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FNCCI

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Nepal Economic Summit
Working Committee Member of Clean Energy

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INTRODUCTION

The energy debate is at the heart of a global discussion on sustainable futures. Nepal, which naturally has an abundance of energy generation potential from clean energy sources, holds the possibility of leading this drive for sustainable energy solutions by being an example. This has been prepared in the backdrop of this global context. Although the larger discussion on overall energy supply, demand and security is relevant, this paper focuses mainly on electricity generation given the prevailing electricity shortage scenario and the need for adequate availability of affordable electricity to drive Nepal's economic growth. Within the theme of the Nepal Economic Summit 2014, where this paper will be presented, the paper highlights the prospects of increasing investments in electricity generation and switching to sustainable sources of energy in Nepal.

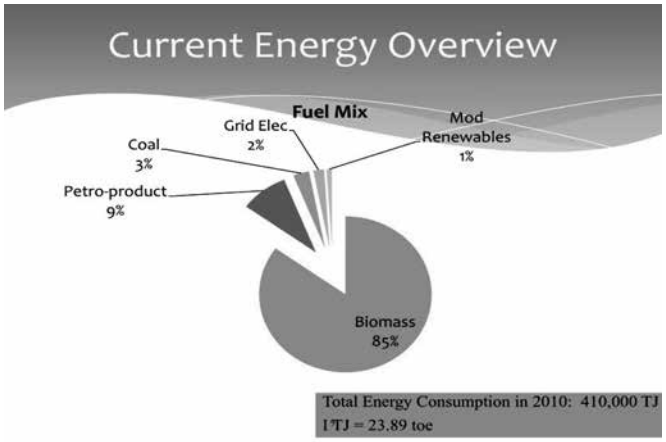
The paper covers Nepal's energy potential from hydropower, solar energy and biogas and discusses initiatives that need to take place in order to increase investment. It also puts forward strategies for greater energy efficiency to ensure productive use of scarce resources. This paper has been prepared by the Working Committee on Energy for Nepal Economic Summit 2014, comprised of representatives from the government, private sector, development agencies and civil society organizations.

Borrowing from existing researches that have been done by various agencies involved in the mentioned sector, the paper highlights the immediate electricity deficit scenario and potential areas of reform to bring in more investment. It also covers the potential, challenges and opportunities for investment in harnessing the country's modern renewable energy sources.

PART I: Existing energy Secenario

As Asia gears up to power a change in global growth trends, with India and China in its basket, energy needs are on the rise than ever before. A study conducted by Asian Development Bank (ADB) in 2013 on the Energy Outlook in the Asia and the Pacific estimates hydropower to grow at 2.9 percent per year through 2035, which is the fastest growth rate amongst all forms of energy discussed in the study (ADB, 2013). Given this demand projection, there is a lot of space for the energy market in Nepal to flourish.

As the chart demonstrates, from a supply perspective, there is a predominance of biomass energy including firewood and animal dung. Similarly, grid electricity (mostly provided by hydropower sources) is limited to 2 percent while modern renewables (mostly concentrated on alternative energy supplied to rural areas) is limited to 1 percent.



Source: WECS, 2010

Nepal faces a major challenge of fulfilling energy demands of the immediate nature. Ministry of Energy projects a deficit ranging from 351 MW to 597 MW for mid-December to mid-June (Paush to Jestha) leading to a load-shedding of up to 14 hours per day (MoE, 2013). This projection is based on a suppressed demand forecast and implies that the gap could be larger (NPC, 2013).Pet-

ro products, which comprise 9 percent of the total energy supply, pose a big challenge to Nepal as country is importing 100 percent petroleum products with rising cost. The import of petro products has exceeded the total commodity exports of Nepal and is creating a large trade deficit (MoF, 2012). This issue not only brings forth the problem of energy security and reliance on import but is a major drain of scarce foreign reserve. Transportation and industrial sectors' reliance on diesel fuel to cover energy shortage and urban households' reliance on LPG for cooking and heating has also been growing over the years (NPC, 2013). The subsidy provided in petro-products has become a strain on annual fiscal expenditure. Importing petro products is an unsustainable method of fulfilling energy demands in the long run and Nepal has to look for alternative measures.

From a demand perspective, Nepal's per capita electricity consumption stands at 93 Kwh and is one of the lowest in South Asia (IEA, 2012). Similarly, residential consumption of energy stands at 87 percentage while industrial consumption stands at only 5 percentage (WECS, 2010). Biomass consumption is concentrated to cooking in rural households. Rural households rely on animal dung and firewood for cooking. This has two negative implications. Firstly, the traditional stoves where firewood and animal dung are used produce indoor air pollution contributing to serious public health issues. Secondly, animal dung is useful as organic manure that contributes to agriculture production in rural areas. Using it as a source of energy, reduces fertilizer availability for farming purpose, which is the primary source of income for majority of rural households. The modern renewable energies include micro-hydro plants, solar and other renewables being used in rural areas. These are heavily subsidized forms of energy largely used for electrification purpose. In the urban areas, solar power has been used as an alternative to help overcome the load-shedding of grid electricity, mostly for lighting purpose. One major issue with solar power in its' current system of usage is the de-rating of the life of batteries and proper disposal of batteries. Biogas plants have been used as an alternative to traditional sources of energy used for cooking purpose. Similarly, improved cooking stoves have been used to overcome the public health risk posed by traditional stoves using biomass. The two percent energy source, i.e. from grid electricity has been used in electrifying urban areas and powering industrial production. However, owing to the gap between demand and supply, Nepal still faces power cuts. Coal has been used in industrial production. Petro products usage ranges from industrial use to transportation and even domestic consumption to a certain extent like kerosene for cooking. The challenge for commercial and industrial use of energy is making it reliable and affordable so that it can consistently power production. Gap analysis conducted under the SE4All initiative by NPC project shows that 11 percent to 26 percent of the total energy mix can be powered by renewable sources by 2020 and 2030 respectively (NPC, 2013).

