



AN OUTLOOK OF CURRENT ENERGY SCENARIO, POLICIES, INVESTMENT CLIMATE, AND DEVELOPMENT PRACTICES IN NEPAL

Durga Prasad Chapagai¹, Neeta Dhusia Sharma¹, Amit Kumar Roy² and Manish Kumar Roy²

¹Department of Management Studies, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Majitar, Sikkim, India

²Department of Mechanical Engineering, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Majitar, Sikkim, India

ABSTRACT

Nepal is a Himalayan country having a high possibility of renewable energy. Despite the possibility of renewable energy, the development pace of the country tends to be slow and which has affected the socio-economic development. Particularly, the development of the energy projects in the country has been affected by the current policies and practices of the government of the country. In this paper, the current energy outlook of Nepal has been summarized along with its related recent policies issued by the government for the development of the energy sectors in the country and forwarded the suggestions regarding the current issues inherent in the energy sectors development in Nepal. To solve the current issues of the country, Nepal needs to consider electricity demand management and transmission line distribution issues soon and review the existing policies and institutional arrangements for the promotion of the private sector investment. Moreover, access to finance for investment and people's awareness regarding the use of clean energy is the key barriers to the development of the energy sectors in the country.

Keywords: Energy policies, Investment climate, Development practices,

DOI Number: 10.48047/NQ.2022.20.20.NQ109131

Neuroquantology 2022; 20(20): 1260-1276

1260

1.1 BACKGROUND

Energy is a vital component of economic development and a need for the fulfillment of multiple tasks in the economy. The pandemic of COVID-19 built up new challenges in the world. In this situation, sustainable access to energy sources is an important aspect of the quick recovery of the economy. Use of the energy is a reflection of the people's living standards and the well-being of society. In this modern era, the development of energy sources and infrastructures is important for all types of economies. The development of reliable sources of the energies in the country reduced

their economic dependency, cost of doing business, and environmental degradation. The major social issues include poverty, employment, health conditions, development of the enterprises, and gender inequality are closely related to the access and availability of energy in developing countries [1]. Developing countries have been several benefits from promoting sustainable renewable energy within countries such as direct economic benefits include the high pace of establishment of small business entities, simplification of household activities, and increasing the public utilities apart from that it has a



positive impact on the environment through reducing the level of emissions and natural disaster in the society [2].

Energy development issues are one of the important concerns of the nation [3]. Energy development strategies have been focused on energy planning, energy conservation, and energy security which will be closely related to economic sustainability. Economic growth rate, import-export conditions, urbanization, and industrialization, are based on energy prices, access, and availability within countries [4-6]. The growing consumption pattern with increasing population level, scarcity of natural resources, climate change effects, extreme hunger, and poverty are contemporary issues for the government (SDGs) which enforce the government for drafting, reviewing the new policies and practices in the countries. New policy coherences provide better formworks and guidelines to meet the current agenda sustainably. SDGs have been set up as “clean and affordable energy for all” as an important guideline with a target of universal access to modern, renewable, efficient sources of energy and promoting research activities, advancements in energy technology, and investments in clean energy; and expand and upgrade energy services for developing countries. For achieving the SDGs targets developing countries need to review and reform the current energy-related policies and strategies.

The paper attempt to solve the research questions of what is the current scenario of different energy sources in Nepal? what policy framework have been taken by the government for increasing access to energy? and briefly review the energy development practices within the country.

1.2 METHODS OF THE RESEARCH

The research work was conducted to review the current outlook of the energy and development practices of Nepal. For this purpose, researchers collected the basis of the secondary data published by different institutions including the Nepal Electricity Authority, Ministry of Energy water and Irrigations of Nepal, Alternatives Energy

Promotions Center, Nepal Oil Corporations, Ministry of finance, and other related national and international organizations. Moreover, 14th different energy-related policies and acts issued by the government have been reviewed to know the investment climate and promotion of the energy sectors strategies of the government of Nepal. Further, researchers mentioned the suggestions for the development of the energy sectors in the country.

1.3 ENERGY SCENARIO IN NEPAL

Nepal is a landlocked Himalayan country; located between India and China with a GDP of \$122.62 billion in the fiscal year 2021 [7]. The current population of the country is 29.192480 million [8] and the country's hydropower contribution in a national grid is 1458 M.W. Per capita energy consumption rate of the country is 260 kilowatt/hrs. [7]. For the land lock countries like Nepal which have few commercial fuel reserves; sustainable energy is coming to the forefront of economic agendas which reduces the alarmingly increasing pace of imports of fuel and assured energy security in the country. The possibility of the resources in the country including hydropower, and solar biomass, are high and investment in these projects will be resulted to achieved the SDGs 7 objectives. Nepal is one of the least energy consumption countries and traditional biomass energy sources have been prominently used for meeting the energy demand [9]. It has limited national grid existence because of extremely mountainous areas and is facing big challenges when it comes to providing electricity to its rural population [10]. Energy resources in Nepal are classified into three types namely the traditional, commercial, and alternative [11]. Traditional energy resources are firewood, forest resources, agricultural residues, and animal dung. Similarly, coal, grid electricity, and petroleum products are considered commercial resources whereas Biogas, solar power, wind, and micro-level hydropower lie in the alternative energy resources categories. By February 2021, 93.0 percent of the population has access to electricity in Nepal, and



energy consumption was derived from traditional resources, including 68.7% from Traditional biomass, 28.1% from commercial sources, and 3.2% from energy renewable [7]. The current status of the alternative energy as shown in the table:1 micro-hydro plant contribution over time is minimum. it has only 801 kw contributions in the

first eight months of the last fiscal year 2020/21. The use of household solar systems and biogas plants is decreasing in the trend over time. The use of the improved cooking stoves in the last fiscal years was 4647 and the historical technology of rural areas improved water mills are also under existence in Nepal.

