Comparative Studies on

Rural Electrification

in SAARC Countries

Published by
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Forward

The Countries of South East Asia formed an alliance to improve their relationship and specially work for economic development and remove any misunderstandings if any. It is a unique concept of regional cooperation with success.

For that purpose SAARC was formed with 7 (seven) of South Asian countries. The heads of Seven South Asian Countries of SAARC (Bangladeshi, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka) signed the charter to establish the South Asian Association for Regional Cooperation (SAARC) on December 8th, 1985 with its Secretariat in Katmandu, Nepal. Then Afghanistan also joined this group in 14th SAARC Summit held in New Delhi , India in April 2007 making it 8 (eight) members countries.

The formation of such group could bring effective economic gains, develop relationship and bring prosperity among the countries has been proved by SAARC member Countries.

The SAARC Energy Center is striving to develop overall energy improvement in its member countries and to make each member country energy secured utilizing all means for development. Rural Electrification is one of the important sectors and renewable also come under it.

An example is inter-country electricity trade among the member countries which even ASEAN Countries could not develop practically though they had huge potentiality but it was made practically possible by SAARC member countries and what is found is on papers for them. SAARC Grid is the next step for energy security and sustainability.

Rural electrification is another aspect of development in this region. The member countries bought massive development in the life of rural people through rural electrification. The commendable achievements of the member countries and how to be further benefitted is shown in this publication. It will benefit the member countries to learn and follow the achievements of the success stories of the other member countries. Rural electrification is also a requirement for food security of any country in the region.

The success stories are based on the fact “what is the cost of not providing electricity vs. cost of providing the same”.

The SAARC Energy center believes that energy development which forms an important means of attaining MDG is possible through successful rural electrification.

Director
SAARC Energy Centre

Preface

The world gave less importance to rural electrification specially the less developed countries. SAARC member countries were no exception. The Alliance of South East Asia i.e. SAARC is a unique concept of regional cooperation with success. It has removed many barriers among the member countries. But then some of the member countries started giving more priority to it. Soon the difference between electrified village and non-electrified village was evident especially it started from Bangladesh. They developed a successful model of consumer owned rural electric cooperative.

Sari Energy played an important role in bringing harmony and coordination among the countries of this region especially in development of rural electrification.

We tried to get update about the current situation of rural electrification and how to further advance it. Almost all the member countries gave due importance to it as most of the population was rural based. This brought massive economic uplift of rural areas.

Other SAARC member countries tried to copy as it is. Nepal is following this concept but have some modification as per terrain. Afghanistan though badly affected by long war has developed a long term master plan for rural electrification and over all for the country.

The SAARC Energy Center is striving to develop overall energy improvement in its member countries and to make each one energy secured utilizing all means for development. Rural Electrification is one of the important sectors and renewable also come under it.

An example is inter-country electricity trade among the member countries. Rural electrification is another aspect of development in this region. The member countries bought massive development in the life of rural people through rural electrification. The commendable achievements of the member countries and how to further be benefitted is produced in this publication. It will benefit the member countries to learn and follow the achievements of the success stories of the other member countries. Rural electrification is also a requirement for food security of any country in the region.

We have taken information from differ websites and other sources. We have given link of the references. Unfortunately during compilation, we may have missed some references unintentionally for which we beg apology. We will give their link if any such mistake comes in our knowledge. For convenience of the reader we have given reference link immediately after the reference item.

I am Thankful to all who helped us to prepare the paper and specially the SEC whose active support made us complete the report.

We are waiting for your feedback. It will be helpful to further develop and update the report.

Shah Zulfiqar Haider, PEng, CEA

Acknowledgement

A successful report or research is outcome of support and assistance of a Team. The SAARC Energy Center who has credit of producing many International research papers which are helping the developing SAARC member countries took the initiative to produce paper on rural electrification policies of its member countries. The Researcher is grateful for their relentless support in preparing this research paper. This vast topic of rural electrification policies could not have been prepared without direct assistance and support of Fahad Haider, B. Eng. (Electronics) from Macquarie University, Sydney, Australia and Engr. Saddaf Haider who is M.S (Business Communication) from Monash University, Malaysia.

I am specially Thankful to Mr. Khondkar Abdus Saleque (better known as Saleque Sufi) who is an Australian Bangladesh Chemical engineer and is advisor to the Government of Afghanistan.

I am Thankful to all those who helped me to prepare and compile this report, specially to my wife Zahida Alam whose continuous support made me produce this paper.

Shah Zulfiqar Haider, PEng, CEA

3. Currencies Exchange Rates, Conversions & Definitions

3.1 Currency:

All SAARC countries currency values have been given with respect to other SAARC member countries' currencies and US Dollar. The exchange rates are of **1st October 2014.** One can easily compare any currency with other SAARC countries' currencies and US Dollar.

Currency comparison is given horizontally in rows.

Country	Afghan-istan Afghani	Bangla-desh Taka	Bhutan Ngultrum	India Rupee	Maldives Rufiyaa	Nepal Rupee	Pakistan Rupee	Sri Lanka Rupee	USA $
Afghanistan Afghani	**1.000**	1.339	1.071	1.071	0.266	1.707	1.782	2.265	0.017
Bangladesh Taka	0.747	**1.000**	0.800	0.800	0.199	1.275	1.331	1.692	0.013
Bhutan Ngultrum	0.934	1.250	**1.000**	1.000	0.249	1.594	1.664	2.115	0.016
India Rupee	0.934	1.250	1.000	**1.000**	0.249	1.594	1.664	2.115	0.016
Maldives Rufiyaa	3.757	5.029	4.023	4.023	**1.000**	6.414	6.695	8.510	0.065
Nepal Rupee	0.586	0.784	0.627	0.627	0.156	**1.000**	1.044	1.327	0.010
Pakistan Rupee	0.561	0.751	0.601	0.601	0.149	0.958	**1.000**	1.271	0.010
Sri Lanka Rupee	0.441	0.591	0.473	0.473	0.118	0.754	0.787	**1.000**	0.008
USA $	57.740	77.300	61.830	61.840	15.370	98.580	102.900	130.800	**1.000**

(#16.01 Currency comparison of SAARC Countries)

3.2 SAARC Countries other Statistics: Some of the basic data of SAARC Countries is given in the table given below. It may not be wholly accurate as many could not maintain their respective data. Again some variation is always there from each source.

Item	Afghanistan(Land locked)	Bangla-desh	Bhutan(Land locked)	India	Mald-ives (Island)	Nepal (Land locked)	Pakis-tan	Sri Lanka (Island)
Area in sq. km(slight variation as per various sources)	652,090	147,570	47,001	3,287,590	300	147,181	796,095	65,610
Population 2014 (million)	31.28	158.512	0.7655	**1267.401**	0.351	28.12	185.13	21.448
Share of World population in %	0.43	2.19	0.01	**17.50**	0	0.39	**2.56**	0.30
Population density (P/sqkm)	48	**1101**	16	386	1180	191	233	327
Rank as per population	40	8	163	2	177	46	6	57

Item	Afghanistan(Land locked)	Bangla-desh	Bhutan(Land locked)	India	Mald-ives (Island)	Nepal (Land locked)	Pakis-tan	Sri Lanka (Island)
Rural Popul-ation %	76	70	62	68	56	82	63	**85**
SAARC Neighbouring Countries	*Pakistan*	**India**	**India**	Pakistan, Bangladesh, Afghanis-tan, Nepal, Bhutan, (Sri Lanka & Maldives nearby)	Sri Lanka nearby, but not bordered	**India**	**India**, Afghanistan	India nearby, but not bordered
Non SAARC Neighbours	Iran, Turkmenistan, Uzbek-istan, Tajikistan, **China**, Iran	Myanmar	**China**	**China,** Myanmar	-	**China**	**China**	-
Access to electricity % (year)	30	63 (2014)	94+	75.3	93+	76.3	68.6	85
Per capita Consumption kWh/mo	**35 (2006)**	259 (2011)	227 (2007)	**684 (2011)**	604.5 (2006)	106 (2011)	499 (2011)	490 (2011)
Total electrification % (2011)	20 approx.	60 63 (2014)	85 approx.	75	100 approx.	76	69	85
Rural elect-rification % (2011)	7 to 10	48 (2011), 54+ (2014)	67	67	100 approx.	72	57	84
Urban elect-rification % (2011)	30	90	94	94	100 Approx.	97	88	96
Achievement in RE	Import from neighbouring countries. Master plan prepared for whole country.	Successful rural electrification.	Mostly electrified. Electricity export.	Top priority to energy sector. Successfully solving RE problems	No primary fuel available	Systematically solving the RE problems	Advancing well despite so many earlier bottleneck.	No load shedding.
Main Barrier – 1	Conscious required of all parties not to hamper electrification and other development works	Expertise. Tariff	None	Vast country. Huge electricity demand.	Its existence is at question because of GHG emission by others. No Primary fuel	Land locked. Huge unexplored hydro potential, but still load shedding. High losses & less revenue	Huge unexplored energy resources.	No significant barrier.

(#16.2 SAARC Countries other Statistics)

(Ref. http://www.worldometers.info/world-population/population-by-country)

3.3 Conversion Factors and Energy Equivalents

1 Lakh = 0.10 million

1 Crore	= 10 million	
1 kilogram	= 2.2046 pounds	
1 Pound	= 454 gm.	
1 Cubic meters	=35.3 cubic feet (gas)	
1 Metric ton	= 1 Tonne	= 1000 kilogram
1 joule	= 0.23884 calories	
1 mega joule	= 1 million joules	= 238.84 x 103 calories
1 giga joule	= 109 joules	= 238.84 x 106 calories
1 tera joule	= 1012 joules	= 238.84 x 109 calories
1 peta joule	= 1015 joules	= 238.84 x 1012 calories
1 Million TOE	= 41.87 peta joules of energy	= 4.1868 x 104 tera joule (TJ)
One billion cubic meter of natural gas		= 38.52 peta joules of energy.
One million cubic meter of natural gas		= 38.52 tera joules of energy. = 0.03852 peta joules of energy.
One billion kilowatt hour of electricity		= 3.60 peta joules of energy.

1 calorie (cal) = 4.1868 J

1 British thermal unit [BTU] = 1.055 kJ = 0.252 kcal

Electricity

1 MW = 1000 kW

1 TW= 1000 MW = 1 million kW

1 kWh of electricity output = 3.6 MJ = approx. 860 kcal

1 kW = 1.341 HP

I Ton refrigeration = 3.516852842 KW

1 Ton refrigeration = 12,000 BTU/hour

1 HP = 2545 BTU/hour

1 KW = 3413 BTU/hour

WEC Standard Energy Units

1 tonne of oil equivalent (toe)	= 42 GJ (net calorific value)	= 10,034 Mcal
1 tonne of coal equivalent (tce)	= 29.3 GJ (net calorific value)	= 7,00Mcal

Note: the tonne of oil equivalent currently employed by the International Energy Agency and the United Nations Statistics Division is defined as 107 kilocalories, net calorific value (equivalent to 41.868 GJ).

Volumetric Equivalents

1 barrel = 42 US gallons	= approx. 159 liters
1 cubic meter	= 35.315 cubic feet = 6.2898 barrels

Representative Average Conversion Factors

1 tonne of crude oil	= approx. 7.3 barrels
1 tonne of natural gas liquids	= 45 GJ (net calorific value)

1,000 standard cubic meters of natural gas = 36 GJ (net calorific value)

1 tonne of uranium (light-water reactors, open cycle) = 10,000–16,000 toe

1 tonne of peat	= 0.2275 toe
1 tonne of fuel wood	= 0.3215 toe

3.4 Definitions

i. Installed capacity: The net capacity measured at the terminals of the stations, i.e., after deduction of the power absorbed by the auxiliary installations and the losses in the station transformers.

ii. Utilities: undertakings of which the essential purpose is the production, transmission and distribution of electric energy. These may be private companies, cooperative organizations, local or regional authorities, nationalized undertakings or governmental organizations.

iii. Hydro Electricity: refers to electricity produced from devices driven by fresh, flowing or falling water.

iv. Thermal Electricity comprises conventional thermal plants of all types, whether or not equipped for the combined generation of heat and electric energy. Accordingly, they include steam-operated generating plants, with condensation (with or without extraction) or with back-pressure turbines, and plants using internal combustion engines or gas turbines whether or not these are equipped for heat recovery.

v. Nuclear Electricity is defined as the heat released by the reactors during the accounting period and is obtained by dividing the generation of nuclear electricity by average efficiency of all nuclear power stations.

vi. Production is defined as the capture, extraction or manufacture of fuels or energy informs which are ready for general use. In energy statistics, two types of production are distinguished, primary and secondary. Primary production is the capture or extraction of fuels or energy from natural energy flows, the biosphere and natural reserves of fossil fuels within the national territory in a form suitable for use. Inert matter removed from the extracted fuels and quantities reinjected flared or vented are not included. The resulting products are referred to as "primary" products. Secondary production is the manufacture of energy products through the process of

transformation of primary fuels or energy. The quantities of secondary fuels reported as production include quantities lost through venting and flaring during and after production. In this manner, the mass, energy and carbon within the primary source(s) from which the fuels are

manufactured may be balanced against the secondary fuels produced. Fuels, electricity and heat produced are usually sold but may be partly or entirely consumed by the producer. Comprised gross production, i.e. the amount of electric energy produced, including that consumed by station auxiliaries and any losses in the transformers that are considered integral parts of the station. Included is the total production of electric energy produced by pump storage installations.

vii. Imports of energy products comprise all fuel and other energy products entering the national territory. Goods simply being transported through a country (goods in transit) and goods temporarily admitted are excluded but re-imports, which are domestic goods exported but subsequently readmitted, are included. The bunkering of fuel outside the reference territory by national merchant ships and civil aircraft engaged in international travel is excluded from imports. Fuels delivered to national merchant ships and civil aircraft which are outside of the national territory and are engaged in international travel should be classified as "International Marine" or "Aviation Bunkers", respectively, in the country where such bunkering is carried out. Note that the "country of origin" of energy products should be recorded as a country from which goods were imported**.**

viii. Exports of energy products comprise all fuel and other energy products leaving the national territory with the exception that exports excludes quantities of fuels delivered for use by merchant (including passenger) ships and civil aircraft, of all nationalities, during

international transport of goods and passengers. Goods simply being transported through a country (goods in transit) and goods temporarily withdrawn are excluded but re-exports, foreign goods exported in the same state as previously imported, are included. Fuels delivered to foreign merchant ships and civil aircraft engaged in international travel are classified as "International Marine" or "Aviation Bunkers", respectively. Note that "country of destination" of energy products (that is country of the last known destination as it is known at the time of exportation) should be recorded as a country to which these products are exported to.

ix. Losses refer to losses during the transmission, distribution and transport of fuels, heat and electricity. Losses also include venting and flaring of manufactured gases, losses of geothermal heat after production and pilferage of fuels or electricity. Production of secondary gases includes quantities subsequently vented or flared. This ensures that balance can be constructed between the use of the primary fuels from which the gases are derived and the production of the gases.

x. Energy Industries Own Use refers to consumption of fuels and energy for the direct support of the production, and preparation for use of fuels and energy. Quantities of fuels which are transformed into other fuels or energy are not included here but within the transformation use. Neither are quantities which are used within parts of the energy industry not directly involved in the activities listed in the definition. These quantities are reported within final consumption.

4. Executive Summary

Electricity is required 24 hours a day and 365 (or 365.25) days a year with quality. Our dependence on it for economic development, food security, attaining MDG is no more questionable. All citizen of any country have equal right. Then why this Rural Electrification a separate issue? Whatever is the case or cost rural citizen have equal right to have access electricity. Today all SAARC countries have realized and giving almost equal importance to rural electrification.

The institutional structures for rural electrification in SAARC Countries are reviewed in this report. Analysis of the current rural electrification programs and objectives in SAARC Countries are provided along with more analysis of the costs, incentives and tariff structures of each Member States. The country-specific challenges in rural electrification including access and availability of electricity and how the respective countries addressed them are discussed. The energy technology options commonly used in rural electrification policies in SAARC Countries are mentioned. Last but not the least action plans for successful implementation of rural electrification policies in SAARC Member countries are proposed along with recommendations of policy options for successful implementation of rural electrification policies in SAARC Member States.

No SAARC member country borders more than 2 member countries except India which has border with 4 (four) countries and Pakistan has border with 2 (two) SAARC member Countries. China though a non SAARC country borders 5 (five) SAARC countries. So among SAARC countries India and among non SAARC countries China is strategically important.

Afghanistan

Afghan people have almost no access to modern forms of energy. More than 80% of the population live in rural areas and depend on traditional fuels (fuel wood and crop residues) for cooking, heating water and kerosene for lighting. Afghanistan has complete planning of Power or Energy system master plan prepared with help of International experts and was supposed to attain sufficient progress in this sector, but the war has jeopardized all the progress. The energy network in Afghanistan is made up of nine isolated systems, which deliver electricity to only about a quarter of Afghan households, according to the World Bank. Even though access to electricity has improved in ‘cities and towns’, access in rural areas is very limited; some estimates put it at 7% of the total Afghanistan population. Addressing rural energy needs and expanding access to commercial supplies of energy is a massive task, requiring a long-term commitment of resources, both financial and institutional and a coordinated approach to addressing this issue through regional and local organizations. Afghanistan has got complete detailed planning for its both Urban and Rural electrification. Only its implementation is required. The fragile political situation is a barrier not only to its economic development but also to rural electrification which is affecting the whole nation.

Bangladesh

Bangladesh case was quite different. A country over populated on a small piece of land, i.e.

having a population of 157.512 million on 147,570sqkm of land with most people living below poverty level. Food security was a continuous problem together with fragile urban electric infrastructure. How to give electricity to the rural people when urban electrification was a real problem? There came the concept of Consumer owned rural electric cooperative based on US and Philippine system. This brought a real positive result as the system was run by efficient management and there was no significant political interference. It use to run on "No Loss no profit basis". The burning challenge of rural electrification was the Losses. The State owned Utilities had system loss as high as 40%. The rural electric cooperatives had a system loss around 14% and Bill collection was almost 100% against urban Bill collection around 80%. This proved that rural people are law abiding. They utilized electricity for irrigation, education, additional income, recreation and for overall community development. Today Bangladesh has attained food security along with sound economic activities. The only problem it faces is shortage of expertise. Because of massive employment generation in Telecommunication and urban utilities these rural electric experts are switching their jobs making the urban loss utilities a profitable organization. The Bangladesh model is worth following with modifications as per respective country's requirement. Bangladesh can be Center of excellence for Rural electrification.

Bhutan

Energy in Bhutan has been a primary focus of development in the Kingdom under its Five-Year Plans. In cooperation with India, Bhutan has undertaken several hydroelectric projects whose output is traded between the countries. Bhutan Power Corporation (BPC) was entrusted with a mandate to provide electricity for all by 2013 in the 10th Five Year Plan (FYP) with a total of 40,257 households to be electrified through on-grid supply scheme. Despite best efforts, BPC could fulfill only 94% of the targets due to major challenges faced during the implementation of the rural electrification works. This still is a very good statistic to have especially compared to other SAARC countries. This data was collected from the Bhutan Power Corporation Limited Annual Report of 2013, and currently, work is still being done to electrify the remaining 6%.

Maldives

The need of energy in Maldives is fulfilled by importing fossil fuels due to its lack of access to the conventional energy sources. The institutional framework for the energy sector of the country compromises of government institutions, lead agency, regulatory bodies, local governance system, private sector, legal division, international partner organization and bilateral partners who's examples and roles are stated in this report. Several policies are recommended for successful implementations of rural electrification policies in Maldives such as promoting energy conservation and security, increasing national energy security, etc. Additional policies for strengthening the institutional and legal framework of the energy sector are also stated such as adaptation of an appropriate pricing policy for the energy sector, enhancing the quality of energy services, etc. Last but not the least, numerous strategies for all the mentioned policies are mentioned in the report.

India

India is the only SAARC country which neighbours 4 (four) SAARC countries. So it has vital importance in energy and other sectors of SAARC Countries. The very dream of SAARC

electric grid ring is mostly advocated by India which is essential for energy balancing and harmony in the SAARC region.

As a part of the efforts of Government of India to achieve the goal "Electricity for All", rural electrification was identified as a major thrust area. A plan for rural electrification – The Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) – has been launched to extend rural electricity services to hitherto un-electrified areas in the year 2005.

With the largest rural population in the world, India is facing a huge electrification challenge. Today, 64.5% of India is electrified, with an electrification rate of 93.1% in urban settings but only 52.5% in rural areas. This has been achieved mainly through grid extension or small-scale renewable energy systems. But India is currently faced with insufficient electricity generating capacity, which is seriously hindering the implementation of future rural electrification programmes and undermining their viability. Over the past few years, many restructuring policy reforms have been initiated in power sector but key challenges are yet to be addressed. Some of the constraints faced by the sector are growing demand at rapid rate, losses borne by ailing power distribution companies, accessibility of quality and affordable power. However, they are progressing at a decent rate to have 100% rural electrification.

Nepal

In Nepal, only 15% of the population has access to electricity. The energy technology of Micro Hydro power plant program implemented in Nepal is discussed along with its highlights and benefits. The current rural electrification program in Nepal includes Nepal Energy Efficiency Program, Electric Cooperative and Community Rural Electrification Program and its rural electrification via Grid Extension, all of which are described in this report. Due to reasons such as high distribution losses, the high investment and low return in rural electrification in Nepal, poor revenue collection in rural sectors, etc. it is recommended to implement electric cooperatives for successful implementations of rural electrification policies. A three phase electric model is also proposed. In the end emphasis is given on Energy Efficiency, suggested strategies and policies and its implementation in households and industries.

Pakistan

Pakistan is rich in energy and mineral resources like coal, gas etc., but mostly untapped due to many reasons. Then there was management problem in electric utilities. There is some crisis regarding electricity in Pakistan: the deficit exceeds 6000 MW. Pakistan has a good number of IPPs but Government could not make payment to them as a result it further aggravated the situation. The government recently came up with two policy decisions to decrease the gap: pay half a trillion rupees (just under $5 billion) to energy companies, and announce a new power policy of a tariff hike. Both steps were aimed at resolving problems plaguing the companies belonging to the energy chain, to optimize the average cost of electricity generation. The lack of electricity in urban areas means that emphasis is being put on the rural areas.

Pakistan is giving emphasis to off grid electricity and renewable. However, the Government of Pakistan (GoP) has planned to electrify some 7,000 remote villages (to serve around 10 million citizens) in Pakistan, mostly through the Alternative Energy Development Board (AEDB) using off-grid renewable energy technologies. It is unlikely to be economic to serve these remote communities through expanding the national electricity network in the coming decades. 7876 of un-electrified villages in Pakistan cannot be connected to the national grid for another

20 years due to their distance from the national grid, which rendered these villages technically and economically unavailable. But in the rural areas, there have been solar panels, and in some areas hydro power stations set up that have given access to a small percentage of the total population. However, a lot more steps need to be taken, as explained later, to make Pakistan have access to electricity in all areas.

Sri Lanka

Electricity generation in Sri Lanka is primarily run by hydro power and thermal heat, with sources such as photovoltaic and wind power in early stages of deployment. It has attained sufficient generation and is almost load crises free The Sri Lankan government has formulated many policies and laid stress on rapid and effective implementation of different Rural Electrification projects. Many rural electrification schemes have been completed up to year 2007 electrifying 79% of the total households in the island with funds received from various lending agencies. The primary energy contributions in 2009 to national energy supply were 51% from biomass, 44.8% from crude oil and petroleum products, and 3.6% from hydroelectricity and other renewable sources. The use of non-conventional energy resources, (small-scale hydropower, biomass, biogas and waste, solar power and wind power) in Sri Lanka is of a relatively smaller scale (<1%) and therefore its contribution is presently of low significance in the macro energy picture.