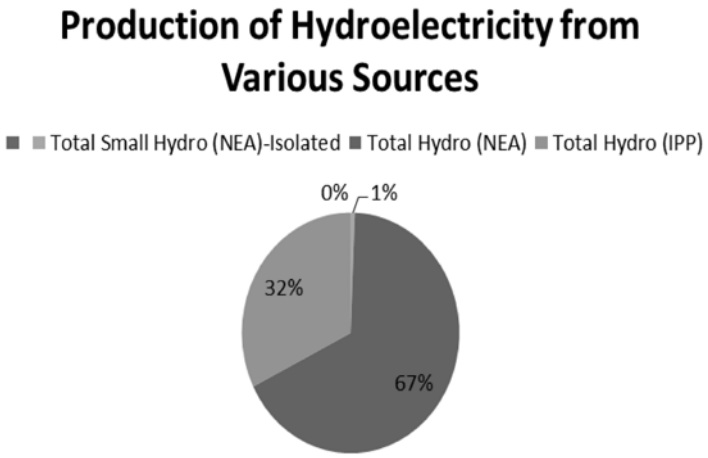
The Government of Nepal (GoN) has shown a serious inclination towards discussing sustainable energy solutions for Nepal by devising various energy strategies, policies and legislations in the past. Due to the rise in electricity shortages and the resulting pressure it has put import of fuel, the Government has shown commitment to accelerate reforms in the energy sector. This commitment is visible through recent efforts by WECS, AEPC and GoN to ensure energy access and streamline institutional mechanisms, policies and legislation associated with energy by joining initiatives like Sustainable Energy for All (SE4All - Initiative of UN Secretary General, Energy for All (Initiative by the Asian Development Bank conducted in partnership with AEPC in Nepal) and the recent exercise by WECS (with the support of GIZ) to develop an Integrated Energy Strategy. These efforts have resulted in some progress and therefore, need to be duly noted and appreciated in this discourse.

PART II: HYDROPOWER – Powering urban areas & fueling growth

So far, hydropower has been the most cost effective and reliable source of energy conducive to commercial and industrial use. Most urban areas of Nepal rely on electricity generated through hydropower and distributed through the national grid.

Current Status & Potential

Although hydropower represents about 2 percentage of total energy consumption currently, it demonstrates the largest potential of commercially feasible energy in Nepal (WECS, 2010). The theoretical hydropower potential of Nepal is 83,290 MW and economic potential capacity is 42,133 MW (NPC, 2013). Among the various locations, Karnali and Saptakoshi have the largest economically feasible hydropower potential (Ibid.).



Source: NEA, 2012/13

There is a huge domestic market for electricity in Nepal as demand has increased every year by more than 10 percent (75 MW) (NEA, 2013). Nepal also has a locational advantage in power and the demand of electricity in India is higher during summer season when there is surplus energy in Nepal from hydropower sources.

As per NEA's annual report of 2013, only about 719 MW out of the estimated hydroelectricity potential was produced by the end of 2012. Nepal faces 12 hours of load shedding per day on an average. About 32 percent of the hydroelectricity is generated by more than 33 projects run by Independent Power Producers (IPP). Currently, 86 projects with a capacity of 673 MW are in different stages of construction after concluding Power Purchasing Agreements (PPAs) with Nepal Electricity Authority (NEA, 2013, pp. 115 &116).

NEA's electricity demand forecast (NEA, 2012) shows that the system peak load will be 3,700 MW by 2028. However, is a suppressed demand forecast since it has not considered the potential for switching to electricity for cooking, etc. and there is potential for consumers switching to electricity from LPG and kerosene for cooking, provided sufficient electricity is available at a suitable price (NPC, 2013).

In 2013, the political leadership had also shown commitment towards developing hydropower, whereby top leaders of seven major political parties — the Unified CPN-Maoist, Nepali Congress, CPN-UML, Madhesi Janaadhikar Forum-Nepal, Rastriya Janashakti Party, Madhesi Janaadhikar Forum-Democratic and Terai Madhesi Loktantrik — and the Chairman of the interim election government Khil Raj Regmi had signed a commitment paper, pledging support measures for hydropower development in the country. The Federation of Nepalese

Chambers of Commerce and Industry (FNCCI) had taken the initiative and the signing of the Common Minimum Economic Agenda for hydropower development took place during the 47th Annual General Meeting of FNCCI.

Government of Nepal has also introduced several policy measures and incentives to induce investment in the hydropower sector. Some major initiatives include:

- **Electricity Act, 1992** which opened up private sector investment in hydropower generation.
- **VAT exemption** for the purchase of electro-mechanical equipment.
- **Nepal Rastra Bank Directives** that require commercial banks to set aside 12 percent of their portfolio to hydropower and agriculture investments (NRB, 2013).
- **National Water Plan, 2005** that envisioned both small and micro hydro projects for rural electrification and large hydro projects for export.
- **Ten years Hydropower Development Plan, 2009** that targeted the generation of 10,000MW in ten years. It also suggested public-private partnership projects (MoE, 2009).
- **Twenty years Hydropower Development Plan, 2009** that targeted the generation of 25000MW in twenty years.
- **National Energy Strategy (yet to be adopted)** was prepared by WECS which looked at both demand and supply side management and addresses key issues of connectivity and institutional mechanism reform in hydropower.
- **Three year plan,** also envisions hydropower investment and increasing the per capita consumption of electricity and reducing reliance on traditional fossil fuel sources.