Table:1(Status of the Alternatives Energy)

Program	Units	Fiscal years					
		2015/16	2016/17	2017/18	2018/2019	2019/2020	2020/21*
Electricity production from micro and small hydropower project	kw	1901	1245	1249	1453	764	801
Installation of the household solar system	Number	56770	16084	109147	75454	9858	6329
Installation of Biogas plant	Number	16706	20536	16988	11803	1341	2255
Installation of the improved water mills	Number	673	160	203	161	-	-
Installations of improved cooked stoves	Number	51211	60555	37788	43015	4647	-
Electrification from a mix of Air and Solar system	kw	57	-	200	305	50	250
Installation of institutional, urban, and commercial biogas plant	Number	5	55	101	58	49	5

*First eight months of data. Source:[12]

1.4 Electricity Demand and Supply Conditions



The demand and supply conditions have been globally significant for the continuous development of the economy [13]. The size of the economy is expanding through increasing human populations, urbanization, and modern means of communication and the energy demand has been continuously increasing with the increasing size of the economy [14]. The current demand for Nepal is also increasing with the expansion of the economic size. We present the current electricity demand and supply situations of Nepal in the following

tables. Nepal Electricity Authority (NEA) is a public enterprise; established having the objectives of production, distribution, and transmission of energy within a country [15]. NEA of Nepal contributes about half of the electricity in total production and that has been increasing over the last five years. NEA purchases electricity from independent power suppliers (IPS) and imports electricity from India too. The given table clearly shows the deficiency in electricity between the current peak demand and the availability of electricity in Nepal.

Table:2(Demand and Supply Conditions of Electricity 2012-2021)

Details	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
NEA Own Generation	2359	2292	2299	2368	2133	2305	2308	2548	3021	2811
Power Purchase from IPS	1074	1176	1070	1269	1166	1778	2168	2190	2991	3291
Power purchase from India	746	790	1319	1370	1778	2175	2582	2813	1729	2826
Total availability (GWh)	4179	4258	4258	4687	5007	6258	7058	7551	7741	8878
Peak demand (MW)	1027	1095	1201	1291	1385	1444	1508	1320	1408	1482
Peak demand Annual (MW)	102665	109462	120098	129110	138530	1444010	150816	132028	140794	148200

Source: [15]

1. 5 Energy Consumptions

The energy consumption pattern of Nepal is dominated by traditional biomass sources including firewood, agricultural residues, and animal dung (Table ;3). The contribution of the traditional sources in the total energy mix is 68.63 percent whereas 62.7% firewood, 3.07% agricultural residues, and 3.17% is animal dung cake in the

2020/21 fiscal year. Petroleum products are the most popular source of commercial sources of energy about 17.78 percent contribution to total energy consumption in the last fiscal year 2020/21. Electricity and coal have minimum consumption sources of energy in comparison to other sources with 3.76%, and 6.63%, in the total energy mix.

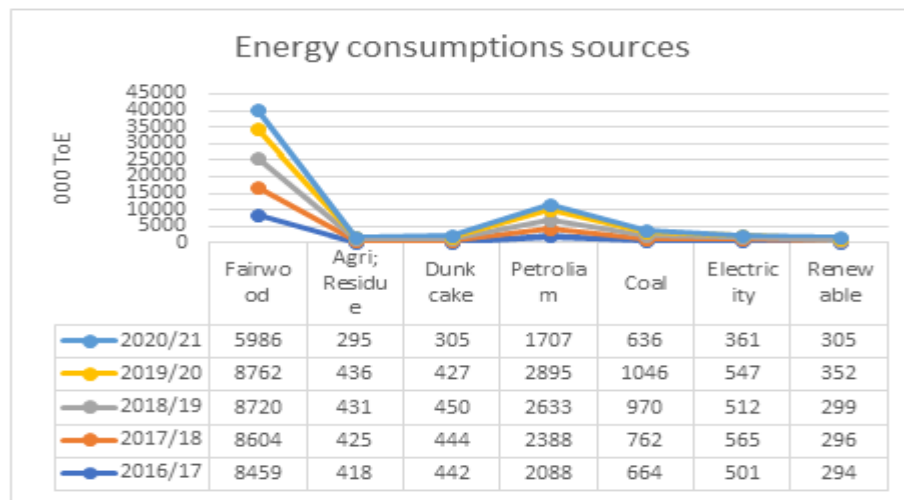
Table: 3Energy Consumptions distributions



Fiscal year	Unit	Sources of Energy									Total
		Traditional sources				Commercial sources				Renewable	
		Firewood	Agri; Residues	Dung Cake	total	petroleum	Coal	electricity	Total		
2016/17	000 ToE	8459	418	442	9319	2088	664	501	3253	294	11768
2017/18	000 ToE	8604	425	444	9473	2388	762	565	3715	296	12866
2018/19	000 ToE	8720	431	450	9601	2633	970	512	4115	299	13484
2019/20	000 ToE	8762	436	427	9624	2895	1046	547	4488	352	14464
2020/21*	000 ToE	5986	295	305	6587	1707	636	361	2705	305	9597

* First eight months of data Sources: [16]

Fig: 1 Energy Consumptions Sources



Source: [16]

Fig: 1 clearly shows the current consumption pattern of energy within the last five years. The consumption of firewood and petroleum product is tremendously increasing whereas the ratio of coal, electricity and renewable energy and other sources are relatively stable. Further explanations of the energy consumptions pattern of energy on a sector-wise basis; the domestic sectors are a large sector for consumption of power as shown in table:4. Residential purposes, the use of energy for residential purposes is an increasing trend over the

last five years. About 43.91% of the energy consumed in domestic sectors in fiscal years 2019/2020. The industrial sector is second in energy consumption which used 35% of the energy out of total consumption last fiscal year. Commercial sectors of the country used a minimum level of energy in comparison with residential and industrial purposes whereas the proportion of the export of energy is least over time. Only the 107 Gigawatt/hour exported by the government of Nepal to India in the last fiscal years 2020/2021.