The potentialities and resources of SAARC member countries are enormous. Utilizing their resources forgetting the boundaries will make this region and its people economically happy, energy secured etc. That is why SAARC Grid ring is being developed.

If Europe can be without boundaries and with single currency then why cannot we, the SAARC members do it?

Some of the basic suggestions for attaining sustainability in electrical sector and rural electrification are:

a. **Political stability**. Keep energy outside Country politics.
b. Accuracy of data for better planning of rural electrification.
c. Proper master plan both for off grid and grid connected areas for whole Country including long term Generation – Transmission – Distribution system.
d. Sufficient tariff with minimum technical and non-technical losses.
e. In financial analysis of rural electrification, overall economic gains to be considered and not only the electricity sector.
f. For financial stability revenue criteria should be followed.
g. For renewable one time subsidy may be given, but it should be implemented in business model. This will make it sustainable as done in Bangladesh.
h. Energy conservation and efficiency to be simultaneously given maximum priority.
i. For renewable Net metering and Fit may be encouraged.
j. Involve rural people in development of rural electrification.
k. Minimum political pressure on the program.
l. Go for procurement of good quality items even if it costs more.
m. Success model of neighbouring countries may be followed.
n. Keep qualified Staff with proper remuneration.

5. Acronyms

AA	Allocation Agreement
AD	Accelerated Depreciation
AEDB	Alternate Energy Development Board
AGM	Annual General Meeting
AKRSP	Agha Khan Rural Support Programme
ASEAN	Association of Southeast Asian Nations
ARTF	Afghanistan Reconstruction Trust Fund
BEA	Bhutan Electricity Authority
BERC	Bangladesh Energy Regulatory Commission
BHPC	Basochu Hydro Power Company
BOO	Build, Own and Operate
BOOT	Build, Own, Operate & Transfer
BOT	Build, Operate and Transfer
BPC	Bhutan Power Corporation
BPDB	Bangladesh Power Development Board (earlier it was PDB)
BREB	Bangladesh Rural Electrification Board (earlier it was REB)
CA	Concession Agreement
CCS	Clean Cook Stoves
CDC	Community Development Council
CDM	Clean Development Mechanism
CEA	Central Electricity Authority (of India)
CEA	Certified Energy Auditor
CEB	Ceylon Electricity Authority (of Sri Lanka)
CER	Certified Emission Reduction
CERC	Central Electricity Regulatory Commission (of India)
CFL	Compact Fluorescent Lamp
COD	Commercial Operation Date
CRED	Community Rural Electrification Department
CREE	Community Rural Electrification Entities
CREP	Community Rural Electrification Programme (of Nepal)
CSI	Cottage and Small Industries
DABM	Da Afghanistan BreshnaMossasa
DABS	Da Afghanistan BreshnaSherkat
DDG	Decentralized Distributed Generation
DESA	Dhaka Electric Supply Authority
DESCO	Dhaka Electric Supply Company (of Bangladesh)
DfID	Department for International Development (of UK)
DOE-EIA	Department of Energy- Energy Information Agency (of US)
DGPC	Druk Green Power Corporation (of Bhutan)
DPP	Detailed Project Proposal
DRE	Department of Renewable Energy
DPP	Detailed Project Proposal
DPR	Detailed Project Report
DTW	Deep Tube Well
EBRD	European Bank for Reconstruction and Development
ECO	Energy Cooperation Organization
EDP	Economic Development Policy

EEST	Energy Efficiency Strategy
EIA	Environmental Impact Assessment
EMP	Environment Management Plan
EoI	Expression of Interest
ERCA	Energy Regulatory Commission Act
ETFC	Electricity Tariff Fixation Commission (of Nepal)
EU	European Union
FDI	Foreign Direct Investment
FiT	Feed in Tariff
FYP	Five Year Planning
GAIL	Gas Authority of India Limited
GBI	Generation Based Incentive
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Green House Gas
GNHC	Gross National Happiness
GNHC	Gross National Happiness Commission
GOA	Government of Afghanistan
GOB	Government of Bangladesh
GOI	Government of India
GOP	Government of Pakistan
GOSL	Government of Sri Lanka
GSA	Gas Supply Agreement
GTCC	Gas Turbine Combined Cycle
GVEP	Global Village Development Programme
HPDP	Hydro Power Development Policy (of Nepal)
HYV	High Yielding Variety (mainly crops)
ICE	Inter Ministerial Commission for Energy
ICS	Improved Cook Stoves
IDA	International Development Association
IA	Implementation Agreement
ICB	International Competitive Bidding
IDB	Islamic Development Bank
IDCOL	Infrastructure Development Company Limited (of Bangladesh)
IFI	International Finance Institutions
IGA	Income Generating Activities
IPI	Iran – Pakistan - India (gas pipeline)
IPP	Independent Power Producer
IRA	Islamic Republic of Afghanistan (or IROA)
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KESC	Karachi Electricity Supply Corporation (of Pakistan)
KHPC	Kurichu Hydro Power Company (of Pakistan)
kV	Kilo Volt
kW	Kilo Watt
LDC	Least Developed Country
LECO	Lanka Electricity Company (of Sri Lanka)
LED	Light Emitting Diode
LLA	Land Lease Agreement
LLP	Low Lift Pump
LNG	Liquefied Natural Gas

LoI	Letter of Intent
MDG	Millennium Development Goal
MEW	Ministry of Energy and Water (Afghanistan)
MEP&MR	Ministry of Energy Power & Mineral Resources
MoAF	Ministry of Agriculture & Forest
MoEA	Ministry of Economic Affairs
MoF	Ministry of Finance
MoIC	Ministry of Information and Communication
MoU	Memorandum of Understanding
MOP	Ministry of Power (of India)
MRRD	Ministry of Rural Reconstruction and Development
MTI	Ministry of Trade and Industry (of Bhutan)
MVA	Mega Volt Ampere
MW	Mega Watt (=1000kW)
NEA	Nepal Electricity Authority
NEC	National Environment Commission
NEPRA	National Electric Power Regulatory authority
NEPS	The North East Power System (of Afghanistan)
NERA	National Economics Research Associates (of the US)
NES	National Energy Strategy
NGO	Non-Governmental Organization
NRECA	National Rural electric Cooperatives Association
NURC	National Regulation Utility Commission (of Afghanistan)
NWFP	North West Frontier Province (of Pakistan)
O&M	Operation and Maintenance
PCRET	Pakistan Council for Renewable Energy Technology
PDA	Project Development Agreement
PPIB	Private Power & Infrastructure Board
PPA	Private Party Agreement
NTPC	National Thermal Power Corporation (of India)
NEPRA	National Electric Power Regulatory Authority (of Pakistan)
PDA	Project Development Authority
PFC	Power Finance Corporation (of India)
PGCB	Power Grid Company of Bangladesh
PGCI	Power Grid Corporation of India
PPA	Power Purchase Agreement
PSMP	Power System Master Plan (of Bhutan)
PTA	Power Trading Agreement (between India and Nepal)
PTC	Power Trading Corporation of India since renamed as PTC Limited
RE	Renewable Energy
REC	Rural Electrification Corporation (of India)
REDB	Renewable Energy Distribution Backbone
REDCO	Regional Electricity Distribution Company/ies
REDF	Renewable Energy Development Fund
REMP	Rural Electrification Master Plan (of Bhutan)
REO	Renewable Energy Obligation
RER	Renewable Energy Resources
RERED	Rural Electrification & Renewable Energy Development Program (Bangladesh)
RETs	Renewable Energy Technologies

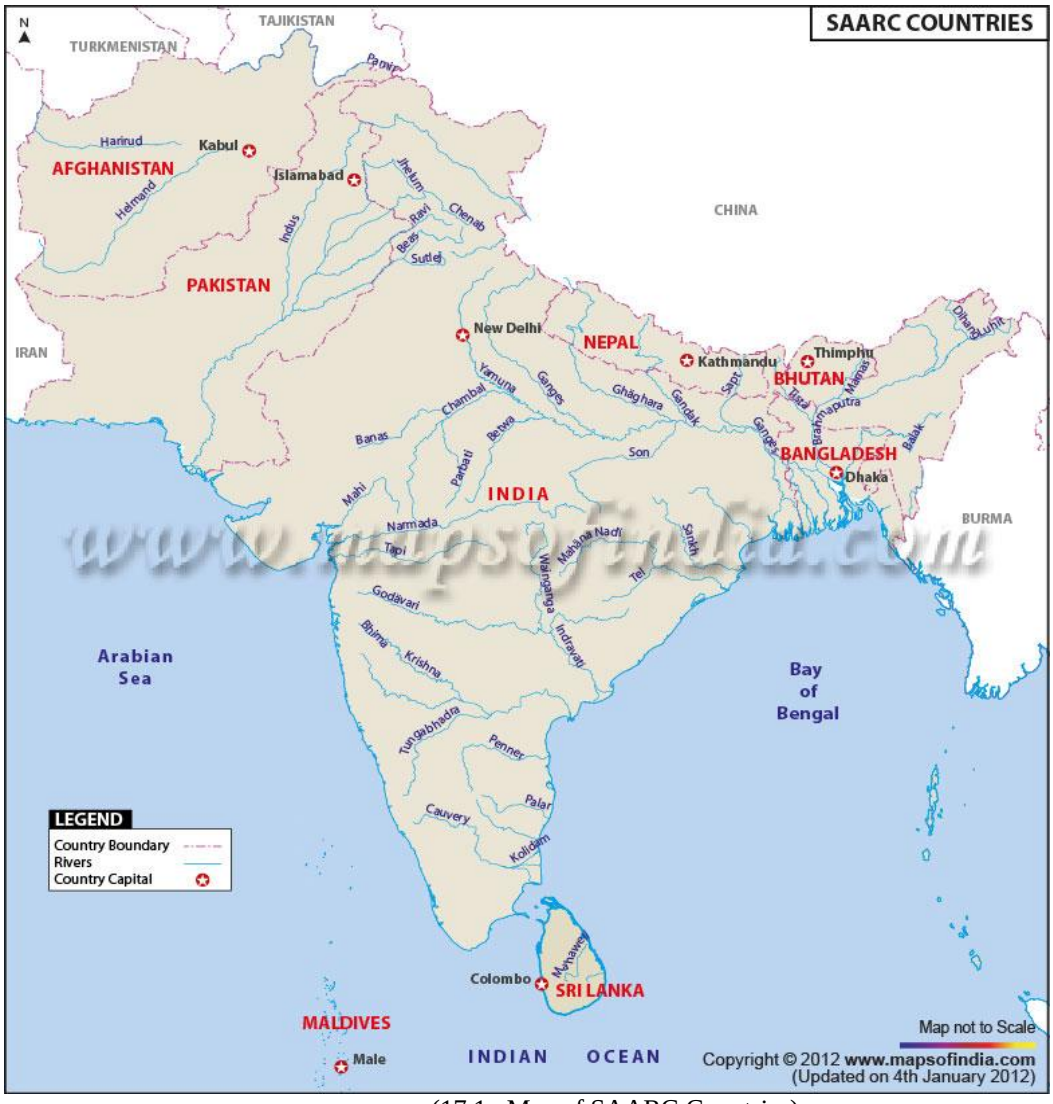
RfP	Request for Proposal
RGoB	Royal Government of Bhutan
RLED	Rural Livelihoods and Energy Development
RoC	Registrar of Companies
ROR	Run-of-River
RPO	Renewable Purchase Obligation
RVE	Remote village Electrification
SAARC	South Asia Association for Regional Cooperation
SARI	South Asia Regional Initiative (of the USAID)
SEB	State Electricity Boards (of India)
SEPS	South Electrical Power System (of Afghanistan)
SERC	State Electricity Regulatory Commission (of India)
SHP	Small Hydropower Projects
SHS	Solar Home System
SPP	Small Power Produce
SPV	Solar Photo Voltaic Panel
SPV	Special Purpose Vehicle
SREDA	Sustainable and Renewable Energy Development Authority (of Bangladesh)
STW	Shallow Tube Well
TAP	Turkmenistan - Afghanistan - Pakistan (gas pipeline)
T&D	Transmission & Distribution
TSC	Technical Specification Committee
TWh	Tera Watt Hour
UCTE	Union for the Co-ordination of Transmission of Electricity
UDA	Urban Development Authority
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
VEI	Village Electrification Infrastructure
WAPDA	Water and Power Development Authority (of Pakistan)
WTE	Waste to Energy

6. Comparative Study on Rural Electrification Policies in SAARC Countries

Electricity is required 24 hours a day and 365 (or 365.25) days a year with quality. Our dependence on it for economic development, food security, attaining MDG, social requirement is no more questionable. All citizen of any country have equal right. Then why this rural electrification a separate issue? Whatever is the case or cost, rural citizen have equal right to have access to electricity. Today all SAARC countries have realized and giving almost equal importance to rural electrification.

SAARC Countries initially constituted of 7 (seven) Countries i.e. Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. Though some of the member Countries had differences but with time they started to look after economic interests. Then Afghanistan was joined SAARC making it an association of 8 Countries.

The approximate population of these 8 Countries more than 1693.54million and total area is approximately 5,143,437 sq. km.



(17.1 Map of SAARC Countries)

(Ref. http://www.mapsofindia.com/maps-of-asia/saarc-country-map.html)

Energy and especially rural energy is the main source of today's development of the world. Mainly we understand rural electrification from rural energy. Though it is not directly included in the MDG, but many of the MDG targets directly depends on energy use. Now the MDG revision is going on and Energy is in the priority list. If it is included then it automatically gets priority not only for SAARC countries but for the whole world. Experts very much feel that energy usage should have been a parameter of MDG. A Country's energy usage is a parameter of its economy, development, living standard, GDP etc. The SAARC Countries i.e. Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal and Sri Lanka had tremendous energy shortage though rich in mineral/energy resources with huge population. This made them behind the race of development. Again lack of expertise was a main reason. Though these Countries produced scholars, scientists, engineer etc. but they moved to Middle East and other developed Countries for better opportunities.

6.1 World over-view on electricity access

Region	**Approx. Population without electricity** (million)	**Electrification rate** %	**Urban electrification rate** %	**Rural electrification rate** %
Africa	587	41.8	68.8	25.0
North Africa	*2*	*99.0*	*99.6*	*98.4*
Sub-Saharan Africa	*585*	*30.5*	*59.9*	*14.2*
Developing Asia	675	81.0	94.0	73.2
China & East Asia	*182*	*90.8*	*96.4*	*86.4*
South Asia	*493*	*68.5*	*89.5*	*59.9*
Latin America	31	93.2	98.8	73.6
Middle East	21	89.0	98.5	71.8
Developing countries	**1,314**	**74.7**	**90.6**	**3.2**
World*	**1,317**	**80.5**	**93.7**	**68.0**

(IEA 2011)

(16.3 Region wise electrification data)

In South Asia, some 50% of the total population lack access to electricity. About 80% of those without access to electricity in South Asia live in rural areas. Though South Asian countries have worked to improve access to electricity services, but still access to electricity across the countries is low and ranges from roughly 30% in Afghanistan to over 90% in Sri Lanka. Today, 64.5% of India is electrified, with an electrification rate of 93.1% in urban settings but

only 52.5% in rural areas (IEA, 2009). This has been achieved mainly through grid extension or small-scale renewable energy systems. Strong political will and sufficient funds have accelerated the speed of electrification. Lack of access to electricity is not limited to India. In Bangladesh 37% of the population does not have access to electricity; in Pakistan, the number is 38%; and in Nepal 56% is without power.

The main objective of this study program is to provide keys to successful implementation of rural electrification policies in SAARC Member States. This study will be focusing exclusively on rural electrification policies of the Member States.

The success stories, the socio-economic gains due to rural electrification, impact on GDP together with failures, reasons for failure and suggestions for its remedy. These examples and lessons for SAARC countries will be actually helpful for uplift of this SAARC region.

Important is cost of providing reliable, quality electricity vs. economic cost of not of not providing electricity, initial cost and its recovery and how to minimize load shedding?

- Subsidy, cross subsidy, its analysis and justification.
- Political commitment and its impact (often important in some of SAARC countries).
- Economical and cost effective new technologies and its implementation.
- Availability and development of specialists/experts to run successful rural electrification with scope of inter country or regional long term skill development.

Ultimate aim is to bring massive economic improvement through rural electrification in SAARC region (let politics is kept out of rural people economy improvement).

6.2 Why Rural electrification program?

The goal of rural electrification programs in developing countries goes beyond providing rural households affordable modern energy at a cheaper price than inferior alternatives over the long run. Rural electrification is expected to improve rural people's quality of life and spur growth on a range of socioeconomic fronts. Various examples can be given to substantiate such expectations

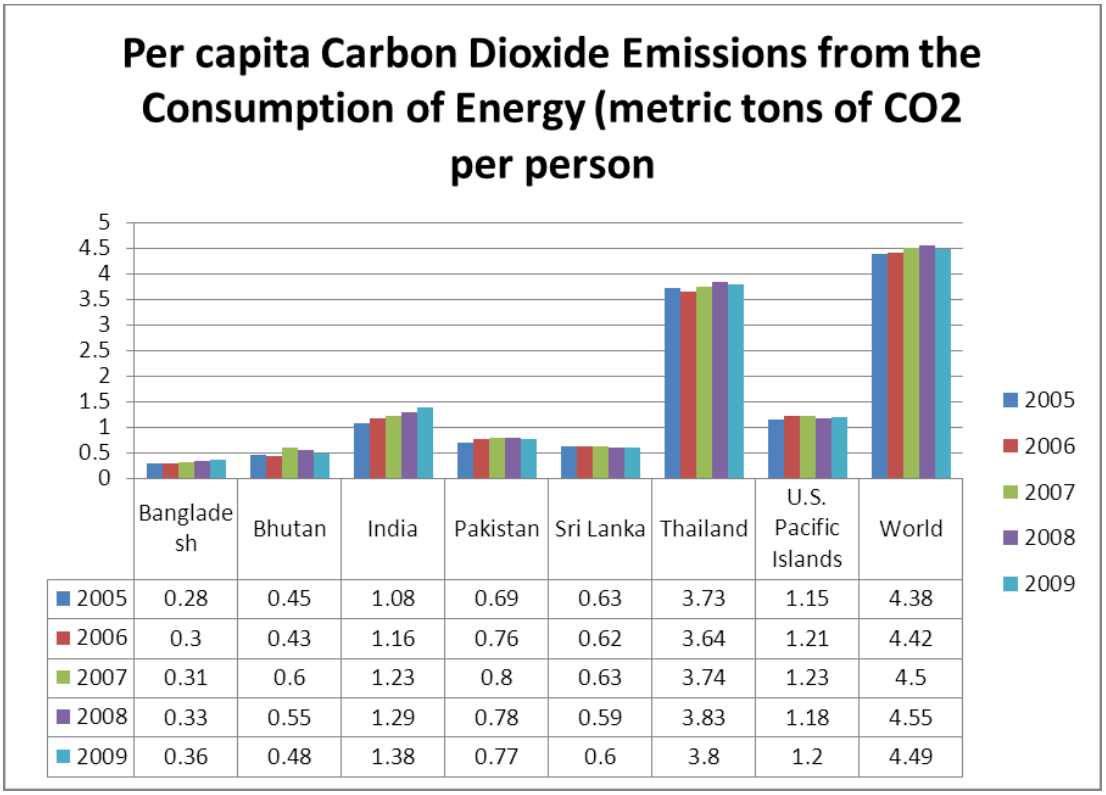
Viable and reliable electricity services result in increased productivity in:

a) Agriculture and labour.
b) Improvement in the delivery of health and education.
c) Access to communications (Internet, telephone, television, mobile telephone etc.).
d) Improved lighting and comfort.
e) Facilitating the use of time and energy-saving equipments, motors, and pumps etc.
f) Increasing public safety through outdoor lighting.
g) Electricity based Industries.

6.3 Carbon emission

Rich and developed Countries are mainly responsible for Carbon emission because of their massive development and energy use, whereas the poor developing countries are to take liability and work for its solution. That is these Poor countries are made work fight against global warming whereas they are not at all responsible for this global disaster. Below is given per capita Carbon dioxide emission of 5 SAARC Countries together with Thailand, US Pacific

Island and the World standard. Even the highest Carbon dioxide producer SAARC Countries i.e. India is far less than that of World standard. But still SAARC Countries are taking all possible efforts to minimize losses especially in rural electrification and also minimize global warming.



	Bangladesh	Bhutan	India	Pakistan	Sri Lanka	Thailand	U.S. Pacific Islands	World
2005	0.28	0.45	1.08	0.69	0.63	3.73	1.15	4.38
2006	0.3	0.43	1.16	0.76	0.62	3.64	1.21	4.42
2007	0.31	0.6	1.23	0.8	0.63	3.74	1.23	4.5
2008	0.33	0.55	1.29	0.78	0.59	3.83	1.18	4.55
2009	0.36	0.48	1.38	0.77	0.6	3.8	1.2	4.49

(# 18.1 - Per capita Carbon dioxide consumption of some SAARC/Non SAARC countries)

Each SAARC Country has its own complexity on energy issues. Some are almost energy secured, others are running after ever increasing demand for energy and there is another category which is striving very hard to achieve energy security. The biggest problem is energy demand increase in geometric rate whereas fossil fuel reserve is depleting fast, GHG emission and renewable is still expensive.

Another problem is subsidized electricity by the State often for economic or political reason. Stable political and peaceful environment is another challenge in the region.

6.4 SAARC Achievement in Electricity – Regional Power Grid

Of the many achievements of SAARC, a significant accomplishment is inter-country electricity trading and work for Regional Power Grid. Some of the SAARC Countries gave priority to rural development especially rural electrification to attain energy and food security. Again this area of Asia is very much populated and has many political and other problems. Each SAARC

Country has its own way of attaining rural electrification. A feat of SAARC countries is inter country electricity trade like Bangladesh importing electricity from India, electricity trade between Bhutan, India, Nepal etc., Afghanistan importing electricity from neighbouring Countries etc. SAARC Countries are ahead of ASEAN Countries in this aspect.

A SAARC framework agreement for energy cooperation, pending since the past 4 years, was finalized at last after Energy Ministers of SAARC countries met in New Delhi in October

2014. The agreement, which will facilitate development of a SAARC Market of Electricity (SAME), now awaits ratification by the respective governments.

The meetings were chaired by power, coal, new and renewable energy minister who said that discussions over development of a SAARC power grid had also been held, the specifics of which still remained to be worked out.

"No financial figures or technical specifications regarding the grid have been arrived at so far but we will begin work towards this soon. We realize the urgent need for it since economic sustainability of SAARC region is pillared on its energy security. 30 per cent of the region's energy demands are met through imports and the household per capita consumption of electricity within SAARC is mere 128 units versus global average of 3,045 units," Goyal said.