Investment Related Issues

Private sector participation in hydropower sector demonstrates its' potential and opportunities for investment. However, owing to the institutional structures, policy implementation and related infrastructural issues, retaining existing investment and garnering further investment has been a big challenge. Some of the major issues that have been identified by several reports commissioned by the Government of Nepal are outlined as follows (NPC, 2013; WECS, 2010; NEA, 2012):

- **Connectivity issues:** The pace at which transmission lines are being constructed is not enough to meet the growing electricity demands. Many hydropower projects, although approved by NEA, have not come into operation due to the lack of connectivity. Construction of internal transmission lines faces challenges such as adequate investment, environmental regulations, land acquisition and compensation, regular maintenance and quality assurance (NEA, 2012). Similarly, cross border connectivity would also ensure a higher investment in hydropower with access to a larger market. However, institutional issues such as ownership of the transmission lines, cross-border state talks and policy instability in the Indian side regarding imports, along with foreign exchange guarantee mechanism are some of the primary challenges in this area. Similarly, for trading electricity with India, efforts to jointly discuss and identify issues that could be potential hurdles from the Indian side are also matters of priority.

- **Policy issues:** As outlined above, there are a number of plans, master-plans and policies made by the Government that set different targets. However, policy instability has affected the hydropower sector with arbitrary incentives and phasing out of such incentives and frequent policy changes. Although an integrated

energy plan and strategy has been discussed many times, it is yet to be adopted.

- **Institutional & Regulatory issues:** One of the major challenges in the hydropower sector has been the absence of an independent regulatory authority that could work on regulations in an independent manner. The regulatory challenges include price fixing below market prices, licensing in the generation sector, distribution leakages, transmission line construction to name a few. Hydropower as a sector falls under the purview of several Government agencies and coordination between these agencies have not been streamlined yet. This creates a regulatory maze that results into very few entrepreneurs attempting to enter this sector.

- **Trading issues:** The trading issue is closely tied up with connectivity and transmission lines. Lack of connectivity affects trading in the domestic as well as international market. In addition to this, Power Purchase Agreement (PPA) rates for domestic and international trading, unclear provisions regarding VAT and other tax relief and having a sole purchaser in the domestic market are some of the trading issues.

- **Long term sustainability issues:** With regards to long term sustainability, storage projects need to be planned such that hydropower generation is only one product of an overall water resource management strategy. Without storage projects, we cannot feasibly discuss a long term solution to the load-shedding problem as run of the river projects typically suffer from seasonal fluctuations. There are several challenges associated with building storage projects which include but are not limited to high technological cost of building these projects in the Himalayan region, unavailability of suitable project sites and environmental concerns regarding the ecology of the selected locations.

- **Political and Social issues:** Hydropower projects often suffer from the lack of a strong political commitment and this in turn gives rise to social issues such as demand from local communities with hydropower companies, which raises the cost of the project for entrepreneurs.

Recommended initiatives to promote investment in hydropower

Short Term Measures

- With the political willingness that currently exists for ending the ongoing electricity crisis within two years, importing electricity from India in the short term is a practical option available. To enable this, speeding up the construction of Kataiya-Kusaha (16 km, 132kv) transmission line and concluding the construction in twelve months is a priority. Similarly, the Raxaul-Amlekhgunj transmission line, on which the Indian government is currently conducting a detailed project report, should be completed within two years. Depending upon the design, these two transmission lines will be able to add significantly to the current import, thereby bringing the load shedding to nominal hours in the mentioned time period. In addition, construction of these cross border transmission lines will open up the market for export thereby increasing the incentives for private sector investment.

- Draft Electricity Act, 2065 and draft Nepal Electricity Regulatory Commission Act, 2065 should be taken to fresh round of consultations in the changed political and economic context. These two Acts should then be proposed in the legislature addressing these key issues: issues of transmission (internal as well as cross-border), Right of Way, land acquisition and pricing of electricity in light of contemporary market dynamics which

highlight the need to restructure institutional arrangements and develop competition in the electricity market. These reforms will pave way for further private investment in this sector eventually helping fill the supply gap that exists today.

- Fiscal spending has to be concentrated on building further transmission lines especially in areas where hydropower projects have already been approved by the NEA. Expansion of transmission lines will help materialize the investment that has already been committed to hydropower development by the private sector.

- Provisioning for open access of transmission lines and introducing a wheeling charge system would relieve NEA of the burden of power purchase agreements and can be the first step towards introducing multiple buyers in the power market. This kind of system can be piloted in the industrial corridors that are currently relying on petro products for meeting their energy needs at a much higher cost. Open access would widen the market and serve as an incentive for further investment.

Medium term measures

- Hydropower, as potentially the fastest growing energy source in Asia (ADB, 2013), has a huge market in neighboring India which is projected to face short supply of electricity for many more years. This longer run potential requires focus on construction of cross border transmission lines. The high voltage cross border transmission lines like 400 KV D/C Mujaffarpur – Dhalkebar transmission, will not only help us to sell off excess electricity to India during wet season but also help Nepal import during the dry season when there is acute shortage in electricity supply. The Government of Nepal has already initiated several such cross border connectivity lines. At the same time, emphasis should also be drawn towards taking measures which will enable efficient and timely construction of transmission lines within the country. Another area to focus in terms of transmission lines is that of open access. Cross-border transmission lines require open access which can then be utilized with a wheeling charge system.

