UNDP

Empowered lives.
Resilient nations.

NEPAL:

RAPID ASSESSMENT AND GAP ANALYSIS

Empowered lives.
Resilient nations.

NEPAL:

RAPID ASSESSMENT AND GAP ANALYSIS

Published by:

Government of Nepal
National Planning Commission
Singha Durbar
Kathmandu, Nepal
Telephone: +977 1 4211629
Website: www.npc.gov.np

Publication support provided by:

United Nations Development Programme
United Nations House
Pulchowk, Lalitpur
Telephone: +977 1 5523200
PO Box 107
Kathmandu, Nepal
www.undp.org.np

Contents

Abbreviations

SE4ALL	Sustainable Energy for All
NPC	National Planning Commission
SNAP	SE4ALL Action Plan
UNDP	United Nations Development Programme
PV	Photo-voltaic
ICS	Improved Cook Stoves
GDP	Gross Domestic Product
Kgoe	Kilograms of oil equivalent
AEPC	Alternative Energy Promotion Centre
NEEP	Nepal Energy Efficiency Programme
DSM/EE	Demand side management/energy efficiency
NEA	Nepal Electricity Authority
CBS	Central Bureau of Statistics
MoF	Ministry of Finance
HDI	Human Development Index
MDG	Millennium Development Goal
WECS	Water & Energy Commission Secretariat
TPES	Total Primary Energy Supply
TJ	terajoules
FNCCI	Federation of Nepalese Chamber of Commerce and Industries
MW	Megawatt
MOFSC	Ministry of Forest and Soil Conservation
FAO	Food and Agricultural Organization
NOC	Nepal Oil Corporation
LPG	Liquefied Petroleum Gas
KL	Kilolitres
BOP	Balance of Payment
MLCC	Monthly Life Cycle Costs
GWh	Gigawatt hour
SARI/E	South Asian Regional Initiative Energy
USAID	United States Agency for International Development
CFL	Compact Fluorescent Lamps
ADB	Asian Development Bank
KWh	Kilowatt hour

CCS	Clean Cooking Solutions
WB	World Bank
IOE	Institute of Engineering
NLSS	Nepal Living Standards Survey
IEA	International Energy Agency
VSBK	Vertical Shaft Brick Kiln
IWM	Improved Water Mills
SHS	Solar Home Systems
GIZ	German International Cooperation
UNIDO	United Nations Industrial Development Organisation
IRENA	International Renewable Energy Agency
UNFCCC	United Nations Framework Convention on Climate Change
CDM	Clean Development Mechanism
MOE	Ministry of Energy
WEC	Water & Energy Commission
MOCS	Ministry of Commerce & Supplies
MOI	Ministry of Industries
MOEST	Ministry of Science, Technology & Environment
DMG	Department of Mining & Geology
DOED	Department of Electricity Development
IPP	Independent Power Producers
IAEA	International Atomic Energy Agency
CES	Center for Energy Studies
NRREP	National Rural and Renewable Energy Program
RET	Renewable Energy Technology
BESP	Biomass Energy Support Programme
GoN	Government of Nepal
NACEUN	The National Association of Community Electricity Users Nepal
RERL	Renewable Energy for Rural Livelihood
NBSM	Nepal Bureau of Standards & Metrology
SASEC	The South Asia Sub-regional Economic Cooperation
PPA	Power Purchase Agreement
IPO	Initial Public Offering
VDC	Village Development Committee
RA/GA	Rapid Assessment/Gap Analysis

Foreword

It is my pleasure to present to you the Sustainable Energy for All (SE4ALL) Rapid Assessment/Gap Analysis Report. This Report is the first of its kind, which provides insights on various aspects, including on the status of energy situation, challenges, opportunities and future prospects of energy development vis-à-vis the SE4ALL initiative.

Nepal joined the UN Secretary General's SE4ALL Initiative in August 2012. The National Planning Commission of Nepal (NPC) is the ministerial focal point for this Initiative, and a High Level SE4ALL National Mechanism has been established under my chairmanship. The National Mechanism and the three Coordination Groups have representation from the government, private sector and civil society. Nepal's current Three Year Plan (2013/14 to 2015/16) commits to formulating and implementing an action plan to achieve the SE4ALL goals. This Rapid Assessment/Gap Analysis Report serves as a basic document in the formulation of Nepal's SE4ALL Action Plan (SNAP). The Gap Analysis Report describes Nepal's baseline with respect to the three SE4ALL goals and discusses the barriers that need to be addressed to meet or exceed these goals.

On behalf of the National Planning Commission, I would like to thank the United Nations Development Programme (UNDP) for the technical support in taking the SE4ALL process forward in Nepal.

Finally, I would like to thank my Team at NPC for their efforts in implementing the SE4ALL initiative in Nepal.

Dr. Rabindra Kumar Shakya
Vice Chairman
National Planning Commission
Government of Nepal

Acknowledgement

This Sustainable Energy for All (SE4ALL) Rapid Assessment/Gap Analysis Report has been prepared as a baseline document to support the formulation of Nepal's SE4ALL Action Plan (SNAP). It discusses the challenges and barriers to be addressed to meet or exceed the SE4ALL goals.

Nepal's predominant use of traditional biomass resources (mostly in the residential sector), contributes to deforestation, indoor air pollution, drudgery and loss of agricultural productivity. Furthermore, Nepal has become dangerously dependent on oil imports to meet its energy requirements, adversely affecting its balance of payment. Conversely, very little of Nepal's high hydropower and other renewable energy potential have been utilized for electricity production and the country is currently facing severe electricity shortage, which adversely impacts our economy. In this context, the SE4ALL initiative is a very important initiative for Nepal to ensure that we promote and develop sustainable energy that will contribute to sustainable development of all sections of society and all areas of the country. This Report will go a long way in identifying gaps and barriers which need to be addressed and overcome to achieve our vision of sustainable energy for every Nepali household and business.

I would like to thank Mr. Amrit Nakarmi, Dr. Bhakta Bahadur Ale and their team for preparing this report. I appreciate the hard work of Mr. Suman Basnet, Sustainable Energy Coordinator for coordinating the finalization of the Report.

I would like to thank the United Nations Development Programme (UNDP) for the technical support in producing this Gap Analysis Report.

Finally, I would like to acknowledge all the valuable contributions, feedback and support from individuals and organizations in bringing out this Report.

Gopi Nath Mainali
Joint Secretary
Infrastructure Development Division
National Planning Commission
Government of Nepal

Executive Summary

Energy Situation

Use of traditional biomass resources, which supplies over four-fifths of the total energy needs in Nepal, contributes to deforestation, indoor air pollution and drudgery. This mainly affects women and children. It causes loss of agricultural productivity resulting in reduced fodder for livestock. All fossil fuels consumed in Nepal are imported. Consequently, Nepal is facing financial constraints in importing oil due to soaring global oil prices.

Very little of Nepal's high hydropower potential has been utilized for electricity production. The electricity system has high losses. Electricity is provided in many rural areas by off-grid hydro and solar PV systems. Development of solar energy technology is favorable for most parts of Nepal. Wind is still an unharnessed energy resource in Nepal.

The residential sector consumes the maximum amount of energy, where biomass resources are the major fuels. Recently, in rural areas, biomass fuel and fossil fuels are being replaced by renewable energy systems. LPG is the main cooking fuel in the urban centers. Transport, the second largest energy-consuming sector is the main consumer of petroleum products. For process heating, the industrial sector mostly uses coal. Insufficient and unreliable supply of electricity formotive power and lighting has adversely affected industries. Energy consumption in the commercial sector is small but is rapidly growing. Agricultural sector mainly uses diesel for water pumps used in irrigation. There is growing use of petroleum based electricity generation during load shedding hours in the residential, industrial, and commercial sectors.

Nepal has become dangerously dependent on oil imports to meet its energy requirements. This adversely affects the balance of payment. The country is also facing severe electricity shortage, which has adverse impact on the economy. The present load forecast is a suppressed demand forecast. If Nepal can switch to electricity for cooking, transport, process heating etc,it will have more chances to save electricity through energy efficiency measures. The government subsidy to government institutions for fossil fuels and electricity does not provide a level playing field. Regulation of consumer prices of petroleum products and electricity is also a major disincentive for private investment in the energy sector. However, the subsidies for off-grid renewable energy have helped in rapid dissemination of these technologies.

Nepal has formulated many plans, strategies and targets for the energy sector. However, most of these are not coherent and have differing targets.

Situation Regarding SE4ALL Goals

There is conflicting data regarding population-having access to electricity ranging from 53% to 74%. Further study will be required to address this disparity. Though the access to electricity is shown to be high, the quality of electricity supply is a serious issue. Furthermore, Nepal's electricity consumption per capita compared to other countries in South Asia is low. About one fifth of the urban population and over four-fifths of the rural population still depend on solid fuel for cooking. Usage of LPG is rapidly increasing especially in the urban households and

commercial sector. Lack of modern forms of energy especially electricity, in rural areas impedes enterprise development and income generation, since many such activities require clean, flexible and versatile forms of energy.

Nepal's energy efficiency is very low due to its high dependence on solid biomass for its energy needs. Usage of commercial energy, though increasing at a rapid pace, is still quite low compared to neighboring countries. Energy efficiency in the electricity sector will bring significant reductions in energy usage, resulting in economic and environmental benefits. Residential sector has the potential for the greatest energy savings. Significant savings can also be achieved in the industrial sector. Energy efficiency indicator of Nepal is dismally poor compared to the neighboring countries.

The share of renewable energy (which includes grid connected hydropower and also off-grid hydro and solar PV) in the total primary energy consumption in Nepal is 3%.However, no data exists to accurately ascertain the percentage of fuel wood use. Therefore, this is an area for further studies.

SE4ALL Goals

It is estimated that all households will have electricity access by 2030, mostly from the grid. It is also estimated that cooking with solid biomass will be completely done on improved cook stoves (ICS) by 2030.

For the improvement of energy efficiency, Nepal needs to first focus on its improvement in the household sector. With a target to decrease energy intensity from 1,166kgoe/USD 1,000 GDP in 2010 to 421 kgoe/USD 1,000 GDP by 2030, Nepal's energy efficiency indicator will be close to that of the neighboring countries.

Analysis has indicated that in order to meet the country's development needs 11% and 26% of the total energy mix in 2020 and 2030respectively needs to be from electricity (from grid and off-grid sources).

National Strategies, Plans and Institutions

Nepal's policies and periodic plans have focused on increasing access to modern energy, linking energy development with employment creation and stimulating economic activities. This will consequently attract private investment and accelerate rural electrification. Furthermore, the government has pledged to make all Nepali homes smoke-free by 2017.

Despite the policies to attract private investment in hydropower development, investment has been limited. However, Nepal has developed a remarkably diverse but unified rural energy sector, with subsidy as a major instrument. However, inadequate subsidy funds and the dependence on donors have frequently created uncertainties. Fossil fuels like kerosene, diesel and grid-electricity are still subsidized by the government. Off-grid rural renewable energy systems though emerging as new areas of investment are still perceived as high risk. As a least developed country, Nepal still has opportunities for carbon financing.

Institutionally, the energy sector does not come under the purview of one organization but is dispersed in various Ministries. Coordination among them is one of the major problems being faced in the country from the integrated energy policy and development aspect. Furthermore, lack of an independent regulatory body in the energy sector has prevented rationalization of energy pricing.

Programs and Financing

Apart from the AEPC, no government organizations or public sector enterprises has programs and financing for the improvement of access of thermal energy to the people. Some NGOs are involved in promoting renewable energy technology in the rural areas.

Many hydropower projects are currently under various stages of development, many of which are being developed by the private sector. Lack of adequate transmission line capacity is a major bottleneck hampering development of hydropower plants. Community grid rural electrification program has been mainstreamed as an effective means of grid-based rural electrification in Nepal since early 2000s. Many international development partners are assisting the government in the grid-electricity arena.

The GiZ/Nepal Energy Efficiency Programme (NEEP) is the only DSM/EE project currently being implemented.

Private Investment and Enabling Business Environment

In the thermal energy sector, private enterprises are engaged in technology supply to commercial and industrial sectors. Commercial banks are financing the import and supply of thermal energy. The biggest barrier for private sector investment in the supply of thermal energy is the government fixation of domestic prices and tariff.

Since early 1990s, the private sector is participating in electricity generation. There are also private technology providers from overseas and some local technology providers for small scale power plants. Communities are involved in distribution of electricity, and this has been shown to be effective in providing electricity to rural households. The major barrier for private sector investment in power sector is the tariff fixation from the Government and the reluctance by NEA to sign Power Purchase Agreements. The other major barrier is lack of sufficient transmission.

Due to high upfront costs of renewable energy technology, affordability is a major barrier for the rural people.

Gaps and Barriers

There is lack of quality data regarding access to electricity and modern cooking solutions in Nepal. Electricity is being generated from captive generation sets, and only a fraction of fuel wood supply is renewable. Furthermore, there are multiple targets for each energy subsector. There is also a lack of integrated energy policy and regulatory body and planning for integrating and addressing the cross-cutting issues among the individual energy subsectors. There is also a lack of competition for public institutions in the energy sector, which has inhibited advent

of advanced technologies and know-how, as well as high quality of products and services. Furthermore, management and implementation capabilities of these public enterprises are weak. The pricing of petroleum products and electricity tariff are strictly regulated by the government and motivated by political rather than economic considerations. This has been a significant factor in discouraging private sector participation in the sector.

In the thermal energy subsector, there is a lack of awareness among the intended users. Women, the real users of ICS, are generally not the economic decision makers at household level. Furthermore, there is a high drop-out of trained stove builders and ICS promoters due to migration for foreign employment or business opportunities and other reasons, creating shortage of trained human resources. ICS is still not affordable for all rural households. ICS designs and models to serve various socio-economic strata of the society are not yet available. There are insufficient entrepreneurs in the subsector.

In the electricity subsector, there is lack of an integrated policy framework and plan, and a nodal institution for rural electrification. There is also an urgent need to strengthen and streamline the community rural electrification efforts. Furthermore, there is lack of environment that is conduciveto business because of political instability, inconsistency and "regulation-rather-than-promotion" focused legal and regulatory frameworks. There is inadequate infrastructure, NEA's credit and off-taker risks, lack of adequate security to personnel and facilities at plant sites and unrealistic local community expectations. The skewed electricity generation pattern contributes significantly to the severe load shedding faced by the country. The infrastructures required for hydropower development are grossly insufficient.

In the energy efficiency subsector, there is lack of awareness and sufficient information concerning the potential financial savings from energy efficiency efforts. There is lack of upfront capital needed for DSM/EE. There is a lack of appropriate policies, suitable institutional structure, and incentives to promote and support DSM/EE. There is also lack of information on the best practices and best available technology on energy efficiency. All this has resulted in an immature DMS/EE industry in the country.

Objectives:

The purpose of Rapid Assessment and Gap Analysis is to provide:

- A brief look of the energy situation in Nepal (Section 1) within the context of its economic and social development and poverty eradication.
- A review of where the country is in terms of the three SE4ALL goals (Section 2).
- An estimate of the main challenges and opportunities vis-à-vis the three goals of SE4ALL where the major investments, policies and enabling environments will be required (Section 3).
- A sound basis and background for aSE4ALL Action Plan for Nepal.

A. INTRODUCTION

I. Country Overview

Nepal is a mountainous landlocked country in South Asia situated between two giant emerging economies- India and China. With an area of 147,181 km2, it has three distinct ecological zones- mountains (15 percent), hills (68 percent) and the Terai(17 percent).