Table: 4(Sectoral energy consumptions)



Sectors	Fiscal Years (GWh)				
	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020
Domestic	1793	2150.12	2442	2666	2867
Industrial	1205.7	1735.05	2074	2422	2286
Commercial	286.48	352.37	407.6	466	488
Export	3.15	2.69	2.83	35	107
Other	430.7	536.18	637.9	749	780
Total	3719	4776.5	5560	6338	6528

Source [12]

The consumption of petroleum products has increased over time in Nepal. It is the first largest import item in the country (Economic survey, 2021). The supply of petroleum products in the country has a monopolistic right of the National Oil Corporation (NOC), Nepal whereas NOC largely depends on the

Indian Oil Corporation for trading the petroleum items. Nepal Oil Corporation imports a large volume of petroleum products from the Indian Oil Corporation. Table: 5 shows the consumption trend of petroleum products over time.

Table: 5 (Status of Petroleum Product Import)

Petroleum Product	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Petrol (KL)	253381	313695	238755	407270	488675	566827	512128
Diesel (KL)	808567	956719	789922	1319873	1588869	1714905	1473536
Kerosene (KL)	18409	20439	14203	20082	22337	25004	18924
ATF (KL)	125678	142373	78680	164976	197220	200108	137424
LPG (MT)	232660	258299	217579	312644	370560	429609	449063
Others (KL)	2172	1658	38	-	-	-	-

1265

Sources: [16]

1.6 Sustainable Development Goals (Sdgs) and Current Progress

The Sustainable Development Goals were developed by the United Nations and provide the share guideline for its member countries having 17 different targets. SDGs 7 target is universal access to affordable, reliable, and clean energy in

the global energy mix by 2030. Nepal is achieving the historical performance in expansions of electricity and being a way to achieve these targets in specified time by SDGs and continuous efforts of the government are still required for the electrification solutions for the rural settlements [17].

Table: 5 (Status for SDGs 7)

Targets	Indicators	2019	2021	2030
7.1 universal access to affordable, reliable, and modern energy services	The proportion of the population with access to electricity	86%	93%	100%
	Population proportion is clean technology in cooking	46.5%	50.5%	100%
7.2 Share of renewable energy in the energy mix	Renewable energy shares in total final consumption	21.3%	23.7%	38.8%
7.3 Double the global	Energy intensity	4.14 MJ/US\$ (2011)	-	2.46 MJ/US\$ (2011) PPP



rate of improvement in energy efficiency	Grossdomestic product.	PPP		
--	------------------------	-----	--	--

Sources: [16]

The major indicators of SDGs include affordability, and clean, efficient energy sources are an unavoidable part of sustainable development and are considered challenging tasks to attempt [18]. In the scenario of Nepal, SDG 7.1 is universal access to electricity will be achieved by 2024 however the continuous cooperation efforts of the government are needed with private-public stakeholders[17]. About fifty percent of the population of Nepal has universal access to clean cooking technology in the current scenario and it is expected to be 72.3 percent within a stipulated time [19]. The use of renewable energy is increasing in current situations. The energy efficiency of the countries was to have been 4.12 MJ/USD2011 in 2019. Energy intensity in Nepal has declined at an average annual rate of 1.49 percent between 1990 and 2010. A doubling of the 1990- 2010 improvement rate is required to achieve the SDG 7.3 target, which requires an average annual rate

increase of 2.98 percent between 2018 and 2030[19].

1.7 Energy Policies

Environment and energy issues are becoming the burning economic and political agendas for the government [20]. The development of energy sources in the nation reflects the result of economic growth. Energy policies have played an important role in sustainable energy development. It is the key challenge to achieving the defined target of the SDGs7 for the developing countries through delivering universal access to clean affordable and reliable energy in a stipulated time period. The current policies and practices of the nations can be important for the use of renewable energy and related technologies and meet the public benefits government targets and protections of the environment[21]. Table: 6 reveals the ongoing policies and their major goals and strategies are taken by the government of Nepal for uplifting the energy sectors.

Table: 6(Major Energy-Related Policies & Strategies of Nepal)

Sources Details	Majors Goals and Strategies
National Water Resources Policy, 2020	Social and economic transformations through the conservation and promotion of the resources in a sustainable manner. Increasing participation of the private sector and other stakeholders in the development of water resources. Provisions for Institutional arrangements for the water resources development. Increasing co-ordinations among the federal, provincial, and local bodies for the utilization and development of the water resources.
National Energy Efficiency Strategies, 2018.	Double the average improvement rate of energy efficiency in Nepal from 0.84% per year, which existed from 2000 to 2015 AD to 1.68% per year in 2030. Reducing the energy import. Increasing the awareness of consumers about energy efficiency. Employment opportunities through the development of the energy market development. Developing the national standard for energy efficiency.
Water Disaster Management Policy, 2015	Minimization of water disasters through structural and non-structural technology.