- The Barghat-Butwal-Gorakhpur connectivity should be more than 400KV and of higher capacity to take Kaligandaki as an export corridor during wet months.

- Heavy industrial load exists in the Birgunj corridor and Duhabi, Biratnagar corridor. After the connection from aforementioned transmission lines, these two areas should be connected by Indian supply. This will cut Nepal's diesel import to a great extent and industries will be able to purchase electricity at a much lower rate than that exists today.

- The Bhairawa-Sugauli-Gorakhpur's 132KV line should be extended and construction of 400 KV transmission line between Siliguri-Anarmani should be initiated, although initially transmitting at 132 KV.

- As more and more independent power producers join the hydroelectricity market and given NEA's (State owned utility) resource limitation in terms of buying produced electricity, there is a need to discuss alternative market mechanisms for power trading. Independent power trading has been successfully tried by many developing nations and it has reaped benefits of attracting higher investment in this sector. Therefore, Nepal should also begin the discourse of independent power trading at the domestic level first. NEA can be an important player in this power trading market. The concept of power trading, however, naturally aligns with ownership of transmission lines. The exact arrangement requires an intensive discourse and several models are available to consider from international experiences, such as public-private-partnership (PPP), solely

public or private. Eventually, this kind of domestic power trading can pave way for regional power trading with India and Bangladesh as well.

Long term measures

Storage projects need to be developed to utilize the monsoon season flows (July-August) to have regulated flow with multiple benefits such as irrigation, flood control, fishery, navigation, hydropower etc. Constructing high dams in the northern Nepal valleys will significantly increase dry month's water supply and electricity generation. Nepal needs to go for priority storage projects such as the Saptakoshi High Dam (3500MW). Similarly Pancheswor (Mahakali) (5600MW) and Karnali (Chisapani) 10800 MW are also some important storage projects. The role of India is critical. Focusing on export projects will optimize the usage of Nepali rivers and decrease the cost per unit which is beneficial for both Nepal and India.

PART III: SOLAR ENERGY – Powering rural Nepal & relieving immediate load-shedding problems in urban areas

The share of fossil fuel in global energy consumption is expected to decline with the increasing use of renewable energy sources (IEA, 2013). With the innovation in technologies in solar power, the cost per watt has reduced drastically from $76.67 /watt in 1977 to $ 0.74 /watt in 2013 (forecast) (Romm, 2013). With the falling prices and their benign impact on environment, solar energy sources are poised to become a major source of primary energy for the world.

Current status & Potential

On an average, Nepal has 6.8 sunshine hours per day with the intensity of solar isolation ranging from 3.9 kWh/m^2/day to 5.1 kWh/m^2/day and the national average is about 4.7 kWh/m^2/day. If all of this energy is captured, Nepal could produce about 80,000 GWh/day which is about 17 percent of the world's primary energy consumption. If 0.01 percent of land of Nepal is used for this purpose, the energy produced would be 8 GWh/day or 2920 GWh/year (KC, Khanal, Shrestha, & Lamsal, 2011). It is estimated that 2,100 MW power can be generated from solar energy if 2 percent of the area of Nepal is considered. Although solar energy is still more expensive than hydroelectricity, it is much cheaper than petroleum based electricity, which is being used as an alternative currently. In long-term, grid connected solar power can be more cost effective and this can help remove the provision of batteries to store the power thereby resulting in cleaner and sustainable form of energy. As we are able to install higher capacity solar power systems, their cost also comes down as has been demonstrated by the system installed by AEPC at its own premises.

Alternative Energy Promotion Center (AEPC) supported installation of more than 400,000 Solar Home Systems (SHS) and 30,000 Small Solar Home Systems (SSHS) in 2,500 VDCs of 73 districts in Nepal till 2013 July, which is around 10 MW in total. AEPC has worked closely with the Solar Electric Manufacturers' Association Nepal (SEMAN), its member companies and the beneficiaries from local communities in this process. In addition to these, the solar PV installed in schools, health post, & offices and solar PV for pumping water would be around 4 MW. All these activities have been carried out through private companies. Around 200 solar companies are estimated to be operating in Nepal. However most of them are focused on rural areas because of the subsidy scheme.

Stand-alone solar PV systems in rural areas receive subsidies ranging from NRs. 5000 to NRs. 10000 depending upon geographical remoteness with very remote region receiving a high priority provisioned via the subsidy policy for renewable energy (AEPC, 2013). Similarly, solar systems installed in public institutions like schools and health posts receive maximum amount of subsidy at 75 percent of the total systems cost but not exceeding Rs. 1,000,000 whereas solar based pumping systems for drinking water managed by community receive subsidy of 75 percent of the total system cost but not exceeding Rs. 1,500,000 per system. Additionally, households with single women, underprivileged, disaster victim, poor and endangered ethnic groups receive additional subsidy of NRs.2500 per household. Solar thermal technologies also receive subsidies in rural areas. Every household receives the maximum subsidy amount of 50 percent of the total cost but not exceeding NRs.10,000 for solar cooker and a maximum subsidy amount of 50 percent of the total cost but not exceeding NRs.15,000 for domestic scale dryer with drying area of 3-20 sq. ft. Similarly, medium scale commercial dryer with drying area of 20-85 sq. ft. receive maximum subsidy amount of 50 percent of the total cost but not exceeding NRs.100,000 whereas large scale institutional or commercial dryer with drying area of more than 85 sq. ft. receive a subsidy of 50 percent of the total cost but not exceeding NRs.150,000.The government has also waived commodity import duties and Value Added Tax (VAT) for green energy products such as solar panels.