According to 2011 National Population Census (CBS, 2012), Nepal's population is 26.5 million in 5.4 million households. The rural population constitutes 83 percent of the population. About 7 percent of the population lives in the mountain region, 43 percent in the hills and 50 percent in the Terai. Around 74 percent of the households (4.1 million) are agricultural households with land. The average population growth rate is 1.35 percent.

The poverty incidence (headcount rate) for Nepal in 2010-11 is 25.16 percent. The poverty rate is much lower in urban areas (15.46 percent) than in rural areas (27.43 percent). Within urban areas, poverty ranges from 9 percent in urban hills to 22 percent in urban Terai. Within the rural hills, poverty ranges from 16 percent in the Eastern Region to 37 percent in Mid and Far Western Region. Within the rural Terai, poverty ranges from 21 percent in Eastern region to 31 percent in Mid and Far Western Region. Within each of the development regions except the Eastern Region, hills have higher poverty rates than the Terai. The depth and severity of poverty is the highest in the rural hills of Western and Mid-Far-Western region (CBS, 2011a).However, the disparity between the income of the lowest quintile and highest quintile of the population is narrowing. This is attributed to increased remittance from Nepalese migrant workers in foreign countries, which stood at 23.1 percent of the GDP in 2012 (MoF 2013).

The Gross Domestic Product (GDP) for the fiscal year 2012/13is estimated at Rupees 1,709 billion or about USD 18 billion. The contribution of agriculture (including forestry and fisheries) to GDP has been declining and stands at 34.8 percent. The contributions of industrial and service sectors were 14.6 percent and 50.6 percent respectively (MoF, 2013).The per capita GDP stood at USD 717. The GDP growth rate was around 5 to 6 percent during the 1990s but it declined due to the armed conflict in the country from 1996 to 2006. According to the Approach Paper of the Government of Nepal for the Thirteenth Plan, the GDP growth rate declined to 3.6 percent in 2012/13.This was mostly attributed to political instability and energy

crisis. With the expected stabilization of the political situation in the country, the Thirteenth Plan projects economic growth during 2013 to 2016 at 6 percent (NPC, 2013).

Human Development Index (HDI) in Nepal varies by urban-rural divide, by ecological belt, and by development region and sub-regions. On an average, urban dwellers have much higher Human Development Index(HDI=0.63) than their rural counterparts (HDI=0.482). The population in the hills enjoys the highest standards (HDI=0.543), while the mountain population has the lowest (HDI=0.436). Among the development regions, the Mid-Western region has the lowest level of Human Development Index(HDI=0.452). The people of the three castes and ethnic groups— Madhesi, Brahman and Chhetri, Newar and the Brahmans from the hills—have a higher HDI value (0.6 and above)—than that of Dalits and Janajatis, both from the Hills and the Terai. Muslims (HDI=0.401) have lower HDI than that for Dalits as a whole (HDI=0.424), but higher than MadhesiDalits (HDI=0.383) (UNDP, 2009).

The MDG Progress Report 2010 for Nepal shows that the country was on track for meeting many of the MDGs by 2015. However, it is recognized that ensuring supply and access tomodern and sustainable energy supports the attainment of the MDGs. The progress report emphasizes that the availability of affordable and sustainable energy services will have a positive effect in achieving the MDGs. These effects will be observed in health, education, transport, telecommunication, safe drinking water, and sanitation services, and on the productivity of income-generating activities in agriculture, industry, and tertiary sectors.

II. Energy Situation

a. Energy Balance

Table 1shows the energy balance calculated for the year 2010. It is based on the energy synopsis report (WECS, 2010) and the economic survey (MoF, 2012). The Total Primary Energy Supply (TPES) in 2010 is calculated to be 417,000 TJ and the final energy consumption is around 410,000 TJ. Nepal's energy sector is mostly based on traditional biomass energy resources. With regards to commercial energy, 64percent of petroleum products are consumed in the transportation sector and almost 100percent of coal in the industrial sector. 44percent of electricity is used in the industrial sector and 39percent in the residential sector. Almost 99percent of traditional biomass energy carrier is used in the residential sector. Modern renewable energy is used mostly in the residential sector.

In Table 1, there is a mismatch of about 6,900 TJ or 17percent between primary supply and final consumption of petroleum products. It is assumed that this amount of petroleum products is being used by captive electricity generating sets. Data on electricity generated by captive gensets are not indicated in the energy statistics published by the Water Energy Commission Secretariat (WECS) and the Nepal Electricity Authority (NEA). Calculation indicates that the total installed capacity of the captive generating sets in Nepal in 2010 is in the range of 600 MW[1]. A representative of the Federation of Nepal Chamber of Commerce and Industries (FNCCI) informed that industries alone have about 300 MW of captive generating capacity. A baseline study on the use of petroleum products for generation of electricity in Nepal is required for accurately ascertaining the actual situation.

[1]The calculations are based on the use of the mismatched quantity of petroleum products, assumed to be mostly diesel, for generation of electricity during load-shedding, using capacity factor of 15 percent.

Table 1. Energy Balance of Nepal in 2010 in TJ

Particulars	Petroleum products	Coal	Hydro	Electricity	Biomass	Modern renewables	Total
Primary Supply							
Indigenous production			11,031		349,263	2,933	363,227
Imports	40,173	11975		2,205			54,353
Exports				(268)			(268)
Stock changes	230						230
Total Primary Supply	40,403	11,975	11,031	1,937	349,263	2,933	417,312
Transformation							
Inputs	(6,912)		(9,928)				(16,840)
Electricity generation				11,551			11,551
T & D losses				(2,862)			(2,862)
Other losses, own-use etc.			(1,103)				(1,103)
Net supply to consumers	33,491	11,975	(0)	10,626	349,263	2,933	408,058
Final Consumption							
Industry	1,651	11,940		4,581	1,949		20,121
Residential	4,687	35		4,064	345,519	2,933	357,238
Commercial	2,994	-		747	1,794		5,535
Transport	21,289	-		20	-		21,308
Agriculture	2,872	-		184	-		3,056
Others	-	-	800	0			800
Total	33,491	11,975	-	10,396	349,262	2,933	408,058
Statistical error	(0)	-	(0)	230	1	-	0

(Calculated based on WECS, 2010 and MoF, 2012)

b. Energy Supply

Energy resources in Nepal are of three types:

1. Traditional: This includes fuel wood, agricultural residue, and animal dung cakes.
2. Commercial: Petroleum products, coal, and grid-electricity.
3. New renewables: Biogas, solar, wind, and off-grid micro and mini hydro.

Traditional biomass resources, supply about 85 percent of the total energy needs, whereas commercial energy supply 14 percent. New renewables account for less than 1 percent of consumption (Figure1).

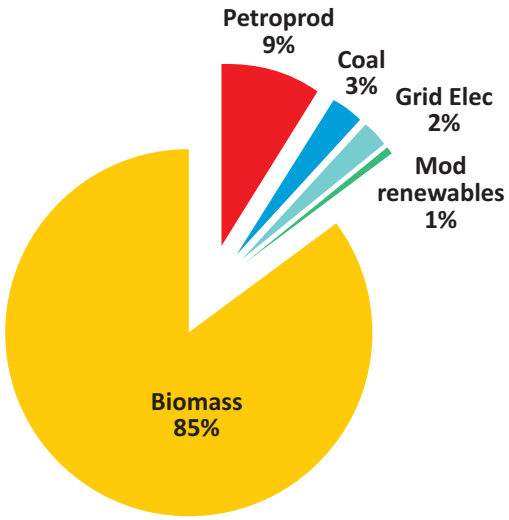
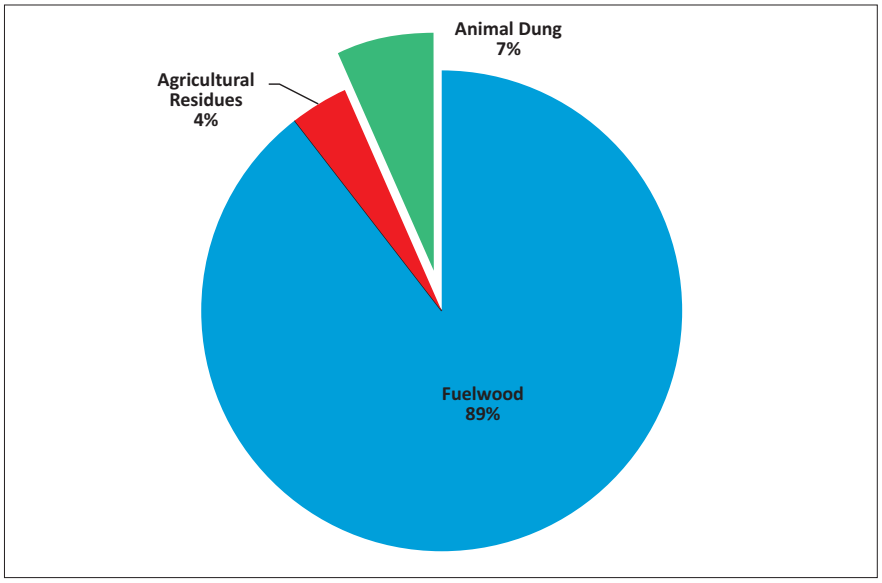


Figure 1. Energy Mix by Fuel type in 2010 (MOF, 2012; WECS, 2010)

Traditional biomass energy resources

Traditional biomass energy has been the mainstay of Nepal's energy sector for a long time. Solid biomass fuels are derived from trees and plants, agriculture by-products and animal dung.



(WECS, 2010; MoF, 2012)

Figure 2. Shares of different solid biomass energy carriers in 2010

Fuel Wood

Fuel wood accounted for about 89 percent of the total biomass energy supply in 2010/11. This is about 76 percent of the total primary energy supply (MoF 2013). Fuel wood supply is obtained primarily from forests, and secondarily from logging residue, saw milling and plywood production. In 2010, the fuel wood consumption was 313,000 TJ, whereas sustainable supply was around 202,000 TJ (MOFSC, 1987; WECS, 2010). This indicates that trees are being felled for fuel wood, contributing to deforestation with consequent negative environmental impact. Furthermore, its use in traditional stoves results in indoor air pollution affecting mostly women and children. In addition, collection of fuel wood for cooking is becoming ever more difficult. It is noteworthy that WECS data (WECS 2010) indicates that the sustainable supply of fuel wood is increasing by 4 percent, whereas FAO (FAO 1997) indicates the potential supply of fuel wood in Nepal is declining by 0.7 percent. This difference in the data suggests the need for carrying out further studies to ascertain the real consumption of solid biomass and their sustainable supply.

Animal Dung

Animal dung accounted for about 7 percent of the total biomass energy supply in 2010/11. In the Terai, there is a shortage of woody and herbaceous biomass supply. Therefore, animal dung is most commonly usedfor fuel. Dung is traditionally used for fuel as dried cakes. Use of dung as fuel competes with its use as manure resulting in the loss of agricultural productivity. Furthermore, its use as dried cakes for fuel results in indoor air pollution affecting mostly women and children.

However, animal dung is also being used increasingly for biogas production, which is primarily used for cooking. The slurry from the biogas plant is very good organic manure and is rich in soil nutrients. It is estimated that the technically feasible potential for biogas plant in Nepal is 1.02 million plants. Biogas plants are currently being used by 282,000 households in all the 75 districts of Nepal.

Agricultural Residue

Agricultural residue accounted for about 4 percent of the total biomass energy supply in 2010/11. Agricultural residues are stalks, stems, and leaves (mainly from harvesting) and husk, bran, and cob (mostly from agro-processing). Paddy, wheat and maize account for about 75 percent of the supply. Use of agricultural residue may compete with its use as livestock fodder. Furthermore its use in traditional stoves results in indoor air pollution affecting mostly women and children.

Hydro Resources

In Nepal the theoretical and economic hydropower potential has been estimated at about 83,000 MW and 42,000 MW, respectively. A summary of the theoretical hydropower and economically feasible potential of the major river systems of the country is presented in Table 2 and 3 respectively. Among the major river basins, Karnali and Saptakoshibasins have the most potential and economically viable hydropower resources.

Table 2. Theoretical Hydropower Potential of Nepal

River Basin	Potential in MW		Total Potential in MW
	Major river courses having catchments areas above 1000 km^2	Small river courses having catchments areas 300-1000 km^2	
Sapta Koshi	18,750	3,600	22,350
Sapta Gandaki	17,950	2,700	20,650
Karnali and Mahakali	32,680	3,500	36,180
Southern Rivers	3,070	1,040	4,110
Country Total	72,450	10,840	83,290

Table 3. Economic Hydropower Potential

River Basin	Number of Project Sites	Economic Potential Capacity in MW
Sapta Koshi	40	10,860
Sapta Gandaki	12	5,270
Karnali	7	24,000
Mahakali	2	1,125
Southern Rivers	5	878
Country Total	66	42,133

Source: WECS, 2010

Electricity

As of July 2012, the total installed capacity of all electricity generating plants in Nepal was about 719 MW. This included:

Power Plants	Installed capacity
Hydroelectricity	
NEA (Grid connected)	472.9 MW
NEA (Isolated)	4.5 MW
Independent Power Producers (IPPs)	187.6 MW
Total hydroelectricity	565.0 MW
Thermal	
NEA	53.4 MW
TOTAL	**718.4 MW**

Source: NEA Annual Report, July 2012

The total electricity available in Nepal during 2011/12 was 4,179 GWh.

Source	Electricity
NEA Hydro	2,357GWh
IPP Hydro	1,074GWh
NEA Thermal	2GWh
Import from India	746GWh
Total available electricity	**4,179GWh**
Export to India	4 GWh

The net system loss was 26.43 percent.

Electricity is provided in many rural areas by off-grid hydro and solar PV systems. The total installed capacity of the off-grid hydro plants is 37 MW (AEPC, 2012).

Petroleum Resources

All the petroleum products consumed in Nepal are imported from India or overseas in the refined form for direct consumption. Nepal Oil Corporation (NOC) is the sole organization responsible for the import and distribution of petroleum products in the country. The NOC has current storage facilities of 72,000 KL for all essential petroleum fuels, except for LPG (NOC, 2011), which is bottled and distributed by private companies.