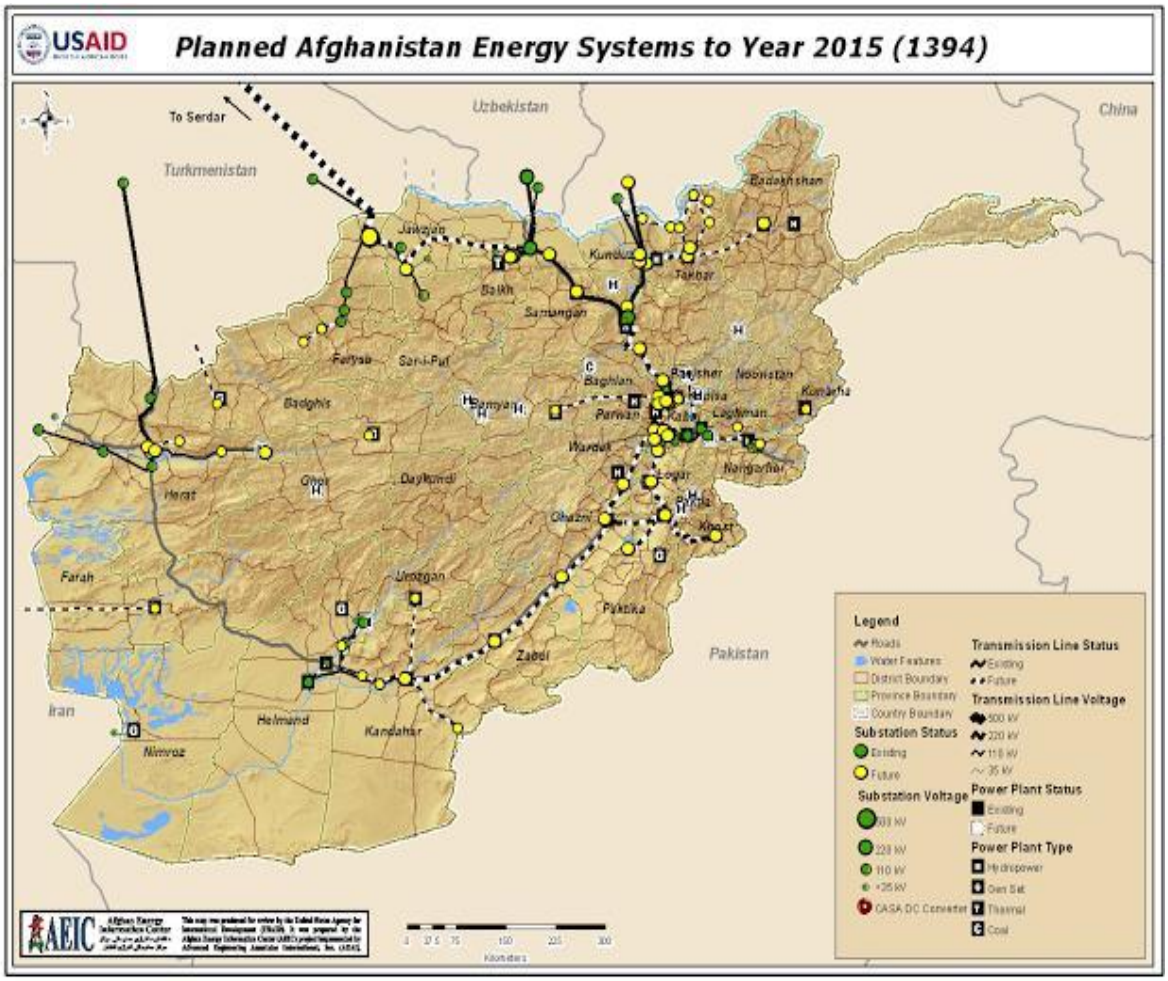
This was the fifth meeting of the energy ministers held after a gap of three years, and will be followed up by a meeting of various energy regulators from the region in Bangladesh later in December this year.

Currently, India is importing around 1,500 MW from Bhutan while exporting around 500 MW to Bangladesh and 150 MW to Nepal, in addition to a slew of projects waiting to be constructed or finalized with these countries.

A plan to construct an ultra-high voltage underwater HVDC line all the way to Sri Lanka is also in the pipeline. India has also offered to set up a training programme for power professionals in the region. Pakistan, however, was absent from the conference and had not responded to the invitation from the SAARC secretary general.
(http://indianexpress.com/article/business/saarc-calls-for-regional-power-grid/)

All eight SAARC countries rural electrification policies, state and other details are given Country wise in alphabetical order.

7. Rural Electrification in Afghanistan



(#17.2 Map of Afghanistan)

Rural Electrification in Afghanistan

7.1 Introduction & country background

Afghanistan is bordered by Tajikistan, Turkmenistan, and Uzbekistan to the north, Iran in west, Pakistan in east and south and it has a small stretch of border in north east with both China and India (disputed because in Pakistan occupied Kashmir). *Only SAARC Country Pakistan is a neighbouring county of Afghanistan. Its capital is Kabul.*
As per Brookings Afghanistan Index 0f June' 2014 (http://www.brookings.edu/about/programs/foreign-policy/afghanistan-index) and other statistics, Afghanistan's statistics are given below:

a.	Area	-	652,225 sq. km
b.	Population	-	32.7million
c.	Male population	-	16.8 million (51%)
d.	Female population	-	15.9million (49%)
e.	Rural population	-	22.53 million
f.	Annual inflation in 2013	-	07.40 % (Anticipated 2014 6.80%)
g.	GDP in 2013	-	3.30% (Anticipated in 2014 3.50%)
h.	Total electricity capacity	-	1,200 MW (approximate)
i.	Access to electricity	-	30%
j.	Reliable electricity access	-	20% (approximate in 2013)
k.	Total Connections	-	818,290 (March 2012)
l.	Approx. Domestic Consumers	-	731,970 (March 2012)

Afghan people had almost no access to modern forms of energy, such as electricity, gas, and liquid fuels. Traditional fuels meet more than 85% of energy needs, while commercial energy sources, such as oil, gas, coal, and hydropower, meet the remaining requirements. Fuel wood accounts for about 75% of total energy supplies.

More than 80% of the population live in rural areas and depend on traditional fuels (fuel wood and crop residues) for cooking, heating water and kerosene for lighting. This is having an adverse impact on forests and watersheds. In addition, burning these fuels increases indoor air pollution, which adversely affects the health of women and children in particular. Rural electrification is the only way that the majority of the rural populace can move toward attaining energy security and enhancing social well-being.

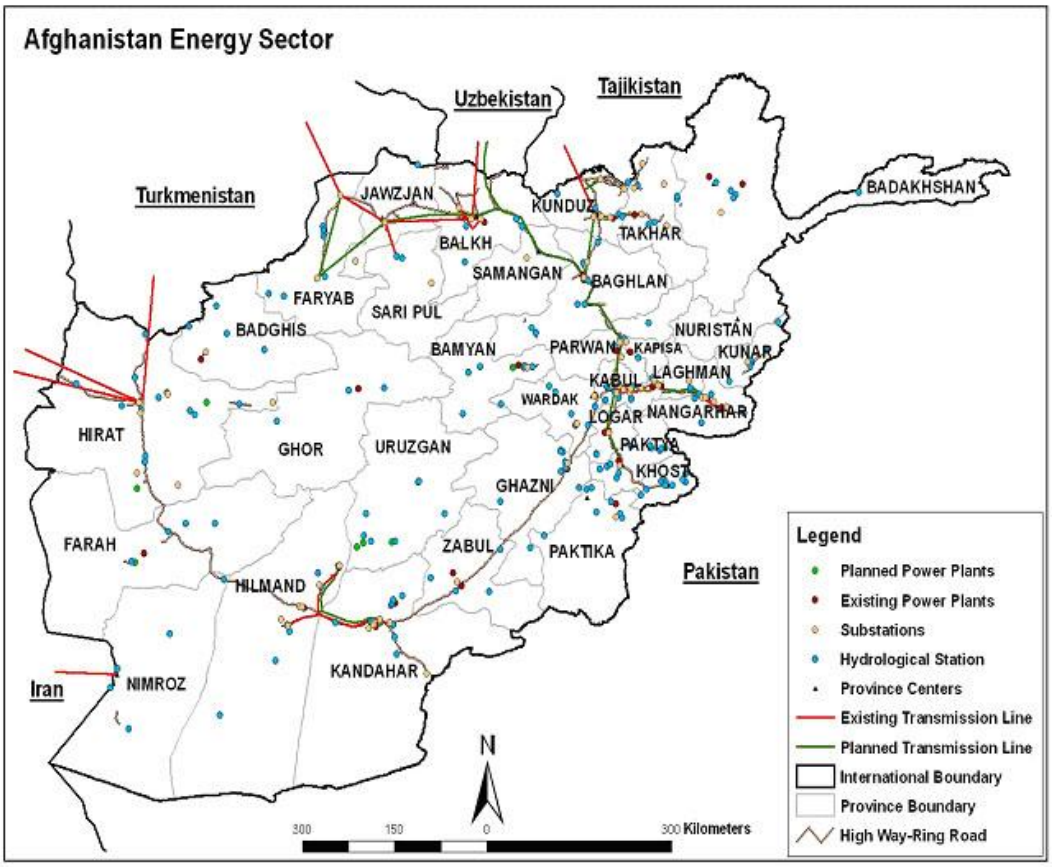
Afghanistan has complete planning of Power or Energy system master plan prepared with help of International experts and was supposed to attain sufficient progress in this sector, but the war has jeopardized all the progress. It has all the wealth and mineral resources to achieve sustainability in energy sector only lack of leadership and understanding.

7.2 Economy vs. Poverty

Though Afghanistan is very rich in mineral resources but due to its non-exploration and other political and domestic problems extreme poverty in rural areas exists partially due to the lack of income earning opportunities. The productive use of electricity would help reduce poverty by enabling alternative sources of livelihoods. At present, the Afghan power infrastructure consists primarily of three isolated power systems. Electricity networks are located around major urban centers. The remoteness of rural locations and the country's topography would make it difficult to expand the electricity supply in these areas through a centralized grid system, and such an expansion might not be economically feasible. Therefore, an exploration

of renewable, sustainable energy sources that can be maintained in decentralized approach, and that the poor can afford, is urgently needed. The Government's programme for environmental preservation and regeneration envisages promoting renewable energy in the private sector. This approach of increasing the use of renewable and more efficient energy resources would result in less reliance on unconventional sources of energy, such as coal, oil, kerosene and gas. (1http://www.eia.doe.gov/cabs/Afghanistan/Background.html 2http://news.bbc.co.uk/2/shared/spl/hi/pop_ups/05/south_asia_snow_engulfs_central_afghanistan/html/4.stm)

Poverty in the province of Ghor is extreme. There is no electricity, no running water, and no sewage system.



(#17.3 Afghanistan energy map)

Deforestation:
Deforestation and overgrazing have contributed to serious soil erosion. (http://www.adb.org/Documents/TARs/AFG/tar-afg-38044.pdf). Up to 8 million people face severe food shortages. Again continuous military and counter actions on it have been a great obstacle on stability which hampered smooth rural electrification development and poverty alleviation. Ultimately Afghan people common people are the looser though they are a very brave nation with glorious history since British regime prior to 1947.

As per UN Development Index rank Afghanistan**169 out of 174poorest countries in the world**. Firewood costs $0.08 per kilogram in Kabul and $10 a donkey-load in Faizabad. Kerosene costs $0.39 per liter. It is estimated that the average family burns four to seven kilograms of firewood daily for cooking. In this case, they will spend $10 to $17 a month on fuel. This is a heavy burden for many who earn $30 a month (a teacher's salary) and for many

who are unemployed. However, the country enjoys a sunny climate, so conditions for using solar energy for cooking food and boiling water are quite ideal. Afghanistan averages 300 solar cooking days a year. Even in the winter months, many days have clear skies and solar cooking can be used. In addition to saving money, solar cookers reduce the amount of smoke in the women's eyes and lungs. Air pollution and respiratory problems are reduced whenever solar cookers are used in place of wood or fossil fuels.

The solar cooker consists of a parabolic reflector, in which a cooking pot device is situated for heating various dishes. By focusing the sunbeams, the meal or cooking foods can be heated to high temperatures. For this reason, the solar cooker is suitable for baking, roasting, deep frying, and sterilizing.6

Another item to be specially patronized in Afghan rural masses is Clean Cook Stoves or Improved Cook Stoves (CCS or ICS). This will save at least 50% of their firewood and medical problem of women and children due to excessive smoke will be greatly minimized. But who will teach or make them aware of this new technology?

7.3 The Drug Trade

Necessity knows no laws. And most of the Afghans are below poverty. Again Afghanistan is a very proper place for Drugs cultivation. As much as one-third of Afghanistan's GDP comes from growing poppy and illicit drugs including opium and its two derivatives, morphine and heroin, as well as from hashish production. But why they have adopted to this killer item? Because they have International Buyers who are willing to pay a very high price and time period is less.

5http://solarcooking.org/newsletters/scrnov04.htm#Pilot_project_in_Afghanistan
6http://www.afghan-solar.com/e/products/solar_cooker.html
7 http://www.solarnavigator.net/geography/afghanistan.htm

Unfortunately Afghanistan's top business is the drug trade. The World Bank and Great Britain argue in report that this illicit business can only be combated if impoverished farmers have other means of making a living. When agricultural productivity declined or was monopolized by certain warlords; the cultivation of opium became another cheap and accessible alternative for the poor farmers. That was mainly encouraged by the growing international drug market. This resulted in further degradation of Afghanistan's environment.

Note. But International Buyers are to be barred to get access to this illicit product which is very much possible if Developed Countries gives priority to it.

"**Electricity is in serious shortage all over Afghanistan, in particular in the remote rural areas**."
8http://www.iht.com/articles/ap/2008/02/05/asia/AS-GEN-Japan-Afghan-Opium.php
9 http://dark-wraith.com/index.php?itemid=43
10http://www.mindfully.org/Energy/2004/Afghanistan-Geothermal-Energy1feb04.htm

7.4 Review of institutional structures for rural electrification

The energy network in Afghanistan is made up of nine isolated systems, which deliver electricity to only about a quarter of Afghan households, according to the World Bank. This percentage varies widely from 0% in rural areas to as high as 90% in urban areas. Increasing

Afghanistan's energy supply and expanding the energy grid to underserved areas is a national priority. Without low-cost, reliable grid power, population centers either go without power or rely on limited amounts of high-cost and unsustainable diesel-generated power. Afghanistan's

current energy supply consists of 77% imported power, 21% hydro power and 2% diesel generated power. Afghanistan Energy Infrastructure, generation, transmission and distribution were almost destroyed over the past three decades due to the war and conflict. The government of Afghanistan corporatized the National electricity service department Da Afghanistan BreshnaMossasa (DABM) into an independent state owned utility. As such, all assets, staff and other Rights and Obligations of DABM were transferred to Da Afghanistan BreshnaSherkat (DABS) on May 2008.
DABS, according to their website, provide safe and reliable power and reasonable rates to facilitate national economic growth with integrity, transparency and efficiency. The responsibilities and duties of DABS are maintenance, expansion, renovation and accurate management process of electricity and also distribution and revenue collection of it all across Afghanistan.

Many donors are contributing to Afghanistan's energy sector, including USAID, the U.S. Department of Defense, the Asian Development Bank (ADB) and the World Bank. The results of those efforts are starting to build. Afghanistan is having electricity from neighbouring countries which is often not found in many Asian countries. For example, prior to 2009, a limited number of households in Kabul were receiving power for about four hours every other day with frequent outages. In 2009, ADB completed a 220-kV transmission line that initially delivered 125 megawatts of power from Uzbekistan (inter country trade). Although this did not meet Kabul's full electricity demands, it did usher in a wave of strong economic growth. That received a boost in 2012 when a USAID project more than doubled the transmission line's power, providing energy to residences and commercial establishments 24 hours a day. This has led to increased sales of electrical appliances, longer work hours at commercial establishments, and extended class times in schools.

In 2002, only 6% of Afghans had access to reliable electricity. Today, 18% do, including more than 2 million people in Kabul who now benefit from electric power supply almost24 hours a day. In addition to building hydroelectric and solar facilities, the Afghan national power company, DABS, with the help of the donors, has taken significant steps to become fully self-sustaining. DABS collected $220 million from the sale of electricity in 2012, an increase of 67% from 2010.

Afghanistan generates around 600 megawatts (MW) of electricity mainly from hydropower followed by fossil fuel and solar. Officials from DABS estimate that the country will need around 3,000 MW to meet its needs by 2020. The Afghan National Development Strategy has identified alternative energy, such as wind and solar energy, as a high value power source to develop. Alternative energy projects are already being tested across the country, from wind turbines in Panjshir Province to micro hydro dams in Badakhshan, to family-size biogas digesters throughout the country.

7.5 Analysis of the current rural electrification programmes and objectives

Polity, politics, policy
The stakeholders of the sub-sector of rural electrification are mapped according to their functions as political decision makers, central public agencies, 'front line agencies' that

actually deliver services, control agencies and civil society pressure groups. The institutions marked in grey have not yet been established.

Foreign Major Donor Assistance Projects
Many foreign Donors are helping to rebuild its electrical infrastructure which was totally shattered by war and political disturbance.

Operations and Commercialization (USAID 2008-today): This is looked after by DABS for creating a reliable energy source to reach out to more people in rural Afghanistan.

• NEPS Construction (ADB/India 2007-2009): The North East Power System (NEPS) is the largest network in the country and includes Mazar-e Sharif and Kunduz in the north down to Kabul in the south. Afghanistan is working with donors to expand NEPS and to introduce new power supplies from ADB's 500-kilovolt transmission line importing power from Turkmenistan and from gas turbine generators using Afghanistan's vast Shebergan gas field resources.

• Tarakhil 100MW TPP (USAID 2006-2009): The objective of this project was to provide more reliable power to the people of Afghanistan. Tarakhil is a modern diesel power plant that will assist Afghanistan in meeting its current and future power needs. Currently, it has 105 megawatt (MW) capacity.

• SEPS/Kandahar-Helmand Project (USAID 2010-2013): The South Electrical Power System (SEPS) serves Helmand and Kandahar Provinces. USAID is increasing generation at Kajaki Hydro Power Plant down there. SEPS's power demand is 125 megawatts but the power supply is limited to 60 megawatts—30 from Kajaki Dam and 30 from costly diesel generator power plants. Delivery of low-cost grid power from NEPS to SEPS is a top priority for both Afghanistan and the United States.

• Transmission, Expansion Connectivity (USAID 2011-14): Again looked after by DABS, and helped set-up by USAID.

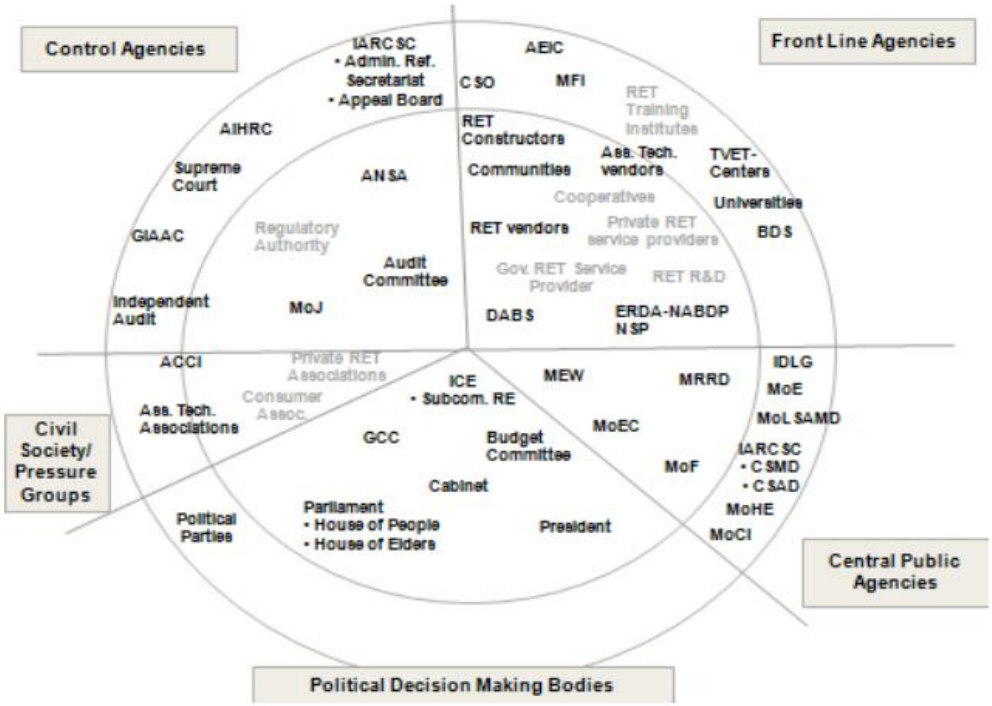


Figure: Governance Map (Schmid, 2009)

(#16.4 Political Decision making chart (of Afghanistan))

7.6 Analysis of the costs, incentives and tariff structures:

DABS's current tariff regimes do not even recover costs, (at present, according to the World Bank, DABS's per kWh revenues are US 5.1 cents against its power generation cost of US cents 12.3, as of 2005) moreover, it distorts market prices, and creates significant gaps between power supply costs and revenues on a system-wide aggregate level. In addition, DABS's billed revenues, which are based on a customer providing its power meter readings, in many cases go

unbilled and/or uncollected. The entire system suffers from numerous serious shortfalls. Power tariffs are based on political rather than economic decisions, including non-payment of power bills for over two years by some key government institutes. The cash-strapped Government fills the gap through subsidies, averaging US $56 million/year. Based on anecdotal evidence, the indicated amount is an underestimate.

To date, some operational and management improvements in DABS have been made which includes: tariff increases in some areas, completion of the DABS's inventory, establishment of a loss reduction unit, and staff training in billing and collections. The utility is waiting for the approval of by-laws authorizing its liquidation. This will enable it to expeditiously move towards its planned 'corporatization'. On-going efforts call for:-

1. Putting DABS' functioning on commercial basis, and as an autonomous body, reporting to the Ministry of Energy and Water (MEW)
2. Preparation and enactment of power sector specific or decree
3. Implementing pricing reform, metering and billing and procedures
4. Computerization of DABS's accounts and billing and collection systems
5. Tariff reforms for Kabul and Herat, followed by other cities, and
6. Building MEW's capacity, in particular, to improve its operations.

7.7 Challenges in rural electrification including access and availability

Rural Energy Availability and Use:

Emphasis has been put so far in the development of electricity in the whole of Afghanistan because the whole country has been in turmoil over the past decade, and sources need to be set-up in most areas. More than 80% of the population live in rural areas though and depend on traditional fuels (fuel wood and crop residues) for cooking, heating water and kerosene for lighting. This is having an adverse impact on forests and watersheds. In addition, burning these fuels increases indoor air pollution, which adversely affects the health of women and children in particular. Rural electrification is the only way that the majority of the rural populace can move toward attaining energy security and enhancing social well-being.

Even though access to electricity has improved in 'cities and towns', access in rural areas is very limited; some estimates put it at 7% of the total Afghanistan population. (There are no reliable estimates of rural electricity coverage).Sources of power, except for those villages in the close proximity of the grid, are micro hydro power, private diesel generation, candles, batteries, solar lanterns, and hurricane lamps for light, and biomass for cooking.