Households in urban areas have used solar energy for basic household needs such as lighting and water-heating. With the increasing power crisis, solar energy has also been tried in larger scale at few instances such as powering radio stations. But as of now, there is no provision of feeding energy produced by individual homes into the national grid. Detailed study on the power produced by individual solar units installed in households in the urban and peri-urban areas is yet to be conducted and therefore, actual estimate of solar power installed in Nepal is yet to be determined.

Till date, 0.1 MW of energy from solar power is connected to the national grid (Nepal Electricity Authority, 2013). The 680 KW solar plant of Kathmandu Valley Drinking Water Limited at Sundarighat also feeds its surplus electricity into the national grid.

Investment Related Issues

Despite incentives from the government and a high potential for growth, solar energy sector has largely been subsidy driven in the rural areas and has been serving rural electrification needs. Following are some of the key challenges in this sector:

- The existence of **subsidies has diverted the need to find a commercial market** for solar energy and consequently the potential of this sector to make a significant contribution in the energy sector. The commercial viability is clearly demonstrated by the increased demand for solar power to meet residential needs in urban areas. The Government of Nepal has announced policy statement for providing partial subsidy in solar PV in urban households in very limited urban areas.

- The discussion around energy needs have mostly centered on hydropower, owing to its cost effectiveness. However, solar power has been playing an important role to fill in the immediate energy demands of the residential and commercial sector to a certain extent. **Policy discourse in solar power has not received due attention.**

- In order to scale up the potential of solar power, several infrastructural requirements need to be addressed immediately. There are no **micro-grids dedicated to solar power** which limits the economies of scale of

solar plants. Some effort in this area has recently been made by AEPC (ADB, 2013).

- **Access to finance in rural areas** is also a major challenge for solar systems based in rural areas. Although financial institutions have eased up the process in urban areas, the perceived risks are high in rural areas and there have been very less innovation in risk mitigation mechanisms. There are some microfinance and other financial institutions that provide financing for rural households as well. However, the reach of these institutions is very limited.

- Installation of solar power systems of large capacities faces similar constraints as hydropower i.e. that of land acquisition. Solar power systems of large capacities require large areas of land conducive to capturing solar energy. **Land acquisition** is a deterrent to large scale investment in solar power.

Recommended initiatives to increase investment in solar power

Short Term Measures

- In the near future, the Government of Nepal needs to introduce a policy frame work for construction of mini and micro-grids dedicated to solar power in its policies and programs. The challenge here is the connectivity of these micro-grids into broader national grid system along with issues such as ownership of the micro-grid, land acquisition for grid construction and tariff rates for usage. AEPC is already venturing into a pilot project in the construction of a micro-grid for solar power and is best positioned to lead this policy discourse. Rural micro grid for solar, currently envisioned under this pilot, would use inverters to convert the DC voltage to AC voltage and will have the capacity to connect to a 240 KV grid system. Energy for all initiative of ADB has provided a platform for sharing success stories of mini grids in Asia and the Pacific and AEPC has been a central agency from Nepal in these platforms. Therefore, there are successful models of micro and mini-grids including financing options and innovations that can be used in the Nepali context and this discussion can be led by AEPC.

- Financing rural projects has been a challenge in the solar power sector with higher risk associated with rural investments. While there are efforts made by multilateral and other donor agencies in bringing together investors through platforms like 'Investors Forum' (ADB, 2013), the financing issue also needs to be addressed by the Government. Commercial lending is reluctant to enter rural project financing for several reasons, including higher perceived risk and higher administration costs. This is one area that communities, development partners and the Government of Nepal have an important role to play as facilitators and intermediaries to help mitigate the risk and bring down the cost of administration. Therefore, a strategic discourse on financing models for rural projects to increase commercial viability also needs to take place at the national level.

- Enabling solar energy to power industrial sector will be important to develop commercial orientation in the solar sector, which will require provisions for wheeling charge system.

- Pilot projects on net metering have been successful in Kathmandu Valley. Kathmandu-based Centre for Energy Studies in collaboration with the Swiss university SUPSI has integrated grid-connected 1KW solar photovoltaic systems each at Pulchowk Engineering Campus and the Rural Integrated Development Ser-

vices (RIDS) Nepal and 3KW system at Nepal Electricity Authority's Baneshwor office. However, net metering provision needs further research on its viability. Government of Nepal can launch a study on net metering provisions. A detailed cost-benefit analysis is required to introduce a system of net metering as a viable measure to promote solar power.

Medium Term Measures

- AEPC, with its experience in dealing with all forms of energy, can lead a discourse such that better strategies and policies are identified and formulated to address the policy gap in sectors like Solar Power. Attracting investment in larger solar power from a commercial point of view requires further policy discourse like Feed - in- Tariff law which will guarantee the tariff for longer period and also will ensure return in few years and an expansion of scope from rural areas to urban areas where commercial viability can be achieved. Similarly, this discourse needs to address a sunset policy on subsidies and encourage innovation for longer term commercial viability. Providing subsidies in the long run may not be a sustainable solution. This kind of policy discourse can further identify long term measures to be taken to increase investment in solar power.