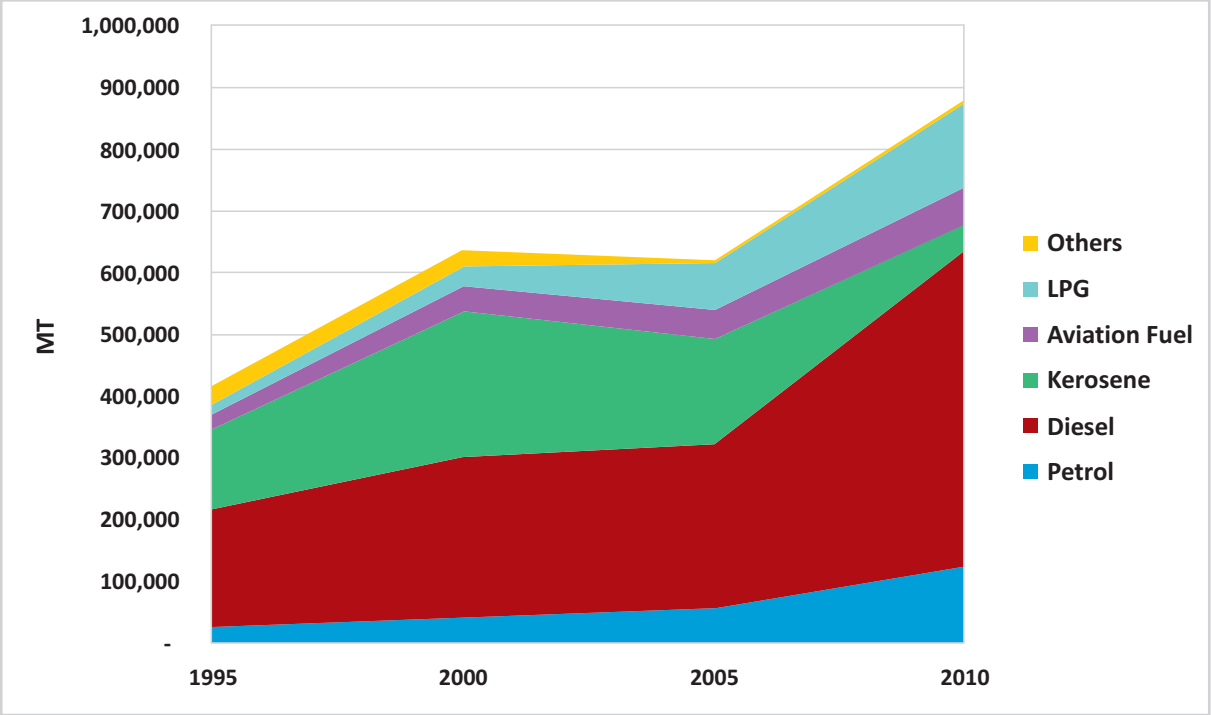


Figure 3: Sales of Major Petroleum Products from 1995 to 2010 in MT (toe) (NOC, 2011)

Figure 3 indicates that consumption of petroleum products was virtually stagnant during the period from 2000 to 2008 due to political conflict in the country. However, consumption of diesel has doubled from 2008 to 2010, whereas consumption of heating oil such as kerosene has plummeted since 2003. This happenedafterNepal Oil Corporation (NOC) made the domestic prices of diesel and kerosene the same to control rampant diesel adulteration with kerosene. Partly for this reason, consumption of LPG is growing at double digits, as it is the most available and cheaper energy option for cooking and heating.

Nepal is facing financial constraints in importing oil due to soaring global oil prices. Till now, no serious effort has been made for the exploration and production of petroleum products within Nepal.

Coal Resources

Nepal has some sporadic deposits of low-grade lignite coal. A very small amount of the total coal supply is extracted in Dang district, Western Nepal, for consumption in brick industries. For major supply, coal is imported from India and abroad.

New Renewable Energy Resources

Solar Energy

Nepal, located in favourable latitude, receives ample solar radiation. The average solar radiation varies from 3.6–6.2 kWh/m2/day, and the sun shines for about 300 days a year. The development of solar energy technology is thus reasonably favourable in most parts of the country. As per Kawajiri et al. (Kawajiri et al., 2011), the Himalayan Range has a good performance of Photovoltaic System (PVS) due to its high altitude.

Wind Energy

Wind is still an unharnessed energy resource in Nepal. Various studies conducted at different times show that there is low potential of wind energy in Nepal, except for some locations such as Thakmarpha, Khumbu and Khanjiroba, which are at high mountainous locations (AEPC, 2008).

c. Energy Consumption

In Nepal, energy consumption is categorized according to the economic sectors of the country: residential, commercial, transport, industrial and agricultural. In 2010, residential sector consumed the maximum amount of energy, whereas productive sectors like transport, industry, commerce and agriculture accounted for only 13 percent of the final energy consumption (Figure 4).

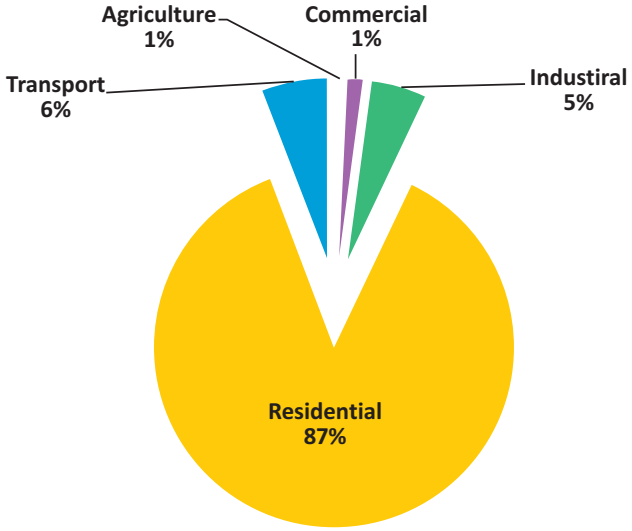


Figure 4. Final Energy consumption by Economic Sectors in 2010 (MOF, 2012; WECS, 2010)

Residential Sector

In the residential sector, biomass resources, viz. fuel-wood, agricultural residue and the animal dungare the major fuels. Traditional cook stoves are inefficient, consuming excessive firewood. This produces a lot of smoke causing household air pollution leading to health disorders, and increase drudgery for women in collecting firewood as well as in cooking and cleaning related household chores. Recently, in rural areas, renewable energy systems like biogas and electricity from off-grid hydro and solar PV systems are substituting biomass fuels for cooking and kerosene for lighting. Improved cook stoves are being installed to reduce or eliminate problems related to traditional cook stoves. The commercial sources of fuel used are nominal in amount and is mainly used in the urban centres.LPG is the main cooking fuel in the urban centres. There has been a sharp decrease in the use of kerosene for cooking in the residential sector. The consumption of renewables in rural areas is small but growing at a rapid pace. There is also a trend of use of petroleum based gensets during load shedding in the urban residential sector.

Industrial Sector

The main uses of energy in the industrial sector are for process heating, motive power, boilers and lighting. The industrial sector is broadly categorized intomodern and traditional. Modern industries

are also grouped into large industry and medium industry. The share of energy consumption in large modern industries is about 78 percent, followed by 17 percent in medium industries and 5 percent in traditional industries. Most of the large industries are located in the Terai and account for about 63 percent of the total sector energy consumption. Industrial sector energy consumption is dominated by coal-fired boilers, followed by motive power and process heating (WECS, 2010). Insufficient and unreliable supply of energy particularly electricity has adversely affected industries. Electricity provides nearly one fourth of the total industrial energy consumption. Uses of electricity are mostly for power motives and lighting. There is a small but growing use of petroleum products for electricity generation during load shedding in the industrial sector. Biomass, mainly fuel wood and agricultural residue, is used for boiler ignition and heating together with coal. It supplies about 15 percent of the industrial energy requirement.

Transport Sector

Transport is the second largest energy consuming sector. This includes road transport, railway, ropeway and aviation. Most of the petroleum products are used in this sector. Diesel has the highest share (about two-thirds) followed by petrol (one-fifth) and then aviation fuel. The contribution of LPG is also increasing in this sector. However, electricity consumption is very little. Road transport accounts for over 85 percent of thesectoral consumption followed by aviation. Consumption in railway and ropeways is minimal.

Commercial Sector

Energy consumption in the commercial sector is small but rapidly growing. This sector mainly includes academic and health institutions, offices, shops, hotels and restaurants. The main fuels used are petroleum, mainly LPG and kerosene (over 50 percent), fuel wood (over 35 percent) and electricity (over 10percent). They are used in cooking, heating, lighting, boiling, cooling, pumping water and for electric appliances, etc. There is a growing trend of petroleum based gensets being used during load shedding in the commercial sector.

Agricultural Sector

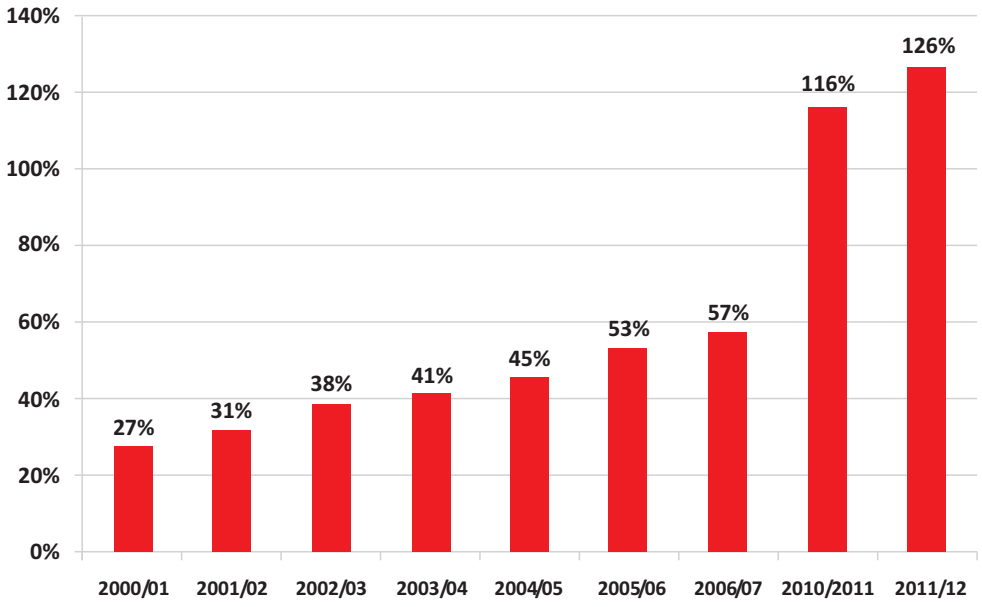
Agricultural sector uses diesel (about 95 percent) and electricity[2]. However, electricity consumption is increasing at a faster rate than diesel. The energy is mostly used for pumping water for irrigation.

d. Energy and Economic Development

Total Dependence on Imported Petroleum Products

Figure 5 shows that Nepal is becoming dangerously dependent on oil imports to meet its energy requirements. The expenditure on import of petroleum has increased from 27percent of the export earnings in 2000/2001 to approximately 126 percent in 2011/2012. This means that the total commodity exports from Nepal are not sufficient to meet the rising demand of petroleum products (MOF, 2012). This is adversely affecting the Balance of Payment (BOP) indicators of the country.

[2]Human and animal draft power are not considered in the sectoral energy demand because of difficulties with its assessment.



(Source: MOF, 2012; NOC, 2011)

Figure 5: Import of Petroleum Products against Commodity Exports in 2012

Insufficient and Unreliable Electricity Supply

Nepal's installed electricity generating capacity is mostly run-of-river hydropower generation. The electricity demand peaks in the dry season, when generation is the lowest. On the contrary, the generation is the highest in summer when demand is low. Figure 6 depicts the peak demand of power against the installed capacity of power plants till 2010.According to NEA, the peak load in January 2012 was 1,026 MW, while the supply was only 40 percent of this. This gap has given rise to severe electricity shortage in the country, with daily load shedding reaching 14 hours in the dry season and 6hours even in the wet season. This can be mainly attributed to the increasing demand, low rainfall, no significant addition of new generation, and poor utilization of available resources. In addition to creating difficulties for the general population, the power shortagehas had adverse impact on the industrial and commercial sectors. As described earlier, this has led to a dramatic increase in the useof fossil fuel based electricity generation, with consequent increase in consumption especially of diesel.

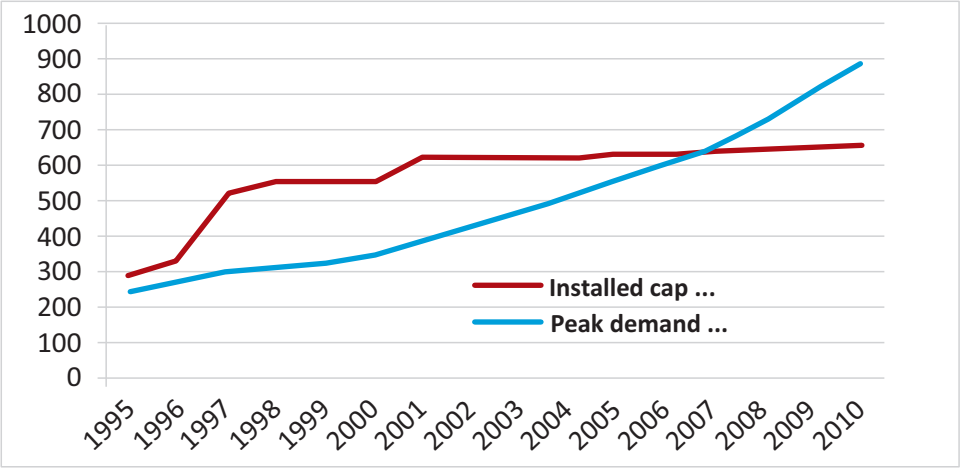


Figure 6: Difference between Peak Demand and Installed Capacity of Power Plants (MW) (NEA, 2012)

Potential for Switching to Electricity

In recent years, subsidized Liquefied Petroleum gas (LPG) is being widely used as cooking fuel not only in urban but also in rural areas. However, due to price rises in the international market, fossil fuels like kerosene and LPG have now become uneconomical for cooking compared to electricity.

Table 4. Monthly Life Cycle Cost of Cooking in an Urban Household

Year	Kerosene	LPG	Electricity
1997	180	350	605
2000	270	410	680
2003	340	510	790
2012	**1,640**	**1,030**	**940**

(Calculated based on D'sa and Narasimha Murthy, 2004)

Table 4 presents the monthly life cycle costs (MLCC) of cooking intheurban household of average 5 persons. These values are based on the calculations for the past 15 years in Nepal (D'sa and Narasimha Murthy, 2004).It reveals that compared to 1990s and early 2000s, cooking using electricity has become the cheapest option for an urban household in spite of the 20 percent hike in electricity tariff in July 2012. Since cooking in the households takes place during peak load time, calculations show that to completely substitute LPG imports an additional 500 MW electricity is required during peak hours. This translates to about 1,750 MW of installed capacity in 2010. The economic costs of cooking in kerosene and LPG for an average urban family are NRs. 1,470 and NRs. 1,330 respectively in 2013. If the country can supply reliable electricity, urban dwellers will no doubt switch over to cooking using electricity. With the expansion of grid-connection, rural areas can also use electricity for cooking.

Suppressed Electricity Demand Forecast

As per NEA's electricity demand forecast (NEA 2012), the system peak load will be 3,700 MW and demand will reach 17,000 GWh by 2028. However, the load forecast indicates growth rates of peak load and electricity demand by 8 percent annually (Figure 7). This forecast is a suppressed demand forecast since it has not considered the potential for switching to electricity for cooking, etc. As indicated above, there is potential for consumers switching to electricity from LPG and kerosene for cooking, provided sufficient electricity is available at a suitable price.