	<p>Assured the participation and coordination of local, public, governmental, and non-governmental institutions for the management of possible water disasters.</p> <p>Implementations of the emergency rescue programs.</p> <p>Preservation of the environment.</p>
Hydropower Development Policy, 2001	<p>Developing hydroelectricity as a main exportable commodity.</p> <p>Expansion of rural electrifications.</p> <p>Developing reliable and qualitative electrical services in the country at a reasonable price.</p> <p>Increasing the participation and investment of the private sectors in hydroelectricity.</p>
Rural Energy policy, 2006	<p>Reducing the dependency on traditional energy in rural areas.</p> <p>Increasing the people’s living standards and employment opportunities through the development of integrated sources of energy.</p> <p>Provisions for the subsidy and resource arrangements for the rural electrifications.</p>
Renewable Energy Subsidies Policy, 2022	<p>Increasing access to clean, affordable, and reliable energy by 2030.</p> <p>Increasing public-private participation in renewable energy development.</p> <p>Provisions for the basis of subsidies.</p> <p>Development of renewable energy by providing a professional loan for the possible investor.</p> <p>Improvement of the technical quality of renewable energy.</p>
Bio-mass Strategy, 2017	<p>Increasing the access to biogas for conservation of the environment and transformation from traditional to modern energy.</p> <p>Supporting entrepreneurship, employment, and reducing the imported fuel through the development of the biomass sources</p> <p>Development of clean cooking technology.</p>
National Renewable Energy Framework, 2017	<p>Increasing the productivity and market access of renewable energy for the fulfillment of the objective of energy for all.</p> <p>Establishment of the public institutions, policy framework, and governing system of renewable energy.</p> <p>Capacity building through knowledge management.</p>
15 th Five Years Development Plan	<p>Ensured energy security through rapid energy development.</p> <p>Ensuring access to clean, reliable, and affordable energy for all.</p> <p>Import substitutions by increasing the regional and transnational energy trade.</p> <p>Increase the attraction of the investment in electricity.</p> <p>Gender and social-economic empowerment through increasing</p>



	access to alternative sources of energy.
People’s Electricity Program, 2019 (Procedure).	Development of hydroelectricity through the massive participation and ownership of the people. Collection of funds through the internal capital market.

As the above table:6 highlights, a summary of the current energy policies of Nepal; is being focused on clean, affordable, and reliable energy access for all which is a prime guideline of SDGs7 by 2030. The current policies of Nepal depict the priorities of the government on renewable energy sources through the active participation of the public-private sectors for minimizing energy dependency and import. Rural electrification is also being kept at the forefront. For the expansion of rural energy, special privileges and subsidies are given to the user and investors. Hydroelectricity is being considered an exportable commodity for reducing the current trade deficit of the country. The government of Nepal has given priority to people’s participation and ownership through the implementation of the People’s Electricity program with a plan to create funds from the internal capital market.

1.8 Investment Climate in Nepal.

A favorable business environment is a key to economic development[22]. The Government of Nepal followed the liberalizations after the restoration of the democracy in the 1990s. which was a milestone for the opening of the economic border for investment purposes. Doing business in particular areas has been affected by different variables including the current access to the energy mix, tax system, start-up process, construction permit, property registrations, credit facilities, and others[23]. The ease of doing business index developed by the World Bank major the total business investment climate of the country considering the different dimensions. The details of major parameters have been mentioned in Table:7. Nepal is ranked 94th position in ease of doing business in the world.

Table: 7 (Ease of Doing Business Comparison in South Asia)

Country	Rank Overall	Startup Business	Construction Permit	Access of Electricity	Credit Facility	Tax System	Trading Across Border	Resolving The Insolvency
India	63	136	27	22	25	115	68	52
Nepal	94	135	107	135	37	175	60	87
Pakistan	108	72	112	123	119	161	111	58
Bangladesh	168	131	135	176	119	151	176	154
Bhutan	89	103	91	78	94	15	30	168
Shri Lanka	99	85	66	89	132	142	96	94
Maldives	147	74	63	149	144	119	157	141

Source: [23]

As shown in the table:7 of the investment climate of South Asia, Nepal lies the 3rd in the overall ranking after India and Bhutan in South Asia. The dimensions like access to electricity facilities for the industries, construction permit, start-up process, and tax system are the relative fragile where as trading across the border, resolving insolvency, and credit system is the quite satisfactory compared to

other neighboring countries in the South Asian region.

1.8.1 Energy Markets Potentiality in Nepal

Nepal is located between the two world’s most populated countries in the world. Because of the strategic location of the country, Nepal’s Clean energy market potentiality is high. As mentioned in the above table: 2, the country is close to meeting its domestic demand (NEA). The share of the



traditional sources of energy in the total energy mix is high and the replacement of the traditional biomass and petroleum sources has been possible by increasing the use of renewable energy in the country. Currently, the domestic demand for energy from hydroelectricity is around 3% and less than 10 % is good enough to fulfill the domestic demand [15]. India’s energy demand has increased rapidly with the size of the economy over time. For supporting the increasing demand of India, the use of the excess clean energy from Nepal will be the right option. Geographically, West Bengal, Sikkim, Bihar, Uttar Pradesh, and Uttara khanda are shared with the border of Nepal which are relatively backward and power-hunger states of India [24]. The government of Nepal recently signed the Power Trade Agreement (PTA) and expansions of the cross-border high voltage transmission line with India in 2022; which explore a huge breakthrough in the clean energy market access.

Moreover, the collective talk of energy banking and MoU with the neighboring country Bangladesh will be further achievements to the development of the energy market of Nepal. The cooperation between China and Nepal on the cross Himalayan electricity transmission network is also another market avenue for the transnational power trade with China [25].

