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Solar Energy a Major Source for Energy Consumption and Sustainable Economic Development

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Introduction

As an economic good, energy affects all the sectors of the economy. So, it is taken as a means of achieving sustainable development for addressing the issues related to carbon reduction, reducing production cost and consumption expenditure, reducing energy gap as well as insuring energy security. Energy efficiency practices implemented through energy policy and change in human behaviour is one of the attempts for efficient energy conservation and management..

Nepal is dominated by rural areas and most of rural people are poverty ridden. Poverty in rural areas is reflected in low level of income, low level of literacy and poor health status. Poverty is also reflected in low level of energy use. Like other developing countries, Nepal is heavily dependent on traditional energy sources. The heavy dependency on biomass energy, especially fuel wood, agriculture waste and cattle dung, particularly in rural areas has given rise not only to environmental degradation and irreversible consequences in the country, but also has caused the social burden on majority of the rural women and the large number of children.

Providing clean and affordable energy reliably for poor households in developing countries is an important prerequisite in the fight against poverty. Even though rural households often have an easy access to traditional forms of energy: firewood, charcoal and agricultural residues to fulfill their basic energy needs, these fuels carry adverse effects, such as emissions of particulate matter that are harmful to health, deforestation and environmental degradation.

Mainly energy is defined as the ability to produce change or do work, and that work can be divided into several main tasks. It produces the light, heat, motion, sound, growth and powers the technology . Energy is an essential input for the economic activity for the human being and at the industrial zone. Current energy services light up our homes and schools, fuel economic activity to produce and consume, provide comfort and mobility, pump water and contribute to health and well-being. Connecting energy sources to replace manual and animal effort was the platform of the Industrial Revolution: a period of unprecedented economic and social development.

Forms of Energy

There are many forms of energy, but they all fall into two categories–potential or kinetic.

Potential Energy:

Potential energy is stored energy and the energy of position, or gravitational potential energy. There are several forms of potential energy, including:

Chemical energy is energy stored in the bonds of atoms and molecules. It is the energy that holds these particles together. Foods we eat, biomass, petroleum, natural gas, and propane are examples of stored chemical energy. During photosynthesis, sunlight gives plants the energy they need to build complex chemical compounds. When these compounds are later broken down, the stored chemical energy is released as heat, light, motion, and sound.

Elastic energy is energy stored in objects by the application of a force. Compressed springs and stretched rubber bands are examples of elastic energy.

Nuclear energy is energy stored in the nucleus of an atom—the energy that binds the nucleus together. The energy can be released when the nuclei are combined or split apart. Nuclear power plants split the nuclei of uranium atoms in a process called fission. The sun combines the nuclei of hydrogen atoms into helium atoms in a process called fusion. In both fission and fusion, mass is converted into energy, according to Einstein's Theory, E =mc2.

Gravitational potential energy is the energy of position or place. A rock resting at the top of a hill contains gravitational potential energy because of its position. Hydro power, such as water in a reservoir behind a dam, is an example of gravitational potential energy.

Kinetic energy is motion—the motion of waves, electrons, atoms, molecules, substances and objects.

Electrical energy is the movement of electrons. Everything is made of tiny particles called atoms. Atoms are made of even smaller particles called electrons, protons, and neutrons. A

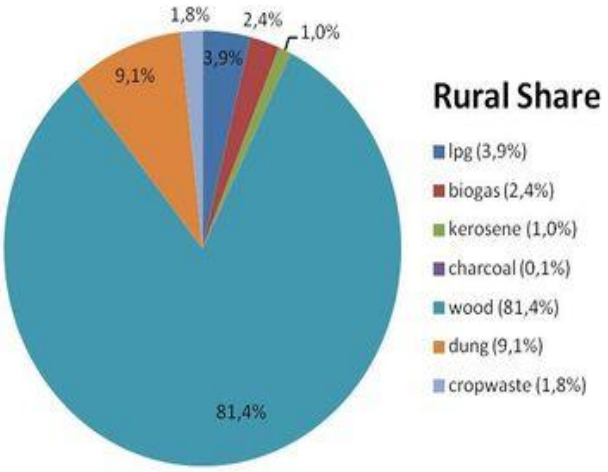
Radiant energy is electromagnetic energy that travels in transverse waves. Radiant energy includes visible light, x-rays, gamma rays, and radio waves. Solar energy is an example of radiant energy.