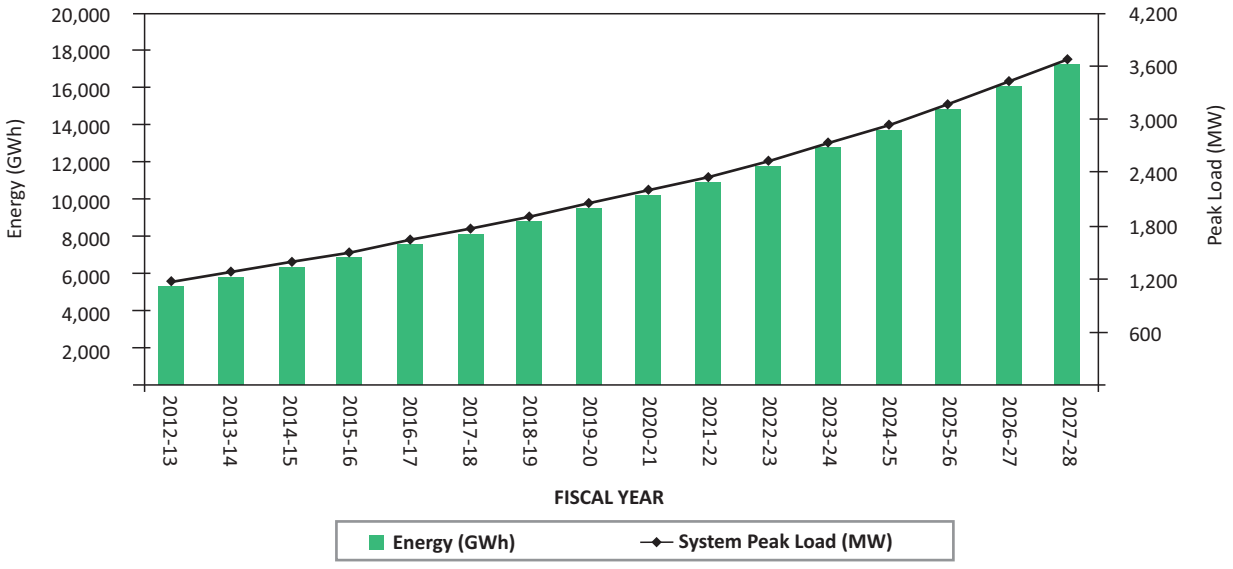


Figure 7: Load forecast as per NEA (NEA, 2012)

Demand Side Management and Energy Efficiency

According to a study conducted by South Asian Regional Initiative Energy (SARI/E) under USAID, Nepal could save 50 to 80 MW (80 to 100 MW from supply side) of peak power demand through energy standards and labelling program, use of energy efficient household appliances such as rice cookers and refrigerators, replacement of incandescent bulbs with compact fluorescent lamps (CFL), and a strong public awareness campaign to use energy efficient appliances in a period of five years (ADB, 2012). Similarly, a baseline survey conducted in the industrial sector in 2012under the assistance of GIZ program revealed that energy efficiency measures can save electricity by 4percent of the total sales of NEA and 2percent of diesel sales of NOC in the country (NEEP/GIZ, 2012).

Energy Subsidy

The Nepal Oil Corporation (NOC) has been providing subsidy in diesel and LPG for quite some time. NOC loses almost NRs. 500 per cylinder (14.2 kg) and it incurred an expenditure of almost NRs. 5 billion for subsidies in the fiscal year 2010 -2011. Similarly, NEA has not been able to adjust its tariff due to virtually defunct tariff commission and because of the fact that there is no independent regulatory body in the energy sector. Therefore, it can be said that NEA is also indirectly subsidizing electricity supply in Nepal.

Both NOC and NEA are in deep red and virtually insolvent due to the tariff and pricing still controlled by the Government of Nepal. NEA recently hiked its tariff by around 20percent in July 2012 and NOC has not been able to adjust its domestic prices in accordance with the international oil price. NOC has liabilities of around NRs. 28 billion which far exceeds its total assets. NEA is incurring heavy losses every year and it incurred a net loss of NRs. 8.5 billion in 2012 (NEA, 2012).The current electricity tariff for domestic use between 151 to 250 kWh/month is NRs. 9.50 (US$ 0.11) per kWh, which was recently adjusted in August 2012.It is apparent that the dominance of state institutions in the energy sector will be one of the major bottlenecks in achieving the main objectives of the SE4ALL program.

The Government of Nepal is also providing subsidies for the installation of off-grid renewable energy technologies (off-grid hydro, solar PV, solar thermal, biogas, etc.) based on the location and remoteness of the installation (AEPC, 2013a). AEPC is not providing direct subsidy for the improved cook stoves but are providing financial assistance to the local bodies for their installation. AEPC is providing NRs. 3,000 per unit for two-holed metallic ICS and NRs. 4,000 for three-holed ones. For residential biogas plant, AEPC provides subsidy as follows (Table 23): Mountainous

Table 5. Subsidy on biogas plant in NRs (AEPC, 2013a)

Regions	2 cu. M	4 cu. M	6 cu. M	8 cu. M
Mountains Region	25,000	30,000	35,000	40,000
Hilly Region	20,000	25,000	30,000	35,000
Southern Terai Region	16,000	20,000	24,000	25,000

Fuel woodin rural areas iscollected from the forests free of cost. The market price for a cylinder of 14.2 kg LPG is NRs. 1,470. (US$17.00). For this the government is providing an indirect subsidy through NOC, an amount equivalent to 30 percent of its market price. Kerosene is supplied at a market price NRs. 99.00 (US$1.15) per litre and NOC makes some money in its supply.

e. Energy Strategies and Relevant Targets

National Water Plan, 2005

The National Water Plan, 2005 (WP) aims to integrate, coordinate, decentralize, ensure popular participation in and implement water-related programmes within the framework of good governance, equitable distribution and sustainable development. Hydroelectricity is one of the sectors addressed.

The main strategies for the electricity sector are the development of:

- Small and medium hydropower projects for domestic needs, including residential use, use by energy-intensive industries and transport sector.
- Off-grid hydro and other alternative energy technologies to increase electricity access.
- Large hydropower projects mainly for export.

The Plan has set the following targets for 2027, which are relevant to SE4All:

- 4,000 MW of hydropower is developed to meet the domestic demand, with additional electricity exported to earn national revenue.
- Seventy-five per cent of the households are supplied with grid electricity, 20 percent by isolated (micro and small) hydro systems and 5 percent by alternative energy.
- Per capita electricity consumption of over 400 KWh.

Ten-Year Hydropower Development Plan 2009

Government of Nepal formed a task force in 2008 to formulate programs for developing 10,000 MW in 10years. The Task Force submitted its report in 2009. The report presented a plan and recommendations on meeting the ten-year target.

Twenty-Year Hydropower Development Plan 2009

Government of Nepal developed another plan in 2009 to develop 25,000 MW in 20 years. The Plan aims to develop 1,100 MW of hydropower in the first five years, of which 127 MW will be by private sector, 231 MW by NEA and 743 MW by NEA subsidiaries. It aims to develop 1,600 MW in the second five year period, 5,100 MW in the third five year period and 18,000 MW in the final five years, raising a total of 26,000 MW by 2029.

National Energy Strategy (to be approved)

WECS (2009) was developed for the period 2005 -2030 with a vision to meet the demand for energy services of the people of Nepal by ensuring security, sufficiency, and sustainability for

poverty reduction and economic development through the efficient use of the indigenous energy resources. This strategy is under the process of approval.

Some of the strategies to develop hydropower as the lead energy resource are:

- Develop transmission network in coordination with electricity generation.
- Promote energy efficiency.
- Promote switching to electricity and other renewable energy from traditional and fossil fuels.
- Focus on rural energy access.
- Reform the institutional and incentive structures of the energy sector.

The strategy targets to reduce fuel wood share in urban and rural residential sectors to 75 percent and 30 percent respectively. It also targets to install improved cook stoves in 50 percent residences and 50%commercial institutions currently using traditional wood stoves, replace 75 percent incandescent bulbs with CFLs and attain installed capacity of electricity generation of 11,480 MW and per capita electricity consumption of 1,070 kWh. All these targets are to be met by 2030.

Clean Cooking Solutions for all by 2017

The Government of Nepal has pledged to make all Nepali homes smoke-free by 2017. The Prime Minister of Nepal had announced the "Clean Cooking Solutions for all by 2017 (CCS 2017)" in January 2013.

Three-Year Plan, 2013

The approach paper for the current Three Year Plan (2013 – 2016) envisions upgrading Nepal from least developed country to developing country status by 2022. It has identified hydropower and other energy development as one of the priority areas. It seeks to increase access to reliable and quality electricity through hydropower promotion. It also seeks to reduce dependence on traditional fuels and increase electricity access to population living far away from the national grid through off-grid renewable energy systems. The Plan targets addition of 665 MW of hydroelectricity and ensuring electricity access to 87 percent of the population. It also seeks to achieve electricity consumption of 140 kWh per capita. It targets to add 15 MW of off-grid hydro, 6 MW of solar electricity and 1 MW of wind energy, providing electricity access to an additional 7 percent of rural population. The Plan has specifically highlighted the formulation and implementation of an action plan to meet the three SE4ALL objectives.

B. CURRENT SITUATION WITH REGARDS TO SE4ALL GOALS

I. Energy Access vis-à-vis Goal of SE4ALL

The first objective of SE4ALL program is the universal access to modern energy by 2030 and achieving this objective is of paramount importance for a developing country like Nepal.

Energy is an essential requirement for individual and economic development and indispensable for achieving the developmental goals. The widespread discussion on energy and its connections with all the three pillars of sustainable development - economic, social and environmental - is at the core of meeting the Millennium Development Goals (MDGs). Almost 1.3 billion people in the world are without access to electricity and 2.7 billion people still use traditional biomass energy for cooking purposes (IEA, 2011).

Access to Electricity

The National Population Census 2011 (CBS, 2012) has shown that electricity has reached 74percent of the Nepalese population; 94 percent of urban population and 70percent of the rural population. Table 6 gives the breakdown for these data. It is assumed that electricity is supplied to a household either by grid electricity, off-grid hydropower or by solar PV systems.

Table 6. Segments of populations using different sources of energy for lighting (CBS, 2012)

Households	Electricity	Kerosene	Biogas	Solar	Other	Not Stated
Urban Household	94%	4%	0%	0%	1%	1%
Rural Household	61%	22%	0%	9%	7%	1%
HH/National	67%	18%	0%	7%	6%	1%

On the other hand, theWorld Bank's World Development Indicators (WB, 2012) states that access to electricity in Nepal is 53 percent - 41percent by grid connected electricity and 12percent by off-grid and isolated electricity. As there seems to be a difference in the data from different sources regarding access to electricity in Nepal, further study needs to be carried out to establish a sound baseline.

Though the access to electricity is shown to be high, the quality of electricity supply is a serious issue. In rural areas, electricity supply from off-grid hydropower plants is limited to an average of about 120 watts per household. Electricity is used mostly for lighting, charging mobile phones, and powering small equipment and appliances. Electricity from solar PV home systems is even more limited, to an average of about 40 watts per household. This is enough for lighting and charging mobile phones only. Grid electricity is not available for 40percent of the day on average. Households without electricity access depend on kerosene lamps for lighting. Furthermore, Nepal's electricity consumption per capita compared to other countries in the South Asia is low as shown in Figure 8.

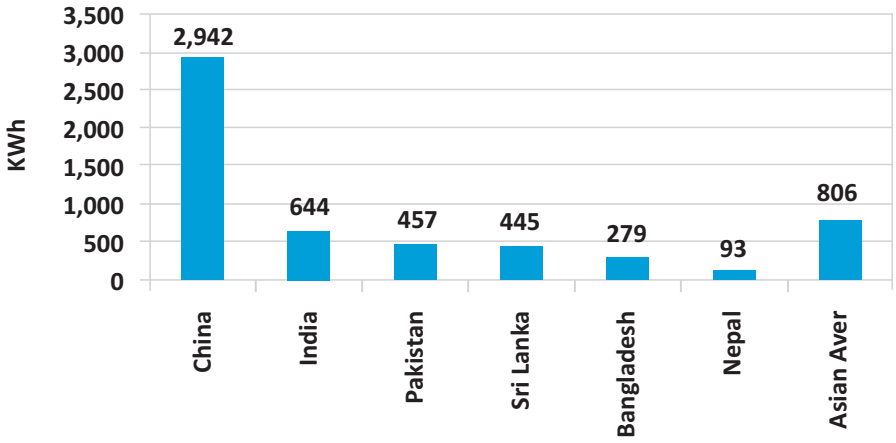


Figure 7: Comparison electricity consumption/capita in kWh in 2010 (IEA, 2012)

As described earlier, household residents and commercial entities in urban areas are depending on captive generating sets due to load-shedding and poor reliability of grid-electricity by the NEA.Recent surveys conducted by the students of Institute of Engineering (IOE) in 2012 at Thamel and Durbar Marg indicated that the cost of electricity generated by these captive plants was in the range of NRs. 30 to NRs. 60 per kWh (US$ 0.33 to US$ 0.66 per kWh). This reveals that high-income urban dwellers, commercial and industrial enterprises are willing to pay significantly more for electricity if availability and supply reliability is assured.

Access to Modern Energy for Thermal Applications (cooking, heating)

As described earlier, in Nepal most of the energy is derived from traditional solid biomass energy sources, which is mostly consumed in the residential sector.

As shown in Table 7 below, the National Population Census 2011 (CBS, 2012) has shown that about 72 percent of the urban population use non-solid fuels for cooking. However, 26percent of the urban population still depend on fuel wood. For the rural population, only 14 percent use non-solid fuels. About 86 percent still depend on solid fuels (mostly fuel wood and animal dung) for cooking.

Table 7. Use of different sources of energy for cooking (CBS, 2012)

Households	Fuel Wood	Kerosene	LPG	Animal Dung	Biogas	Electricity	Other	Not Stated
Urban HH	26%	2%	68%	2%	2%	0.1%	0%	1%
Rural HH	73%	1%	10%	12%	3%	0.1%	0%	1%
National	64%	1%	21%	10%	2%	0%	0%	1%

Usage of LPG is increasing in double digits for the past couple of years especially in the urban households and commercial sector. The percentage of people using LPG for cooking has increased from 8 percent in 2003 (NLSS II, 2004: NLSS III, 2011) to 18percent in 2010. The statistics showed that only people in the richest quintile have been using it. However, affordability for people in the lowest quintile virtually is insignificant at 0.1percent in 2011. Poorer people are still using fuel-wood (around 80 percent).

Modern Energy for Productive Uses

Analysis of modern energy use for different economic sectors shows that coal is mostly used in the industries, whereas petroleum products are predominant in the transport sector. Agriculture sector uses petroleum products and electricity for farm machinery and irrigation purposes respectively. Industries and commercial sector still consumes sizable volume of solid biomass for thermal uses.

Table 8. Share of Modern energy carriers for different sectors in 2010

Economic Sector	Petroleum Products	Coal	Electricity	Solid Biomass	Mordem Renewables	Total
Industry	8.2%	59.3%	22.8%	9.7%	0.0%	100%
Residential	1.3%	0.0%	1.1%	96.7%	0.8%	100%
Commercial	54.1%	0.0%	13.5%	32.4%	0.0%	100%
Transport	99.9%	0.0%	0.1%	0.0%	0.0%	100%
Agriculture	94%	0.0%	6.0%	0.0%	0.0%	100%
Others	0.0%	0.0%	100%	0.0%	0.0%	100%

(Calculations are based on MoF, 2012 and WECS, 2010)

Commercial entities such as hotels and restaurants use LPG and solid biomass mostly for cooking purposes.

Apart from electricity, energy sources such as petroleum products and coal areused for industrial end-uses such as boiler and furnaces. Most of the imported fossil fuels can be substituted by electricity but, supply of electricity is very unreliable and powercuts have become usual practice at huge losses to the industrial and commercial sectors. They have to rely on fossil fuels for the generation of electricity by diesel generating sets. For sustainable development and energy security power supply needs to be drastically improved.