1.8.2 Energy Investment Incentives and Privileges In Nepal

The Government of Nepal opened the private investment in hydroelectricity through Hydropower Development Policy, 1992. The investment climate of the private sector of Nepal has been more conducive over the years. Significant reforms have been experienced in private investment. Numbers of policies act and guidelines have been amended and provide the different privileges and incentives for the investment in renewable energy are mentioned in the table:

Table: 8(Major Incentives and Privileges for Energy-Based Industries)

Details of Policies	Incentives and Privileges for Energy-based Industries
Industrial Enterprises Act, 2020	Industry licensee starts their operation within 12th April 2024 related to renewable energy including Hydropower production, transmission, distribution, and electricity from wind, solar, and bio-substances are subject to 100 % income tax exemption for 1 st 10 years and 50% for the next five years. Energy sectors are considered priority sectors.
Value-added Tax Act, 1996	Provision of tax exemption for imported items, machinery, tools, and equipment used for electricity generation.
Monetary Policy, 2021	Mandatory 10% debt financing by commercial banks within 2023.
Foreign Investment and Technology Transfer Act, 2020	Equal treatment, No nationalization clause, and provision for repatriations.
Renewable Energy Subsidy Policy, 2022	Provision of subsidy is varied (up to 80%) on the basis of geographic regions and sources of renewable energy for generators, distributors, and users.



Income tax rebates, tax holidays, and tax benefits have been given by the Government of Nepal to the energy-based industries. Hydropower projects are given a 100 percent income tax exemption for the first ten years and a 50 percent income tax exemption for the next five years after the commercial generation of electricity. Value Added Tax is exempted concerning imports of machinery, equipment, and the tools required for hydropower projects that are not produced in Nepal. Similarly, a facility of zero rate Value Added Tax is provided with respect to the use of machinery, equipment, and tools required for hydropower projects that are produced in Nepal. Only one percent of customs duties are levied on the import of hydroelectric machinery, equipment, and tools.

1.9 Development Practices of Renewable Energy in Nepal

Historically, people used hydropower for the purpose of grain grinding in Nepal. However, the use of electricity through hydropower started only after 1911 with 500 kW from the Pharping plant the first hydroelectricity plant in Nepal[26]. The access to electricity in Nepal to the general public only started after the establishment of the 2.4 MW Panauti hydropower in 1965. Currently, 93% of the population has access to electricity in the country [16]. The contribution of electricity to the national grid by 1451.33MW at the end of the fiscal year 2020/21[15]). The grid contribution is made from different large and small hydroelectricity plants built by NEA, private sector independent power purchase units, and solar and thermal plants. Fig:3 shows the details contributions from the different sources of energy.

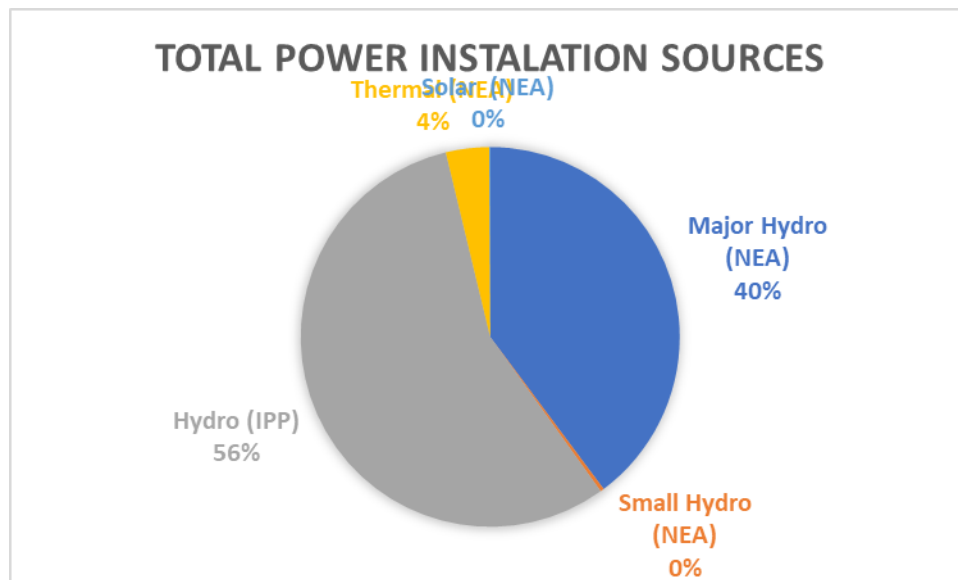


Fig: 3, Sources:[15]

Table:9 depicts the total installed capacity of the current electricity and the number of energy projects that contribute to the country. Development of the hydro project in Nepal is with the joint effort of both NEA as public

enterprises and private sectors. NEA contributes the 581930 kW and 814645 kW power purchases from the private sector's independent power units [15].

Table:9 (Total Installed Capacity)

Types of Sources	Number	Capacity (kW)
Major Hydro Project	14	563150



Small Hydro Plant	17	14244
Small Hydro Plant Isolated	23	4536
Thermal Power Plant	2	53410
Solar Plant	3	1350
Total Installed Capacity		1451335

Source:[15]

The country is considered a high possible investment destination for renewable energy and played an important role in economic development [27]. The involvement of the private sector in the hydroelectricity project development in Nepal is significant. The production of renewable energy including micro-hydro, solar, wind, and biomass are economically viable in rural areas in

Nepal, however, the development is not satisfactory [28]. 266 numbers of construction projects of different power plants of 8110 MW licenses have been distributed by the government of Nepal within 2021; Similarly, 250 different projects of 16685 MW have achieved the survey license in the same period [29].