At present, there is no clear institutional framework or policy for rural electrification and a de facto split of responsibilities exist among various ministries. There is a need to develop a robust enabling environment such as through articulation of a Rural Electrification Policy that encourages community buy-in, and emphasizes the role of Community Development Councils (CDC's), and also the private sector in advancing rural electrification. This approach will recognize the Government's limitations to meaningfully intervene, given the extent of the need, which is estimated to be over 85-94% of the total energy needs of the Afghan rural population, which is often thinly spread including over mountainous and over difficult- to-access terrains. Notwithstanding these difficulties, it is important to note that providing rural electrification is important to alleviate Afghanistan's poverty, for bringing rural economic development as a strategic intervention against the opium economy. Obviously, there is a need to promote income-generating opportunities, which are virtually non-existent at this time. A

numbers of developing countries have successfully provided rural electrification covering over most of its population. Included are: Thailand and Bangladesh, via grid power, and Kenya via Solar Home Systems, all of which is under private sector. In Bangladesh they followed Consumer owned rural electric cooperative, private entities but with adequate Government support.

Under a World Bank-funded program called the 'National Solidarity Program (NSP)', which is working with local Community Development Councils (CDC's), over 500 micro-hydro projects have been built since 2003. CDC's participation has involved operations and maintenance (O&M) and established viable systems of cost-recovery, in turn providing sustainability. As experience is generated, this model could be reviewed for potentially wider use. For small towns and cities, the current efforts to provide and/or strengthen power availability include:-

1. The Qalat Electrification project, which established 4,300 new connections, among other improvements
2. The Aybak Distribution Project
3. Micro hydro project in various parts of the country
4. Limited wind energy projects (such as in Herat, with over 120 days of strong winds), and
5. Estimated 200 small biogas digesters in Kandahar.

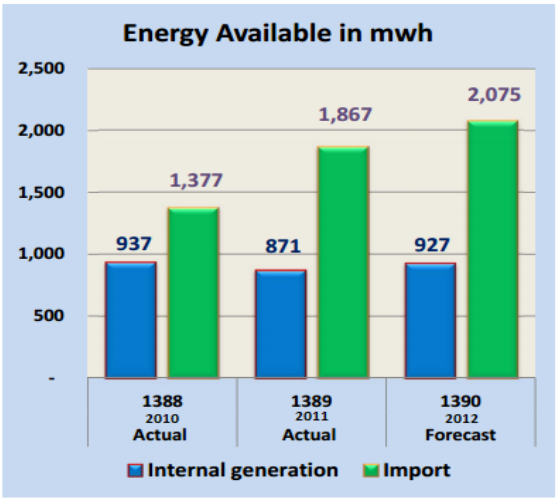
The Ministry of Rural Rehabilitation and Development is focusing attention in these areas.

7.8 Energy technology options commonly used

So far Afghanistan mainly relies on Energy (electricity) import from neighbouring countries and has some hydro/thermal/diesel source. A brief data on electricity production is given.

Energy available for system

	Actual 2010	Actual 2011	Forecast 2012
	2,313,193	2,737,767	3,002,825
Internal generation	936,520	871,171	927,472
Hydro	876,896	772,803	827,525
Thermal	3,562	41,245	38,950
Diesel generator	56,061	57,123	60,998
Import	1,376,673	1,866,596	2,075,353
Republic of Uzbekistan	657,183	964,242	1,102,800
Republic of Turkmenistan	323,662	386,306	420,650
Republic of Tajikistan	74,347	87,234	102,623
Islamic Republic of Iran	321,481	428,813	449,280



(#18.02 Primary Energy available for Afghanistan)

Other Energy Sources include hydro, solar and wind power, which is yet to be implemented on a desirable scale.

7.9 Proposed Action plan(s) and Recommended Policy Options for Successful Implementation of Rural Electrification

Afghanistan's energy sector and its economy are at a crossroads. Energy, abundantly and cost effectively supplied, is most certainly a very important input in the sustainable development of Afghanistan. However, energy is no panacea. In fact, if it is supplied imprudently, instead

being a vehicle for growth, it will pull down the Government's development efforts and be a drag on economic growth. Capital investment in energy is rising rapidly attesting to the efforts to the Islamic Republic of Afghanistan (IROA) and the donor community. At the same time though, the efficiency of energy operations is not increasing. If left unchecked, much of the investment that is being made will be wasted.

To illustrate this gravity of the problem, the cost of losses has been estimated. Because of the state of the infrastructure and the familiar short comings of Government owned and operated energy provision, losses are enormous. For example Losses in 2005 amounted US$128.5 million. The actual cost to the economy is much greater! What this highlights is that continuing to operate on a business as usual basis is unsustainable.

Above all parties must look after Afghanistan be they of Government side or at war, at least infrastructures, Utilities, Hospitals, etc. be kept away from politics.

The main aim of any Country is to achieve MDG and sustainability. To achieve it energy/electricity use must reach every corner of the country and most should have access to it. We need sustainable energy/electricity supply. Again Food security depends on sustainable energy sector.

The number one priority in the energy sector must be on operating efficiency: commercialization of DABM, investments in transmission and distribution to reduce losses, and, repair and maintenance of all power assets. Moreover, it is important to focus now on efficient use of energy and the enabling policy, legal and regulatory frameworks should address this issue. When this is considered against the Afghan Compact Goals, the importance of efficiency becomes even more important. By 2010 the number of connections to meet the AC goals will rise by 211 percent while capacity will increase only 194%, assuming that imports go according to plan. This means that unless there are changes in efficiency, the average kWh consumed per connection must go down. This is not a recipe for economic growth.

Compounding the problem and not included in this analysis are that the demand for power will actually rise and that with more connections the cost of un-served energy will rise. While it is imperative that additional infrastructure be added, it is even more important that the IROA focus on efficiency. While much can be done by the Government, the real solution lies in creating and expanding a meaningful role for the private sector. Realizing that the Afghan economy is starved of reliable and cost effective energy, the immediate task of the IROA, with assistance from the Donor community, is then to provide energy to those that can use best use and pay for it (and that may well be business), in the quantities and quality that they need, at a price that covers cost (for all but the poorest members of society), and to do so in the most cost effective manner. At the same time though, it must begin to take steps that will provide a solid footing for the transition of the sector from Government provision to Private Sector provision.

This strategy acknowledges that there are many steps that need to be taken on the road to fully involving the private sector. It will begin with changes in policy and laws and involvement of the private sector in rural energy provision and in out sourcing at DABM. It is a gradual process that will be enhanced by a deliberate process of reform. The availability of secure energy supplies within Afghanistan was significantly disrupted by the conflicts of the past two decades. Post-conflict efforts by the Islamic Republic of Afghanistan (IROA) and international

donors to date have focused on expanding the availability of energy resources throughout the country. Particular emphasis has been on expanding and rehabilitating the electricity sector in the major economic hubs of the country and providing basic service in rural areas. Efforts also have been taken to improve the supply of natural gas, increase availability of hydro-electric generation, rehabilitate and expand electricity and natural gas transmission and distribution

systems, develop renewable energy resources in rural and remote areas, increase low-cost power imports and improve the capability of energy sector institutions. Since 2001, Afghanistan energy efforts have focused on "bailing out the boat" or keeping the lights on and providing heat in the winter. At some point, one must also focus on stopping the flow of water before they become exhausted. The short term focused activities alone can continue only so long before the long-term growth path of the country is adversely impacted. Having achieved moderate success in these areas, the time is ripe to review current activities and programs and place greater emphasis on behalf of the IROA and donors on a more long-range, sustainable future for the energy sector. This would include balancing on-going efforts to rehabilitate and expand energy resources with a longer-term strategy for the sector.

The Afghan Energy Strategy contains an implicit prioritization of energy sub-sector activities. Electricity is given far greater preference or priority than other sectors because modern economies are built on electricity. Priority is then assigned to other sub-sectors based on their supporting role in electricity and in overall economic activity. In practical terms this means that MoM and MoCI need to prioritize their policies, programs and projects towards the production of fuels for electricity generation. The strategy is based on **five3 prongs or pillars** which are though elaborate and may be some duplication but kept for reference of other Countries.

7.10 Increased Efficiency in Existing Operation:

At this time, it is easier, faster and cheaper to gain a megawatt of power from increasing efficiency than from building a new generating plant. For example, for every US $5 the Government spends in providing compact fluorescent light bulbs, it actually saves US $51 and 49 watts.

7.11 Improved Sector Governance and Public-Private Partnership Promotion:

The ultimate success of the energy sector depends critically on mobilizing the private sector. This can begin now with establishing a multi-sector regulator, looking to outsource at State Owned Enterprises, preparing the enabling legal, policy and regulatory infrastructure for business, and the commercialization of SOEs.

7.12 Improved Coordination and Capacity Development:

Additionally, coordination among the Government entities must increase and coordination between the Government and the Donor community must likewise be strengthened. Assistance needs to be given to ICE to strengthen its capacity. An integrated energy master plan is required to serve as a road map forth Government and Donors alike. To accomplish this, capacity must be significantly strengthened and training is imperative.

7.13 Rural Energy versus Rural Electrification:

Most rural Afghans are unable to pay for expensive electricity. Energy is required for growth but energy alone will not do the job. The role of rural energy to seek out opportunities for

economic activities that lack energy, that will pay for energy and thereby subsidize rural energy consumption while raising rural incomes at the same time.

7.14 Expenditure on New Supply:

Investments in new capacity or energy infrastructure: A lot of progress has been made, but not enough, in creating new supply. It is time now that the Government and Donor community can consider alternative supplies such as wind energy or reducing consumption alongside the more traditional methods. New supply must be rationalized and efforts focused on a few large projects such as the North East Power System. These are the pillars of Afghanistan's near term energy strategy. Alongside addressing the immediate and short term needs, it is imperative that the country look to longer term issues. Because it is building its energy infrastructure anew, it

can learn from the lessons of experience in other countries. It can focus on energy efficiency, renewable energy and decentralized energy. If it does this at the same time it builds its industrial base, then the benefits are enormous. Thus, while a national grid is important to transport power from cheaper markets, it will prove more beneficial in the long run to focus on decentralized power.

A recent British study concluded that 61 percent of the energy value of the primary fuel disappears. "Another 4 percent vanished in transmission." This means that roughly two thirds of the energy is lost in a centralized system. By locating power generation closer to users, these losses can be significantly reduced. Thus, the long term strategy will increasingly focus on cogeneration, distributed power, renewable and end-use efficiency as well as the more traditional areas.

The strategy is focused on poverty reduction through all its five pillars. First, by improving operating efficiency, the drain on government resources is reduced. More is available for other programs. Similarly, by focusing on end-use efficiency, the drain on the customer's resources is reduced. More of their income is available for other things. Second, improving sector governance will also have a significant impact on poverty. It will bring about better subsidy mechanisms so that the subsidy is targeted to those that need it the best way possible. While it will reduce the overall level of subsidy in the sector but the neediest members of society will have access to energy at subsidized rates. Moreover, every Afghani of subsidy that can be freed up in this sector can be used in other sectors. Third, this strategy reorients rural energy to focus on income generating activities. Thus, by definition this is a poverty reduction activity.

Fourth, the economy is starved for energy.

The fifth pillar is the investment in new energy supply and the economy can't grow without energy; poverty can't be reduced in Afghanistan without economic growth.

Finally, the combined impact of these policies, programs and projects will be more energy supplied more efficiently and reliably. This is a solid prescription for economic growth, which growth is important for poverty reduction.

7.15 Energy, Poverty Reduction and Economic Growth

The Energy sector of Afghanistan has the potential to drive urban and rural economic growth for years to come. *Energy as a commodity* can provide essential supply service that indirectly helps to create employment. Energy is purchased by consumers to power equipment, facilities and manufacturing processes that generate income. *Energy as a business* can create direct employment in the development of power plants, oil, gas and coal fields, the construction of grid systems and the commercial operations of the sector. For the rural poor, small energy installations are highly successful in cost-recovery and contribute to local economic development.

Through improved sector governance and increased private sector participation, budgetary resources may be improved at the national and provincial levels. In addition, as sector governance improves poor and marginalized populations will have increased opportunity to learn about energy developments that may benefit from them.

Energy as a service can have dramatic impact on urban and rural health, social well-being, security and other quality of life aspects. Basic street lighting provides security; refrigeration and cooling for medical supplies and home light and heat for improved family living, schooling and comfort. Increased attention to energy use can result in improved energy resource and environmental stewardship throughout the country.

7.16 Rural and Renewable Energy

Renewable energy offers the greatest hope for Afghanistan in general and rural energy in particular. Renewable energy includes hydro, solar, wind, geothermal, biomass and wood. Hydro, both large and small, represents significant untapped resources. According tithe ADB, there is 18,400 MW of untapped hydro potential in the country. Afghanistan has excellent wind potential in many areas and is economical compared to diesel as well.

7.17 Demand

Although there is little data for Afghanistan on rural energy use, inferences can be drawn from similar countries in the region. There is a tendency to assume that grid connected electricity offers the best form of energy for rural populations. Experience throughout the world has shown that there is a progression in the use of energy. Due to the dispersed nature of the rural population, renewable energy offers the best solution for electrification for the majority of Afghanistan's rural population that currently does not have access to electricity and has no real expectation of connection to the grid.

It is very important that the economic conditions and opportunities of rural population be fully understood when devising rural energy strategy. Too often donors and Government officials have blindly followed a policy of rural electrification. The result has been much higher cost energy delivered than people can afford and little, if any, associated economic activity. The goal of increasing energy is poverty reduction and economic growth. Electricity alone in rural areas is unable to do that job.

What is not known about rural Afghan's economic and energy characteristics? First, rural Afghani's are poor by most countries' standards. "Over 20.4% of the rural population cannot meet the minimum level of dietary energy required to sustain a healthy life." Unemployment is rampant. Average household income is estimated to be no greater than $231 a year. Probably less than 4% of rural households have access to electricity20. Of those with access, 7% use electricity for lighting.

Kerosene lamps are the major source of lighting, representing roughly 86 percent. It is highly likely given what is known about other countries, that the main source of cooking fuel is from self-collected fire wood from which there is no monetary outlay or charcoal. This information is valuable because it tells us how much of a rural household's money income is devoted to energy. Using detailed data for Baluchistan, the average rural household spends only 3.5% of its budget on energy and this includes imputed or noncash outlays.

Clearly, for many families on the lower end of the income spectrum, the vast majority of energy services are self-supplied – that is through the gathering of fuel wood, crop residues, and other biomass. Energy expenditures were dominated by wood, charcoal, and kerosene. Wood and charcoal are used mainly for cooking and heating, while kerosene is the main source of lighting. Rural Afghanistan is similar.

Extreme poverty in rural areas also is related to lack of income earning opportunities. The productive use of energy helps reduce poverty by providing alternative sources of livelihoods and increase educational and training opportunities. The remoteness of rural locations and the rough terrain make expansion of the electricity grid into these areas economically infeasible. Therefore, the application off-grid technologies to these areas—including renewable energy resources— and other forms of energy is the primary focus of IROA activities.

7.18 Legal, Policy & Regulatory Frameworks

Ministry of Mines (MoM) laws and regulations in accordance with the country's constitution form an appropriate basis for attraction of investments.

There are three energy laws:

a. Power Consumption Law of 1982;addresses power imports, generation, transmission and distribution;
b. Hydrocarbons law has already been dispatched to the parliament for approval.
c. Coal: Minerals Law of 2005; regulations to be drafted in 2007-08.

Additionally, the Environment Law has been in force since January 2007 and this provides a framework for reviewing projects and their impact on the environment.

7.19 Rural Energy Donor Operations

At present, about 650 villages are supplied with electricity from photovoltaic (PV), through a program funded by the National Solidarity Program (NSP) and under the auspices of Ministry of Rural Reconstruction and Development(MR.). The NSP is a nationwide community-driven development program run by the MRRD and funded by various bilateral and multilateral donors, primarily through the Afghanistan Reconstruction Trust Fund (ARTF). NSP is supported by Non-Government Organization (NGO) partners that facilitate the election of Community Development Councils (CDCs) and help the councils to identify community development projects. NGOs are contracted as facilitating partners to assist communities in the technical and financial implementation of projects that for energy have include micro-hydro and diesel power installations. NSP's partners have identified over 3000 rural energy projects. NSP has funded around 1700 diesel generators and 500micro hydro plants. Other donors (e.g., Government of India) and NGOs (e.g., Norwegian Church Aide) are active in this area. The private sector also is encouraged to participate and invest in rural electrification and deployment of energy efficiency and renewable energy technologies.

Although, NGOs and donors provide much assistance, there appears to be no clear IROA policy for rural electrification or for promoting private sector participation in rural energy projects; also coordination among ministries and other project participants' needs improvement.

7.20 The Role of the Private Sector

Throughout the world, the role of the private sector in energy is growing and is significant in most countries. In Afghanistan, it is virtually nonexistent. The roles of the private sector vary from managing government owned assets to outright ownership and operation. There are examples where all these mechanisms coexist in one country. There are other examples where countries have chosen one model and others where the country transitions over time from the simplest model (management contract) to complete ownership and operation.

To be sure, there are obstacles in Afghanistan to greater private sector involvement, primarily to investment, but some of these obstacles can be overcome or offset with innovative mechanisms. The private sector can be called upon to manage, operate, invest and/or own energy entities and operations. Each different mechanism has its advantages and disadvantages. Often, there is a progression from management through ownership that takes into account the current situation. In the electricity subsector for example, it is highly unlikely under the current security, institutional, policy and legal/regulatory situation that private investors will be attracted to invest in a large scale power plant. However, until these issues are

resolved, there are many other ways to use the private sector. Billing cane outsourced. The construction arms of DABM could be sold off, allowing DABM to focus on core operations. Following DABM's commercialization, distribution could be given on a management contract. Individual power plants could be given on management

contract. There are variety of mechanisms available now for the IROA to tap the private sector as it prepares the enabling frameworks and other requisite mechanisms to foster full private sector ownership and operation. One of the questions that have been posed in this strategy

exercise is whether or not DABM (and other SOEs) should be unbundled. In this context, unbundling has meant the separation of the utility into different operating units and the privatization by sale of one or more of those units or ownership unbundling.
For example, the distribution part of DABM might be separated into several smaller distribution companies and then sold as could be generation. The empirical evidence is mixed and does not strongly support one position or the other.
In fact, many of the earlier proponents of unbundling have now taken a more conservative position that the virtues of unbundling depend upon numerous factors such as the size of the market, the availability of substitutes, the cost production and the overall structure and position of the sector within the economy.
Simply put, when a country or market are small, unbundling may not achieve the results it will in larger, more mature markets. Afghanistan's market is quite small and immature. Ownership unbundling is the last stage of a four step process. At this time it is not possible because the other steps have not yet begun.

To be sure, the commercialization of DABM and other SOEs will require some unbundling. The first step is ***accounting unbundling*** or the separation of accounts of different functions. ***Functional unbundling*** will follow. This is the separation of functions within the company and the imposition of restrictions on activities such as physical separation of people, of management, separation of information that competitors may need separation of services that should be regulated from those that are competitive in nature, etc. Functional unbundling can either take place within the same company or be unbundled into an affiliate company. Functional unbundling also means accounting unbundling. Then there is ***legal unbundling*** but this "does not imply a change of ownership of assets and nothing prevents similar or identical employment conditions applying throughout the whole of the vertically integrated undertakings.

However, a non-discriminatory decision making process should be ensured through organizational measures regarding the independence of the decision-makers responsible." Legal unbundling will of necessity include accounting and functional unbundling. The strategy envisions that with time DABM and other energy sector SOEs will go step by step to legal unbundling. Some non-core functions will either be outsourced or completely divested, reaching the last step of ownership unbundling. The outcome of this strategy exercise is that there are more fundamental reforms required in the laws, rules and regulations and at DABM before large scale ownership unbundling should be considered.

7.21 Rural Energy

Addressing rural energy needs and expanding access to commercial supplies of energy is a (24 MEW puts the cost of power generation at US $0.123 per kWh.)daunting task, requiring a long-term commitment of resources, both financial and institutional and a coordinated approach to addressing this issue through regional and local organizations. Moreover, an evaluation and prioritization of rural energy resource and delivery options is needed to ensure the effectiveness of programs and projects, and a comprehensive monitoring and evaluation process is needed. The GOA, with the support of donors needs to review, evaluate and revise its rural energy programs to effectively address these needs. The biggest challenge in

addressing effective rural energy needs will be to find innovative ways to couple energy service delivery with economic activities. Constraints are the low levels of income and lack of access to microcredit and the political inertia of providing rural, grid based electricity. Added to this is the need to rationalize rural electrification between MEW and MRRD so that each can best address the problems with their specific resources. Additionally, as households transition

from biomass to other fuels for cooking, heating and lighting, efforts need to be made to consider the differential impacts and uses between women, children and men. These

differences are significant and adoption and use of different energy sources depends on addressing the needs of these different groups.

7.22 Energy Strategic Vision

"An Energy sector that provides citizens of Afghanistan and drivers of growth in the economy with long-term reliable, affordable energy access based on market-based private sector investment and public sector oversight."

Overall Energy Sector Goals

- Restructured sector governance and cost recoverable operations
- Rehabilitation and expansion of the public power grid
- The attraction of private investment in the energy sector
- Improved rural energy access
- Development of indigenous resources for power and energy use,

There is a time in Afghanistan's future when energy will be abundant, blackouts will be a thing of the past, and most of its energy needs will be provided directly by the private sector. Private investors will develop power plants, operate and own distribution systems and develop in situ resources, just as they have begun to do in many countries. But that is the distant future. For now, Afghanistan must work hard to increase energy production, doing so efficiently and in a cost effective manner. It can do this by building new capacity and by improving the efficiency of existing infrastructure, building capacity in its workforce, and reorganizing its energy operations to make them more transparent, increase operating efficiency and prepare them for eventual entry into the private sector. At the same time though, it must begin laying the ground-work for the eventual large-scale participation of the private sector. Above all, this means that development of the electricity sector and the fuels that feed it are the single most important priority in the energy sector!

India, a country with far greater security, more resources, a larger and better trained technical cadre and a much better established framework for energy and commercial ventures, began serious embarking on IPPs in1992. The first IPP, a gas combined cycle by a local company, was commissioned in late1996. Many foreign IPP developers such as Enron, Congentrix and AES all started the IPP process but only a handful finished. The bottom line is that today, 15 years after the IPP program started, most generation is still Government owned and most IPPs are Indian owned and financed. Afghanistan can learn from India's mistake and their success

but can't expect to have large IPP projects in less time than they did. This is not to say that we can't and won't have private sector involvement; we must and we will. And the time to begin preparing for the private sector is now.

Afghanistan must not only focus on the immediate energy needs but turn attention to the longer run. It knows where it is going and but not necessarily how to get there. This strategy will address the questions of where we are going and how we get there. What this means for energy is that as we continue to focus our efforts on short run options to increase supply25, one must

begin developing the foundation that will support long run sustainable growth. It means stemming the losses at SOEs like DABM, reorganizing them and commercializing them. It means investing in repair and maintenance and in loss reduction. It means making difficult choices among various projects of the different Government entities for the next two to five years. It means in some cases organizing other Ministries' projects around electricity supply because this is what will drive the economy. It is imperative that in the near future more electricity be provided to more people in the most expeditious manner possible while being mindful of the long run economic impact. At the same time, Afghanistan must be laying the

legal, regulatory, commercial and institutional foundations to unleash the power of the private sector when conditions are appropriate.