- Public private partnership model should be piloted for large scale solar power installations in the medium term. In such a partnership, GoN can take up the issue of land acquisition or frame leasing arrangement for the land used while the private sector brings in the investment for technology installation. In order for this to happen, some pre-requisites include ensuring grid connectivity for such connections and ensuring power purchase agreements for such investments.

PART IV: BIOGAS – EMPOWERING HOUSEHOLDS THROUGH CLEANER ENERGY SOLUTIONS

Above 85 percent of energy needs is met through traditional sources in Nepal. Biogas is a major component of this mixture (NPC/UNDP 2013). Since Nepal is an agrarian economy, biogas can play a major role in meeting its energy needs. Traditional technology of using firewood and animal dung emit harmful gas and therefore, improved biogas technology has become imperative from a public health perspective as well as an energy consumption perspective.

Current Status & Potential

According to the Report on "Market Mapping Study for Biogas Companies" by AEPC (2013), the total potential for biogas in Nepal based on livestock is estimated to be around 2.5 million plants. The total technical potential is 2.2 million plants and feasible plants are 1.3 million. Meanwhile, till date, total number of biogas plants installed till 2013 is 290,510 in various regions in Terai, Hills, remote hills and mountainous location. Biogas plants are estimated to save 239,386 tons of firewood and 3,830,000 liters of kerosene annually (Centre for Rural Technology, 2005). Biogas seems to be popular amongst middle income households. Poor income household have limited accessibility while rich income households prefer LPG over biogas. In terms of accessibility, 67 percent of the customers are reported to be in accessible areas in urban centers compared to only 33 percent in the rural/remote areas (AEPC, 2013).

Similarly, solid waste management is a prevalent issue in several urban areas of Nepal. Majority of the waste produced, which is around 65 percent, is biodegradable and has potential for generation of renewable energy like biogas through anaerobic digestion (KC, Khanal, Shrestha & Lamsal, 2011). According to AEPC, Biogas Support Programme(BSP) in Nepal has been working in promoting biogas in rural areas, amongst other activities. BSP managed the installation of over 200,000 domestic biogas plants between 1992 and 2009. The plants use cattle manure to provide biogas for cooking and lighting (BSP, 2009).

There have been several efforts by the Government of Nepal to promote investment in biogas sector. Some of the major initiatives are highlighted below:

- National Rural and Renewable Energy Programme (NRREP): In 2011, GoN and development partners (Danida, DFID, the Norwegian Ministry of Foreign Affairs, KfW, SNV and UNDP) jointly agreed to support formulation of a National Rural and Renewable Energy Programme (NRREP).The Programme was launched on 16 July 2012 for the period of five years. The GoN has committed itself to reform the subsidy system and finance a higher portion of the subsidies for Renewable Energy Technologies(RET).

- The Government of Nepal has promoted biogas projects since 1975 with various financial provisions like low interest rate and subsidies. GoN's plans have also promoted biogas projects. The seventh Five-Year Plan (1984-1989) set biogas installation targets and subsidies in the year 1984-86 in which 50 percent represented loan interest to families that purchased biogas. The policy further extended a provision of granting 25 percent subsidies for installation cost. The Eighth Plan (1992 - 1997) saw the need to create a coordinating body that would create a favorable environment for large scale promotion of alternative energy in the country and thereby AEPC was founded. The Ninth Plan (1997 - 2002) had long term plans for science and technology, particularly to help rural energy systems for the creation of employment opportunity, with the introduction of modern energy instead of traditional energy. The Tenth Year Five Year Plan saw the government set goals to install 200,000 bio gas plants and 250,000 improved cook stoves in 45 districts of Nepal.The Perspective Plan (2000-2020) also emphasizes on the development and promotion of alternative energy in the country and has emphasized the promotion of biogas technology especially for rural development.

Investment related issues

Despite the benefits of biogas, its implementation faces several challenges in rural areas. Following are some challenges:

- Private sector participation has increased over a period of time in the biogas sector. However, biogas sector has been subsidized to reach out to rural communities. In such a scenario, commercial viability is yet to be explored in this sector. Although biogas production is superior technology to direct burning of cake (dung) in terms of energy utilization (thermal efficiency of 60 per cent against 11 per cent for dung cake), it can only be profitable and attractive to marginal farmers if a subsidy is provided along with appropriate financing mechanism. There are microfinance institutions that provide loans to household for the installation of biogas plants to a certain extent.

- Biogas plants currently face a couple of technological issues. These issues range from temperature control in mountainous region to low gas yield during the winter season. In addition, they require water to operate which is a resource that requires a lot of rural women's time and energy involvement, especially in the hilly and mountainous region (KC, Khanal, Shrestha &Lamsal, 2011; Wargert, 2009). These technological issues

show limited innovation in this sector to suit local requirements. Such innovation can happen only if incentives for private sector participation can be opened up.

Recommended initiatives to promote investment in biogas

Short Term Measures

- Urban waste management also has potential for biogas. In order to demonstrate this potential to the private sector, GoN can initiate a waste to energy program with the help of development partners. This kind of project would help explore the potential problems that investment in such a sector can face and help frame a regulatory framework for such a provision.

- Current subsidy scheme is tied to biogas technology. GoN will provide subsidy only to those plants that the Government has approved. Due to this, the focus of private sector has been on constructing only those kind of plants. This has as a result, created a disincentive for innovation and adaptation to local environments. The GoN can revise its subsidy on biogas plants such that subsidy is administered through vouchers directly to beneficiaries and this can open up the biogas plant market to competition and innovation.