Table: 10(Status of Distributed License for Energy Production)

Project Type	Construction License		Survey License	
	Number of Project	Capacity	Number of Projects	Capacity
Hydro < 1MW	24	18.638 MW	15	10.74 MW
Hydro > 1MW	220	7067.532 MW	192	14497.434 MW
Hydro (IBN)	1	900 MW	2	1100 MW
Thermal	0	-	-	-
Solar	19	117.97 MW	30	1058.9 MW
Wind	0	-	1	3 MW
Cogeneration	2	6MW	10	15MW
Total	266	8110.14MW	250	16685.074MW

Source:[29]

As shown in the table:10 the development of the electricity generation effort of Nepal under construction granted projects license are 266 with a total capacity of 8110.14 where the most of the projects are related to the hydro and solar projects. The effort of thermal and wind energy project development in the country is minimum. In spite of the high possibility, only a single wind project got a survey license in the Mustang district in high Himalayan regions. The alternative energy development efforts have been started in 1996 after the formal establishment of the Alternative Energy Promotion Center, Nepal [30]. About 3.6 million households are benefited from alternative energy in Nepal [31]. The NEA of Nepal made a power purchase agreement with 244 independent projects of 4138 MW at the end of 2018 and some of the projects have been connected to the

national grid [31]. The development of renewable energy in Nepal is still in its infancy compared to the possibility. It has a theoretical potential hydro-capacity is 83,290 MW however 42110 MW of hydroelectricity is feasible economically. Similarly, the use of other sources of renewable including the wind, solar, and biomass substances base at a minimum level (Table: 7).

1.10 CONCLUSIONS AND WAYS FORWARDS

The wave of the economic activities of Nepal is increasing over time. The country is recently graduated from least developed economy to developing economy. To support the increasing size of the economy, the role of the currently available energy sources in the country is important. With the recent progressive result of the NEA performance, the energy crisis of Nepal is on the way to decreasing [27]. However, there is a



still deficit of electricity between the peak demand and supply (Table:2). The majority of the energy demand of the country is met by the traditional biomass which affects the people's health and environment. The use of petroleum energy has expanded significantly over time which resulted in a high trade deficit in the country. Out of the total imports, 17% imports of the country are related to petroleum products [16]. The price of petroleum products seems to be more ups and downs in the world market because of the ongoing war between Russia and Ukraine in 2022. Nepal Oil Corporation (NOC), as a public enterprise has a monopolistic right to supply the petroleum product in Nepal and it has a sole dependency on the Indian Oil Corporation for import. The frequent misunderstandings between them are also causes of irregular supplies of petroleum products in the country. When the price of petroleum increases, user preferences only shift toward alternative sources including solar, wind, hydro, and biomass [32]. The establishment of renewable energy projects has a positive impact on the local people particularly, on employment generation, increasing the opportunities for small and micro enterprises, and supporting their livelihood and high crops production at the village level [33]. Clean, reliable, affordable, and universal access to energy sources is defined as targets of the United Nations guideline SDGs. Nepal has an aim to achieve the goals mentioned in SDGs by United Nations within 2030 AD. at the same time it is also expected to minimize its dependency on traditional sources and imported energy in the country [34]. Undoubtedly, Nepal is on the way to achieving universal access to energy within the stipulated time frame (table: 5) however access to clean cooking technology will be a great challenge to achieve. The most of existing energy policies and strategies of the country have been commonly emphasized in the SDG targets. Moreover, expansion of rural electrification, development of hydroelectricity as an export item, subsidies for renewable energy development, and accelerating the joint efforts to public-private investment are the common hallmarks. Utilization

eISSN1303-5150

of possible sources of local energy has been crucial for meeting the defined SDG's target. Therefore, the need for integrated energy management and planning practice in rural areas in Nepal is being taken as a prominent means that can address the current problems of energy. The development status depends on the existing policies and strategies of the countries [35]. In spite of the tremendous possibility of hydropower projects development in Nepal, the performance is not satisfactory as per expectations, however, the momentum has been seen in the last couple of years. By considering the ongoing construction development projects, the country being able to meet its domestic demand soon [15]. Further, the concerned authorities of the country have considered the following aspect for better energy development in the country;

ENERGY DEMAND MANAGEMENT

Demand management attempt to provide better results and high utilities by using similar inputs and available supply of the energy. [20]. It is one of the important parts to solve the current energy problems in the country. Policies, categories, and implementors of the demand-side played important role in energy demand management. Currently, the peak demand for electricity is high in comparison to the available supply in the country (table:2). In these conditions, the country needs to give more emphasis on efficiency, conservation, and storage of energy. Similarly, constrictions of the electricity projects have been completed soon and extra electricity will be generated in the national grid from the power purchase agreement with different independent domestic units which will be estimated to exceed the supply of the electricity in comparison with the demand [15]. In that situation, the concerned authority of the country needs to redefine their possible market, consumer, and pricing system of energy through the amendment of new energy policies in the country.

EXPANSIONS OF THE TRANSMISSION LINE

The transmission system provides a better link between the power producer and consumers in supply chain management. Currently, the

www.neuroquantology.com



wastage of the electricity in the system is high because of the poor connection, aging transmissions line, and frequent disruptions from floods and natural calamities. The loss of power ratio from transmission lines is 4.64% in the last fiscal year 2020/21 [15]. The government of Nepal has implemented power purchase agreements with independent units of the private sector. As power increased, the need for the transmission line was also high. The country has few installations of a high voltage transmission line in the generated areas. With the development of the hydro transmission line, it was always been experienced that the frequent dispute regarding the compensation of the property, land, and using the forest areas. The government of Nepal can play an important role in ideal solutions to the transmission issues in the country. It is necessary to form a structure for the scientific solution to the compensation management issues and NEA needs to work tougher with the private sector for the development of the transmission line under the public-private partnership model. Moreover, the government needs to encourage the private sector to expand the transmission line through the enactment of the new policies in the country.

INSTITUTIONAL ARRANGEMENT AND POLICIES BARRIERS.