Afghanistan does not have an integrated energy strategy. Rather, it has a coal strategy, an electric power strategy, and a hydrocarbons strategy. In part, this reflects the government's treatment of energy as separate institutional and sector silos and, in part, it reflects the lack of institutional depth to see that energy markets and, perhaps, more importantly, that electricity supply projects are highly intertwined with other sub-sectors. In part it reflects the nature of assistance activities that focused on keeping the lights on and the vehicles rolling.
Integrated energy planning and policy development are key to a well-functioning energy sector. But the IROA is not yet equipped to develop an integrated strategy, plans or policy analysis because the basic energy sector data is missing or rudimentary; energy-economic models do not exist; mechanisms for sharing information and collaborating are not in place. In short, work must begin on all of these so that better subsector and integrated energy planning and policy analysis/formulation can take place. For example, fundamental gaps in data on energy supply and consumption and the developable resource base coupled with uncertainties in forecasts of key developmental indicators (economic growth, income, level and structure of energy demand, rates of population growth and urbanization)have made development of an effective sector strategy, including determining the effectiveness of short-term assistance activities, all the more difficult.

To date, the primary focus has been short term, the rehabilitation of generation and expansion of energy services using high cost resources such as diesel. Long-term sustainability requires promoting development of energy resources on a least cost basis in an environmentally sound and socially acceptable way. Now is the time to begin developing the tools that will help Afghanistan take a broader more long-term approach, to review options, and to look at developing least-cost energy resources for meeting Afghanistan Compact goals and objectives. This strategy incorporates projects that are already in the pipeline but also considers what policies, programs, and projects could be re-evaluated and given anew priority (e.g., sector governance) to ensure that they provide results at lowest cost and maximize impacts for a given level of assistance.

The broad goals for the energy sector are:

a. Increased Private Sector Provision of Energy
b. Better Sector Governance
c. Increased trade with neighboring countries, focusing on the transmission of energy;
d. Expand the availability of electric power;
e. Develop a Master Plan for Rural Energy; and,
f. Establish market-based tariffs with a clear timetable to phase out subsidies.

The best strategy at this time is a four paralleled prong approach. The first prong is to improve the efficiency of existing operations. This will be accomplished by physical investments such as the repair and renovation of existing energy infrastructure and the procurement of spares. It will involve changes in the operations of energy sector SOEs. The most important of these is DABM. Commercialization of DABM must be fast tracked. It must operate on a commercial basis with clear targets for loss reduction and officers and employees need to be rewarded for increasing efficiency and cutting losses and held accountable for performance. Aside from the financial implication of continued losses, there are other sound reasons for focusing on this area. Adding a megawatt of power through repair and renovation is usually quicker and certainly cheaper than building new capacity. Progress is being made on building new capacity but repair and renovation is slower than it should be. For example, it is only now, in September 2007, that DABM has begun a limited campaign to identify losses. Training is urgently required in all areas from general accounting to advanced power system controls. The second

prong must be to significantly improve sector governance and begin involving the private sector in various aspects of energy until the legal, commercial and security climate is conducive to transfer most aspects of the energy sector to the private sector. The single most important governance measure will be the establishment of a multi-sector regulator under the Ministry of Economy. Arguments are frequently made that the private sector won't participate or that it should not participate until and unless significant reform and improvements have been made. The reality is different. Afghanistan can begin now by introducing management contracts for some aspects, outsourcing others and in the case of peripheral operations such as construction, they can be spun off. Small as these measures may be, they will invigorate the sector by tapping private sector resources and management. They will allow Government entities to focus on core activities and build a successful track record in private sector involvement. At the same time though, every effort must be made to lay the foundation of enabling laws, policies and regulations that unleash the full potential of private sector investment and operation of large scale energy facilities.

7.23 The Third Prong is Rural Energy Instead Of Rural Electrification

a. Rural Energy in the Vision

Empirical evidence from the developing world clearly indicates that household's transition to different forms of energy based on complex economic, cultural, technical and social relationships. People do not just go from cooking on firewood to cooking on electricity. Additionally, if they used a certain amount of lumens or BTUs in, for example, lighting, they do not use the same amount when moving up from candles to kerosene or from kerosene to electricity.

The findings discussed earlier lead to several major conclusions that have profound implications for rural energy.

First, given these income levels, some electricity services will need to be subsidized. As shown above, if rural households were putting all their energy expenditures into electricity, this would mean consumption of 13.5 kWh per month or enough to run two 60 W electric light bulbs for about 4 hours per day.

Second, residential energy use will be very limited and there is a definite transitioning in energy use that takes place. The order of use will most likely be lighting, radio, fan, TV, and then an iron or some other small appliance. It will be a long time before electricity takes on uses for cooking and heating in rural areas. This means that, until incomes rise significantly, only a small portion of energy expenditures will be directed to electricity. Rural residential consumers will consume very small amounts of electricity for the foreseeable future. Income generating activities will require other forms of energy as well as electricity.

Third, another problem exists because of low income levels and imperfect markets. Even if consumers were willing and able to afford the full cost electricity per kilowatt hour, they certainly could not afford the connection costs. This is called the first cost problem. For example, it has been estimated that the cost of purchasing a small solar home system (SHE)

would be 61% of a typical rural Pakistani household's annual income. In essence, it means that even if consumers would benefit or save money by paying their monthly electricity bill, they could not afford the "first cost" of adopting a more electricity intensive consumption pattern. With rural Afghanis spending the bulk of their income on food, they would be unable without some form of subsidy to purchase a SHS. This leads many countries to subsidize connection costs even if they do not subsidize consumption or to provide other forms of concessional financing.

Fourth, even when the first cost problem is overcome, the low population density coupled with the low income and low demand, will mean that either: (a) the consumption will need to be met by small modular units like solar; or (b) that a base load needs to be identified and developed such as a school or clinic or a larger scale economic use such as milling or irrigation.

Fifth, where incomes and consumption are unlikely to support electricity, then rural electrification may need to focus on finding or creating a customer that can act as the base load as well as subsidize the other users. Then, productive uses of electricity will reduce costs, increase incomes or both. This must be the cornerstone for most rural electrification activities. It also means that this productive use will subsidize other consumers. Productive use here can be defined as either income generating activities such as milling or irrigation or end use in clinics or schools. There is an important difference between these two types of productive uses. In the first case, the productive uses are those that have economic impacts in the near term and those act to increase consumption and ability to pay because the demand for electricity grows as income increases. This first case impacts rural electrification in two ways. First, it acts as a base load with the on sequent reductions in the cost of supply. Second, in the near term it increases economic activity in the area and increases demand due to the positive spillover effects. In the second case, those that consume education and health services will see an economic impact but it is usually in the distant future. The second use can benefit rural electrification by acting as a base load and reducing costs in that manner. All of this leads to some important implications for the third prong of the energy strategy. **One**, focus on income generating activities, **Two**, determine the type of energy and amount of energy best suited for that specific income generating activity. **Three**, follow an integrated model that combines energy provision with that of other services. The Global Village Energy Partnership provides an excellent platform for sharing experiences and lessons learned.

Finally, and most importantly, Afghanistan needs a program focused on rural energy needs as opposed to focusing on rural electrification and one that is focused on appropriate technology. The **fourth prong** is new supply of energy such as new investment in transmission, generation or distribution assets. It is principally concerned with the grid connected systems – generation, transmission and distribution assets. Priority activities here remain the NEPS and SEPS and the activities in other energy sub sectors that support them.

The overall policy framework for the sector is:

1. Restructured energy sector governance and commercialized operations
2. Rehabilitation and expansion of the Afghan public power grid Expansion of rural energy and Electricity services
3. Promotion of private investment to develop indigenous energy resources (including Renewable, natural gas, coal and oil)
4. Public Power Grid. Emphasis on improved distribution and transmission of power will require funding from international donors and provides opportunity for private investment. Capacity building of Afghan staff to operate and maintain the system is essential.
5. Oil, Natural Gas, Coal. Immediate call for tenders to explore and develop known coal/natural gas reserves, noticeably for power, may be conducted.
6. Liquid Fuels. There is no plan to divest or assess the Liquid Fuels Enterprise under the Ministry of Commerce and Industries. Operating some 1600 gas pump stations and1300 fuel trucks should provide considerable opportunity for private investment, improved quality of product and competitive pricing.

7.24 Renewable Energy

There is not a coordinated approach in place to support the development of renewable energy sources. A number of small renewable projects are underway; many are affiliates of larger

programs – i.e., alternative livelihood programs in poppy growing regions. Use of solar water heating and lighting, water pumping and micro-hydro can be expanded and privately operated. In rural locations, communities have gathered resources to construct small hydro and limited solar facilities that support minimal but important light and small power supply. More emphasis is required.

7.25 Priority Policies and Objectives

Following from the broad objectives above and using the four prong strategy approach, priority policies to support implementation of the Sector Vision have been put forward. This section provide more detail on elements Energy Sector Strategy, including those that address overall energy sector needs (e.g., prioritizing projects based on a cost-benefit analysis) as well as sectors specific elements (e.g., electricity tariff reform and completion of the Sheberghan gas field development). The intent is for this Strategy to provide overall guidance on achieving Afghanistan's energy sector goals in a timely and cost-effective manner and to address five primary areas:

Adopt policy that:

a. Recognizes the priority of electricity supply projects and develop the mechanism to ensure coordination among the other Government entities as required. This means viewing electricity supply projects on an integrated basis so that development of fuel supply another required infrastructure is an integral part of the electricity project. Prioritizes projects on the basis of their time and cost focusing on:

- Reducing technical losses in transmission and distribution.
- Reducing demand through end use efficiency such as CFLs.
- Metering of existing cross border transmission.
- Expanding transmission capacity to neighboring countries.
- Rehabilitating the Sheberghan gas fields and construction of its solar power plant.
- Develop New Hydro capacity.

- And investment in oil, natural gas and coal infrastructure based on tenders using performance contracts and a permitting system. (Greater detail on these and other priority programs are presented in detail in the subsector strategy areas.)

Energy Sector Governance is the single most important issue for the long run health of the sector. The enabling frameworks and implementing rules and regulations need to be established along best practice guidelines.

Activities include:

a. Develop and adopt a modern, comprehensive energy law and then separate laws for electricity, oil and natural gas. Concurrently develop the implementing rules and regulations.

b. Adopt in policy and embody in law, the principle of private sector provision of energy. The overarching energy law should explicitly address the role of the private sector which role is further developed in sub-sector law.

c. Establish a Multi-Sector Regulator for electricity, coal, Petroleum and Petroleum Products and Water.

d. Develop an Energy Policy that establish guidelines for energy production and consumption that is cross sector in nature, e.g. energy efficiency, cost recovery, environmental issues. The National Energy Policy should provide guidance on the role of energy in the Nation's economy and set guidelines for how energy will be used.

e. Establish procedures to ensure effective coordination among the different sector Government entities and sharing of data by these institutions.

f. Ensure that Government energy entities are effective by implementing capacity building programmes and reorganizing these entities as and when their roles change.

g. Improve the production and delivery of rural energy by clarifying the roles of MEW and MRRD and evaluating options for project development and ownership, technical support and pilot projects based on international best practices and attraction of private sector participation.

h. Enhance policy and planning and the effectiveness of donor support by strengthening Inter-agency cooperation and adopting tools that will allow integrated planning and analysis.

i. Develop and deploy tools to evaluate and prioritize options such as a least-cost plan.

j. Improve data collection and analysis.

k. Establish a comprehensive monitoring and evaluation program, and

l. Improving assistance coordination.

m. Accelerate private sector provision while an effective supporting framework is being put into place by such measures as:

n. Making an unequivocal commitment to involving the private sector including an aggressive time-table for action.

o. Recognizing that in the long run diesel power is too expensive but, in short run, it may serve as a stop gap measure. Explore limited term IPP for diesel, say five years.
This meets the immediate objective of getting power while developing some expertise in negotiation and power contractual instruments. It also has the advantage of restricting diesel power to a limited time period, time in which lower cost power can come on line.

p. Issuing tenders for private investment in IPPs based on a ceiling bulk power tariff(avoided cost) or some other method that might promote more competition in cost, and a "one-stop shop" window at the MEW.

q. Using "regulation by contract, "management performance contracts and "light handed regulation" concepts;

r. Issuing tenders for coal sector development based on a permitting system.

s. Expediting the commercialization of Stated owned Enterprises such as DABM; and,

t. Outsourcing activities now that can immediately benefit from private sector involvement such as meter reading and billing.

7.26 Establish a commercially oriented financial environment: Create a commercially oriented financial environment by:

- Increasing tariffs (while maintain a lifeline rate or mechanism)
- Public awareness programs providing information about the link between the cost of energy and its availability.
- GoA to pay subsidy directly to the Utility

- Establish subsidized tariffs for the poor and ensure that they are targeted
- Require both Governments to pay the utility for all power that is has purchased and require the utility to settle its accounts with other Government entities. Given the initial hardship that this could impose, reconcile the accounts up to the value of accounts receivable from other Government entities. Similar treatment to other SOE in the energy sector.

a. Objectives of Reform

1 **Reform of Sector Governance.** This strategy supports the consolidation of energy planning and policy-making functions through the Inter-ministerial Commission for Energy (ICE) as well as improved line ministry staff capacity to plan and budget. The law of hydrocarbons was referred to the Parliament for probe into and approval while its regulations are still underway in MoJ that upon its enforcement, appropriate ground will be prepared for participation of private sector in this section.

2 **Institutional Reforms.** A new market paradigm is being supported for Afghan energy; significant institutional changes and relevant staff capacity is required.

- *Inter-Ministerial Commission for Energy (ICE).*Support of the government sponsored institution brings together the seven energy-relevant ministries, donors and private sector to review priority energy development aspects. Offices for ICE are established.
- **Sector Regulation.** Significant change in how the sector is regulated is required. Steps are underway in hydrocarbons and more is required in electricity and liquid fuels.
- ***Line Ministries.*** As the energy line ministries shift from operating as production based to become policymaking regulatory agencies, staff capacity and in-house functions will need to be reoriented to market practices.
- *Ministry of Finance.* In order to ensure that the introduction of market-based contracting, a predictable royalty regime and tax payments are inherent to the hydrocarbons sector. Liquid fuel and petroleum product import aspects as well as tariffs for power all need to be considered. This strategy supports the establishment of a working group (likely under ICE) that will operate for 5 years to monitor and evaluate the performance of the sector vis-à-vis government return.

3 Legal and Regulatory reform and standards. Finalization of primary legislative and regulatory tools is essential. These include mining and hydrocarbons as well as drafting legislation for the electricity sector. There are no meaningful technical standards for operation are in place; these need to be urgently developed as well as staff capacity to implement them.

4.Commercialization and/or divestiture of state and "quasi-state" assets. Development of a plan that includes promotion of private operations will support a new operational market paradigm for the sector. Government will immediately assess its sector assets and plan for liquidation, restructuring and commercialization or sale. In particular Government will provide more support for the corporation and commercialization of national power operations.

7.27 Prong Three – Rural and Renewable Energy

Amend electricity law to clearly demarcate the boundaries between MEW and MRRD with respect to rural energy; concentrate rural remote energy activities within the Rural Livelihoods and Energy Department (RLED). It is important to more clearly define the areas of control between the MRRD and MEW in providing energy services. MEW is principally concerned with providing electricity services to: (1) urban and peril urban areas; (2) secondary towns and cities of5,000 persons or more; and, (3) large industrial, mining, commercial or agro industries. To more accurately reflect these differences, the distinction between rural energy and rural-remote will be made following the Bangladesh experience. Rural-remote energy is energy that

serves remote communities of a village or village and where the settlement is less than 5,000 persons that is a reasonable distance from a transmission line, or an urban or peri-urban area or any other area that would be covered by MEW. This is the clear domain of MRRD and this may include conventional energy such as diesel, liquid fuels, and coal and it may include small scale renewable such as biogas and micro or mini hydro. While demarcating clearer lines of authority for energy services, this does not reduce the need for the two ministries to collaborate. The need to collaborate arises for many reasons such as: The MEW will have expertise in renewable energy, albeit large scale, that maybe of use to MRRD; Eventually, some of the MRRD areas will connect to the grid and so a common understanding of the requirements for grid connection is require; and, there is a need to collaborate on technical standards for rural electrification. Coordinate donor assistance activities for rural-remote energy through RLED.

- **In collaboration with NURC, develop Rural-remote Energy Policy** and include **Light Handed Regulation** as an official policy to promote development of standalone rural energy systems. Policy and regulation must set guidelines for cost recovery. In essence projects need to be able to recover operation and maintenance costs and set aside a sinking fund for capital replacement.
- Undertake a Rural Energy Master Plan for rural-remote and develop criteria for project selection based on the policy of income generation and cost recovery and on the master plan and do so in coordination with MEW as their rural electrification plan is developed.
- Develop and implement the organizational structure and staffing plan for RLED. This needs to be accompanied by a shadow expat staff to do the heavy lifting and provide critical on-the-job training.
- Establish the Rural Energy Fund administered by RLED and allocated on the basis criteria developed above. MEW to develop a rural electrification master plan to cover their area of control and coordinate it with the MRRD.

Due to the dispersed nature of the rural population, renewable energy offers the best solution for electrification for the majority of Afghanistan's rural population that currently does not have access to electricity and has no real expectation of connection to the grid. Most of Afghanistan's 25 million people have no access to modern forms of energy. Fuel wood accounts for an estimated 75% of total rural energy supplies. This is having an adverse impact

on forests and watersheds. In addition, burning these fuels increases indoor (*Government of Afghanistan; Ministry of Energy and Water: Policy for Renewable Energy Rural Electrification, December 8, 2006.)* air pollution, which adversely affects the health of women and children in particular. Extreme poverty in rural areas also is related to lack of income earning opportunities. The productive use of electricity helps reduce poverty by providing alternative sources of livelihoods and increase educational and training opportunities. The remoteness of rural locations and the rough terrain make expansion of the electricity grid into these areas economically infeasible. Therefore, the application off-grid technology to these areas—including renewable energy resources—is the primary focus of IROA activities. The role of the IROA is to provide policy and regulatory frameworks to encourage and facilitate participation by the private sector and civil society in rural electrification and application of renewable energy technologies. Ultimate responsibility for renewable and rural electrification resides in the Ministry of Energy and Water (MEW), although other entities, particularly the MRRD and its program, NSP, CDCs, NGOs, and donors are active in rural development projects. MEW also is charged with establishing a renewable and rural energy policy in conformance with the development objectives of the IROA and ANDS. In addition to hydro, solar energy is considered the most important renewable energy source. Estimates indicate that in Afghanistan solar radiation averages about 6.5kWh per square meter per day and the skies

are sunny about 300 days a year. Consequently, the potential for solar energy development is high, not only for solar water heaters for homes, hospitals and other buildings, but also for generating electricity. In addition, some 125 sites have been identified for micro-hydro resource development with the potential to generate 100 MW of power. Other renewable energy technologies, particularly micro-hydro and wind energy, have broad applicability within rural areas of Afghanistan. The GOA, primarily through the Ministry of Rural Rehabilitation and Development in cooperation with the MEW has developed projects to promote micro-hydro development in rural areas. In addition, under the US National Renewable Energy laboratory, wind mapping has been undertaken for many parts of Afghanistan as abases for developing individual projects. The data indicate good potential for generating wind electricity in several parts of the country. The lead institute to support development of these resources in Afghanistan is the National Renewable Energy Research and Development Center, a part of MEW. It is proposed that a Rural Energy Institute (REI) be established in the MRRD to demonstrate the application of appropriate technologies to rural environments and to demonstrate business models for income generation and cost recovery. The National Renewable Energy Research and Development Center would still remain the focal point for development of large renewable and would coordinate and lend assistance as required to the REI. This is consistent with both the new delineation of roles and the mission of MRRD as working with and through other Ministries.

At present, about 650 villages are supplied with electricity from photovoltaic. The private sector also is encouraged to participate and invest in rural electrification and deployment of energy efficiency and renewable energy technologies. Although, NGOs and donors provide much assistance, there appears to be no clear IROA policy for Rural Electrification or for promoting private sector participation in rural energy projects; also coordination among ministries and other project participants' needs improvement. Hydropower, solar, wind and biomass offer the most potential to contribute to energy supply. Development, however, requires sound institutional and financial support, sustained commitment and a long-term development horizon. Use of renewable energy is beset by a number of factors, including high upfront costs, lack suppliers, inadequate financing mechanisms, and weak institutional and technical capacity. The objectives of the IROA's program for rural and renewable energy development are to provide a sufficient level of efficient, clean energy service to all rural customers.

7.28 Barriers to Access

For Afghanistan, barriers to increasing access to electric power, particularly in rural areas— in addition to policy constraints—have much to do with the physical nature of the investments required, the large scale of the undertaking, and broad country issues (e.g., security, remote location, difficult terrain). These issues need to be effectively addressed through IROA policies and project development and implementation. Solutions to these problems can be found through a mixture of policies and programs that continue to rely on IROA involvement in the sector (with donor assistance) particularly over the short-term while the necessary framework is being put into place. These programs also need to unleash the potential of the domestic and international private sector to provide an expanded array of energy services and allow the withdrawal over time of direct involvement in the sector by the IROA and its transition to an oversight and regulatory function. The IROA needs to explore options for achieving this goal and to put in place policies and programs that will remove barriers to private participation in the energy sector. Examples of supportive policies and programmes include "Light Handed Regulation for Stand Alone Systems" similar to that currently practiced by the Omary Electric Company. However, to be effective this needs to be part of an official IROA policy for rural electrification. The policy would allow self-contained power systems in rural or urban areas to be "self-regulating" in terms of setting service quality, pricing, connection and disconnection

standards, billing, etc. and would apply to cooperative or private sector providers. Basic licensing, safety and technical standards would be applied by the GOA. The need for small-scale, site specific solutions means that significant technical and financial resources are required to bring modern energy services to the bulk of the rural population. Given the scope of the problem and the limitations on Government resources, it is particularly important to prioritize specific means measures to be pursued in order to maximize impact and ensure sustainability. The Government should seek to promote rural electrification with an emphasis on income-generating activities where possible. This underscores the importance of maximizing the benefit of limited resources and of considering the tradeoffs within an overall Energy Sector Strategy of rural versus urban programs; government versus private intervention; and fossil versus renewable energy resources. Given the scope of rural energy needs and the limitations on IROA resources, it is important to prioritize specific measures to be pursued, to ensure that they meet IROA objectives and the effort by the GOA, donors and NGOs are properly coordinated to maximize results.

7.29 Recommendations

To accomplish these goals within the Energy Sector Strategy, the following activities should be pursued.

1. Increase collaboration between MEW and MRRD and Delineate Responsibility for Rural Energy Development. As noted under the Electricity Sector section, responsibility for all rural-remote energy efforts should be consolidated within one institution, RLED, with membership by all stakeholders to help coordinate rural-remote energy programs and projects.

It appears that the MRRD is the proper entity to head up this effort. Rural energy is defined as off grid applications such as SHS, micro-hydro, and diesels in areas of less than 2,500 persons. It could also include the use of wind power for both electrical and mechanical energy, for example. It would not include any grid connected applications. It also includes rural electrification. Since there is no universal definition of rural, the definition for this purpose is something needs to work out. REDA would also be responsible for developing a rural-remote energy master plan.

2. In collaboration with NURC, develop Rural Energy Policy to include Light Handed Regulation as an official policy of the IROA and implemented by the MRRD to promote development of stand-alone rural energy systems by cooperatives or the private sector. Policy and regulation must set guidelines for cost-recovery. In essence all project need to be able to recover operation and maintenance costs and set aside a sinking fund for capital replacement. The rural energy policy and master plan will investigate appropriate fuels for cooking.

3. Develop a Methodology for Assessing Rural and Renewable Energy Resources and Technologies, including hydro(large scale, mini and micro), diesel, solar, wind, biomass; and evaluating and prioritizing potential projects based on expected benefits; and a rural and renewable energy development program needs to be incorporated within the IROA's overall energy sector strategy, including an effective monitoring and evaluation program.

