives. Decentralized RE solutions in less developed economies must expand quickly and become more affordable, which requires international elements like large-scale investment and adequate technology transfer (Nepal, 2012). For the development of society and the economy, access to energy is essential. In addition to impeding attempts to end poverty, a lack of access to modern electricity also reduces chances for income generating and community improvement. The last mile people are residing in topographically difficult-to-reach locations with poor incomes. This makes difficulty to provide energy access to them (Bhattacharyya, 2012). The Sustainable Development Goal (SDG) 7 also intends to ensure "access to affordable, reliable, and modern energy for all by 2030".

Rajkarnikar et al. (2021) discuss the future prospects and challenges of renewable energy in Nepal. One of the most significant forces behind socioeconomic development is now energy. However, conditions in poor nations are largely disregarded. It is discovered that the outcomes are crucial for human sustainability. Although Nepal has a lot of potential for many forms of energy, it primarily depends on imported fossil fuels to meet its energy demands. Renewable resources, including hydroelectric, solar, and biomass, have developed into somewhat dependable replacements for fossil fuels due to their abundance in water resources and broad geographic distribution. The insufficient supply of electricity in Nepal remains a major barrier to the social and economic development of the nation despite ongoing efforts by the government and assistance from development partners.

While traditional energy system contributes for GHG emissions and climate change, renewable energy emits no or help reduce GHG emissions. In addition to this benefit, renewable energy technologies provide multiple socio-economic benefits and serve as a reliable option for adaptation to climate change. Lohani et al. (2022) highlights that Nepal's energy mix is heavily dominated by traditional biomass (66.54%) and fossil fuels (27.24%), with modern renewable energy accounting for less than 3% despite the declining cost of solar photovoltaics. This situation emphasizes the urgent need for favorable and aggressive policies to promote the adoption of clean energy and achieve the country's sustainable energy goals. Many RE and energy efficient technologies implemented by AEPC directly replace carbon intensive fuels hence reducing GHG emission. Those technologies contribute to the socio-economic development of people and thereby enhance their adapting capacities. The central question is whether renewable energy technologies (RETs) can serve as a triple win-win strategy by addressing the mitigation-adaptation-development nexus with minimal or no trade-offs to the developmental needs of people. Can RETs, therefore, provide a foundation for a



climate-resilient development pathway? Both nationally and globally, RETs are widely recognized for their positive contributions to climate change mitigation and adaptation.

In Nepal, RETs hold significant potential to address both climate mitigation and adaptation challenges. However, it is crucial to clearly define the role of these technologies in tackling these interconnected issues. Given that climate change is a relatively new topic in Nepal, public awareness about it and its interaction with renewable energy remains limited.

**RETs installation data in Nepal**

In both the rural and urban areas, AEPC has successfully promoted renewable energy technologies. In the 28 years since its founding, AEPC has helped over 15 million people across the nation realize their needs for renewable energy through the appropriate deployment of technical support, subsidy, and credit financing. The number of renewable energy technologies that AEPC has promoted up until the most recent fiscal year 2023/24 is shown in the table below. The following table highlights the number of RE systems installed till the fiscal year 2023/24 in Nepal.

**Table 1**

*RETs installation data in Nepal*

<b>RE Technologies</b>	<b>Unit</b>	<b>Till FY 2023/24</b>
Mud Improved Cooking Stoves (ICS)	Nos.	1,423,242
Solar Home System	Nos.	996,647
Domestic Biogas	Nos.	450,770
Micro/Mini Hydro	kW	40,253
Institutional Solar PV System	Nos.	4,332
Portable Metallic Stoves	Nos.	132,211
Institutional Gasifier	Nos.	33
Institutional, Urban and Commercial Biogas	Nos.	369
Electric Stove	Nos.	59,385
Improved Water Mill (IWM)	Nos.	11,104
Urban Solar Home System	Nos.	21,144
Solar Drinking Water and Irrigation Pump	Nos.	3,691
Solar Mini Grid / Solar Wind Mini Grid System	kWp	3,097
Solar Rooftop	kWp	18,293
Solar installed at religious place and homestay	Nos.	4,758
Solar Dryer and Cooker	Nos.	2,464