Medium Term Measures

- Biogas promotion in Nepal is heavily reliant on Government, development partners and civil society initiatives that fund programs for plant installation. The benefits of biogas have already been realized by many rural communities and there is a high demand for biogas technology. However, for the private sector to enter biogas sector, feasibility in terms of storage and distribution needs to be explored. This kind of initiative will help relieve increasing pressure on import of LPG used for cooking and heating in urban areas. The Government of Nepal needs to bring forward a policy discourse that initiates the idea of biogas use in urban areas as well as rural areas. Currently, the programs and policies have been highly rural centric while the affordability to make biogas commercially viable lies in urban centers. AEPC as the central coordinating body and implementing agency of Government subsidy programs is best suited to lead this policy discourse. Although, there is a subsidy for biogas plants that use kitchen waste in urban areas, getting sufficient waste for continuous supply is a challenge.

- Policy framework that addresses biogas production from urban and agro-enterprise waste (like poultry and dairy farm waste) that is storable is an area that requires a policy framework for discussion. AEPC has a major role to play in this discourse. This kind of innovation and policy promotion will lead to commercially viable solutions of biogas in urban areas.

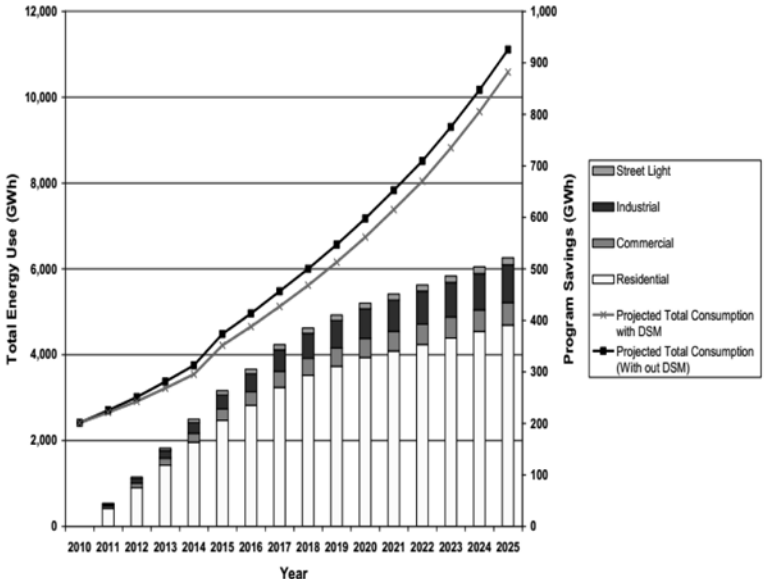
PART IV: ENERGY EFFICIENCY

Demand side management (DSM) describes the actions often taken by the government or electricity supply authority to improve the efficiency at the point of final energy use (ADB, 2013a). In the context of Nepal, Energy Efficiency is still an untapped reserve. The focus in Nepal has been on the supply side rather than on demand side. The concept and practice of energy efficient techniques can actually yield in energy and cost savings for industries and households alike in Nepal and elsewhere (NEEP, 2013). Moreover, Energy efficiency can play an important role to slow down the growth of energy demand and, thus contribute to overcome the crisis seen in the energy sector.

Current Status & Potential

In 2009, World Bank and NEA conducted a DSM potential study that estimated the electricity saving potential in the industrial, commercial and residential sector. About 260 Mega Watt of peak demand and 419 Gigawatt hours of power could be saved by 2020 (WB/NEA, 2009).

Similarly, a study conducted by Energy Efficiency Centre (EEC)/ FNCCI in 2012 focusing on the industrial sector found out that energy-intensive industries could save 160 Gigawatt hours of electricity and 8 Million Gigajoule of thermal energy (mainly coal, furnace oil and diesel) every year by implementing major energy conservation measures. This would lead to cost saving up to NPR 6 billion annually. The environmental benefit is estimated to be 139 tons of carbon emissions avoided (EEC/FNCCI, 2012).[1]The establishment of a proper energy management system in the companies, regular energy audit in industries and other big energy consumers like commercial and public buildings, are effective tools to tap energy efficiency opportunities in the economy.



Projected Impact of Demand Side Management (DSM) Options on Energy Use and Peak Demand in Nepalese Electricity Sector (The World Bank/Nepal Electricity Authority, 2009)

NEEP, a Nepalese German bilateral program, works with the private sector apex body FNCCI, supporting the establishment of the Energy Efficiency Centre (EEC) that conducts awareness programs and provides professional energy auditing services to the industries. By the end of December 2013, EEC has conducted energy audits of twenty four industries and identified annual saving potentials of NPR 520 million through implementation of short, middle and long terms EE measures (EEC/FNCCI, 2013). Most industries have already implemented short and middle term measures while long term EE investments are rarely done due to lack of financing.

1. *For a detailed list of various sectors and cost saving that can be achieved in these industrial sectors, please refer to a detailed analysis of energy efficiency fact sheet available at* http://eec-fncci.org/content-learn-download

According to a study conducted under USAID/SARI/EE Project, by introducing an Energy Standard and Labelling program, covering fluorescent lighting, rice cookers and refrigerators, complemented by a public awareness campaign, Nepal could save up to 80 MW of peak demand over a period of five years (USAID-SARI, 2002).