Thermal energy, which is often described as heat, is the internal energy in substances— the vibration and movement of atoms and molecules within substances. The faster molecules and atoms vibrate and move within a substance, the more energy they possess and the hotter they become. Geothermal energy is an example of thermal energy.

Motion energy or mechanical energy is the movement of objects and substances from one place to another. According to Newton's Laws of Motion, objects and substances move when an unbalanced force is applied. Wind is an example of motion energy.

Sound energy is the movement of energy through substances in longitudinal (compression/rarefaction) waves. Sound is produced when a force causes an object or substance to vibrate. The energy is transferred through the substance in a wave.

The renewable energy technology has positive role for the fulfillment of energy needs of the rural community that was recognized in the Seventh Five Year Plan prepared in the leadership of National Planning Commission of Nepal. The Eight Plan (1992-1997) of the government of Nepal also envisaged the need for a coordinating body for large-scale promotion of alternative energy technologies in Nepal. Thus the Alternative Energy Promotion Centre (AEPC) was established to promote the use of Renewable Energy Technology and act as the authorized coordinating body. Though renewable energy programs have positive implications on poverty reduction, this has not been the explicit goal of renewable energy programs in Nepal until the commencement of the Tenth Plan in 2002.



Source: WHO Household Energy Database 2010

Of the tenth periodic plan is to achieve a remarkable and sustainable reduction in poverty level. The national long-term vision of alternative energy sector as outlined in Nepal Poverty Reduction Strategy paper explicitly recognizes the role of renewable energy technology in the socio- economic development of rural people. The aim is "Accelerating economic development, improving living standard of rural people, increasing employment opportunities and maintaining environmental sustainability through the development of rural energy systems."Considering this long term vision the tenth plan included objective of renewable energy development as "developing and expanding alternative energy as a powerful tool for alleviating poverty, raising purchasing power of the rural people by developing alternative energy technologies based on the local resources, skill and increasing consumption of alternative energy and reducing dependency on imported energy by lowering the cost of installation through the proper utilization of local resources and means.

National Energy Situation Survey Report

Focus on Renewable Energy & Poverty Reduction (INFORSE, 2005) suggested for the future strategies in promoting Renewable Energy Technologies in Need. The recommended possible directions are; a) encourage financial institutions for formulating effective and appropriate policies, and to increase more financial institutions, besides the existing ones to participate in the development of renewable energy sector; b) adequate allocation needed for subsidies in a constant manner to promote the renewable energy sector. It should be determined by the accessibility and the appropriate method of energy generation; c) strengthening education and training in renewable energy, especially end users' training, technical/vocational training and trainers' training and d) emphasize Research and Development works.

After a decade of the energy situation survey report, pattern of distribution of energy consumption by fuel types in FY 2014/15 (GoN, WECS, 2017) is different as given in the table below:

S.No.	Fuel Types	Amount (000GJ)	% share
1	Fuel Wood	352229.10	70.47
2	Agriculture-residue	17408.43	3.48
3	Animal dung	18401.96	3.68
4	Coal	19819.09	3.97
5	Petroleum	62618.27	12.53
6	Electricity	16932.75	3.39
7	Renewable	12430.26	2.49
Total		499839.86	

Monthly energy consumption, GHG emission and environmental impact are relatively lower in the household having access to electricity provision and LPG as cooking energy (Uddin, Iqbal, & Talukdar, 2017).

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In the developing countries, the energy demand at the household level is generally based on the concept of hierarchy of energy or its replacement.

Three steps of the hierarchy can be discussed as below:

1.Universal reliance on biomass in the form of wood, dung and agricultural residues;

2.Use of transition fuels such as switch to fuels to kerosene and coal;

3.Adoption of LPG, natural gas, electricity or other 'clean' sources of energy.