Source: AEPC, 2024

Up until the fiscal year 2023/24, Nepal’s Rural Energy Technologies (RETs) unit achieved notable progress in implementing a variety of renewable energy solutions, as reported by AEPC in 2024. The installations included 1,423,242 Mud Improved Cooking Stoves (ICS), 996,647 Solar Home Systems, and 450,770 Domestic Biogas units. Additionally, 40,253 kW total installed capacity of Micro/Mini Hydro units, 4,332 Institutional Solar PV Systems, 132,211 Portable Metallic Stoves, and 59,385 Electric Stoves were installed. The efforts



extended to 33 Institutional Gasifiers, 369 Institutional, Urban and Commercial Biogas units, and 11,104 Improved Water Mills (IWM). The Solar Rooftop installation capacity reached 18,293 kWp, and Solar Drinking Water and Irrigation Pumps stood at 3,691 installations. The implementation also saw a deployment of 3,097 kWp Solar Mini Grid / Solar Wind Mini Grid Systems, 4,758 Solar Photovoltaic systems installed at various religious places and homestays and 2,464 Solar Dryers and Cookers.

Climate change presents a major challenge for least developed countries (LDCs), including Nepal. The adoption of RETs is a key strategy for addressing this crisis. With its abundant natural resources, Nepal has the potential to generate renewable energy through various technologies. The country has made consistent progress in expanding RET installations, supported by both government initiatives and development partners.

According to energy experts, alternative energy sources for rural and isolated locations in developing nations like Nepal include RETs like solar, wind, and biomass in addition to being economically feasible solutions. However, six different categories of hurdles were identified, including social, policy and political, technical, economic, administrative, and geographic ones (Ghimire & Kim, 2018). Poudyal et al. (2019) identify several factors contributing to Nepal's widening energy supply-demand gap, including delays and cost overruns in energy projects, outdated infrastructure, transmission and distribution losses, energy theft, poor management, and inefficiencies in equipment and pricing strategies. Geographic and geopolitical challenges, heavy reliance on imports, and underutilization of renewable resources further exacerbate the crisis. The authors emphasize that renewable energy sources are critical not only for addressing the current energy crisis but also for achieving energy independence through reliable and sustainable energy solutions.

Off-grid dwelling is often linked with rural areas rather than the nation's economic and financial hubs. Off-grid settlements typically have low energy demand, and a large number of households have minimal and unstable incomes, which makes financing electrification initiatives challenging. The ethnic, cultural, and institutional variety of communities in off-grid areas poses social issues (Garces, Tomei, Franco & Dyner, 2021). Recently, the GoN of Nepal has highly prioritized to promote RETs especially solar mini-grid and mini/micro hydro in last mile areas where the national grid access is a real challenge (AEPC, 2024).

Some positive measures could be taken toward basic rural village electricity in some of Nepal's most remote Himalayan regions, among the poorest and most disadvantaged populations. However, obstacles in the form of technical, budgetary, institutional, and governance issues have prevented effective implementation.

### **Renewable Energy Subsidy Policy in Nepal**

For over two and half decades GoN has been striving to provide access to modern energy services in remote rural areas, and more recently through the enactment of policies and plans. The policies encompass the Rural Energy Policy (2006), Nationally Determined Contributions (NDC) (2018), Biomass Energy Strategy (2017), National Energy Efficiency Strategy (2018), National Climate Change Policy (2019), Environment Policy (2019), National





Renewable Energy Framework (2022), Renewable Energy Subsidy Policy (2022), and the Renewable Energy Subsidy Delivery Mechanism (2023). Additionally, the Sixteenth Plan and other relevant policy and legal frameworks also play a critical role in shaping the energy sector. They provide detailed guidelines on the institutional mechanism, subsidy criteria and delivery mechanism, including the setting up of a Central Renewable Energy Fund (CREF), with AEPC played a crucial role. The subsidies, usually co-financed with donor funds under specific projects or programs, are primarily aimed at supporting low-income rural households (HH) access energy services as well as environmental protection.