Energy and Productive Uses in Rural Areas

Predominant use of traditional energy resources in rural areas is adversely contributing to reduced quality of life and living standards of the rural population. Use of traditional fuels in households adversely impacts health, especially of women and children, through indoor air pollution. It increases drudgery (fuel wood collection)mostly for women. It has adverse impact on children's education because of poor lighting and other factors. It adversely affects rural environment, contributes to deforestation and reduces agricultural land productivity. Making use of traditional fuels more efficient and smoke-free through improved cook stoves and biogas, and possibly replacing use of traditional fuels with renewable and clean sources of energy are urgent needs. Furthermore, lack of modern forms of energy especially electricity, in rural areas impedes enterprise and income generation. Such activities require clean, flexible and versatile forms of energy like electricity to power motors, electrical and electronic equipment, and appliances to provide good quality lighting and heating. Thus, ensuring universal access to modern energy services, promoting renewable energy development and energy efficiency is vital for rural development in Nepal.

II. Energy Efficiency vis-à-vis GOAL OF SE4ALL

The second goal of SE4ALL is doubling of the rate of energy efficiency by 2030. Demand side management and energy efficiency (DSM/EE) programs are essential for saving capital investment in energy supply technologies in developing countries.

For sustainable development of the energy sector, a country needs to concentrate not only on supply but also on demand. World Energy Outlook 2006 (IEA, 2006) estimated that US$ 1 spent on energy efficiency improvement saves more than US$ 2 on supply investments. A developing country like Nepal, which is reeling under power crisis, needs to focus on demand side management such as energy efficiency much more in order to curtail rising dependence on fossil fuels. Nepal's energy efficiency is very low due to its high dependence on solid biomass for its energy needs.Usage of commercial energy, though increasing at a high pace, is still quite low compared to its neighboring countries.

In the electricity sector, in addition to adding new generation capacity, it is important that the country focuses on demand side management of energy and energy efficiency (DSM/EE). This will not only bring about significant reductions in energy usage, but will also reduce costly captive generation, avoid or reduce load shedding and its associated adverse economic impacts. There will also be environmental benefits. Furthermore, there will be significant cost-saving because of avoided addition of generation capacity. The two main objectives of DSM/EE in the electricity sector will be to reduce peak demand and energy consumption across all sectors using electricity. More efficient lighting equipment and appliances in the residential sector, more efficient motors, power factor correction and energy conservation in the industrial sector, more efficient lighting and energy conservation in the commercial sector will be some of the priority areas.

A study on potential DSM options and priorities commissioned by NEA and World Bank indicates that DSM/EE in the residential sector will produce the greatest energy consumption and demand savings (NEA/WB 2012). This includes replacing traditional cook stoves with improved cook stoves (ICS) in rural areas, substitution of kerosene and LPG by electricity for cooking in the urban areas and replacement of incandescent lamps with compact florescent lamps (CFLs) and light emitting diode (LED) lamps. With sufficient and reliable supply of electricity, use of electric hot plates (efficiency in the range of 70 percent) can be promoted to replace LPG stoves (efficiency in the range of 60 percent).
Electricity cost in the range of NRs. 800 million and petroleum import cost of NRs. 2 billion could be saved in the industrial sector through DSM/EE (NEEP/GIZ, 2012). An energy efficiency technical report submitted to the Asian Development Bank indicates that there is a potential of capacity saving of 100 MW out of the installed capacity of 700 MW currently, and 33 MW by the distribution of 750,000 CFLs (ADB, 2012).

NEEP Report on Baseline Study of selected sector industries concludes that cost of energy is a significant portion of the cost of operation or the turnover of industries. The products with highest proportion of energy cost on the value of product: limestone based cement (47.6%), cold storage (37.91%), bricks other than VSBK (31.51%), pulp & paper (19.83%), and VSBK (14.41%). Furthermore, cement, food and hotel industries have the highest potential for electricity saving, whereas brick, cement, and food industries have the highest potential for thermal energy saving. Coal has the highest value of potential saving followed by diesel and

purchased electricity. It also concluded that sugar mills have a significant amount of cogeneration potentials. The study reveals that there is potential of energy efficiency improvement in the range of 20 to 40 percent inenergy use in some industries (NEEP/GIZ, 2012).

AS per IEA (2012), compared with neighboring countries, the energy efficiency of Nepal (kgoe/US$ 1,000 GDP) stands dismally poor.

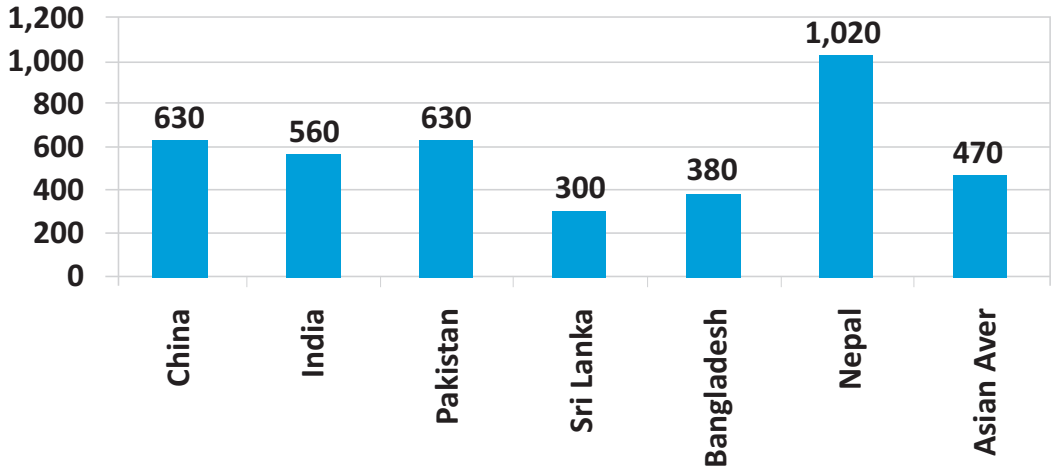


Figure 8. Energy efficiency in kgoe/US$ 1,000 GDP (IEA, 2012)

Historical trend of energy intensity in Nepal shows improvement but the magnitude is quite low. Energy efficiency in the industrial sector for the period 2000- 2010 indicates an average twice those in other sectors.

Table 9. Energy intensity in various economic sectors of Nepal

Energy intensity	2000	2005	2010	Period 2000-2010
Energy intensity level of final energy (MJ/$2005 PPP)	15.3	14.6	13.1	-1.52%
Energy intensity level of primary energy (MJ/$2005 PPP)	15.4	14.7	13.2	-1.52%
Energy intensity of agricultural sector (MJ/$2005)	0.4	0.3	0.5	1.58%
Energy intensity of industrial sector (MJ/$2005)	4.3	4.0	3.2	-2.97%
Energy intensity of other sectors (MJ/$2005)	33.3	32.2	27.4	-1.93%

(SE4ALL database, 2013)

III. Renewable Energy vis-à-vis GOAL OF SE4ALL

SE4ALL database (IEA/World Bank, 2013) considers solid biomass and hydropower as renewable energy. Hence, in the database, the share of renewable energy in Nepal is shown to be 88 percent of the total final energy consumption in 2010. In Nepal's case, solid biomass consumption exceeds its sustainable supply. However, these statistics need to be further investigated.

Development of renewable energy is essential for sustainable energy development and it has immense economic implications for an oil-importing developing country like Nepal for energy security reasons.

Out of the current installed capacity of the grid-power system of about 719 MW, 92percent is from hydropower with the remaining power from thermal power system.12 percent of households are supplied with electricity by micro hydro and solar home systems in rural areas. For thermal application, biogas and solar thermal heaters or cookers are used. In Nepal, a large number of the households in the urban areas use solar thermal heaters for heating water. Biogas is gaining popularity for cooking in rural areas and at the periphery of urban areas. There were 280,000 biogas plants in 2012 and the annual growth rate is around 8 percent. The energy generated is almost equivalent to the heating energy generated by 225 MW power plants. Some SHS are used for charging cell phones as well as for running other electronic gadgets like radio and TV in the villages. Inrural areas, improved water mills (IWM) are used mainly for grinding or de-husking grains but micro hydro plants alsofind productive uses apart from lighting purposes.

Referring to Figure 1, if we consider grid electricity and new renewables like off-grid hydro, solar PV systems as renewables, the total share of renewable energy in Nepal's total primary energy consumption is 3%. However, even though use of some portion of biomass is renewable because of sustainable supply of fuel wood from the forest(i.e. fuel wood is got from the forest without cutting down/killing trees) and as by-products of wood processing and also the use of animal dung in biogas plants,data does not exist to accurately ascertain what the percentage of this sustainable use is. Therefore, this is an area for further studies.

IV. SE4ALL Goals

Ensuring Universal Access to Modern Energy Services

Ninety-six percent urban population and 61 percent rural population had access to electricity in Nepal in 2010. As per the definition from International Energy Agency (IEA,2011), *energy access means a household having reliable and affordable access to clean cooking facilities, a first connection to electricity and then an increasing level of electricity consumption to reach the regional average*. The initial threshold level of electricity consumption for rural household is 250 kWh and for urban household 500 kWh per year which should reach 800 kWh in 2030. This definition also includes clean cooking energy such as electricity, LPG and environmentally sustainable biomass cook stoves. The goals set for the energy access for meeting the minimum threshold are given in table 10.The table consists of modern energy consumption for lighting and cooking.

Table 10. Goals for energy access in kWh/capita per year

Modern energy consumption	2010	2015	2020	2030
Modern energy/ capita rural	35	92	145	249
Modern energy/ capita urban	376	437	510	707

(Author's calculations)

By 2030, rural households will reach the threshold whereas urban households will almost come near to 800 kWh per capita.

The power requirement with 25 percent reserve on peak power (table 11) is as follows:

Table 11. Expected power requirement and electricity consumption per capita

Particulars	Units	2015	2020	2030	Percentage
Grid poser	MVV	3,078	5,555	13,902	86%
Off-grid & Isolated power	MVV	29	61	219	1%
Grid-connected solar	MVV	-	100	2,100	13%
Total	MVV	3,106	5,716	16,221	100%
Grid electricity cons./capita	kWh	209	345	838	

Even though the number of households expected to achieve the minimum modern energy access is increasing, other energy forms are still used in households for cooking. Rural households will be still using solid biomass and renewable energy technology such as biogas plants for cooking purposes, whereas urban households are expected to switch over to electricity by 2030. The number of households using different forms of energy is shown in table 12. Commercial energy in households means electricity, LPG, kerosene and coal at the initial period but will be mainly electricity and LPG in the final year.

Table 12. Expected targets for energy mix for cooking (millions)

No. of households	2010	2015	2020	2030
HH/com energy	0.16	0.40	0.80	2.72
HH/biomass	5.06	5.18	5.17	4.10
HH/biogas	0.23	0.27	0.32	0.44
Total	5.45	5.85	6.29	7.26

Traditional stoves used for household cooking will be completely replaced by improved cook stoves (ICS) by 2030 and the required penetration of ICS per year at different periods is given in table13.

Table 13. Expected targets for annual installation of ICS

	2015-2020	2020-2025	2025-2030
ICS installation/year	202,033	336,448	378,778

If the targets are achieved by 2030, Nepal will have access to modern energy both in the rural and urban households by 2030.

Doubling the Rate of Improvement in Energy Efficiency

Nepal scores the lowest in terms of energy efficiency among other countries in South Asia. It is due to high reliance on solid biomass fuels for meeting its energy requirementsModern energy used in the productive sectors such as industry, commercial or services, transport and agriculture sectors are significantly lower than solid biomass consumed in the non-productive household sector. For the improvement of energy efficiency, Nepal needs to first focus on its improvement in the household sector and subsequently in other sectors like industry, transport and the service sectors. GIZ is assisting WECS in developing national energy strategy with particular focus on energy efficiency and the sustainable use of biomass.

Nepal currently spends 87 percent of its energy consumption in the household sector, out of which 64 percent of energy use is for cooking. As per UNIDO's energy strategy, industrial development should be geared up to increase competitiveness by increasing its energy intensity and to reduce carbon emission by enhancing energy efficiency and promoting renewable energy technology applications (UNIDO, 2009). The energy development pathway, as suggested in this analysis with the emphasis on the development of indigenous hydropower and renewable energy sources, is based on usage of electricity in the manufacturing end-uses such as boilers and motive power, efficiency improvement in the process heat, introduction of electric railways in freight and intercity transport and use of electricity in the agriculture and services sectors.This can improve Nepal's energy intensity and efficiency by more than two folds (Table 14). Though the data for 2010 in table 14 is slightly different from the IEA data in 2010, the difference is not so significant.

Table 14. Energy intensity in Nepal in kgoe

Particulars	2010	2020	2030
Energy Intensity/US$ 1,000 GDP	1,166	652	421

(Based on the author's calculation)

The calculation is based on MARKAL energy systems modeling framework of which the previous version was also used for the development of the national energy strategy for Nepal.

Table 15 shows the expected improvement in the energy efficiency in the period 2010-2020 and 2020-2030 respectively. The SE4ALL database for Nepal indicates the energy efficiency improvement in 2000-2010 is 1.52 percent. Table 15 is calculated based on table 14.

Table 15. Expected decline in energy intensity

Particulars	2010-2020	2020-2030
Expected decline	**-5.6%**	**-4.3%**

With these expected targets Nepal's energy efficiency will be in comparison with its neighboring countries in the South Asia. Just by improving clean energy access to the household sector energy efficiency can be more than doubled in Nepal to 470 kgoeper capitaby 2030. The Asian average energy intensity as shown figure 11 is 470 kgoeper capita in 2010 (based on author's calculations).

Doubling the Share of Renewable Energy in the Energy Mix

The current energy situation of Nepal reveals that Nepal has abundance of renewable energy resources especially hydropower resources which are poorly harnessed in the country. On the other hand, Nepal's economy is becoming much more dependent on imported fossil fuel which is detrimental to the national economy from the aspects of energy security and sustainable development. Nepal has to develop its indigenous renewable energy resources for its economic development and energy security. The energy development pathway taken in this analysis expects the hydropower development as indicated in figure 9.It shows the power requirement in order to meet the end-user demand in the country with the combined policy intervention necessary for achieving SE4ALL objectives. Therefore, the power requirement is much higher from the existing installed power capacity.