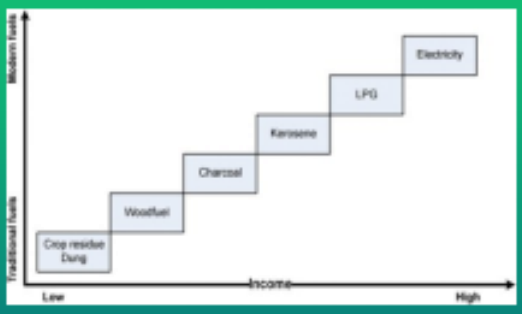

Figure 2: Hierarchy of household energy / fuels

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- Electricity seems at the top of the list while at the low-end of the range are fuel wood, dung and crop wastes. There is strong relationship between level of income and type of fuels. The above figure (Figure 2) shows the relationship between level of income and type of energy (Kayode, Akhavan Fashchi, & Ford,2017).
- This paper is suggested for the further separate research study for the urban, peri-urban and rural settings. So that the findings can be compared based on the geographical, socio-cultural and economic situations.
- Future studies are required and useful for the clear understanding of the major determinants of energy in the urban and rural areas because this will contribute in assisting the formation and revision of the relevant policies and strategies on energy. It will also be helpful to compare the results of modeling the household energy consumption using different packages and methods in order to be able to establish the modeling technique as an impact of results generated from analysis of primary data (Kayode, Akhavan Fashchi, & Ford, 2017).
- A study on Dynamics of Economic Growth, Energy Consumption and Health Outcomes in Selected Sub-Sahara African Countries investigated the relationship between energy consumption, economic growth and health outcomes in some of the countries of sub-Saharan Africa- SSA (Arawomo, Oyebamiji, & Adegboye, July 2018). According to the study, it reveals that neither economic growth nor energy consumption was found significant effect on health outcomes. However, the study showed that medical factor such as health care expenditure remains an important determinant of health outcomes in Sub-Sahar Africa.
- Modern energy should be accessible and affordable to all with the provision of subsidy targeting to the poor and marginalized group of people. Renewable sources of energy should be promoted along with the hydro energy (electricity).

Figure 3: Theoretical Links among Health Outcomes, Growth and Energy Use

The health policy goals in the SSA including developing countries must be clearly defined in a measurable way and strategic efforts towards achieving the goals should be stated and commenced without delay when the economy of the developing countries are plagued with problems of slow economic growth .

Advancing better population health is possible with clean energy known as electricity as an efficient source. The low level of electricity consumption in Sub-Saharan Africa is alarming.

The health hazards associated with alternative sources of energy or fuel including traditional solid fuels cannot be under estimated. The study on Electricity Consumption and Health Outcomes in Sub Saharan Africa examined the effect of electricity consumption on some health outcomes in sub-Saharan Africa. Estimating a panel model and accounting for potential endogeneity, electricity consumption per capita was found to have no significant effect on the mortality rates of infant and under-five years' children. However, where it was significant, it was found to reduce life expectancy at birth. An aggressive effort towards enhancing availability and affordability is paramount towards increasing electricity consumption and the consequential health gains.

In order to maximize quality of life, energy consumption predictions and identify various reasonable scenarios to optimally steer future energy demands, the scenarios consider the coupling between energy consumption rate per capita, quality of life, population growth, social inequality, and governments' energy-for-life efficiency. The results of the study on Energy and quality of life shows the energy cost of increasing quality of life in the developing countries, energy savings that can be realized by limiting over consumption without impacting quality of life, and the role of the governments on increasing energy- for-life efficiency and reducing social inequality.

Figure 4: Energy and sustainable development challenges

Rural Urban Situation of Energy Consumption

- Energy in the form of electricity plays an important role in the overall development (Leung & Meisen, 2005) including social and economic aspects. For the increased use of the electricity investment towards human, financial and natural resources should be increased. Leung & Meisen (2005) confidently stated that per capita increased consumption of electricity directly stimulate the faster economic growth and indirectly achieve enhanced social development for the medium and low human development countries. They have mentioned these findings in the paper titled - How electricity consumption affects social and economic development by comparing low, medium and high human development countries, after completion of the empirical analysis around 40 countries.
- They have also highlighted that there is strong relation between electricity consumption and infant mortality. In those countries where there is low electricity consumption, their infant mortality is high and increasing the consumption decreasing the infant mortality. Maternal mortality is also associated with the per capita electricity consumption. Life expectancy at birth has also a certain degree of correlation with electricity consumption per capita. This relationship was also perceived in this paper through the analysis (Leung & Meisen, 2005). One of the major means for the improvement of the quality of life of people is energy, which is recognized as a basic needs. The direct impact of the energy is on the people's life throughout the world. Poverty alleviation and sustainable development are supported by promoting renewable energy to improve the quality of life (Voller, KlauB-Vorreiter, & Hanko, 2012).
- Improvement in living quality as well as the increasing trend of energy consumption of the residents, their energy conservation behavior (ECB) also plays an increasingly significant role in energy conservation and emission reduction (Yue, Long, Liu, Liu, & Chen,2019).