4. Assess and Establish Models for Project Ownership and sustainability with emphasis on capital and operating requirements, government subsidies, and financing methods. Models could include electric cooperatives, franchises, provincial or district government entities, or some combination. Any policy needs to incorporate household and community involvement to the maximum extent possible.

5. Assess and Establish Models for Technical Support (technical standards, installation, O&M support) such as university outreach or extension program; MRRD/DAMB offices at the

district level to include rural technical support and funding; district or provincial governments; private sector involvement.

6. Pilot Projects utilizing alterative project implementation techniques (e.g., coops, franchise) and technologies (e.g., wind, solar, hydro) need to be developed. Best practices in developing, operating, monitoring and assessing the benefits for projects from within the region and elsewhere need to be applied. Pilot projects may also include appropriate cooking and heating that is not electricity based.

7.30 Cross – Cutting Issues

To achieve its goals, in addition to providing for affordable and sustainable energy development the Energy Sector Strategy will incorporate mechanisms to support crosscutting issues that impact all energy sector initiatives. These include the environment, counter narcotics, anti-corruption, gender and regional cooperation—in addition to capacity building.

a. Environment

Energy, even renewable energy, has an environmental impact. This strategy directly addresses environmental impacts by:

- Focusing on policies and projects that improve the operating efficiency of energy production. It strives to get the most energy delivered for the minimum environmental impact. For example, reducing technical losses or cogeneration.
- Focusing on policies and projects that improve end use efficiency. These are areas that seek to reduce the amount of energy needed for any given activity. A CFL program is one such measure.
- Shifting investment and production to cleaner sources of energy, for example, wind power.
- Through the promotion of combining energy supply with income generating activities, as incomes increase, there is less pressure on natural assets.
- Through focusing on appropriate energy such as better cooking fuels and better lighting, thereby reducing indoor air pollution.
- For oil, gas and coal, current law provides a set of environmental requirements to conform to NEA regulations. These will be incorporated into sector implementing rules and regulations. In addition, all environmental impact assessment and pollution control provisions of the Afghanistan Environmental Law will complied with in regard to the construction, upgrading and operation of facilities and infrastructure for the generation, transmission, distribution and use of electricity developed through this strategy.
- The National Environmental Protection Agency (NEPA) will issue new Environmental Impact Assessment regulations in conjunction with the Ministry of Justice. Energy sector institutions, including the MEW, MoM, and MRRD will establish a working relationship with the NEPA to learn about the EIA process and ensure that its provisions are incorporated into all energy sector activities.

b. Gender and Poverty Reduction

Most energy interventions have the potential to provide positive benefits for women and children in particular and also for the poor in general. For example, women have specific energy needs in water pumping, agriculture processing, security, work productivity and health – most often that energy is provided by their own effort meaning that work significantly longer days than men. More efficient stoves, drinking water pumping and agro-processing can reduce women's workloads, improve their health, and expand income-earning potential. The energy sector has the potential to provide a wide pool of jobs as it is developed; for example, in the construction and repair of thermal plants, in coal mines, and in oil fields.

Labor intensive construction methods should be considered. For skilled technical jobs, the energy sector can initiate training and apprenticeship schemes to provide on the job experience for new trade and technical graduates and engineers. Foreign personnel can contribute to such schemes as mentors and can also be tapped to advice on competency based occupational analyses, new curricula for training colleges and universities. Planning for major energy development projects should involve an "employment audit" which indicates numbers of temporary and permanent jobs expected; plans for training and replacement of foreign workers.

c. Coordination and Effectiveness:

Use of the ICE mechanism as well as improved public information will be essential for improved government coordination in the energy sector.

8. Rural Electrification in Bangladesh

(#17.3 Map of Bangladeah)

Rural Electrification in Bangladesh

8.1 Background

Bangladesh is located in South Asia, bordered by India in the north, the Bay of Bengal in the east and west, while Myanmar surrounds it to the south. Bangladesh is the eighth most populous country in the world. Officially known as the People's Republic of Bangladesh, it is the fourth largest Muslim country in the world after Indonesia, Pakistan and India.

After Independence in 1971, during Constitution framing of Bangladesh, it was included that State will be responsible to provide electricity to its Nationals. As a result government established a Rural Electrification Directorate under State owned Power generation/distribution organization i.e. Power development Board (PDB) which is now renamed as Bangladesh Power Development Board (BPDB). Since BPDB was entrusted to look after the electrification of whole Bangladesh with fragile infrastructure and shattered economy, so it was found that BPDB's one Directorate cannot take the gigantic task of electrifying 80% of Bangladesh. Funding was a major problem as electrification is one of the costliest services.

The Government then went for study of different means including funding for rural electrification. Most of the Donors and International Institutions discouraged rural electrification in the shattered economic state (after independence). The US Government came with the idea that rural electrification is possible through Consumer owned Cooperatives as in USA which was successfully followed in Philippines. In 1976 USAID conducted feasibility study through NRECA for reaching electricity to each and every rural home and other rural establishment. It was developed with some modifications in context of Bangladesh.

8.2 Review the institutional structures for rural electrification in Bangladesh

First a separate organization was considered to be formed under the Government control which will be responsible for rural electrification of the Country. The Bangladesh Rural Electrification (RE) Program was founded with a Presidential Ordinance in October 1977 that established the Rural Electrification Board (REB) which is now renamed as Bangladesh Rural Electrification Board (BREB) as the semi-autonomous government agency reporting to the Ministry of Power Energy and Minerals Resources, which was responsible for electrifying rural Bangladesh. Since its inception, the purpose of the program has been to use electricity as a means of creating opportunities for improving agricultural production and enhancing socio-economic development in rural areas, whereby there would be improvements in the standard of living and quality of life for the rural people. It provides electricity on the basis of Area Coverage, but revenue criteria are also considered to ascertain the priority.

Again whole country electricity system starting from Generation to transmission and distribution was looked after by State owned electrical organization Power Development Board (PDB) which is now renamed as Bangladesh Power Development Board (BPDB). It had mismanagement due to very large system and Losses (System Loss) were very high. As a result it was running under huge financial loss.

The Rural Electrification Board of Bangladesh has been providing service to rural member consumers for over 37 years. Continued support from the Government of Bangladesh, the donor community, consulting partners, and member consumers will help this program continue to expand, providing the gift of electricity to more than 10 million Bangladeshi households, businesses, and industries. Rural Electrification Board Act, 2013 has been established instead of Rural Electrification Board Ordinance, 1977 (Ordinance No. LI of 1977) and the name of

Board is Bangladesh Rural Electrification Board, which was responsible for electrifying rural Bangladesh. Since its inception, the purpose of the program has been to use electricity as a means of creating opportunities for improving agricultural production and enhancing socio-economic development in rural areas, whereby there would be improvements in the standard of living and quality of life for the rural people.

Rural Electrification Board forms Palli Bidyut Samity (PBS) or Rural Electric Cooperative for a particular area taken into consideration. First the whole area is divided into certain Elakas (Areas) on the basis of population, house hold etc. maximum 15 Directors. A Board of Directors is selected, one from each Elaka or Area to form the Board. In order to look after the womenfolk interest through rural electrification, 3 (three) Lady Advisors were selected. They were part of the Board but without any voting right. Now the 3 (three) Lady Advisors are Lady Directors (nominated and have equal Voting rights. The Board of Directors selects Executive Committee consisting of the President, Vice President, Secretary and the Treasurer from among the Board Directors.

Initially Cooperatives will be formed with selected local elites. They continue to work till electrical infrastructure of the PBS is complete and energized. Then gradually the Directors whose term is 3 (three) years are replaced through Election within the Consumers. Again every year AGM is held in a predefined month. After AGM, new Executive Committee is formed from among the Directors. This system reflects democratic process in the PBS system.

Bangladesh is an example of attaining food security, minimizing poverty through rural development.

8.3 Analysis of the current rural electrification programmes and objectives

The rural electrification programme has changed the rural living standard, economy both of rural and as a whole of the Country. A Master plan is prepared for the whole area to be brought under electrification. It is based on revenue criteria. Initially BREB provides Loan o the PBS. A loan agreement is signed between the Utility and the Board. BREB then constructs infrastructure like Office complex, substations, electrical distribution system etc. It is then energized and commercial and distribution activities start.

Since the PBS purchased electricity and had to get income after selling it, so it kept its losses to the lowest. Again it was run on to if any Utility makes profit then it has to reduce its tariff or Utilize its profit for the Consumers.

The PBS concept earned name and fame at home and globally. As a result fund was no problem. Then government made State owned BPDB was asked to hand over their rural areas Lines and Consumers with very high losses to BREB/PBS. As a result the overall losses of the electricity sector of the country reduced. BREB/PBS was mainly entrusted with on grid electricity. Because of massive rural electrification off grid work was entrusted to other organization though under Government umbrella. BREB/PBS had very small contribution to electrification through Solar energy.

8.4 As per BREB website following statistics are given up to August' 2014.

Sl	Item	No	Remarks
1	Number of RES organized	72	
2	Number of RES operating commercially	72	
3	Number of district under the program	61	
4	Number of district under the program (equivalent to	433	

	area of a Police station area)		
5	No of Villages electrified	52,525	
6	Total distribution line constructed	265,506 km	
7	Total distribution line energized	253,225 km	
8	Total 33/11 KV sub-stations constructed and commissioned (429 Constructed by REB, 79 Constructed by Private, 88 taken over from PDB/DPDC/OTHERS)	596	
9	Installed capacity of Sub stations	6075 MVA	
10	System Loss	13.78%	Cumulative
11	Number of Population in programme area	10,28,05,052	
12	**Total Connections**	**1,03,03,779**	Till Aug, 14
	a. Domestic Consumers	8,863,703	
	b. Commercial Consumers (shops, markets, offices etc.)	908,872	
	c. Irrigation (all type)	1,93,173	
	d. GP (Small to medium Industry)	1,45,168	
	e. LP (Large Industry up to 33kV)	627	
	f. Street Light	14,662	
	g. Solar (SHS only)	14,500	
13	No of approved Projects	63	

(# 16.05 Statistics of BREB)

(Ref. http://www.reb.gov.bd/index.php/abreb/stat)

Enormous changes have occurred in areas all across rural Bangladesh due to people having access to electricity. The magnitude of changes and the impact of the RE Program is vast and diversified and information documenting these have become more acute in recent years. All stakeholders, particularly the Government of Bangladesh and the development partners need documentation that supports the large funding requirements that are needed to expand the program further. Given these circumstances, decisions were taken to have this "Economic and Social Impact Evaluation Study of the Bangladesh Rural Electrification Program". A Study was conducted beginning from March 2002 with the selection of the Human Development Research Centre (HDRC). This eight-month study involved more than 100 male and female qualified enumerators, as well as a number of data quality controllers working to collect quantitative and qualitative data through the completion of questionnaires during the interview of 378 cases in more than 70 villages/thanas in both electrified and non-electrified areas of 23 different PBSs dispersed across the country. In addition, the fieldwork also included 27 "focus group discussion" and nine "group discussion with the PBS Board and Members". The four major categories of consumer's namely domestic, commercial, irrigation and industry were included when preparing the sampling sizes for both experimental and control groups. Fourteen different instruments are designed, field tested, and used for the information collection phases of the Study.

8.5 Socioeconomic Impact of rural electrification programme

Electricity has brought many families close to the rural homes. Some of them are thinking of taking new initiatives in industrial and agricultural sectors. Food security was a major achievement for 160 million Bangladeshi people to be fed with very limited land resource. In addition, development of solid Mobile communication network because of rural electrification. Easy communication led to increase in volume of trade, business, employment etc. This aided in economic development. Another voluntary employment generation work done by Rural Electric Cooperatives is free Village Electrician training to rural youth. The qualified youth

electricians works in rural areas, but many have gone for permanent jobs in Government, private jobs and also abroad. This is an achievement of BREB/PBS.

Social life improvement. Electricity gave scope to access Radio/TV/ Internet etc., social contacts increased because of electricity. ICT has also added to it.

Literacy rate in the rural areas has increased significantly due to the expansion of mass education program. Poor workers can attend the night schools at the end of the day's business. They can also sit beside the children to supervise their education. Living pattern in rural areas have changed due to introduction of new consumer items and like Refrigerator, Television, Radio, Cassette Players, Fans etc. Villages are experiencing a kind of urbanization in the shape of civic amenities, regular education, sanitation and health care and enhanced economic activities.

By dint of TV and internet, people are now keeping informed about the latest state of technology, development, sports, culture and political developments. As the satellite has opened up the world before the eyes, people get acquainted with the world and this ensures their early socialization. The workload of women has reduced and they have sufficient time to

watch TV, listen to radio and can assist children in their education. Access to resources, equality of men and women in terms of wage/employment, women trafficking, punishing criminal offences, child trafficking, acid throwing, choice of family planning use, right to participate in the election etc. RE programme have sped the other development activities in the rural areas. Many new infrastructure development NGOs (non-government organizations) and human development bodies have extended their activities in remote rural areas to help government's efforts at poverty alleviation and human development. By dint of electricity, NGOs are encouraging varied human endeavors in the form of handicraft development and cross-cultural interchanges.

These things ultimately reduce migration towards cities and relieve them of stagnation of infrastructures and civic amenities. On the other hand, it ensures effective and maximum utilization of human and other properties. Speedy electrification of our rural homesteads &other consumers have sped timely utilization of natural and other resources.

Women of the rural areas are enjoying the benefits of electricity very well. They can do extra work after household job and add to family earnings. Women are getting self-dependent, making small groups of income generating purposes, specially rearing poultry and cattle, making vegetable farms & taking-up weaving and sewing projects and opening small shops. The use of light during evening ensures women's safe movement from one place to another. Electricity has left a profound impact on women's mobility, participation in Income Generating Activities (IGAs), decision-making, freedom of using income and saving, better utilization of credit, knowledge about gender inequality issues, household work plan according to convenience, changes attitude in terms of reducing health care disparities, increase in overall years of schooling for both boys and girls, preference to send girls to schools, awareness of legal issues (i.e., marriage for girls at 18 and boys at 21) and awareness about negative impact of dowry. Women in the electrified households have selected gender equality knowledge, such as, participation with husband in decision-making, purchase/sale of land/livestock, construction/repair of houses, marriage, health and education. Women spend more time on listening radio and watching TV to news and health- nutrition related program than other program. They are gaining much more knowledge and thus produce modernization effect. About 15 areas of knowledge disseminated through radio/TV include value of good health (1), value of education (2), value of female education (3), utility of family planning (4), development of knowledge-base through news (5), improvement in agriculture practice (6), knowledge of modern fishing (7), knowledge of pest management (8), govt. program for the distribution of Khas land (9), prohibition of dowry (10), laws about divorce (11), legal tools to

combat violence against women (12), local governance issues (13), and women right issues (14) and issues of human rights (15). Electricity has given them special advantage of forming micro irrigation groups in villages, thus revolutionizing the traditional concept of man-run irrigation systems. This is helping them to develop entrepreneurial skills and the qualities of leadership. This is leading to a concept of empowerment of women towards better sustainability and solid social existence. Recently, this has drawn fond attention of the development experts round the globe.

Rural Electricity has acted as a leap-forward in the development of commercial and industrial activities in rural Bangladesh. Out of the total shops in Bangladesh more than 24% are using rural electricity. Rural areas around Dhaka have been converted into Industrial zone thus adding to employment generation helping in economy. Electrified commercial establishments are more attached to market. Banks are being established in remote rural areas. Transaction through Mobile phones has changed the face of rural areas. Even **Bill Gates** praised about rural banking through mobile phones and said "**Bangladesh is moving wildly and aggressively in every sector of IT**". All this is possible because of rural electrification.

In agriculture, rural electricity program (REP) has significantly in attaining food self-sufficiency through use of productive and efficient irrigation equipment. Both land use intensity and cropping intensity with electrified pumps (DTW/STW/LLP) is higher than diesel operated. Average yield per acre under electrified pumps is 24% higher than that of diesel operated ones. Electrified pumps contribute one-third of the food self-sufficiency in Bangladesh. REP through its electrified irrigation pumps covers 4.1 million acres of land for HYV Boro and Aman. REP irrigated land produces 6.43 million tons of HYV Boro and Aman, which is about 29% of all similar types of rice, produced in Bangladesh. 20% rebate to the electric bill to the irrigation pumps sanctioned by govt. induces the farmer to enhance the agricultural growth. As agricultural productivity has increased, availability of rice & other food items in villages have helped rural people maintain better food habits.

Industry is the second highest consumer of rural electricity-using 41.53% of the total MWH. A substantial growth in industrial output and value has been added to the national economy. RE-connected industries have strengthened the local industrial base by promoting backward and forward linkages and diversification, which later forms agglomeration by attracting and generating, diversified services.

Rural Electrification fits in quite comfortably with the current buzz, words in the lexicons of development partners such as poverty alleviation health care, education, food production etc. The program in Bangladesh has already witnessed with manifold and for reaching socio-economic impact in the electrified areas as stated above. A USAID study's findings and assessments about impact of the rural electrification program in Bangladesh found the benefits of the program as under:

1. 55.41% villages and 5.08 million rural households are electrified and no. of beneficiaries is 30.5 million.

2. 93.7% at the electrified households (HHs) reported decrease in fuel cost. Average electrified HHs monthly Kerosene savings 1.7 liters in comparison to non-electric HHs, which is 8.6-million liter Kerosene and of value US$ 3.74 million.

3. Literacy rate in the electrified HHs is 71%, where 54% in the un-electrified HHs.

4. Electrified HHs use daily 50 minutes more than that of non-electrified HHs between sunset and sleep.

5. In the electrified HHs students study 23 minutes more than the non-electrified HHs daily.

6. 78.2% HHs reported an increase on working house.

7. 62.0 % HHs reported an increase in HHs income.

8. 81% HHs reported an increase in reading habits

9. 93.7% reported an increase in children's study time.

10. 92.0% reported an increase in amusement as well as standard of living.

11. 94.7% reported an improvement in security.

12. Electrified HHs per capita daily food intake 96 gram, 164 kilo. Cal. and per capita protein 46 gram more than that of non-electrified HHs.

13. The annual infant mortality rate in the electrified HHs is 42.7/1000 live births, in the non-electrified HHs 57.8/1000. Thus annual number of infant deaths that could be saved will be around 36818, i.e., a saving of 101 infant deaths every day.

14. About 68% of currently married women in the electrified HHs reported of using contraceptive methods, where in the non-electrified HHs the rate is 63%.

15. 61% electrified HHs use hygiene latrine, where only 29% non-electrified HHs use the same latrine.

16. Over 50% Electrified HHs possess TV; TV watching was reported by 70% HHs.

17. Women of the electrified HHs watch TV by 65 minutes; use 56 minutes in income generating and 161 minutes in socio-cultural activities at night daily.

18. 64% women of the electrified HHs reported TV as the main source of knowledge.

19. 11% women of the electrified HHs involve in income generating in handicraft/sewing activities.

20. 53% women of the electrified HHs reported allowing young girls/women to work outside the village.

21. 71% women of the electrified HHs reported that a couple should have two children.

22. Around 25% electrified HHs has radio sets, 39% women listen to radio on an average about 27 minutes per day

23. About 18.8 million bulbs, 2.3 million tube lights, 8.5 million electric fans, 2.7 million TV, 1.5 million electric irons, .3 million refrigerators, .2 million mobile phones, .1 million juice machines are using in the electrified HHs.

8.6 Analysis of the costs, incentives and tariff structures

The rural tariff is not cost based and is subsidized. But why?

It was found in a detailed study that cost of providing 1 kWh electricity is around USD 0.20, but economic loss due to not providing 1 kWh of electricity is around USD 0.40. This was

evident from the fact that though government provided electricity to rural masses at loss but overall grain was tremendous. For last 4 years Bangladesh GDP growth was always more than 6%, a unique feet when Europe and many developed countries are fighting with recession.
Present Tariff though subsidized, but government is gradually adjusting with increase of tariff to minimize the losses. Tariff structure is given below

Tariff structure of various Utilities of Bangladesh

Sl	Consumer Category	Billing slab kWh	BREB	BPDB/DESCO/ DPDC/WZPDCO
		Kilo Watt Hour	BD Taka	BD Taka
1	Domestic (LIFE LINE)	1 to 50	Average 3.74	3.33
	Domestic	51 to 75	3.87	3.53
		76 to 200	5.01	5.01
		201 to 300	5.19	5.19
		301 to 400	5.42	5.42
		401 to 600	8.51	8.51
		Above 600	8.93	8.93
2	Irrigation		3.39 to 3.96	2.51
3	Commercial including Offices	Flat	9.58	9.58
		Off Peak	8.16	8.16
		Peak	11.85	11.85
4	Small Industries (including 11 kV)	Flat	7.42	7.42
		Off Peak	6.64	6.64
		Peak	9.00	9.00
5	Large Industries 11 kV (BREB only)	Flat	7.32	
		Off Peak	6.62	
		Peak	9.33	
6	Large Industries 33 kV	Flat		7.20
		Off Peak		6.55
		Peak		9.28
7	Charitable Institutions (Religious/educational Institution, Mosques, temples etc.	Flat	4.98	4.98
8	132 kV Consumer (only for BPDB & DPDC)	Flat		6.96
		Off Peak		6.35
		Peak		9.19
9	Street Light (all category), Water Pumps (excludes BREB)	Flat	6.93	6.93

(# 16.6 Tariff structure of various Utilities of Bangladesh)

(#17.5 Grid map of Bangladesh)

8.7 Challenges in rural electrification including access and availability of electricity

The main challenge for rural electrification is maintenance of lines through rural areas where thick trees is a problem for line safety. Communication is another factor but it has improved significantly. The main challenge is high cost of electricity and tariff is lower especially in rural areas. Again Government has kept irrigation tariff lower than electricity Bulk purchase price. The Government is not increasing and no subsidy is provided. The overall losses have led to poor maintenance resulting in more outages. Again due to heavy unpredictable demand, most of the feeders, sub stations were over loaded resulting in more losses.

Remedy: Gradual shift in tariff increase of subsidy from the Government. Already financially sick PBS can be rescued by the Government.

8.8 Review the energy technology options commonly used in rural electrification

Technology is moving fast. Efficient equipment is being produced but cost is high and again inferior quality products are also available. For electricity sector always go for Life cycle analyses and procure good quality equipment. Remember losses due to interruption are much than the cost saving due to purchase of less costly products. Bangladesh Rural electrification has gained so much fame worldwide that its model has been implemented in many countries.

8.9 Proposed action plan (s) for successful implementation of rural electrification policies

Bangladesh BREB has already prepared master plan for whole rural electrification under Grid system based on Revenue criteria. That is more revenue earning lines will be constructed first and less revenue lines later on. Practically this is not always followed due to pressure from different quarters. Government is also providing fund. It has vision to provide electricity for all by 2021, the 50th year of independence. But what about off-grid Consumers?

8.10 Rural Electrification through Renewable

The Bangladesh off-grid electrification fund supported by the World Bank Rural Electrification and Renewable Energy Development Project (RERED) provides solar home systems to rural households and has supported deployment of as many as 3,000household systems per month.

The main programme of SHS and RE is entrusted to Infrastructure Development Company Limited (IDCOL) a government owned Company but runs on commercial theme. The IDCOL started the SHS program in 2003 to ensure access to clean electricity for the energy starved off-grid rural areas of Bangladesh. The program supplements the Government's vision of ensuring 'Access to Electricity for All' by 2021.