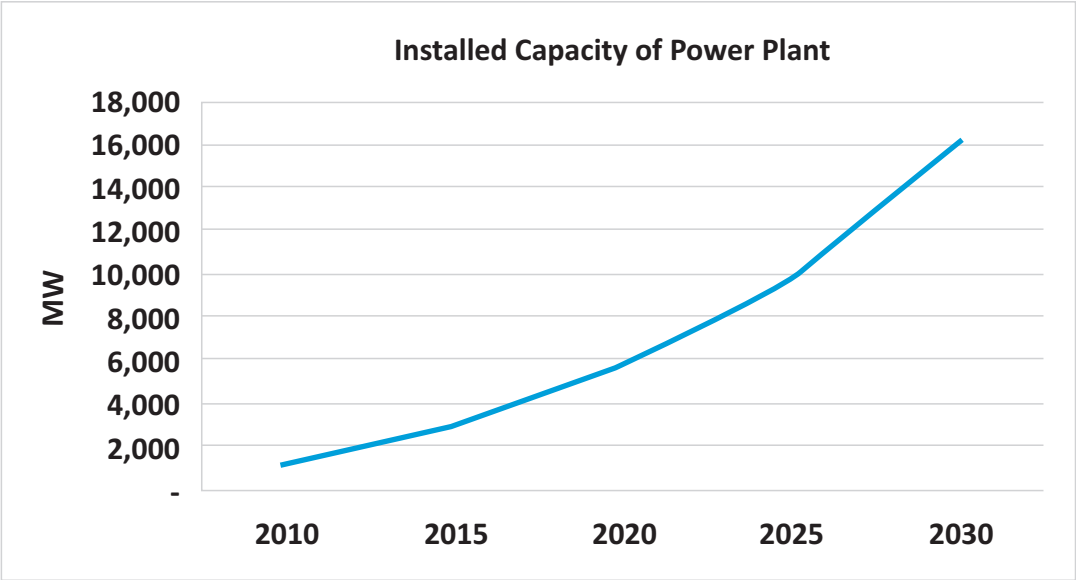


Figure 9. Expected Hydropower installed capacity in MW in the combined policy case

The scenario projection done in this analysis indicates that hydropower plant capacity development needed will be 5, 600 MW and 14,000 MW in 2020 and 2030 respectively with a 25 percent reserve from the peak power demand. Distributed generation of off-grid and isolated electricity with micro, pico hydro and SHS is expected to be 60 MW and 220 MW by 2020 and 2030 respectively. Solar PV power plants are becoming most competitive with declining prices of solar PV modules ininternational markets (IRENA, 2012) and it is expected that around 100 MW and 2,100 MW grid connected solar PV plants will be installed by 2020 and 2030 in Nepal. NEA is in the process of installing 20 MW PV power plant currently in 2013.

Table 16. Share of renewable energy in the total final energy consumption

Particulars	2010	2020	2030
Share of renewable energy	3%	11%	26%

If solid biomass is not considered as renewable energy, with this development of indigenous renewable energy resources of the country, Nepal can easily surpass the target of doubling the share of renewable energy by 2020. It can achieve a share of 11 percent and 26 percent of renewable energy in the total expected final energy consumption in 2030 (table 16). The share includes electricity generated by large hydropower plants as well.

C. CHALLENGES AND OPPORTUNITIES FOR ACHIEVING SE4ALL GOALS

I. Policy and Institutional Framework

Energy in National Strategies and Plans

Energy has been recognized as a prime mover for rural, urban and industrial development of the country. This has been reflected in Nepal's policies and periodic plans.

The Hydropower Policy of 2001 specified facilities and incentivesto attract private investment and accelerate rural electrification. It especially stipulates establishment of an Electricity Regulatory Commission. It seeks to unbundle NEA and have an autonomous public body operate the national grid, and encourage the private sector, local bodies, and community institutions to take over electricity distribution. The policy also envisages the establishment of a Rural Electrification Fund. However, the policy provisions are yet to be established as an Act.

The Rural Energy Policy of 2006 aims to promote clean and reliable energy for poverty reduction and environmental conservation. It seeks to do this by supporting increased access, and linking rural energy development with employment creation and promoting use of rural energy for social and economic activities.

The 10th Five Year Plan (2003-2007), which was also the government's Poverty Reduction Strategy document, emphasized the expansion of electricity coverage in a sustainable and environmentally friendly manner by generating low-cost power, accelerating rural electrification to promote economic growth, improving living standards in rural areas, and developing hydropower as an important export item.

The Three Year Interim Plan (2007–2010) recognized hydropower as an important base for the comprehensive economic development of the country. It envisioned prioritized development of hydropower to meet domestic demand and for export to contribute to the livelihood improvement of the Nepalese. It sought to create an environment that is conducivetodomestic and foreign investment in hydropower and to ensure reliable and affordable electricity services for the rural population. Furthermore, it emphasized on renewable energy promotion and development to reduce dependence on traditional and fossil fuels, contribute to rural development, enhance rural economy and quality of rural life, increase employment opportunities and contribute to environment sustainability.

The Three Year Plan (2010–2013) envisioned provision of reliable, quality, sustainable, and universal access to electricity for all Nepalese by 2027, contributing to the nation's overall development and improving living standards. It sought to make modern energy available to all for economic and social development through generation, transmission, and development of hydropower. It also aimed to attain 10 percent share of renewable energy in the total energy mix and 30 percent in the total electricity supply within 20 years. It also emphasized renewable energy promotion and development for reduced dependence on traditional and fossil fuels, improved quality of rural life, increased employment and enhanced environmental sustainability.

The approach paper for the current Three Year Plan (2013 – 2016) envisions upgrading Nepal from least developed country to developing country status by 2022. It has identified hydropower and other energy development as one of the priority areas. It seeks to increase access to reliable and quality electricity through hydropower promotion. It also seeks to reduce dependence on traditional fuels and increase electricity access to population living far away from the national grid through off-grid renewable energy systems. The Plan has specifically highlighted the formulation and implementation of an action plan to meet the three SE4ALL objectives.

The Government of Nepal pledged to make all Nepali homes smoke-free by 2017. The Prime Minister of Nepal announced the "Clean Cooking Solutions for all by 2017 (CCS 2017) in January 2013. AEPC is currently formulating a CCS 2017 action plan. The action plan will encompass various policy, financing, capacity building, and coordination mechanisms such as creation of a multi-stakeholder coordination platform, establishment of a dedicated unit within AEPC, capacity building for service delivery, awareness campaigns, and national and international

resource mobilization. The action plan will have a strong gender and social inclusion focus. The initiative is estimated to cost about USD 185 million.

Nepal has long recognized hydropower development as a key element in its effort to reduce poverty and stimulate economic growth in the country. The pathway for this is to provide clean energy for socio-economic development, both in urban and rural areas, and generate revenue through export of electricity.

Inspite of the policies to attract private investment in hydropower development, investment has been limited. Small hydro for the grid has provided an opportunity for domestic private sector investment. The reluctance to invest can be attributed to a number of reasons, chief among them being weak governance and institutional structures, insufficient investment, friendly institutional and policy mechanisms, limited availability of domestic funds, a loss making public utility as the sole purchaser of electricity from IPPs within the country and inadequate human resources.

Nepal has developed a remarkably diverse rural energy sector including a broad range of technologies. They havebeen widely disseminated through awareness creation, capacity building, quality assurance, subsidies and micro finance. There is also a unified sector-wide approach to avoid duplication and create synergies in implementation. The donor community is very positive towards Nepal's efforts to develop hydropower and other renewable energy resources.

Policies to increase access to off-grid renewable energy systems for the poor have mainly focused on subsidy provisions. The government's subsidy policies, tied to quality assurance, have been able to bring significant investment in the sector from suppliers, manufacturers, entrepreneurs, financial institutions and end users. However, inadequate subsidy funds and the dependence on donors for this fund have time and again created uncertainties for potential consumers and also the private sector. Fossil fuels like kerosene and diesel are still subsidized.

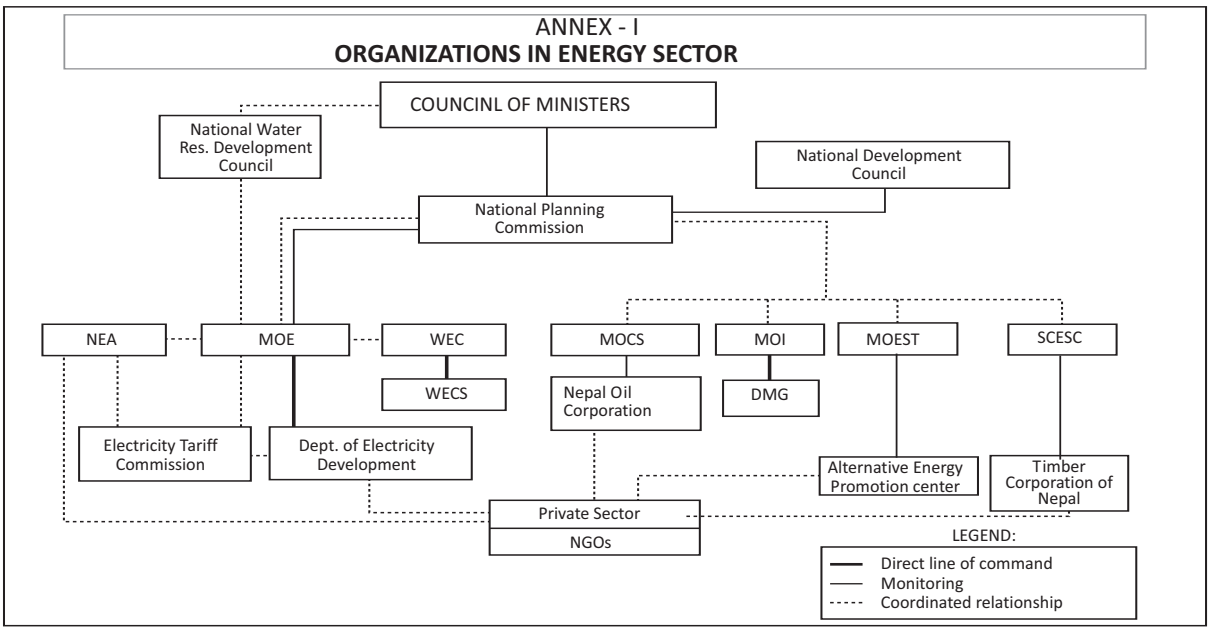
Off-grid rural renewable energy systems are emerging as new areas of investment for financial institutions. However, they are still perceived as high risks, especially with respect to the borrowing capacity of rural households. Micro credit is emerging as an effective financial instrument to increase the access to the poor to renewable energy technologies.

However, especially in rural areas, even though all policies and plans invariably mention reducing dependence on traditional and fossil fuels, neither specific programs of actions for ensuring universal access to modern cooking/heating solutions nor is the implementation of whatever program sexists adequate.

Nepal ratified the UNFCCC Kyoto protocol in 2005. Quite a few CDM projects, especially related to biogas and micro-hydro, have been approved. As aleast developed country, Nepal still has opportunities for carbon financing through this mechanism. However, more effort is required in policy formulation, promotional and outreach activities and also capacity building of relevant stakeholders.

Energy Governance

Considering the importance of energy services, a separate ministry had been established to focus on energy sector as a whole. However, due to political interference, it is focusing on the power sector only.



(Courtesy: Energy Resources Strategy of Nepal, 2009)

(NEA: Nepal Electricity Authority; MOE: Ministry of Energy; WEC: Water & Energy Commission; WECS: Water & Energy Commission Secretariat; MOCS: Ministry of Commerce & Supplies; MOI: Ministry of Industries; MOEST: Ministry of Environment, Science & Technology; MOFSC: Ministry of Forestry & Soil Conservation; DMG: Department of Mining & Geology)

Figure 10. Institutional set-up in the energy sector

Figure 10 sheds light on the institutions involved in the energy sector. Ministry of Energy deals in the power sector, whereas the Ministry of Commerce & Supplies (MOCS) and the Ministry of Industries look upon the downstream and upstream sectors of petroleum products. Alternative Energy Promotion Center (AEPC), Ministry of Science& Technology and Environment (MOSTE), is the sole responsible government agency for the promotion of renewable energy in the country. Solid biomass fuels come under the purview of the Timber Corporation of Nepal, MOFSC.

The institutional set-up in the energy sector reveals that the whole energy sector does not come under the purview of one organization but is dispersed in various ministries and the coordination among them is one of the major problems being faced in the country for the integrated energy policy and development aspects.

Nepal Electricity Authority (NEA), Nepal Oil Corporation (NOC) and Alternative Energy Promotion Center (AEPC) are the major government agencies in the development of power sector, import and distribution of petroleum products, and promotion and development of renewable energy technology, respectively. Water and Energy Commission Secretariat (WECS) is involved in energy systems planning and policy advice to the Government of Nepal.

The institutions involved in supplying thermal energy to household sector are NOC for kerosene and LPG and AEPC for promotion of renewable energy technology. NEA provides electricity to the domestic consumers and electricity is also used as thermal energy in cooking but its usage is insignificant.

There are no market regulators for thermal energy. It is very essential to have an independent regulatory body for domestic price adjustment, as the current practice of government's discretion/political meddling in setting the prices of LPG and electricity tariff has made both NEA and NOC financially insolvent. They have not been able to develop and expand its physical assets in order to meet the growing demand of the consumers. Furthermore, the current

situation of not having an independent regulatory body in the energy sector is exasperating and a major contributor to the energy crisis in the country.

Ministry of Energy (MOE) is the apex body which formulates policy, strategy and plan in the power sector. Department of Electricity Development (DOED) is the body which is involved in licensing and the development activities of hydropower in the country. NEA is a publicly owned enterprise and is also a vertically integrated organization which is involved in the total supply chain of power from generation and transmission to distribution. In the 1990s the hydropower policy introduced the private sector in the generation of electricity. The independent power producers (IPP) account for 25 percent of the total generation of power in the country.

There is no independent regulatory body in the power sector, though a bill is still pending forthe formation of an independent regulatory commission.

The major institutions involved in the supply of modern energy and renewable energy in the productive sectors of the economy are NEA, NOC, and AEPC. To achieve the huge requirement of the power demand, NEA needs to be properly restructured and the current vertically structured supply chain of NEA has to be formed into separate independent segments such as generation, transmission and distribution. Distribution needs to be decentralized and involvement of end-users ensured to reduce pilferage and reduce operational costs. A huge capacity building process needs to be started in the supply of power and the petroleum products.

With this view in mind, Institute of Engineering (IOE), Tribhuwan University, and Kathmandu University have started Master's program in Energy SystemPlanning and Management in recent years. IOE is already running a Master's program in Renewable Energy Engineering for more than a decade. NEA has its own training center for capacity development.

Monitoring Framework for SE4ALL

The key energy indicators (table 17) to measure and monitor the achievement of national SE4ALL goals will be the energy indicators developed by the IAEA. Some relevant energy indicators for Nepal are:

Table 17. Key Energy Indicators for SE4ALL goals

Final energy consumption/capita	GJ/capita
Final electricity consumption	kWh/capita
Final energy consumption	GJ/1000$
Final electricity consumption	kWh/1000$
Electricity power utilized	kWh/1000$
Electricity power utilized	per cent
Total Energy consumption / value added in industrial sector	GJ/1000$ value added
Commercial energy/value added	GJ/Bill Nrs
Total energy used/household	GJ/HH
Transport Energy Utilization	GJ/M T- km
Transport Energy Utilization	GJ/M P- km
Share of non-carbon energy in primary supply	per cent
Share of renewable energy in final total energy consumption	per cent
The ration of net import to total primary energy supply	per cent
GHG emission for every ton of energy production and use	GHG in Kg/capita

(Source: Energy Resources Strategy of Nepal, 2009)

For any monitoring framework, data availability is of prime importance and it is very difficult to have relevant data on traditional biomass energy carriers and their resources. WECS had done energy surveys in different economic sectors in mid 1990s which were subsequently updated around 2005/06. The current study and the national energy strategy are based on these surveys. WECS is conducting energy consumption survey at present. The latest data and energy consumptions pattern will be revealed after the finalization of these surveys within 2013. There is a strong need for capacity building in energy systems analysis and planning. Center for Energy Studies (CES) at IOE is trying to develop capacity building and has started establishing an Energy Systems Planning and Analysis Unit to conduct energy policy analysis and develop required human resources for the energy sector since 2011.