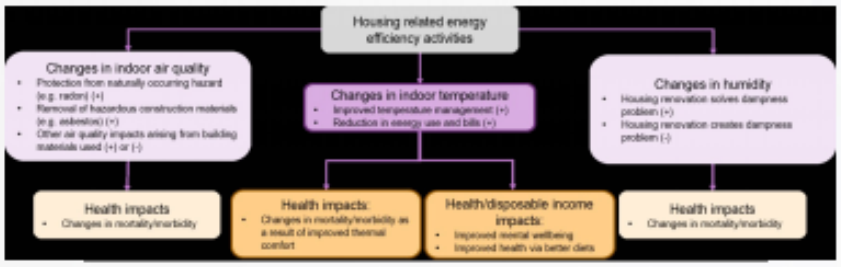

Figure 5: impacts on health and well being arising from housing related energy efficiency actions

Quality of life and the environment are closely related. The environmental dimension is one of the major influences on quality of life, and this can be assessed by applying the various groups of indicators like environmental quality, environmentally responsible behavior and consumption of environmental services. These groups are related because responsible behavior has a positive impact on environmental quality and leads to greater consumption of services provided by the environment.

Environmentally responsible behavior through activities such as saving energy, using renewable resources and sustainable consumption is the main driver of the quality of environmental services provided.

Energy produces lights, heat, motion, sound, growth and powers the technology. Energy is an essential input for the economic activity for the human being and at the industrial zone. It contributes to health and well-being. Rapid population and economic growth especially emerging market economies increase the global demand of energy. Various sources of energy have major environmental implications while harvesting, processing, distribution, and use of it. People always use energy to do their work and began to use the falling water to generate electricity about one hundred thirty-five years ago. The ten major energy sources are classified into two broad groups—nonrenewable and renewable. Nonrenewable energy sources include coal, petroleum, natural gas, propane, and uranium. It can be run out of economically recoverable nonrenewable resources someday. Renewable energy sources include biomass, geothermal, hydro power, solar, and wind.

The linkages between energy and the economy, social and public health issues, environmental protection, and security are major current concerns of the world. For the long term sustainability, political, cultural, social and environmental stresses should be managed. Environmental sustainability is more complex and very articulated, since the criticality found are rooted in political/economic/social options that have been carried out over the time and in other locations. The renewable energy technology has positive role for

the fulfillment energy needs of the rural community that was recognized in the Seventh Five Year Plan prepared in the leadership of National Planning Commission of Nepal.

Improved cooking stove and biogas programs initially had goals to reduce the quantity of firewood consumption and lessen the indoor pollution with health ground and are linked to income generation as well as reduction of women's drudgery. Poverty alleviation is the prime objective of Nepal's developmental effort since a long planning and development process. The result of the research focused the issues with standard models that are used to assess the energy efficiency of residences and points to behavioral response from households.

Universal reliance on biomass in the form of wood, dung and agricultural residues; use of transition fuels such as switch to fuels to kerosene and coal; adoption of LPG, natural gas, electricity or other 'clean' sources of energy. Energy is required to sustain life and it improves the quality of life. Quality of life and economic growth thus depends on the population growth and consumption of the energy.

Physical health, well-being, and prosperity are affected by energy poverty that is one of the major global challenges. It is because of the inefficient institutions and economic constraints. Provision of quality health care is also depends on the uninterrupted electricity power or modern energy services. Improved health care reduces mortality of newborns, children and mothers, hence raising the quality of life.

The policy should focus on shaping the mainstream consumption concept of green, pro- environmental, and energy conservation to be the new way. Health, health behaviors, and use of energy are influenced by the time and outcomes. Further researches need to focus for designing relevant policy and the effect of household energy in the area of health and quality of life for improving indoor and outdoor air pollution and its impact on health.