About 3 million SHS have already been installed under the program in the off-grid rural areas of Bangladesh. As a result, 13 million beneficiaries are getting solar electricity which is around 9% of the total population of Bangladesh. IDCOL has a target to finance 6 million SHS by 2017, with an estimated generation capacity of 220 MW of electricity.

IDCOL initially received credit and grant support from the World Bank and GEF to start the program. Later, GIZ, KfW, ADB, IDB, GPOBA, JICA, USAID and DFID came forward with additional financial support for expansion of the SHS Program.

At present 47 Partner Organizations (PO) are implementing the program. IDCOL provides refinancing and grant support as well as necessary technical assistance to the POs. POs install the SHSs, extend credit to the end users and provide after sale services.

More than 65,000 SHSs are now being installed every month under the program with average year to year installation growth of 58%. The program replaces 180,000 tons of kerosene having an estimated value of USD 225 million per year. Moreover, around 70,000 people are directly or indirectly involved with the program.

The program has been acclaimed as one of the largest and the fastest growing off-grid renewable energy program in the world.

8.11 Analyze the country-specific challenges in rural electrification including access and availability of electricity

The main challenge for Rural electrification is massive expansion within a short time and migration of expertise to other organization. The PBS is the only organization where one has to permanently stay and work in rural areas. With the development of new Utility Companies like DESCO, DPDC etc. and massive expansion of Mobile companies, the experts of BREB and PBS are being taken by other Companies at a higher remuneration and again with scope of urban life. Bangladesh major problem is that good schools/education, medical facilities; social amenities all are urban based. So experts are quitting the rural job. It is ironical that BREB is producing energy experts and other Utilities are taking those experts (at a higher pay which BREB/PBS cannot afford due to less tariff of Irrigation etc.) and making Urban Utilities successful and rural utilities left to produce more and more experts. For rural electrification through renewable, present challenge is to replace more than 500,000 Diesel driven irrigation pumps with solar irrigation at an effective cost. SREDA is working on it and trying to develop an effective business model like IDCOL doing SHS, biogas plants etc. in businesslike manner.

8.12 Technology options commonly used in rural electrification

Existing technologies are seemed obsolete. Equipments are purchased at a less cost but when you go to analyze Life cycle cost, it is a total loss. Power interruptions are unusually high in rural areas. Modern technologies cannot be adopted due to shortage of qualified and skilled expertise.

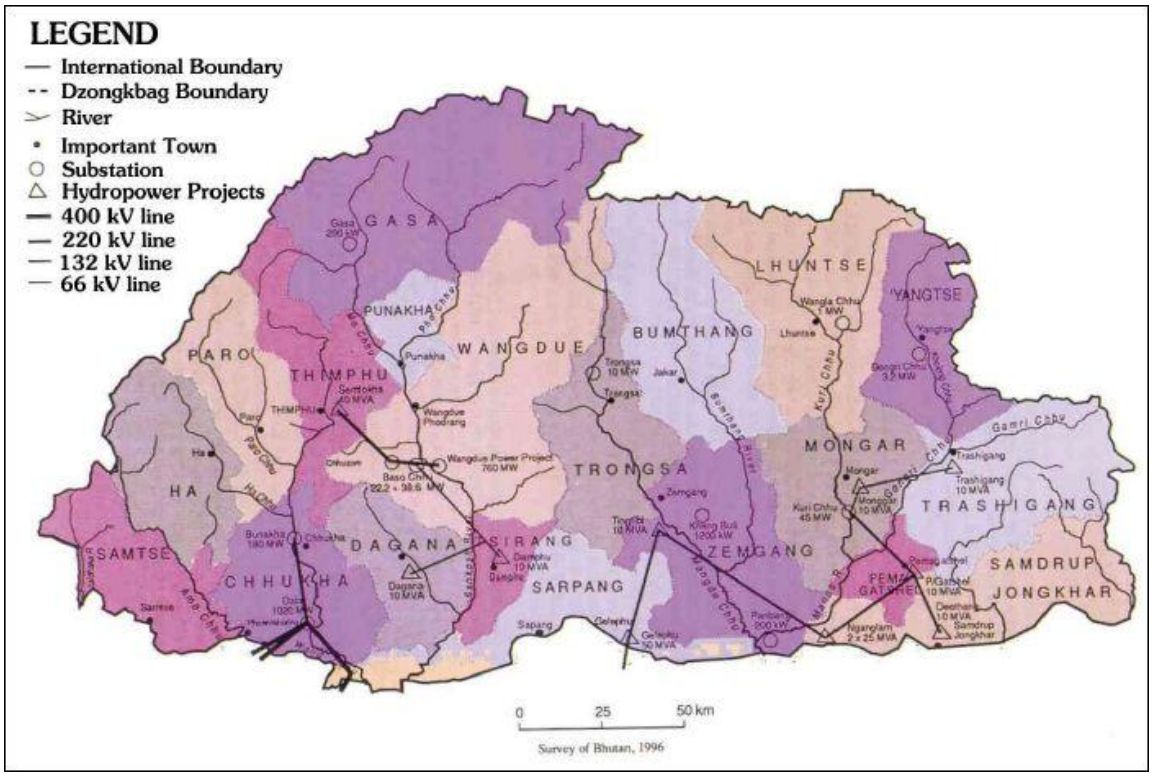
For Industrial zone, they have to go for Smart technologies. Integrated renewable are to be developed.

8. Recommendations

Despite so many odds, Bangladesh is successfully following the rural electrification in correct direction. It's very high response from the Consumers has put pressure on the Utilities but overall progress is satisfactory and may be followed by others for Grid connected electricity system.

Again it is SHS, Renewable and off grid business model through IDCOL may be followed by other countries.

8. Rural Electrification in Bhutan



(# 17.06 map of Bhutan)

Rural Electrification in Bhutan

9.1 Introduction

Bhutan, a landlocked country in the Himalayan mountain range, has an area of 47,000 sq. km (18,147 sq. mi), extending 306 km (190 mi) e–w and 145 km (90 mi) n–s. It is bordered on the e, s, and w by India and on the n and nw by China, with a total boundary length of 1,075 km (668 mi). The capital city of Bhutan, Thimphu, is located in the west central part of the country. Its official name is the "Kingdom of Bhutan".

Energy in Bhutan has been a primary focus of development in the kingdom under its Five-Year Plans. In cooperation with India, Bhutan has undertaken several hydroelectric projects whose output is traded between the countries. Though Bhutan's many hydroelectric plants provide energy far in excess of its needs in the summer, dry winters and increased fuel demand makes the kingdom a marginal net importer of energy from India. As of 2011, the Bhutanese government supplied electricity to 60 percent of rural households, a significant increase from about 20 percent in 2003. About 2,500 people used solar power throughout Bhutan. Even

where electricity was available for lighting, most rural households cooked by wood fire. Rural homes were often heated with firewood, kerosene, or liquid petroleum gas.

Bhutan has no natural petroleum or natural gas reserves. The kingdom has some 1.3 million tons of coal reserves, but extracts only about 1,000 tons of coal yearly, entirely for domestic consumption. Bhutan also imports oil at some 1,000 barrels per day. Most oil imports supplied fuel for automobiles.

Bhutan remains overall carbon-neutral and a net sink for greenhouse gases. As Bhutan develops and modernizes, however, its domestic demand for energy in household, commercial, and industrial sectors has steadily increased.

Until 2002, Bhutan's energy sector was overseen by the Ministry of Trade and Industry, Department of Power. In 2002, reforms in the executive Lhengye Zhungtshog produced three new bodies under the Ministry of Economic Affairs: the Department of Energy, its subsidiary Bhutan Electricity Authority, and the Bhutan Power Corporation (BPC). While the Department formulates policy, planning, and coordination, the Authority is the main regulatory agency of the energy sector. Since 2006, the Authority has had the authority to impose differential tariff structures on low, medium, and high voltage consumers. In December, 2009, Bhutan Power Corporation had 91,770 customers across the country, out of which 47,846 were rural domestic users.

Rural Electrification Department (RED) is part of BPC is responsible for construction of medium voltage (MV) and low voltage (LV) electricity distribution infrastructure by grid extension and ultimately providing service connections to rural areas. In a long-term vision "A Vision for Peace, Prosperity and Happiness" for Bhutan which was established in 1999, rural electrification was identified as an important objective along with road construction from the viewpoint of reducing the disparity between urban and rural areas, reducing poverty, and promoting industries. The 9th Five-Year Plan (July 2002–June 2008) that was developed in line with the long-term vision sets the target of electrifying 100% of households by 2020 and the master plan for achieving a household electrification rate of 100% in rural areas was

worked out by JICA in October, 2005. This project was to be implemented as part of the rural electrification plan drawn up by the Government of Bhutan under the 10th Five-Year Plan (July 2008-June 2013).

(http://www.jica.go.jp/english/our_work/evaluation/oda_loan/economic_cooperation/c8h0vm000001rdjt-att/bhutan01.pdf).

The Royal Government of Bhutan had a target to provide "Electricity for all by 2013".

(http://www.bpc.bt/rural-electrification-department/)

In order to achieve this target, BPC was entrusted with a mandate to provide electricity for all by 2013 in the 10th Five Year Plan (FYP) with a total of 40,257 households to be electrified through on-grid supply scheme. Despite best efforts, BPC could fulfill only 94% of the targets due to major challenges faced during the implementation of the RE works. One of the major challenges faced was the inaccessibility of work sites in the last mile connectivity wherein the transportation of materials has been the single most challenge. This was coupled with harsh climatic conditions and difficult geographical terrain resulting in severe working conditions, thereby making it difficult to get laborers and also retain the existing workers to work at the site. In some cases, BPC lacked support from the community, which further delayed the progress of RE work.

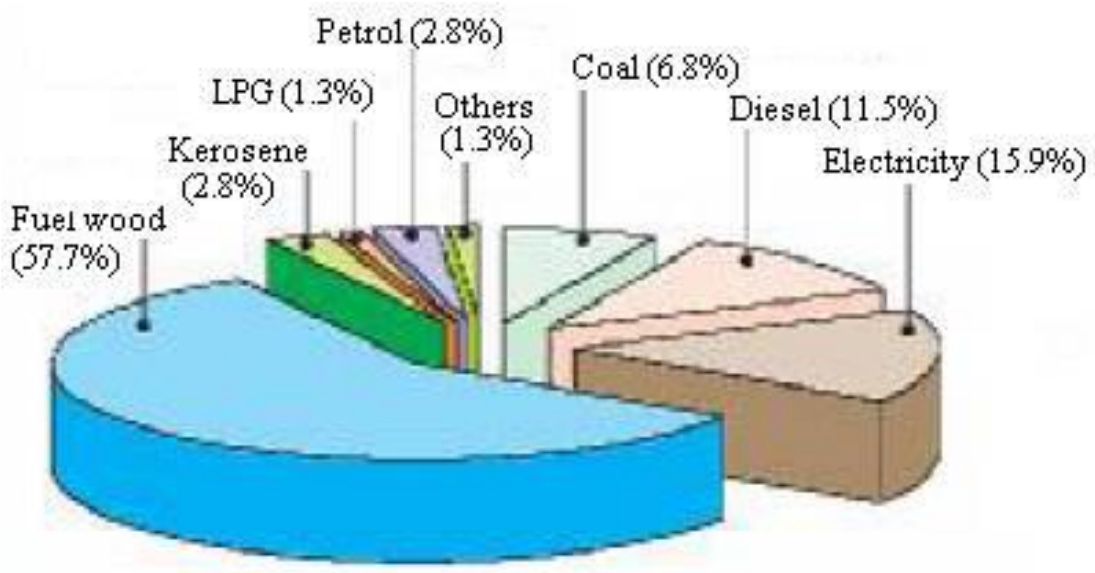
Despite all these challenges, BPC has electrified 37,654 households under the various RE programs including 5,782 households under the Fill-in RE project financed by the BPC during the plan period. With this RE coverage, 94% of the rural homes have grid supply access. For the balance households not electrified, BPC is putting all its efforts to complete the works as soon as possible to enhance the quality of life and living conditions in our countryside.
(http://www.bpc.bt/wp-content/uploads/2014/06/Annual-Report-2013.pdf)

Also, for renewable energy purposes, Druk Green was incorporated on January 1, 2008, through the amalgamation of the erstwhile Chhukha, Kurichhu and Basochhu Hydropower Corporation, with the vision to "promote, develop and manage renewable energy projects, particularly hydropower, in an efficient, responsible and sustainable manner, and to maximize wealth and revenue of the nation''.
(http://www.drukgreen.bt/index.php/about-us)

9.2 Current rural electrification programmes, objectives and technology options

In the early 21st century, about 70 percent of all energy consumption in Bhutan was in the household sector heating and cooking with firewood in particular accounted for between 70 and 90 percent of total energy consumption and virtually 100 percent of household energy consumption. In contrast, commercial activities in Bhutan were fueled mostly by hydroelectricity (about 97%), some fossil-fuel based thermal power (about 3%), and a minimal amount of other fossil fuels. As a result, Bhutan sold much of its hydroelectricity to India during summer months.

To date, the Bhutanese electric energy supply has been virtually entirely hydroelectric. Due to the vulnerability of the water supply amid climate change, the Bhutanese government began exploring alternative energies such as solar, wind and biogas energy in the early 21st century.



Energy mix of Bhutan for FY 2007

9.2.a Hydropower plants

Bhutan operates four major hydroelectric facilities, several small and mini hydroelectric generators, and a handful of further sites in development. Many of the small and mini hydropower plants in Bhutan serve remote villages that remain disconnected from the main power grid. Almost all of hydroelectric plants in Bhutan generate power through run-of-the-river hydroelectricity.

9.2.b Alternative energy

In the face of climate change and growing energy demands, Bhutan has sought additional energy security through developing its alternative energy sources.
Solar energy in Bhutan has received direct investment from domestic and international sources. In 2010, Asian Development Bank made a grant of over USD21 million for electrification of rural homes, aiming to provide power both on-grid and off-grid. The Bhutan Power Corporation provided solar electrification training for villagers from rural eastern areas of Bumthang, Lhuentse, Mongar, Pemagatshel, Samdrup Jongkhar, Sarpang, and Wangdue Phodrang Districts Solar powered lighting is also available to many nomads living within protected areas of Bhutan.

In order to shift household dependence on firewood, Bhutan began re-exploring biogas development from cow dung. This included a five-year trial program in Chukha, Samtse, Sarpang, and Tsirang Districts from 2011 to 2015. Bhutan had previously explored generating biogas in an identical fashion in the 1980s, but the program was abandoned after failures in training of masons and users, after-sales service, and site follow-up.

In 2010, pilot windmill programs were implemented to investigate the feasibility of using wind energy to alleviate hydropower drops during the dry winter seasons.

9.3 Analysis of the costs, incentives and tariff structure

The approved tariff of BPC is given below.

ELECTRICITY TARIFFS

Tariff Structure		1st October 2013 – 30th June 2014	1st July 2014 – 30th June 2015	1st July 2015 – 30th June 2016
Low Voltage				
LV Block I (ruraldomestic) (0-100 kWh)	Nu./kWh	0	0	0
LV Block I (others)(0-100 kWh)	Nu./kWh	0.98	1.12	1.28
LV Block II (all)(>100-300 kWh)	Nu./kWh	1.86	2.13	2.45
LV Block III (all)(>300 kWh)	Nu./kWh	2.46	2.82	3.23
LV Bulk	Nu./kWh	2.56	3.07	3.68
Medium Voltage				
Energy Charge	Nu./kWh	1.98	2.19	2.43
Demand Charge	Nu./kWh/month	155	195	235
High Voltage				
Energy Charge	Nu./kWh	1.67	1.81	1.96
Demand Charge	Nu./kWh/month	130	155	180
Wheeling	Nu./kWh	0.114	0.114	0.114

- Tariff Approval for the period from 1st October 2013 to 30th June 2016

(#16.7 Tariff structure of Bhutan)

The BPC received capital grant of Nu or Rs. 11.212 million during the year for executing rural electrification works.

Power sector of Bhutan at a glance

Description	MW	GWh	Time line
Chukha	336	1860	1986-88
Kurichhu	60	400	2001
Basochhu I	24	106	2001
Basochhu II	40	186	2004
Tala	1020	4866	Sept. 2006-Dec. 2006
Mini/Micro	8.068	24	1967-2005
Total Capacity:	**1488.07**	**7442**	
Length of 220 kV transmission lines	158.69 km (includes D/C & S/C)		
Length of 132 kV transmission lines	261.189 km		

(#16.08 Power structure of Bhutan)

The Asian Development Bank (ADB) assistance to the developing member countries has been consistent with the government policies, and ADB's corporate strategies and policies. ADB has responded well to the demand from energy deficient and expanding economies by significantly increasing assistance to the energy sector, including for rural areas.

Over time, the quality of rural electrification (RE) projects at entry has improved with better and flexible indicators in design and monitoring frameworks. However, a content analysis of 24 loans, 49 technical assistance, and 8 grant documents suggests that only 24% of loan, 7% of

technical assistance, and 13% of grant project indicators met all five smart attributes—specific, measurable, achievable, relevant, and time bound.

9.4 Proposed action plan (s)& recommended Policy options for successful implementation of rural electrification

Rural Electrification has almost been completed in Bhutan. However, with advanced technologies and with the need for renewable, more energy sources might be needed to be set up soon. The Government has to keep doing what it is currently doing and convert the 94% rural houses with electricity to a 100%. Other countries can take note of the efficient approach by Bhutan, however, with a population of a quarter of a million people, their policies were much easier to implement.

The prime intent of the energy and energy systems guidelines is to enable reduction of energy consumed by buildings through appropriate site planning, climate responsive design of buildings, efficient lighting and space heating/ cooling. Integration of renewable energy for water heating and possible generation of electricity by renewable (non-grid, other than the hydro-power based) may also be explored given the key criterion of energy security issues of the country and to also further reduce the carbon emissions. Some of these guidelines proposed in this section are also being looked into more detailed manner at building scale by the ongoing work on "Development of Green Design Guidelines for Buildings", Department of Engineering Services, Ministry of Works and Human Settlement.

9.4.a Guideline 2.2: Renewable Energy Systems

These guidelines on solar hot water and solar photovoltaic system are in addition to the guidelines being proposed by the Department of Renewable Energy which is working on implementation of renewable energy systems in the country. The guidelines proposed by the Department of Renewable Energy shall prevail over the guidelines proposed in this section. The section has been proposed to maintain the integrated approach of sustainable settlements.

9.4.b Solar hot water system

- It is recommended to provide solar hot water system in all types of new commercial, hospitality, health, institutional and residential buildings.
- The capacity of the solar hot water system should be determined as per the requirement of particular building type.
- In residential and light commercial buildings solar hot water system should be integrated preferably in roof of the building, wherever possible so that the panel become the integrated part of the roof.
- In case of new commercial, health, hospitality and institutional buildings, it is recommended to have open space on the rooftop which receives direct sun light.
- The load bearing capacity of the roof shall be at least 50 kg/ m2. All buildings of these categories must complete installation of solar hot water system before these get occupied.
- All the solar hot water heating systems should be equipped with automatic electric power back up so that same may be functional during cloudy or low sunshine days.
- Provision in the building design itself should be kept for an insulated pipeline from the rooftop in the building to various distribution points where hot water is required.
- The installation of solar hot water system should be as per the accepted domestic or international standards.

9.4.c Solar Photovoltaic Panel (SPV) for lighting

- It is recommended that the solar photovoltaic panels be integrated preferably in the building design for providing indoor lighting and emergency lighting.
- Stand-alone solar PV lighting along with electric back up may be provided for outdoor lighting applications i.e. street lighting and common area lighting.

9.5 Rural Electrification Policy of Bhutan

Advocating the development philosophy called "Gross National Happiness (GNH)," the Government of Bhutan has been pursuing, without placing too much emphasis on economic growth expressed in GNP, the establishment of a fair and happy society. In a long-term vision "A Vision for Peace, Prosperity and Happiness" which was established in 1999 for the

realization of the above-mentioned philosophy, rural electrification is identified as an important objective along with road construction from the viewpoint of reducing the disparity between urban and rural areas, reducing poverty, and promoting industries. The 9th Five-Year Plan (July 2002–June 2008) that was developed in line with the long-term vision sets the target of electrifying 100% of households by 2020 and the master plan for achieving a household electrification rate of 100% in rural areas was worked out by JICA in October, 2005. This project is to be implemented as part of the rural electrification plan drawn up by the Government of Bhutan under the 10th Five-Year Plan (July 2008-June 2013) and is based on JICA's master plan.

JBIC's Policy and Past Activities of Assistance in Rural Electrification JBIC's Medium-Term Strategy for Overseas Economic Cooperation Operations (established in April,2005) mentions "poverty reduction" as one of the priority areas and sets out a policy of focusing on "assistance in geographical areas that are heavily inhabited by the poor" including infrastructure development in rural areas. Therefore, the assistance in this project is consistent with the above strategy.

9.6 Rural Electrification Department

(Ref. BPC Annual report 2012)

Bhutan Power Corporation Limited (BPC) has been entrusted to fulfill one of the most important development priorities of the country, i.e. "Electrification for All by 2013", which involves reaching grid electricity to 40,257 rural households.

The entrustment of this mandate posed a huge challenge to BPC, of the fact that up to the end of the 9th FYP; only 52% was the coverage of Rural Electrification (RE). This entrustment is remarkably reflected in the performance achieved by the Rural Electrification Department during the year. Against all challenges 688.37km of MV lines, 778.21 km of LV lines, and 620distribution substations were added in the distribution network system. We were able to connect6,791 rural homes to grid electricity. BPC through its own funding carried out Fill-in RE of around 1,119 households. Overall, BPC has lit around 31,475 rural homes against the estimated target of 40,257 homes as on December2012. This connection takes the RE coverage to 89%. BPC will be completing most the RE works which had been entrusted by second quarter of the fiscal year 2013. However, it is anticipated that few packages will be spilled over mainly due to challenges arising from geographical terrains, harsh climatic conditions and inaccessibility to road. This has led to transportation of RE materials as being a major challenge. On top of that, the contractors are facing major challenges with the workforces since labourers are not willing to work on such complex and difficult environment. Despite all these, RED is all set to complete the target and help achieve electricity for all by 2013 and enhance the quality of living in our countryside.

Transformer transported across Chumkhar Chu without bridge

9.7 Alternative Renewable Energy Policy 2013

With some of these trends and challenges in mind, the Bhutan Sustainable Hydropower Development Policy 2008 and the Economic Development Policy (EDP) 2010 recognize the need for a Renewable Energy (RE) Policy to promote the use of available RE sources to strengthen national energy security. Promotion of RE in the country presents a unique challenge as Bhutan enjoys availability of adequate low-cost hydropower that is green and clean. The cost of RE generation is not competitive with hydropower generation if only cost of generation is considered. However, if the benefits of a more diversified energy system are considered, the rationale for supporting generation is clear. To realize diversified RE potential, it is however necessary to develop targeted policies, supported by shifting existing subsidies away from other sources of energy such as fossil fuels and current grid electricity, toward other RE technologies.

In pursuit of this objective, this Alternative Renewable Energy Policy, built by taking cues from the Integrated Energy Management Master Plan 2010 and efforts of the Rural Electrification Master Plan2005, intends to provide the necessary direction for the promotion and development of RE that not only contribute to meeting the current energy requirements but also shaping future energy options for the Country. This Alternative RE Policy aims to contribute to sustainable development, climate change mitigation, energy and economic security, and conservation of environment in the Kingdom.