Providing the monopoly rights to a particular organization only is a kind of barrier to developing the renewable energy in the country and many of the countries in the world have still few players in energy development [36]. Nepal is not an exception in this regard. Nepal Electricity Authority (NEA) was established as a public enterprise in the country having the monopolistic rights of production, distribution, and control of electricity which seems to be overburdened. Similarly, Nepal Oil Corporation (NOC) is a single organization for supplies petroleum products within a country. Because of inefficiency in their performances, there are frequent difficulties experienced in providing quality services and delivery. The government of Nepal needs to realize the decentralization of the rights of NEA and NOC at the provincial and local

levels through the amendment of new policies. And at the same time, market liberalization needs to follow for further exploration and development of the energy sectors in the country. The government of Nepal introduced the Foreign Investment and Technology Transfer Act, 2019 for regulation of the foreign investment in Nepal. The policy provides some incentives to the investors and still needs an amendment for some cases including the tax system, tax holidays, tax exemptions, and simplification of the administrative procedures to attract foreign investment.

CITIZEN'S AWARENESS

People's awareness regarding the use, production, and distribution of available sources of energy has been considered a prime influential factor in energy planning and management [37]. The pace of using renewable energy depends on the people's awareness and existing socio-economic barriers in the country. Green, reliable and affordable sources of energy are the basic elements for humankind. However, a large size of people in the country uses traditional fossil fuel and petroleum products for different purposes. Using such kind of items have a great impact on health, income, and education. However, people are not aware because of the informational and socio-economic barriers. Energy acceptance level is affected by the cultural domain of the people in the society. For ramping up the use of renewable energy, the government of Nepal needs to initiate an awareness campaign at the ruler level which helps to overcome the socio-economic barriers and redefine the current energy market and tariff system.

FINANCIAL BARRIERS

Financial problems are the major issues to the expansion of renewable energy in developing countries [38]. Most renewable technology development programs are initiated with the support of the donor agency in Nepal. Renewable energy technology installation is expensive in comparison to traditional energy development [39]. People in the country have a poor economic status and reluctant for investment by financial institutions in renewable energy projects which



results in the slow pace of development in the country. The energy generation sector has been taken as a major emerging sector in Nepal with 27.5 % of FDI and 36.4% of paid-up capital [40]. Commercial banks of Nepal have poor willingness for long-term investment in energy sectors, only 4% of share investments are made by the commercial banks in Nepal [41]. As the energy sectors of Nepal have been considered a priority sector, the total financing in the sectors from the commercial banks is minimum. There are only 784 million dollars in hydro financing within the fiscal year 2019 and a further \$ 1.2 to \$ 2.1 billion of the amount to be needed per year for the development of the projected demand and possible export of the electricity between 2019 to 2040 which is equal to forth time more than current investment [41]. In this regard, Nepal needs to identify the possible sources for long-term financing from the domestic as well as international capital markets. Employees Provident Fund, Citizen Investment Trust, Hydro- Investment Development Corporations, and Nepal Infrastructure Development Banks Ltd. are the large sources of internal financing for the energy sectors in Nepal. For the increasing attraction of foreign investors, Nepal needs to reform the regulatory and institutional environment. It is recommended to establish a public investment management authority and coordinating mechanism at the government level. The NEA and NOC need to focus on financial sustainability and sound financial health through a cost-effective pricing system and redefine the possible market areas. Access to long-term financing is the next issue for the development of the stock market in the country. The current stock market of Nepal seems to be more volatile because of poor regulatory mechanisms. To attraction of the local investor, it is needed to address the problems of the current stock market in the country. Foreign investment played important role in the development of energy projects. The required efforts including hedging to reduce the foreign currency risk, one step center for government procedure, and facilitation of the

eISSN1303-5150

foreign currency exchange a significant to harmonize the foreign investment in the country.

REFERENCES

1. Wijkman, A. (2007) Renewable energy: potential and benefits for developing countries, Democracy and Development - European Dialogue Papers - Volume VII (2) Development, 11- 15.
2. Andris Piebalgs (2007) Renewable energy: potential and benefits for developing countries, Democracy and Development - European Dialogue Papers - Volume VII (2) Development, 21- 26.
3. Fan, Jie; Wang, Qiang; Sun, Wei (2015). The failure of China's Energy Development Strategy 2050 and its impact on carbon emissions. Renewable and Sustainable Energy Reviews, 49(), 1160–1170. doi: 10.1016/j.rser.2015.04.096
4. Lo, K. (2014) A critical review of China's rapidly developing renewable energy and energy efficiency policies. Renew Sustain Energy Rev 29:508–16.
5. Menegaki, A.N. (2014) On energy consumption and GDP studies: a meta-analysis of the last two decades. Renew Sustain Energy Rev. 29:31–6.
6. Wang S.J, Fang C.L, Guan X.L, Pang B & Ma H.T (2014). Urbanization, energy consumption, and carbon dioxide emissions in China: a panel data analysis of China's provinces. Appl Energy 136:738–49.
7. Economic Survey Report 2021. Ministry of Finance, Kathmandu, Nepal.
8. National Census Report, 2021. Government of Nepal, National planning commission, Central Bureau of statistics.
9. Gurung, A., Karki, R., Cho, J. S., Park, K. W., & Oh, S. E. (2013). Roles of renewable energy technologies in improving the rural energy situation in Nepal: Gaps and opportunities. Energy Policy, 62, 1104-1109.
10. Jarvenpaa, J. (2014). Micro-hydro and Phototoxic as alternatives for electrification of