The major findings from the relevant researches will contribute to policy makers being able to decide the best combination of energy sources among those available alternative sources in terms of their effects on human health and the quality of life. This will obviously support in the future research related to energy, environment and health with quality of life regarding energy consumption.

Nepal has aimed to achieve the SDGs set by the United Nations and reaches the level of medium income countries by 2030 A.D with the dimensions of economic, physical and social development. Poverty alleviation and sustainable development are supported by promoting renewable energy to improve the quality of life. Energy efficiency has direct relationship with various dimensions along with the health impacts that is related to the morbidity and mortality. Annual death due to urban air pollution is about 1.3 million and household air pollution.

House hold energy consumption for economy & health outcomes will be major areas of the study and will be investigated kind of energy consumption and situation of all pollution in quality of life and effect of air pollution from the energy consumption on the quality of life. The policy direction in terms of health, economic and environmental issue for Nepal. The goal of sustainable development is to secure a good living opportunity for present and future generation, that is we should use natural resource sustainably.

- Controlling overuse and creating an awareness to provide sustainable development
- Less use of fossil fuels

- Introduction of organic farming can save energy economy for sustainable growth and develop

References

1. World Solar Energy Conference& Exhibition Large-scaleIntegration of Solar PowerIstanbul, Turkey 15-17 June 2010.
2. Hossain, M. Arif; Hossain, M. Zakir, Islam A.K.M.Sadrul,"Solar Resource Assessment of Bangladesh: Bay Belt
3. Meteorological Stations of BarisalDivision", BSME-ASME International Conference on Thermal Engineering, Dhaka, Bangladesh, pp 571- 576, 31 Dec 2001- 2 Jan2002.
4. Hossain M. Arif, Hossain M. Zakir, Islam A.K.M.Sadrul, "Solar Resource Assessment of the North-West Division of Bangladesh", Second International Conference on Electrical and Computer Engineering ICECE 2002, Dhaka, Bangladesh, 26-28 December2002.
5. Hoque Mohammad Nasirul,Nandi Sanjoy Kumar, Ghosh Himangshu Ranjan, "Solar resourceassessment for southern part of Bangladesh",Asian Journal on Energy and Environment 2010, 11(01), 1-9
6. Dey Sanjoy, "Solar regime and solar powerin the southern coastal islands of Bangladesh", International Conference on Energy and Environment 2006 (ICEE 2006) Universiti Tenaga Nasional, Bangi, Selangor, Malaysia; 28-30 August 2006.
7. Ambia Mir Nahidul, Islam Md. Kafiul, Shoeb Md. Asaduzzaman, Maruf Md. Nasimul Islam, Mohsin A.S.M., "An Analysis & Design on Micro Generation of A Domestic Solar-Solar Hybrid Energy System for Rural & Remote Areas-Perspective Bangladesh."2010
8. Hanley, N., McGregor P.G., Swales J.K. and Turner K. (2009). Do increases in energy efficiency improve environmental quality and sustainability? *Ecological Economics*, 68:692-709.GoN (2019).
9. National Energy Efficiency Strategy, 2018. Ministry of Energy, Water Resources and Irrigation, Government of Nepal, 2019.
10. Holt L. and Galligan M. (2013). Energy efficiency policies as part of carbon reduction efforts: lessons from the EU for the U.S. *The Electricity Journal*, Vol. 26, Issue 7. Hanley, N., McGregor P.G., Swales J.K. and Turner K. (2009). Do increases in energy efficiency improve environmental quality and sustainability? *Ecological Economics*, 68:692-709.
11. UN (2015). Best policy practices for promoting energy efficiency. *ECE/Energy*/100, United Nations Publication.
12. *worldEcology*.13. Paramati, S.R., Alam, M.S., Chen, C.F. (2017). The effects of solar energy on economic growth and CO2 emissions: a comparison between developed and developing economies.
13. Alternative Energy Tutorials. (n.d.). *Home of Alternative and Renewable Energy Tutorials*.
14. Retrieved 01 30, 2020, from http://www.alternative-energy-tutorials.com/tidal-energy/tidalenergy.html.
15. National Energy Efficiency Strategy, 2018. Ministry of Energy, Water Resources and Irrigation, Government of Nepal, 2019.