The challenge for developing indicators and a monitoring framework is to go beyond the focus on energy supply and focus on energy services, or on how people use energy. This will also mean focusing on social and economic uses of energy in addition to its consumption. The SE4ALL monitoring framework for Nepal should ultimately aim to incorporate these parameters.

II. Programs and Financing

Thermal Energy

Apart from the AEPC, no government organizations or public sector enterprises such as NEA and NOC has come out with programs and financing for the improvement of the access to thermal energy for the people. NOC is providing indirect subsidy for LPG.

AEPC under National Rural and Renewable Energy Program (NRREP, 2012) has come out with the following planned program for the year 2012 -2017 (Table 18).

Table 18. AEPC program for the period 2012 -2017

2012 – 2017	Av. Annual Demand
Hydro	Pico: 167 units - 3 kw
	Micro: 333 units - 30 kw
	Mini 20 units - 500 kw
Solar	SHS: 60,000 units
	SSHS: 50,000 units
Biogas	22,000 units
IWM	LS: 320 units
	SS: 1,750 units
ICS	Mud: 115,000
	Metallic: 2,600
	Inst'n: 220
TOTAL	

In case of the access to thermal energy to households in the rural areas, AEPC has an annual plan of installing 115,000 units of mud ICS stoves, metallic 2,600 units and institutional ICS of 220 units. Apart from this, the program also considers the installation of 22,000 units of biogas plants annually. AEPC is providing subsidy with the financial assistance of development partners - Denmark, Netherlands, UNDP, Norway, Germany, and the UK.

AEPC has estimated that US$ 300 million and US$ 367 million will be required for the subsidy and credit programs under NRREP for the period 2012- 2017. RET financing will generally include up to 40 percent as subsidy, 40 percent as loans from private and micro-financing institutions, and the rest as equity from the users. The NRREP budgeted amount is only US$ 170 million and hence, there is a big gap between subsidy and credit requirements, and the allocated budget. AEPC has been quite effective in its endeavor to disseminate information, conduct training and capacity building in the promotion of ICS. The program's implementation modality shown below (figure 11) indicates how the mud ICS and metallic ICS reach out to consumers.

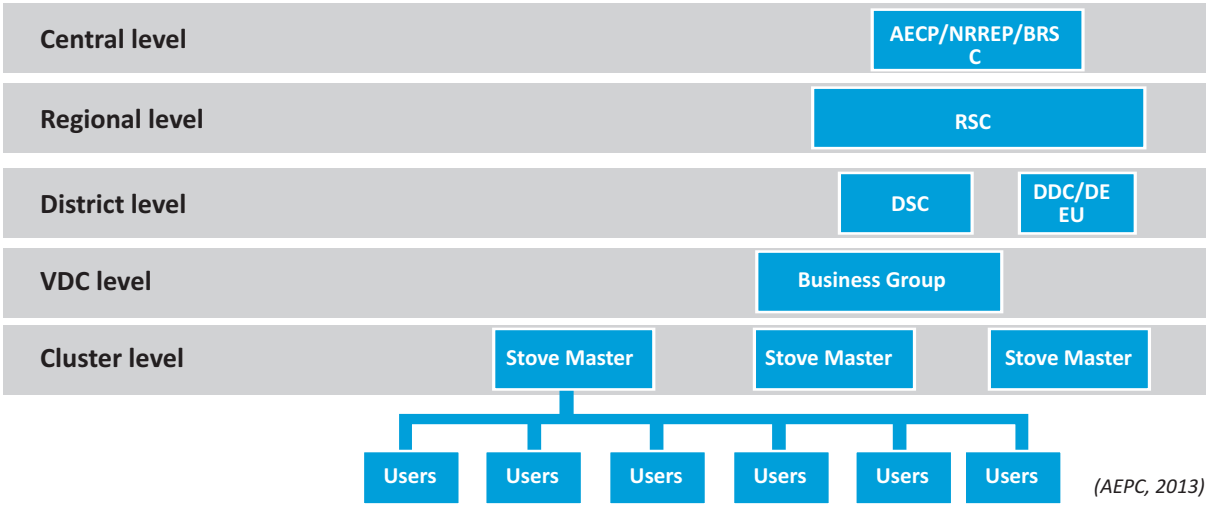


Figure 11 BESP/AEPC Service Delivery Mechanism for mud ICS

Mud ICS reach the users through ICS promoters and stove masters, whereas 32 prequalified manufacturers make the metallic ICS and avail them to the users (BESP/AEPC, 2012). As per AEPC, there are already 600,000 units of mud and metallic ICS installed in the country.

According to AEPC, rural households using solid biomass would be around 4 million by 2017. There are already 650,000 units of ICS installed (end of 2012).To achieve smoke-free kitchen for all by 2017, another 3.4 million ICS have to be installed by 2017, which may be an ambitious target. The current NRREP target is 115,000 units of ICS per year.

Figure 12. Projected scenario for 100 percent coverage of rural households by ICS by 2017

From the historical trend of installation of ICS, to achieve an annual target of 1 million units of ICS may seem like a tall order but AEPC is optimistic about its achievement.

As per AEPC, around 250,000 biogas plants have been installed. There are 81 qualified biogas manufacturers, 17 biogas appliance manufacturing workshops, and 26 micro-finance companies involved in financing biogas plants. Around 9,000 people are involved in direct or indirect employment. Biogas is the first project which has been successful in earning carbon revenue through the UNFCCC Clean Development Mechanism. For both the ICS and Biogas plants, AEPC is providing subsidy.

Regarding LPG and kerosene supply, NOC facilitates imports from India and private dealers are involved in the delivery to the end users. As stated above, NOC is bearing huge losses due to indirect subsidy it is providing for LPG, which goes mainly to the urban users, whereas poor rural and urban households who cannot afford LPG have to pay a hefty price for kerosene (which, in Nepal, is more than its economic cost because of pricing anomalies).

Since modern thermal energy is expensive compared to the traditional biomass energy, AEPC from its inception has been providing subsidies to rural users for installing renewable energy technology such as ICS and biogas plant. The latest AEPC subsidy policy has provisions to take care of gender issues, target areas where human development index is very poor and poor ethnic groups.

Community forests plantation rate cannot meet the current consumption rate of fuel wood but the current installation of ICS and biogas plants will definitely reduce the demand for fuel wood since ICS stoves (efficiency: 15 percent) are twice as much more efficient than traditional stoves (efficiency: 7 percent).

For energy security and sustainability in the case of LPG and kerosene for cooking, their substitution with electricity, as described earlier, is the best option.

Apart from the above, some NGOs are involved in promoting renewable energy technology in the rural areas.

Electricity

NEA has a 592 MW hydropower plant currently under construction, and it has proposed and planned to construct 2,600 MW in future (NEA, 2012). The recent Government of Nepal (GoN) announcement from the Ministry of Energy (June 2013) indicates that there are hydropower plants totaling 4,000 MW under consideration for development and that GoN is keen on developing them if private investors are not interested in investing in these plants. Many hydropower projects being developed by the private sector are also in various stages of project development.

Transmission is sometimes the bottleneck that is hampering development of hydropower plants and is one of the main reasons cited by IPPs for PPAs not being signed on time. NEA has 793 km of 132 kV, 446 km of 220 kV under construction, and has planned and proposed 1,540 km of 132 kV, 1,130 km of 220 kV and 1,880 km of 400 kV transmission lines.

Community grid rural electrification program has been mainstreamed as an effective means of grid-based rural electrification in Nepal since early 2000s. 182,000 households have received electricity under this modality and another 150,000 households will have electricity after

completion of ongoing implementation efforts in 49 districts of Nepal. Rural consumers have invested NRs. 920 million as capital cost sharing in this program. This has helped to rapidly scale up electricity connectivity in rural communities, and has been generally successful in providing quality service, eliminating illegal hooking and enhancing socio-economic activities in rural areas. The National Association of Community Electricity Users - Nepal (NACEUN) is a national federation of community users group formed under this initiative.

Asian Development Bank, under country partnership strategy of 2010-2012, plans to provide assistance to the Government of Nepal to achieve its power sector goals, especially regarding improving access to electricity in rural areas, increasing energy efficiency, clean power development, regional cooperation and integration, strengthening power sector governance and financing restructuring, and promoting private sector participation.

The World Bank had provided assistance of US$ 35 million in 2004 for investment in Nepal's power development, especially for the creation of Power Development Fund (PDF). In 2009, the World Bank made another commitment of US$89.2 million for rehabilitation of Kali Gandaki "A" and construction of Bharatpur-Bardaghat transmission line. The investment will be also utilized for the construction of 4.25 MW of micro hydro power plants. The World Bank has also supported AEPC through REDP/RERL to install 300 micro hydro plants with total capacity exceeding 8 MW.

Apart from the above, some NGOs are involved in promoting renewable energy technology in rural areas.

Modern Energy for Productive Use

There is not such a program from the government agencies for the use of modern energy in the productive sector. Commercial banks are mostly involved in financing larger hydropower plants. One prominent banking institution, Clean Energy Development Bank, is involved in financing of access, efficiency improvement, and the use of renewable energy.

AEPC, through its subsidy program, is providing assistance in the installation of gasifier for agro-processing to the range of 50 percent of the cost or NRs. 150,000 per unit and is also involved in disseminating knowledge to the users. It has a pilot project for promoting gasifier. The technology needs further testing in order to be widely disseminated. AEPC, through its Renewable Energy for Rural Livelihood (RERL), is helping rural populations in the application of renewable energy for productive uses such as poultry farming, tailoring and carpentry. AEPC has now a productive energy use component responsible for promoting productive use through establishment of micro, small, and medium enterprises. Apart from this, there is no provision of support scheme to industries, apart from the training provided by Industrial Enterprise Development Institute through the assistance from GiZ, Germany.

USAID, through its South Asian Regional Initiative/Energy (SARI/E) program in 2000, was involved in energy efficiency standards and labeling of appliances by a series of training and knowledge sharing on EE standards and labeling.

A DSM Roadmap and Action Plan were developed for NEA in 2010 with support from World Bank.

The GiZ/Nepal Energy Efficiency Programme (NEEP) is the only DSM/EE project currently being implemented. The major program components under NEEP are:

- Policy advice on Energy Efficiency: Support the government to formulate a National Energy Strategy for promotion of energy efficiency and sustainable biomass use (WECS).
- Energy Efficiency in Households: Setting of standards and labeling of domestic appliances with respect to energy efficiency (NEA and NBSM).
- Dissemination of Energy Efficient Biomass Cook Stoves: Expand the product range of energy efficient biomass cooking stoves, develop a maintenance system, and support marketing activities for the wider dissemination of these improved cook stoves (AEPC).
- Energy Efficiency in Industry: Establishment of an 'Energy Efficiency Centre' under FNCCI. Training of qualified Energy Auditors and facilitate regional cooperation of technology providers and energy service companies.

The South Asia Sub-regional Economic Cooperation (SASEC) program is an initiative to promote economic cooperation between Bangladesh, Bhutan, India, and Nepal. ADB provides support for SASEC and informally functions as its secretariat. One of the components of SASEC is its Sub -regional Energy Efficiency Initiative. Under this initiative, Nepal will contribute to SASEC Initiative by sharing, with other SASEC member countries, the significant experience in EE technologies and energy management practices in the brick industry. Nepal will receive support from SASEC for the following areas:

- Training and capacity building in energy efficiency & conservation
- Standards setting, performance benchmarking, and testing
- Implementation of an EE pilot programs in the building, dairy, cement, and brick sectors.

III. Private Investment andEnabling Business Environment

Thermal Energy for Households

In thermal energy, NOC is the main supplier of petroleum products to household, commercial and industrial sectors. Since coal is deregulated, the private sector is involved in imports and supply of coal to commercial and industrial sectors. Private enterprises are engaged in technology supply to commercial and industrial sectors. Commercial banks are financing for the import and supply of thermal energy in the form of petroleum products such as light diesel oil, furnace oil, coal, and other thermal energy. Apart from diesel, import and pricing of other petroleum products are not regulated. NOC can fix prices for them.

The strongest barrier for private sector investment in the supply of thermal energy, especially petroleum products, is the government fixation of domestic prices and tariff. Until and unless petroleum products are deregulated, private sector cannot get in the supply chain. Recently, Government of Nepal, announced deregulating the marketing of petroleum products and opening the markets to the private sector. The announcement was suspended because of protests from vested interests. Sugar industries were keen to invest in bio-energy especially in ethanol production almost 7 to 8 years ago but they are virtually silent now. Some entrepreneurs have shown interest in production of biodiesel but no fruitful outcome has been reached as of yet.

Electricity

With the formulation of Electricity Act 1992, power generation was opened up to the private sector and because of it there is power production of 188 MW (almost 25 percent of the installed capacity in the country) by Independent Power Producers (IPP). In order to provide

loan to the private investors in the power sector, the World Bank has developed a Power Development fund (PDF) to the tune of US$ 35 million. There are private technology providers from overseas and some local technology providers for small scale power plants. Hydroelectricity Investment & Development Co. Ltd. was formed by the Government of Nepal in 2011 to facilitate investment in hydropower plant above 25 MW and to arrange financing of hydropower projects from overseas financial institutions. An Investment Board under the Prime Minister's Office has been established to fast-track development of major infrastructure projects.

Communities are involved in the distribution of electricity to member households through cooperatives. Studies have shown that they are more effective in providing electricity to rural households. This needs to be promoted if access to electricity is to be provided to a large number of villages near the grid.

The major barrier for private sector investment is tariff fixation by the government. The Power Purchase Agreement (PPA) has to be done with NEA which is a vertically integrated public sector enterprise having its own generation, and owns transmission and distribution infrastructure. The other major barrier is lack of sufficient transmission for evacuation of generated power. Until and unless NEA is unbundled, this barrier will remain. The question of economic viability for the development of power for household, commercial, and industrial sectors, remain. There is a strong willingness to pay among the commercial and industrial sectors but power development is being hampered due to political instability in the country and rigid public sector enterprise structure such as the NEA.

Similarly, off-grid renewable energy or isolated generation of power for urban households and commercial entities such as SHS exist in time of such energy crisis in the country. However, due to rigid public sector enterprise structure, SHS has not yet materialized in the urban areas in Nepal. Technically and financially, they have become viable.

Modern Energy for Productive Sectors

NOC imports petroleum products in bulk and distributes them to private dealers. Dealers supply them to commercial entities such as hotels, restaurants, and industries. Private enterprises are the technology providers of modern energy. Similarly, private financial institutions provide necessary finances to the importers and users.

There is no barrier to private investment for modern energy. Due to high upfront costs of renewable energy technology, there is a barrier for the rural people in using them and to mitigate this problem, AEPC is providing subsidy and arranging finances to the users in rural areas. Since, the cost of renewable energy technology, especially PV modules, is declining, Solar Home Systems (SHS) is gaining popularity in the urban areas even without subsidy. Recent Initial Public Offerings (IPOs) of financial institutions show that if proper and reliable developers come, the general public will be interested to invest in the range 40 - 50 billion Nepalese rupees in reliable hydropower projects.

IV. Gaps and Barriers

Data Gaps

There is no consistent aggregated data regarding the access to electricity and modern cooking solutions in Nepal. The following questions are yet to be answered.

- How many households get electricity from the grid and from off-grid?
- What is the quality of supply for households with electricity?
- How will the remaining households get electricity from different sources?
- How many households have different types of ICSs?
- How many still rely on traditional wood stoves?