A crucial policy was the Rural Energy Policy of 2006, which has undergone five revisions. Recently, GoN has brought revised Renewable Energy Subsidy Policy 2022. The overall goal of this subsidy policy is to ‘contribute to rural poverty reduction and environmental conservation by ensuring access to clean, reliable and appropriate energy in the rural areas. Its objectives are to reduce dependency on traditional energy, increase employment and productivity and the living standards of the rural population. The revised policy mainly focuses on gradually replacing subsidy by credit in the long-term. Similarly, it focuses on further scaling up of RETs and achieving the objectives of the UN's “Sustainable Development Goals” and “Sustainable Energy for All”. The subsidy to be provided for the construction and installation of different RE systems as per the Renewable Energy Subsidy Policy 2022 shall be disbursed through the CREF on the recommendation of AEPC. The GoN and various development partners have been providing financial and technical support to increase access to clean energy. The Renewable Energy Subsidy Policy 2022 has supported in bringing down costs of RETs, ensuring quality and increasing beneficiary trust on technologies. But majority of the population living in the rural areas under poverty level remain without access to clean energy have been deprived of basic energy solutions due to high initial upfront cost of the RETs.

Nepal's renewable energy sector is also largely driven by renewable energy subsidies, which are mainly targeted at potential users. While many argue that the GoN subsidy played a key role in promotion and acceptance of RETs. Subsidy, which can take many various forms, is one of the key methods used by governments all over the world to support the advancement and promotion of RE technology. Renewable energy subsidies, which are primarily aimed at potential customers, are a significant additional force in Nepal's renewable energy market (Vaidya, 2020). Although many claim that subsidies had a big role in the development and implementation of RETs, it is uncertain how particular RE subsidies have affected different stakeholders and actors in the sector.

The review of existing literature finds that a variety of variables, including user knowledge of RET benefits, government policies and regulations, cost-effectiveness of the technology, after-sales services, and long-term access to RE technologies and services, among others, determine how successful RE subsidies are. The prevailing assumption is that households with higher incomes have profited more from RE subsidies thus far than have low-income individuals. For instance, when subsidies increase, companies often raise the cost of biogas plants, resulting in the program's primary benefits being skewed toward the installer



companies rather than the users. Therefore, it is crucial to regulate the pricing of biogas appliances and accessories to align with market rates, ensuring that the benefits reach the intended users. It was also shown that access for impoverished farmers to biogas technology is likely to remain difficult without subsidies or some other form of financial intermediary. One of the major obstacles to the market-led spread of biogas technology was widely identified as the high upfront cost of the technology (particularly the one being promoted by the Government of Nepal). This emphasizes the need for the technology to develop in terms of resource efficiency (land, raw materials for its construction and operation), cost effectiveness, and economic viability for rural farmers, for whom the technology could be most useful. A study by Neupane (2024) highlights that there is a significant gap between the energy needs of households and the provision of 0.33 kWp power per household in solar mini-grid systems. This disparity is particularly evident in remote hill regions, where existing policy barriers prevent local residents from utilizing eCooking solutions effectively. To make targeted subsidies and pertinent information regarding policy mandates and provisions accessible to the general public, better policies and communication strategies are required.

### **Why RE Sector Development in Nepal?**

Due to geographical variances, inadequate transportability, dispersed communities, an elusive energy development strategy, and a lack of sufficient funding, Nepal faces significant challenges when it comes to access to energy to meet basic necessities. Energy Poverty in this context refers to the lack of access to practical, dependable, efficient, and contemporary energy technology to meet essential demands and foster economic and human growth. More emphasis has been placed on the role of renewable energy technologies in the country's Karnali and Sudurpashchim provinces in order to outline the energy technology solutions for lowering the situation of energy poverty.