The large application of combined heat and electricity generation, also called cogeneration, is one EE technology that has potential to add power supply to the Nepalese grid and, thus, can reduce the electricity deficit. Cogeneration can be an efficient alternative, particularly in Sugar Mills, as their processes are conducive to this technology and have been tried and tested by the private sector in Nepal (EEC, 2013).

Government of Nepal has taken some initiative in promoting energy efficiency. Following are major highlights:

- Establishment of the 'Office of the Energy Efficiency Services' at the Department of Industry in 1995.
- Environmental Sector Support Program (ESPS) was conducted from 2000 to 2005 with the primary objective to help promote energy efficiency in industries (IFC, 2012).
- Implementation of Nepal Energy Efficiency Program (NEEP), with the aim to promote energy efficiency in the country. The programme, executed by WECS with support from German Development Cooperation – GIZ on behalf of Federal Ministry of Economic Cooperation and Development (BMZ), aims to encourage a policy discourse on energy efficiency while helping the Government of Nepal frame pilot programs that demonstrate the benefits of energy efficiency measures adopted.
- At the regulatory level, there are some acts and regulations which have partly incorporated the concept of energy efficiency in a fragmented manner. These include Hydropower Development Policy (2001), Rural Energy Policy (2006), Electricity Crisis Resolution Action Plan (2007), Petroleum Quality Standard By-rules (2008), Ten Years Hydropower Development Plan (2008), Twenty Years Hydropower Development Plan (2009), Three Years Plan (Approach Paper-2010), Climate Change Policy (2011), Electricity Act (1992) and Regulation (1993), Electricity Leakage Control Act (2002), and Electricity Tariff Fixation Rules. However, there is no comprehensive policy framework for energy efficiency which would be necessary to push this important issue. WECS has started to integrate energy efficiency in the draft of National Energy Strategy and is also working on the formulation of Energy Efficiency Strategy and the Biomass Energy Strategy (NEEP, 2013).
- Under the National Electricity Crisis Mitigation Action Plan 2008, the government promoted the use of CFL and developed a code of conduct for efficient use of energy in government offices. A CFL replacement campaign has been implemented in the residential sector by NEA with the support from Asian Development Bank (ADB, 2012).

Investment Related Issues

- The challenge of implementation of the mentioned provisions still remains large. In absence of EE policy/strategy there has been no concentrated effort to implement any of the provisions on energy efficiency made so far, which unfortunately pushes this agenda to a back seat. Among the key barriers is the lack of an integrated strategy and an institutional framework. The current fragmented institutional framework ignores the potential of energy efficiency and demand side management in achieving the optimum balance between supply and demand for energy (ADB, 2012). Further challenges are the lack of awareness and information on EE, limited access to EE technologies, suppliers and services providers, lack of adequate financial incentives and tariff structures that penalize the wastage of energy or reward energy efficient industries.

- Some energy efficiency measures like power-heat/cold-cogeneration require a close coordination between different stakeholders. Cogeneration efforts currently are limited to certain industries focused on meeting their own demand. Therefore, developing an institutional mechanism that allows excess power to be sold to the national grid or a system of net metering could provide an added incentive for industries to invest in cogeneration.

Recommended initiatives to increase investment in energy efficiency

In order to foster a clean energy mix which would not only support an industrial production base but also reap environmental dividends, there is much that can be done in terms of policy reforms:

Short term measures

- Specific incentives such as low cost loans provisions for installing energy efficient technology or a tax rebate on the import of such technology could encourage private sector participation in energy efficiency. A system to recognize or reward energy efficient industries or industries practicing cogeneration for their support in reducing the reliance on state provided energy or thermal energy during peak load times could also function as an incentive for private industries and consumers in addition to the cost saving that it results in. A concept note recently submitted to the Ministry of Energy and Nepal Electricity Authority by NEEP on Energy Audit Scheme for Top 50 Electricity consumers described the incentive mechanism to be developed by the government to promote efficient use of energy. It proposes the implementation of energy auditing on a voluntary basis but as special promotional outreach to the biggest power consumers of the country. A financial scheme on cost sharing basis could on the one hand give recognitions to the industries for going energy efficient and on the other hand help NEA to reduce energy demand that can be provided to other consumers. This concept could be a starting point on incentivizing energy efficiency.

Medium term measures

- Institutionalizing energy efficiency through the establishment of an agency or a department responsible for planning, implementing and monitoring energy efficiency related activities and measures has become the need of the hour. Such an agency can work on institutionalizing energy audits and streamlining energy efficiency policies and provisions into an integrated strategy. The evidence of cost savings and savings to the national economy through energy efficiency measures has already been demonstrated through projects such as NEEP. This evidence requires further marketing and awareness campaigns**.** The institutional body responsible for energy efficiency can also take up this responsibility. One such model along with a detailed cost benefit analysis and governance structure has already been proposed for Demand Side management by the World Bank and NEA study conducted in 2013. This study could be a starting point in integrating and streamlining energy efficiency policies of GoN.

Conclusion

Nepal's current energy mix requires a thorough discussion on sustainable and affordable energy production. At the same time, given the climate change perspective, it is equally important to concentrate this discourse on clean energy solutions. Fortunately, Nepal has a lot of potential in clean energy solutions which can be capitalized with an integrated strategy framework. There have been innovations on several other sustainable energy solutions. This paper has highlighted only those that offer some scale and commercial viability. However, future discourse can add other sources of energy into this discussion. In order to increase investment in sustainable energy solutions in the long run, the paper has highlighted measures that can be taken in the short term, medium term and long term.

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