1274



- a remote village in Nepal; A doctoral thesis, Tampere University of technology.
11. Rural Energy Policy, (2006). Government of Nepal, Ministry of Environment, Singha Durbar Kathmandu, Nepal.
 12. Current status and future guidelines for energy, water, and irrigation (2018), Ministry of Energy, Water and irrigations, Nepal.
 13. Mei Sun; Lixin Tian; Ying Fu (2007). An energy resources demand-supply system and its dynamical analysis. , 32(1), 168–180. doi:10.1016/j.chaos.2005.10.085
 14. M. Asif; T. Muneer (2007). Energy supply, its demand, and security issues for developed and emerging economies. , 11(7), 1388–1413. doi:10.1016/j.rser.2005.12.004
 15. Nepal Electricity Authority Report, 2021.
 16. Economic Survey Report, (2021). Ministry of Finance, Nepal.
 17. SDG7 Roadmap for Nepal (2021). Energy Transition Pathways for the 2030 Agenda, United Nations publication 2021.
 18. Singh, S., Ru, J. Accessibility, affordability, and efficiency of clean energy: a review and research agenda. *Environ Sci Pollut Res* 29, 18333–18347 (2022). <https://doi.org/10.1007/s11356-022-18565-9>
 19. ESCAP (2021). Percentage of Total Population with Access to Clean Cooking, 2000-2018. Available at Asia Pacific Energy Portal: [https://asiapacificenergy.org/#main/lang/en/graph/1/type/0/sort/0/time/\[min,max\]/indicator/\[5069:2554\]/geo/\[NPL,ASPA\]/legend/1/inspect/0](https://asiapacificenergy.org/#main/lang/en/graph/1/type/0/sort/0/time/[min,max]/indicator/[5069:2554]/geo/[NPL,ASPA]/legend/1/inspect/0)
 20. Warren, Peter (2014). A review of demand-side management policy in the UK. *Renewable and Sustainable Energy Reviews*, 29(), 941–951. doi:10.1016/j.rser.2013.09.009
 21. Michael Jefferson (n.d) WORLD ENERGY ASSESSMENT: ENERGY AND THE CHALLENGE OF Sustainability.
 22. Paudel, Ramesh and Gopal P. Tiwari (2017). “Barriers and solutions for better investment climate in Nepal.” *Inter. J. Res. Methodol. Soc. Sci.*, Vol., 3, No. 2: pp. 31-47. (Oct. – Dec. 2017); ISSN:2415-0371.
 23. Ease of Doing Business report, (2021). World Bank,
 24. Subedi, S. (2016) RISING ECONOMY OF INDIA: HOW CAN NEPAL DRAW ECONOMIC BENEFIT? A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree.
 25. Dhakal, Shobhakar; Karki, Pratik; Shrestha, Subina (2019). Cross-border electricity trade for Nepal: a SWOT-AHP analysis of barriers and opportunities based on stakeholders’ perception. *International Journal of Water Resources Development*, (), 1–22. doi:10.1080/07900627.2019.1648240
 26. Sharma, Raj Hari; Awal, Ripendra (2013). Hydropower development in Nepal. *Renewable and Sustainable Energy Reviews*, 21(), 684–693. doi:10.1016/j.rser.2013.01.013
 27. Poudyal, Ramhari; Loskot, Pavel; Nepal, Rabindra; Parajuli, Ranjan; Khadka, Shree Krishna (2019). Mitigating the current energy crisis in Nepal with renewable energy sources. *Renewable and Sustainable Energy Reviews*, 116(), 109388–. doi: 10.1016/j.rser.2019.109388
 28. Ghimire, Laxman Prasad; Kim, Yoenbae (2018). An analysis on barriers to renewable energy development in the context of Nepal using AHP. *Renewable Energy*, (), S0960148118306414–. doi: 10.1016/j.renene.2018.06.011
 29. Department of Electricity Development Report (2022). Government of Nepal. Ministry of Energy, water, and irrigations, Kathmandu, Nepal.
 30. Alternative energy promotion center report 2021. Government of Nepal, Ministry of electricity, water, and irrigation, Nepal.
 31. Whitepaper Report (2018). Government of Nepal, Ministry of electricity, water, and irrigation, Nepal.
 32. Upadhyay, S. N., & Gaudel, P. (2018). Water Resources Development in Nepal: Myths and Realities. *Hydro Nepal: Journal of Water*,



- Energy and Environment, 23, 22–29.
<https://doi.org/10.3126/hn.v23i0.20822>
33. Cebotari, S., Cristea, M., Moldovan, C., & Zubascu, F. (2017). Renewable energy's impact on rural development in northwestern Romania. *Energy for Sustainable Development*, 37, 110–123. DOI: 10.1016/j.esd.2017.02.00.
 34. Energy policy (2020). Government of Nepal, Ministry of electricity, water, and irrigation, Nepal.
 35. Coburn, C. E. (2005). The Role of Nonsystem Actors in the Relationship Between Policy and Practice: The Case of Reading Instruction in California. *Educational Evaluation and Policy Analysis*, 27(1), 23–52. doi:10.3102/01623737027001023
 36. Souvik Sen & Sourav Ganguly (n.d) , Opportunities, barriers and issues with renewable energy development – A Discussion, *Renewable, and Sustainable Energy Reviews*.
 37. Chapagai. D. P, Dhusiya, N. & Roy, A. K (2022). Integrated Energy Management for sustainability, A seminar paper; department of mechanical engineering, Sikkim Manipal University, Sikkim, India
 38. World Bank Group (2014). Enhancing Access to Finance for Technology Entrepreneurs: Analysis of Highly Innovative, High Growth Start-Ups in Vietnam, Cambodia, and Nepal. Washington, DC. © World Bank. <https://openknowledge.worldbank.org/handle/10986/20811> License: CC BY 3.0 IGO
 39. Alex Zahnd; Haddix McKay Kimber (2009). Benefits from a renewable energy village electrification system., 34(2), 362–368. doi: 10.1016/j.renene.2008.05.011
 40. A Survey Report on Foreign Direct Investment in Nepal, (2021), Nepal Rastra Bank, Economic Research Department September 2021.
 41. Nepal Energy Infrastructure Sectoral Assessment Report (2019), World Bank Group.