As a worldwide commodity and the basis of socioeconomic progress, energy is crucial. Access to clean, inexpensive energy has continued to be a major conversation point, given the role that energy plays in the economy and general well-being of society. According to Nepal's Constitution, every citizen has a right to a consistent, reasonably priced energy supply. Energy is essential for driving the national economy and general socioeconomic growth.

The 16<sup>th</sup> periodic plan aims to diversify energy sources beyond hydroelectricity, promoting solar, wind, and hydrogen energy. By the fiscal year 2085/86, Nepal plans to increase its installed electricity production capacity from 3,060.1 MW to 11,769 MW, ensuring 100% electricity access. Per capita energy consumption is expected to rise from 380 kWh to 700 kWh, and employment in the sector is projected to grow from 96,000 to 400,000 jobs. The share of renewable energy in the total installed capacity will increase from 4.69% to 10%, with royalty collection more than doubling from 27 billion to 61 billion. Electricity exports are projected to rise from 450 MWh to 5,500 MWh, significantly boosting foreign exchange earnings from 9 billion to 41 billion. Consequently, the energy sector's contribution to reducing the overall trade deficit will increase from 0.9% to 4% (16<sup>th</sup> Periodic Plan, NPC 2024; Economic Survey Report, 2024).



The Renewable Energy (RE) and Energy Efficiency (EE) sector has set ambitious targets. By FY 2085/86, micro and small hydropower projects aim to reach an installed capacity of 48.84 MW, and wind and solar energy generation is expected to increase to 95 MW. The deployment of eCooking systems is projected to expand to 1,000,000 units, and the number of MSMEs utilizing Productive Energy Uses (PEUs) is targeted to grow to 2,000. The average annual rate of improvement in energy efficiency is expected to reach 1.68% (16<sup>th</sup> Periodic Plan, NPC 2024; Economic Survey Report, 2024).

The Situation Analysis Report on Solar Irrigation in Nepal (IWMI, 2021) indicates that only 69% of Nepal's 2.6 million hectares of arable land is irrigable, with 39% having year-round irrigation facilities. The Government of Nepal aims to increase this to 50% by 2024. Nepal is committed to international climate initiatives, including the Paris Climate Change Agreement, with a target to cut CO<sub>2</sub> emissions by 28% by 2030 (IWMI, 2021).

Nepal's energy sector has seen significant developments, with a strong focus on renewable energy and energy efficiency. The Ministry of Energy, Water Resources, and Irrigation (MoEWRI) has prioritized these areas, aiming to increase per capita energy consumption to 1,500 kWh by 2028. The widespread adoption of renewable technologies is crucial for achieving Nepal's energy targets, enhancing energy security, reducing greenhouse gas emissions, and fostering sustainable development.

## **Conclusion**

The use of off-grid electricity systems in rural areas of developing nations is widely recognized as a practical alternative for grid extension. Through government subsidy programs or initiatives supported by donors, a sizeable number of these installations have been implemented in numerous poor nations. For a thorough examination of the project's outcomes and to accurately assess the project's success, follow-ups are required. The use of electricity for efficient lighting and power for productive activity, such as the automating of daily tasks and raising the economic standing of villagers, has greatly benefited both individuals and communities.

Most rural residents use conventional stoves to burn biomass to meet their energy needs, which has a number of negative effects on the environment and people's health. The great majority of refined fossil fuels utilized in the nation are imported, and the continually increasing petroleum imports have badly impacted the already precarious national economy. Although hydropower, solar power, wind power, and other renewable energy sources have enormous promise, they have not yet been utilized sustainably due to a variety of geographic, technological, political, and economic factors.



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