There is also disparity of existing data on various aspects of energy access depending on the source of data. Therefore, further study needs to be carried out to establish a sound baseline on this.

There is also a lack of authoritative data on how much electricity is being generated from captive generation sets. It is not known how captive generation is provided by a particular sector. A study is needed to ascertain this.

There is also a lack of accurate and updated information on how much of the fuel wood supply is renewable supply. There is need for a study on this.

Lack of Common Targets for the Country

There have been many efforts in establishing targets for the energy sector in Nepal. However, the various efforts have generally come up with different targets. Consequently, there are multiple targets for each energy subsector. Hydropower is a good example of this. The National Plan 2005 has set a target of 4,000 MW by 2027. The 10-year Hydropower Development Plan 2009 set a target of 10,000 MW by 2019, and the 20-year Hydropower Development Plan 2009 set a target of 25,000 MW by 2028. The National Energy Strategy (yet to be approved by the government) has proposed a target of 11,480 MW by 2030. Therefore, there is a serious and urgent need to have one target for the nation that the government, private sector, civil society, and development partners can work together to meet.

Lack of an integrated energy policy, regulations, and planning

There is the Hydropower Policy 2001, but downstream petroleum marketing does not have any policy till now. The off-grid renewable energy sector has the Renewable Energy Policy 2009 and the Renewable Energy Subsidy Policy 2013 which have been instrumental in the rapid promotion of renewable energy. However, they have all been developed independently and do not always work in unison. Appreciating the fact that energy carriers are interchangeable (for example, electricity can substitute thermal energy like fuel wood, coal, kerosene, diesel, gasoline, LPG, fuel oils, etc.), there is an urgent need for an integrated energy policy and regulatory body and planning for integrating and addressing the cross-cutting issues among the individual energy subsectors.

Lack of competition for public institutions

NOC has no competitors on petroleum product (except LPG) import and distribution. NEA is in a similar situation in electricity transmission and distribution, as it is the only agency to purchase power from IPPs. This has significantly contributed to sub-standard quality of the respective energy services. Participation of private sector brings advanced know-how and technologies, along with high quality of products and services. For example, there is ample scope of multinational oil companies coming in the downstream marketing as before, once the

marketing of petroleum products is done.

Weak Management of Public Institutions

Management and implementation capabilities of the public enterprises in the energy sector such as NEA and NOC, and government agencies are dismally poor due to heightened political meddling and the general instability in the country. Efforts need to be made to strengthen their managerial and governance capabilities.

Regulated Energy Pricing Mechanism.

The pricing of petroleum products and electricity tariff are strictly regulated by the government. Therefore, the current prices are motivated more by political rather than economic considerations. To accurately reflect the actual prices of these energy commodities, they need to be market based. This will not only improve the solvency of NOC and NEA, but will also incentivize financial institutions to make capital available for the sector, and encourage participation of private sector in this area.

Lack of Environment Conducive to Business

This is another factor that is very essential for attracting the private sector, for both domestic and foreign investment. If business confidence level increases with proper legal institutions, proper regulatory body, and market-oriented tariff structure, the private sector will definitely be attracted.

Thermal Energy for Households

Lack of Awareness

There is a lack of awareness among the intended users about the disadvantages of traditional cook stoves and the benefits of ICS. For most consumers, the perceived value of ICS is very low and hence it is usually at the bottom of their priority list. Furthermore, adoption of ICS requires behavior change in the users' cooking practices (e.g., chopping of firewood, using less firewood while cooking, regular repair & maintenance of stove, etc.) which has been difficult.

Empowerment and Cultural Issues

Women (the real users of ICS) are generally not the economic decision makers at the household level. Cultural/religious practices also hinder ICS adoption. Examples are the Tharu culture replacing their cook stove every year and the Rai community's practice of never dismantling their cook stove.

Shortage of Human Resource

There is a high dropout of stove masters (trained stove builders) and ICS promoters recently due to migration for foreign employment or business opportunities. There is also a lack of sufficient trained human resources at different levels to ensure extensive coverage. Furthermore, in remote areas, there is a shortage of trained ICS stove masters because of the limited geographic coverage of each stove master. In fact there is an inadequacy of resources for technical support - promotion of ICS involves a lot of indirect costs in promotion, awareness, capacity building, quality assurance, and monitoring but there is always shortage of funds for such activities.

Affordability

Even though ICS is the only potential clean cooking technology within the reach of the lowest economic strata of the society, it may still not be affordable for all of them. Sporadic subsidies provided by few organizations or projects to limited number of households distort the market.

Technological Issue

ICS designs and models (stove menu) to serve various socio-economic strata of the society is yet to be made available.

Business Development

There is insufficient entrepreneurship, because ICS is yet to be established as a profitable enterprise. Furthermore, credit for stove enterprises and stove buyers is lacking. There are also no fiscal incentives in the stove business.

Clean Cooking in High Mountains

Due to environmental concerns and the fact that biogas is not efficient at high altitudes, there is a need to promote electric cooking at places at higher altitudes. However, current policies, including subsidy policy, do not support this. Therefore, there is a need to enact appropriate policy and incentive mechanisms to support this.

Electricity for Households

Lack of an Integrated Policy Framework; Plan andInstitution for Rural Electrification

Currently, rural electrification in Nepal is undertaken by different agencies (among which NEA, AEPC and community-based organizations are the important entities). These institutions and efforts are governed by different legal provisions. This often leads to duplication of efforts, or lack of clarity regarding responsibilities (for example when grid reaches an area having micro-hydro plant). Therefore, it is important to formulate an integrated rural electrification policy, and corresponding acts and regulations, including legal provisions for consumer right protection. Consequent to this, there should be an integrated plan for electrification of all remaining households, preferably through a modeling process that identifies the optimal technology and option for electrification of individual VDCs (or other suitable units). Decentralized planning has shown promising results in Nepal, even in the rural energy sector. Therefore, integrated rural electrification plans should be formulated as much as possible from a bottom-up approach, rather than top-down. To ensure that an integrated approach is pursued, there is a need for a rural electrification agency to look after all rural electrification activities in Nepal.

Strengthening and Streamlining of Community Rural Electrification Efforts

In general, community electrification has proved to be more cost effective and efficient in providing electricity to rural consumers. Therefore, efforts to strengthen and streamline this initiative should be continued. Large areas of the Terai have not yet been electrified and grid extension is the most viable option for a majority of these areas. Therefore, community based rural electrification should especially be supported in the Terai, to provide quick and effective service and to control electricity pilferage.

Hydropower and Large Scale Renewables

Lack of Environment Conduciveto Business

Some of the specific barriers that need to be addressed to attract more private sector investment in hydropower are

- political instability
- inconsistent and "regulation-rather-than promotion" focused legal and regulatory frameworks
- inadequate infrastructure
- roads and transmission lines
- NEA's credit and off-taker risks
- lack of adequate security to personnel
- facilities at plant site and unrealistic local community expectations

Skewed Electricity Generation Pattern

Since Nepal's hydropower generation is heavily dominated by run-of-river projects, there is “flood and famine" scenarios, with usually excessive generation during the monsoon, and severe reduction in generation (almost to one-third) during the dry season. To balance this skewed electricity generation pattern, it is important to also plan for storage hydropower projects.

Lack of Infrastructure

Two major infrastructures required for hydropower development, namely roads for project site access and transmission lines for evacuation of generated power are grossly insufficient. There needs to be a close coordination between generation and transmission to ensure that the necessary infrastructure to evacuate power is set up when or before projects come online.

Energy Efficiency

Lack of Awareness

There is a lack of awareness and sufficient information concerning the potential financial savings from energy efficiency efforts. Even if there is such awareness, many consumers still do not outright appreciate the financial advantage, because of the gap between investments needed (immediate) and gains realized (long term). Even in industries where energy efficiency has high potential for savings, there is lack of awareness of management and employees of industries on energy efficiency. Therefore, there is a need to ensure periodic energy audits by certified energy auditors in all industries, to raise awareness and make a business case for energy efficiency. There is also a need to provide training on energy management and efficiency to relevant staff.

Lack of Capital

There is a lack of upfront capital needed for DSM/EE. Examples include purchase of CFL by households. There is a need to develop and implement financing mechanisms for the implementation of energy saving options.

Lack of Policy, Institutional Structure and Incentives

There is a lack of appropriate policies, suitable institutional structure, and incentives to promote and support DSM/EE. This includes establishment of appropriate government agencies and enactment of suitable policies. In addition, there is a lack of appropriate tariff structure that reflects real energy supply costs and encourages efficiency. Furthermore, there are no import duty concessions or tax incentives in relation to energy efficient equipment or services.

Lack of Standards

There is a lack of information on best practices and best available technology on energy efficiency. For example, there are neither building codes regarding energy efficiency, nor building rating systems.

All this has resulted in an immature DMS/EE industry and insufficient suppliers of DSM/EE products and services in the country.

V. Investment Requirement

The table below shows the tentative investment requirement for different supply and demand technologies in millions of Nepali Rupees. (at 2010 prices). The demand side technology costs include DSM/EE technologies such as CFL for lighting, electric boilers and other demand side management technologies.

Table 19. Undiscounted investment requirements for achieving the main objectives of the SE4ALL (NRs. million at 2010 prices)

Technology costs	2015	2020	2025	2030
Biogas production technology	3,217	3,729	4,291	17,141
Mini/Micro-hydro plants, off-grid	1,526	3,256	6,634	-
Pico hydro plants, isolated	199	476	1,038	1,038
Grid connected hydro power plant	463,542	614,121	886,592	1,182,246
Grid connected solar PV power plant	-	27,053	88,363	289,421
SHS, isolated	7,745	16,523	35,249	79,382
Total supply investment	762,338	1,064,770	1,636,261	2,511,983
End use demand technology costs	9,476	17,548	26,285	40,675

VI. Way Forward

1. This RA/GA analysis is just a preliminary study and detailed action plan for the achievement of objectives of SE4ALL needs to be formulated.

References

ADB, 2012, "Key Indicators for Asia &Pacific 2012", Asian Development Bank, Manila, Philippines. (http://www.adb.org/publications/key-indicators-asia-and-pacific-2012)

ADB, 2012.Energy Efficiency Technical Report -Nepal. RETA 8025:SASECSub region Energy Efficiency Initiative Prepared for the Asian Development Bank, Manila, Philippines

AEPC, 2013a. Renewable Energy Subsidy Policy 2013.Alternative Energy Promotion Centre, Ministry of Science, Technology and Environment, Government of Nepal, Kathmandu, Nepal

AEPC, 2013b.Concept note on Clean Cooking Solution for All by 2017.Alternative Energy Promotion Centre, Ministry of Science, Technology and Environment, Government of Nepal, Kathmandu, Nepal

AEPC, 2012. "Statistics on Renewable Energy Technology (internal data)", Alternative Energy Promotion Centre, Ministry of Science, Technology and Environment, Government of Nepal, Kathmandu, Nepal

AEPC, 2008.Solar and Wind Energy Resource Assessment in Nepal (SWERA). United Nations Environment Program, Global Environment Facility, Alternative Energy Promotion Centre, Ministry of Science, Technology and Environment, Government of Nepal, Kathmandu, Nepal

BSP-Nepal.2012.Biogas Support Program. Interim Phase January 2011 - July 2012. Biogas Support Program - Nepal, Kathmandu, Nepal

CBS, 2012.National Population and Housing Census 2011. National Report, Central Bureau of Statistics, National Planning Commission Secretariat, Kathmandu, Nepal

D'sa, A. and Narasimha Murthy, K. V., 2004, "Report on the use of LPG as a domestic cooking fuel option in India", International Energy Initiative, (was available online on http://www.iei- asia.org.)

IEA/World Bank, 2013.SE4ALL database for Nepal coverage 1990 -2010

IEA, 2012, Key World Energy Statistics 2012, International Energy Agency, Paris, France. (www.iea.org)

IEA, 2011, Energy for All.Financing access to the poor. Special early excerpt of the World Energy Outlook 2011.International Energy Agency, Paris, France

IEA, 2010, "Energy Poverty: How to make modern energy access universal?", Special early excerpt of the World Energy Outlook 2010 for the UN General Assembly on the Millennium Development Goal, International Energy Agency, Paris, France

IEA, 2006.World Energy Outlook 2006. International Energy Agency, Paris, France

IRENA, 2012. Renewable Energy Technologies: Cost Analysis Series. Solar Photovoltaic. Volume 1: Power sector, Issue 4/5. International Renewable Energy Agency, Abu Dhabi, United Arab Emirates

Kawajiri, K., Oozeki, T., and Genchi, Y., 2011."Effect of Temperature on PV Potential in the World", Environmental Science & technology, 45 (20): 9030- 9035

MOF, 2012, Economic Survey 2012, Ministry of Finance, Government of Nepal (http://www.mof.gov.np/ajw/uploads/uploaded_image/Chapter percent20All-Final-Edited.pdf)

MOFSC, 1987, "Master Plan for Forestry Sector Nepal: The Forest Resources of Nepal", Ministry of Forest and Soil Conservation, HMGN/ADB/FINNIDA, Kathmandu, Nepal

NEA/WB 2009, DSM/EE Project Report on Potential DSM Options and Priorities 2009, World Bank and Nepal Electricity Authority

NEA, 2012, "A year in Review: Fiscal Year 2011/12", Nepal Electricity Authority, Kathmandu, Nepal. (http://www.nea.org.np/images/supportive_docs/AnnualReport12.pdf)

NEEP/GIZ, 2012. Report on Baseline Study of selected sector industries to assess the potentials for more efficient use of energy. Nepal Energy Efficiency Programme (NEEP/GIZ), Lalitpur, Nepal

NLSS II, 2004. Nepal Living Standards Survey 2003/04. Central Bureau of Statistics, National Planning Commission Secretariat, Government of Nepal

NLSS III, 2011. Nepal Living Standards Survey 2010/11. Central Bureau of Statistics, National Planning Commission Secretariat, Government of Nepal

NOC, 2011, "Import and sales statistics of Nepal Oil Corporation Ltd.", (available online at http://www.nepaloil.com.np/)

NPC, 2010, "Three Year Plan Approach Paper (2010/11-2012/13)", National Planning Commission, Government of Nepal. Available online at http://www.npc.gov.np/new/uploadedFiles/allFiles/TYP_2012.pdf)

UNDP, 2009.Nepal Human Development Report 2009.State Transformation and Human Development. United Nations Development Program, Kathmandu, Nepal

UNDP, 2005.Energy Services for the Millennium Development Goals. United Nations Development Program, New York, USA

UNIDO, 2009.UNIDO and Energy Efficiency. A low-carbon path for industry United Nations Industrial Development Organization, Vienna, Austria

WB, 2012.World Development Indicators 2012. World Bank, Washington DC, USA

WECS, 2009.Energy Resources Strategy Formulation of Nepal. Water & Energy Commission Secretariat, Government of Nepal, Singha Durbar, Kathmandu, Nepal (yet to be ratified by the council of ministers)

WECS, 2010.Energy Sector Synopsis Report 2010. Water & Energy Commission Secretariat, Ministry of Energy, Government of Nepal

For further information:

Government of Nepal
National Planning Commission
Singha Durbar
Kathmandu, Nepal
Telephone: +977 1 4211629
Website: www.npc.gov.np

United Nations Development Programme
United Nations House
Pulchowk, Lalitpur
Telephone: +977 1 5523200
PO Box 107
Kathmandu, Nepal
www.undp.org.np

Empowered lives.
Resilient nations.