Management of energy demand shall be addressed in the Energy Efficiency Policy to be developed separately.

This Alternative Renewable Energy Policy aims to promote the following clean RE technologies: solar (both PV and thermal), wind, bio-energy, geo-thermal, pico/micro/mini/small hydro and waste to energy (WTE). This Policy shall cover, inter alia, the following areas of RE interventions:

a) Stand-alone systems,
b) Decentralized Distributed Generation (DDG) systems,
c) Grid-connected RE systems,
d) Fossil fuel substitution through green energy sources like bio-fuels, electric and hybrid vehicles.

Renewable Energy Technology in this Policy shall cover solar (both PV and thermal), wind, bio-energy, geo-thermal, pico/micro/mini/small hydro up to 25 MW and waste to energy (WTE). While large hydro power (above 25 MW) is considered as renewable energy, it is not under the scope of this Policy.

The Alternative Renewable Energy Policy strives to ensure adequate provision and extensive use of modern energy services in rural areas, which have been largely dependent on firewood and kerosene for cooking, heating and lighting purposes.

The Alternative Renewable Energy Policy also strives to optimize and conserve the usage of grid-based power through promotion of dispersed energy generation options such as solar thermal, solar photovoltaic and other stand-alone systems. In remote locations/rural areas, community-based initiatives in the form of Decentralized Distributed Generation (DDG) or any other initiatives leading to promotion of RE sources shall be dealt on a priority basis. RE applications such as solar photovoltaic and thermal application in government buildings, institutions, hotels, and the residential sector shall also be promoted under this Policy.

In view of rising energy demand, the reliance on a single electricity source, increasing fossil fuel imports, and low hydropower production in winter months, it is critical to diversify the energy mix by harnessing other domestic sources of clean renewable energy to ensure energy security, economic development, and protection of the environment.

Recognizing the above premise, the long-term and short-term objectives of the RE Policy has been stipulated as follows:

A) Long-term objectives:
i) Contribute to energy security and broaden the energy portfolio through utilization of available renewable energy potential;
ii) Reduce GHG emissions and contribute to climate change mitigation;
iii) Promote green growth and enhance sustainable socio-economic development;
iv) Develop productive manufacturing capacity in the RE Sector; and
v) Develop a framework for Carbon Trading Mechanisms.

B) Short-term objectives:
i) Harness the potential of RE resources and adoption of RE technologies in the Country;
ii) Develop RE Master Plan for each of the RE technologies by mapping capacity, generation potential and cost of generation by location across the Kingdom;
iii) Design appropriate tariffs for various RE technologies to offer secure and stable market to investors and project developers with transparent, guaranteed and time-bound incentives provided by the Government;
iv) Enable, encourage and facilitate both public and private sector participation in the development of RE;
v) Set realistic target for RE in the energy-mix;
vi) Support and promote Research & Development in RE technologies with long term potentials as viable energy resources;
vii) Institutionalize the development of national and local capacities and capabilities for enhanced and optimum utilization of RE systems;
viii) Establish the necessary administrative processes, basic physical infrastructure and institutional mechanisms to implement the provisions of this Policy; and
ix) Strengthen regulatory functions in the RE sector.

This Policy sets out a preliminary minimum target of 20 MW by 2025 through mix of renewable energy technologies. This minimum target maybe increased following more detailed evaluations of resource potentials.
Specific targets include:

a. Electricity Generation
i) Solar – 5 MW
ii) Wind – 5 MW

iii) Biomass – 5 MW

b. Energy Generation
i) Biomass Energy System - 3 MW equivalent
ii) Solar Thermal System - 3 MW equivalent

c. Fossil Fuel Energy substitution in Transport Sector
i) 1000 kilolitres of oil equivalent 111,000MWh
ii) 20% of the state owned and 10% of the private vehicle fleet shall be encouraged to run on clean and green fuels by 2025

The above target does not include micro/mini/small hydro, which shall be developed separately on need basis.

d. This Policy shall be known as "Alternative Renewable Energy Policy2013".

i) This Policy shall come into effect from 8th April 2013 and will remain in force until superseded or modified by another Policy.

ii) All RE projects shall be governed by this Policy.

iii) The institutional arrangement outlines the roles and responsibilities of relevant organizations in the promotion of RE.

9.8 Department of Renewable Energy (DRE)

a) The Department of Renewable Energy (DRE) under the Ministry of Economic Affairs (MoEA) shall be the "Nodal Agency" or "NA" for implementation of the RE Policy. The NA shall be the focal point for sustainable energy development and promotion of RE sources.

9.9 Bhutan Electricity Authority (BEA)

a) BEA shall create a regulatory framework for the RE Sector as per the provisions of the Electricity Act to encourage electricity generation from RE sources.
ii) Besides these functions, the BEA shall design and develop the following:
(i) Feed-in-tariff as per the principles contained in this Policy and
(ii) Norms related to grid connectivity/interfacing and load dispatch, etc.

9.10 Ministry of Agriculture & Forests (MoAF)

a) MoAF shall collaborate with DRE to generate energy from the pico and micro hydropower/biomass/bio-fuels/biogas resources in the country.
b) MoAF shall collaborate with DRE in R&D for development of sustainable bio-energy technologies.
c) MoAF shall be responsible for providing sustainable source of biomass as a source of renewable energy fuel.

9.11 National Environment Commission (NEC)

a) NEC shall provide support for the promotion and development of renewable energy projects.
b) NEC shall have the overall coordination responsibility with regard to water issues in its capacity as the custodian of Water Act.
c) NEC shall ensure expedient, efficient, and priority processing and issuance of clearances/permits to help promote the development of renewable energy projects.

9.12 Ministry of Information and Communication (MoIC)

a) MoIC shall collaborate with NA/MoEA and provide policy and other support towards substitution of fossil fuel by green energy sources in the transport sector.

9.13 Thromdes

a) Thromdes shall collaborate with NA/MoEA and provide policy and other support towards substitution of fossil fuel by green energy sources in urban transport, street lighting and district heating systems.

b) Thromdes shall provide policy and other support towards conversion of waste to energy and for promotion of green buildings.

c) The implementation mechanism will include the mapping of RE resources, identification of potential project sites, and preparation of techno-economic feasibility studies, allocation and development of RE projects.

e. DDG projects

Tariff determination

i) BEA shall determine the tariff for various RE technologies.

ii) The existing DDG projects, owned by the NA (including ones that are handed over to community for O&M) or community or private developers shall have the option to sell electricity to the distribution utility once the national grid reaches the area. The distribution utility shall be obligated to purchase power from such plants as may be directed by the Government.

f. Once the national grid reaches to the area, for the project developed by the NA, BPC may be directed to takeover such projects for O&M against a fee to be paid by the NA.

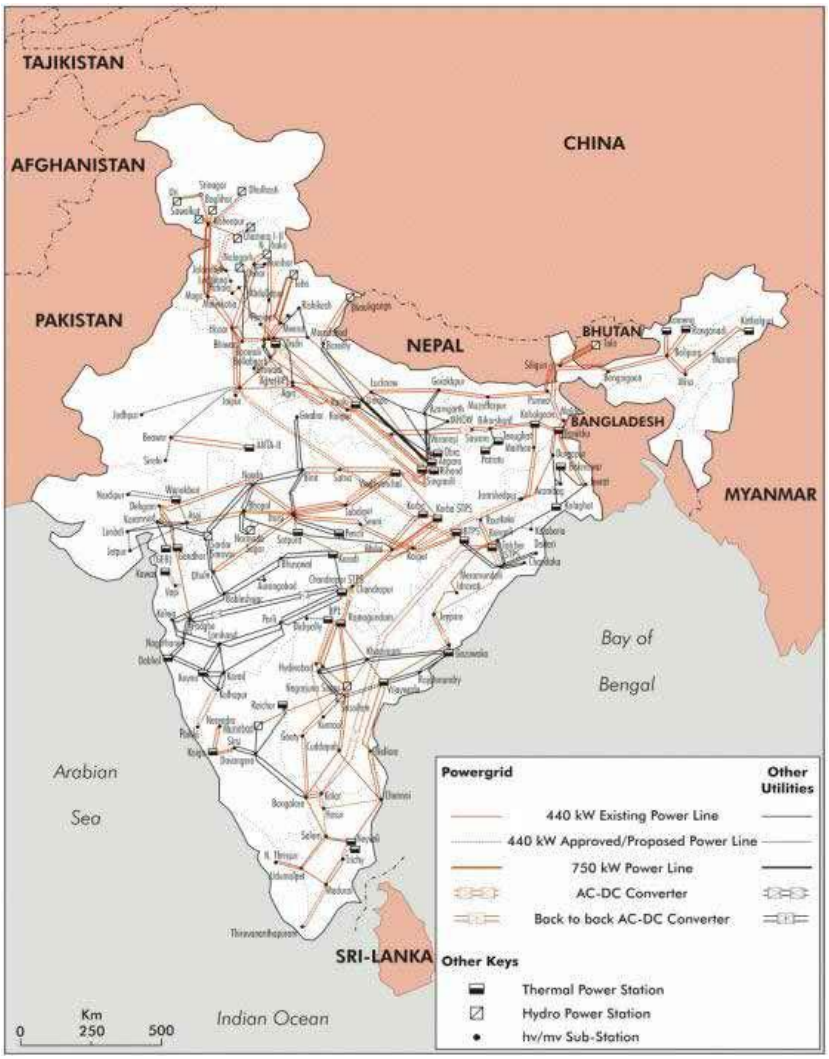
g. The subsidy shall be determined for such projects taking into consideration the project cost at the beginning of the project, subsidy availed by the projects, returns accrued by the project so far, remaining life term of the project, and a normative return as per the tariff determination guidelines, rules and regulations.

h. Payments against the sale of electricity from the projects owned by NA shall be deposited into the REDF.

9.14 Future Plan and Recommendation

Bhutan has almost finished it Rural electrification program. Its main advantage was small piece of land, reasonable population, comparatively low demand and abundant resources.

10. Rural Electrification in India



(# 17.07 Electrical map of India)

Rural Electrification in India

10.1 Introduction

India is a country in South Asia. It is the Seventh-Largest country by area and second-largest by population and most populous democracy in the world. India shares its political borders with Pakistan and Afghanistan on the west and Bangladesh and Myanmar on the east. The northern boundary is made up of the Sinkiang province of China, Tibet, Nepal and Bhutan. India is separated from Sri Lanka by a narrow channel of sea formed by the Palk Strait and Gulf of Mannar. Its capital is New Delhi.

10.2 Institutional structures for rural electrification

The electricity sector in India had an installed capacity of 253.389 GW as of end August 2014. India became the world's third largest producer of electricity in the year 2013 with 4.8% global share in electricity generation surpassing Japan and Russia. Captive power plants have an additional 39.375 GW capacity. Non Renewable Power Plants constitute 87.55% of the installed capacity, and Renewable Power Plants constitute the remaining 12.45% of total installed Capacity.

As a result of this massive growth in electricity production, the electricity use has increased in last few years. It's given below

Trends in Per-Capita Energy Consumption (kWh Per year)

Year	Per capita consumption kWh/year	Remarks
2006-07	3727	
2007-08	3928	
2008-09	5568	
2009-19	6064	
2010-11	6211	
2011-12	6420	

(#16.09 Trends in Per-Capita Energy Consumption)

Initial rural electrification varied from State to State. Since States had enough autonomy so many had adopted Tariffs for popularity like free electricity for irrigation consumers and poor villagers. All this though increased the popularity of the Leaders but it made the rural electrification unstable, people were without electricity for hours together. After all who will pay for free electricity?
As a part of the efforts of Govt. of India to achieve the goal "Electricity for All", rural electrification has been identified as a major thrust area. For this purpose an "Accelerated Rural Electrification Project" for electrification of One Lakh Villages and One Crore Households was launched in February 2004 as a national programme with an overall outlay of

Rs. 6,000 Crores in which 40% was grant and 60% loan. The Central Government, in the last Finance Bill has enhanced the grant component to 90%. A plan for rural electrification – The Rajiv Gandhi GrameenVidyutikaranYojana (RGGVY) – has been launched to extend rural electricity services to hitherto un-electrified areas, with requisite additional funds provided for in the Union Budget.

With the largest rural population in the world, India is facing a huge electrification challenge. Today, 64.5% of India is electrified, with an electrification rate of 93.1% in urban settings but only 52.5% in rural areas. This has been achieved mainly through grid extension or small-scale renewable energy systems. Strong political will and sufficient funds have, since the beginning of the 11th Five-Year Plan, accelerated the speed of electrification. But India is currently faced with insufficient electricity generating capacity, which is seriously hindering the implementation of future rural electrification programmes and undermining their viability.

Over the past few years, many restructuring policy reforms have been initiated in power sector but key challenges are yet to be addressed. Some of the constraints faced by the sector are growing demand at rapid rate, losses borne by ailing power distribution companies, accessibility of quality and affordable power. In order to make the metric for measuring level of rural electrification somewhat meaningful, it has been decided to revise the definition of village electrification and a new proposed definition of village electrification is as under:

- Basic infrastructure such as Distribution Transformer and Distribution lines are provided in the inhabited locality as well as the Dalit Basti/ hamlet where it exists. (For electrification through Non-Conventional Energy Sources a Distribution transformer may not be necessary).
- Electricity is provided to public places like Schools, Panchayat Office, Health Centers, Dispensaries, Community centers etc. and
- The number of households electrified should be at least 10% of the total number of households in the village.

(Ref. http://www.indianelectricity.com/rural.html)

Rural Electrification Corporation Limited (REC) is a leading public Infrastructure Finance Company in India's power sector. The company, which is a NAVRATNA Central Public Sector Enterprise under Ministry of Power, was incorporated on July 25, 1969 under the Companies Act 1956. REC is a listed Public Sector Enterprise Government of India with a net worth of Rs. 20,669.46 Crore as on 31.03.14. Its main objective is to finance and promote rural electrification projects all over the country. It provides financial assistance to State Electricity Boards, State Government Departments and Rural Electric Cooperatives for rural electrification projects as are sponsored by them.

REC provides loan assistance to SEBs/State Power Utilities for investments in rural electrification schemes through its Corporate Office located at New Delhi and 20 field units, which are located in most of the States. The Project Offices in the States coordinate the programmes of REC's financing with the concerned SEBs/State Power Utilities and facilitate in formulation of schemes, loan sanction and disbursement and implementation of schemes by the concerned SEBs/State Power Utilities.

The Mission of REC is to:

- To facilitate availability of electricity for accelerated growth and for enrichment of quality of life of rural and semi-urban population.
- To act as a competitive, client-friendly and development-oriented organization for financing and promoting projects covering power generation, power conservation, power transmission and power distribution network in the country.

(Ref. India Energy Statistics – 2013)

10.3 Analysis of the current rural electrification programmes and objectives

As on 31st August 2013, a total of 32,227 villages of India are yet to be provided with electricity access. Out of a total of 593,732 inhabited villages as per the 2001 census, as on 31st August 2013, a total of 561505 villages were electrified.

Status of Village Electrification in India

	Total inhabited Villages as per 2001 Census	Villages electrified as on 31/03/2013 as per new definition (Provisional)		Cumulative achievement as on 31/08/2013 as per new definition	%age of villages electrified as on 31/08/2013	Unelectrified villages as on 31/08/2013(V)
		No.	%			
India	593,732	560552	94.4	561505	94.6	32227

(# 16.10 Statistics of village electrification (of India))

There are different programmes in India to implement rural electrification. The major ones are:

10.4 The Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) scheme

In February 2005, a large-scale electrification effort, the Rajiv Gandhi GrameenVidyutikaranYojana(RGGVY) scheme was launched by the MoP to speed up rural electrification under the "Power for all by 2012" initiative. The RGGVY is a major programme of grid extension and reinforcement of the rural electricity infrastructure. "By 2009/10 the RGGVY aims to electrify the 125 000 villages still without electricity; to connect all the estimated 23.4 million un-electrified households below the poverty line with a 90% subsidy on connecting costs granted by the Ministry of Power; and finally, to augment the backbone network in all 462 000 electrified villages. The 54.6 million households above the poverty line which are currently un-electrified are expected to obtain electricity connection on their own without any subsidy" (Planning Commission, 2005). The RGVVY policy therefore aims at:

- "Provision of electricity access to all households (including rural households) by year2009 (which includes 23.4 million households living below the poverty line);
- Quality and reliable power supply at reasonable rates; and
- Minimum lifeline consumption of 1 kWh per household per day as a merit good by year2012." (Ministry of Power, 2008)

However, the electrification programme as envisaged under RGGVY was too slow during the 10thplan period. In January 2008, the RGGVY was further extended into the 11th plan period (2007-2012) with the following new conditions for its better implementation:

- States are to ensure a minimum of 6 to 8 hours of power supply;
- States are to ensure quality and reliable power supply at reasonable rates;
- The deployment of franchisees is mandatory for the management of rural distribution;
- Introduction of the three-tier Quality Monitoring Mechanism to ensure quality of materials and implementation; and

- States are to notify their rural electrification plans to the Rural Electrification Corporation (REC) within six months.

Means of electrification in rural areas under the RGGVY
Under the RGGVY, projects would be financed for provision of the following systems:

- A Rural Electricity Distribution Backbone (REDB) with 33/11 kV (or 66/11 kV) sub-station of adequate capacity in every block where none exists;

- Village Electrification Infrastructure (VEI) with provision of distribution transformer of appropriate capacity in villages/habitations; and

- Decentralized Distributed Generation (DDG) systems based on conventional sources where grid supply is not feasible or cost-effective.

Under the RGGVY scheme, the first approach to village electrification will be through grid extension. Where grid connection is either not feasible or not cost-effective, then stand-alone systems are considered which can be powered by renewable energy sources or conventional sources, namely through DDG systems. All infrastructures must be grid-compatible in order to ensure that when a village is ultimately connected to the grid, prior investments are not lost. In DDG projects of the RGGVY, the renewable energy technologies currently used are diesel generating sets powered by biofuel (non-edible vegetable oils); diesel generating sets powered by producer gas generated through biomass gasification, solar photovoltaic, and small hydropower plants. Other technologies, such as diesel generating sets powered by biogas (from animal waste), wind hybrid systems or other hybrid systems, including any "new" technology, are currently not yet popularly used for DDG in India, but may be used in the future. Moreover, although diesel is the easiest form of decentralized power generation, the government of India encourages its use only for stand-by options or in the case of temporary disruption of renewable energy supply. The general rule of thumb supposes that the technology with the lowest marginal cost and which is considered the most appropriate and effective technological option for the area will be chosen.
Achievements of the RGGVY

During the 10th plan, 235 projects sanctioned at an investment of INR 97.33 billion41 (approximately USD 2.43 billion) covered the electrification of 65 419 un-electrified villages and provision of free electricity connections to 8.31 million BPL household. At the end of the 10th plan period (31/03/2007), 38 525 villages were electrified and 672 000 BPL households had been provided with electric connections.
After approving the continuation of RGGVY in the 11th plan, in September 2009, the MoP had sanctioned 332 projects for the period covering the electrification of 49 736 un-electrified villages, the intensive electrification of 242 439 electrified villages and free electricity connections to 16.2 million BPL households. During the 11th Five-Year Plan, focus has been on states that had a heavy backlog of un-electrified villages and BPL households, as well as on special category states (such as north-eastern states, Himachal, J & K and Uttarakhand), border districts and districts led by left wing extremism.

In September 2009, a total of 567 projects had been sanctioned under the RGGVY, covering the electrification of 118 499 villages, the intensive electrification of 354 375 already electrified villages and the free electricity connections of 24.6 million BPL households at an estimated cost of INR 262.56 billion (approximately USD 5.421 billion) as show in Table 21. The expected completion cost is estimated as INR 330 billion (or USD 7 billion).

10.5 The Remote Village Electrification (RVE) Programme

Targets

Since 2005, the RVE programme of the Ministry of New and Renewable Energies (MNRE) has been supplementing the efforts of the Ministry of Power (MoP) through complementary measures for the provision of basic lighting/electricity facilities through renewable energy sources. The Remote Village Electrification programme (RVE) is responsible for electrifying un-electrified remote census villages (with a population of less than 100 inhabitants and remote un-electrified hamlets of electrified census villages where grid connection is either not feasible or not economical (because they are located in forests, hills, deserts or islands) and where DDG projects are not implemented by the RGGVY of the MoP. The scope of the RVE is the provision of electricity for:

- "All un-electrified remote census villages by 2007;
- All households of un-electrified remote census villages by 2012; and
- All un-electrified remote hamlets of electrified census villages by 2012."

The RVE programme is implemented in the states by state-notified implementing agencies, which receive 90% capital subsidy from the MNRE. A remote village or remote hamlet will be considered electrified if at least 10% of the households are provided with lighting facility. Under the RVE programme, the electrification process entails choosing the most adequate energy technologies through the identification of locally available energy resources. However, in the case where these solutions are proven unfeasible, and if the only means for electrification is through use of isolated lighting systems (such as solar PV), these should be taken up. However, the remote villages receiving them should not be declared electrified. In fact, where the population is scarce and remote, there is often no other renewable energy option but the installation of solar photovoltaic (SPV) home lighting systems. According to the MNRE, a total of 95%, a large share of remote census villages are provided with solar photovoltaic home lighting systems. However, these villages are not considered properly electrified until further solutions are implemented.

Means of electrification

Under the RVE programme, solar photovoltaic home lighting systems, small hydropower plants, biomass gasification systems in conjunction with 100% producer gas engines or with dual-fuel engines using non-edible vegetable oils, non-edible vegetable oil-based engines, biogas engines, solar photovoltaic power plants are the most commonly used by the MNRE. However, the vast majority, 95%, of remote census villages taken up for electrification under the programme are provided with SPV home lighting systems. Many villagers in remote areas serviced under the RVE programme that are not recipients of grid distributed power feel discriminated against when they are provided with what they feel is "second class electricity". Such complaints have been taken up by some political parties which have been exerting pressure for grid power to reach their constituents, as opposed to stand-alone systems. As a consequence, the list of villages to be electrified under the Remote Village Electrification (RVE) scheme is being shortened each year. In any case, such electrification is still considered an interim solution as; ultimately, the grid is expected to reach these regions.

Achievements of the RVE

The RVE programme of the MNRE covers remote un-electrified villages which are not covered under the RGGVY. In March 2009, the cumulative sanctions under the RVE programme had reached 9 355 villages and hamlets of which 5 410 have been successfully electrified. At the end of the 11th Plan, a total of 10 000 villages and hamlets should be covered. By March 2009, 2 600 villages and hamlets had been electrified.

10.6 The Jawaharlal Nehru National Solar Mission (JNNSM)

The Jawaharlal Nehru National Solar Mission was launched on 23 November 2009 in a statement to Parliament by the Union Minister for New and Renewable Energies. This mission is part of the 2008 Indian National Action Plan on Climate Change (NAPCC) which seeks to reduce India's future reliance on non-renewable energy sources. Although the JNNSM has not been established to foster rural electrification *per se*, it does mention the use of solar energy as a means for rural electrification, thus helping the MNRE with its electrification goals. By the end of the 13th Five-Year Plan, in 2022, the JNNSM should have led to an installed capacity of 20 000 MW and the deployment of 20 million solar lighting systems in rural areas.

10.7 Analysis of the costs, incentives and tariff structure

The following table gives an overview of the status of village electrification across the 29 states of India.

Status of Rural Electrification in India

Sl No	Percentage of Electrified Villages	Total Number of States	Names of the States
1	100%	9	Andhra Pradesh, Delhi, Goa, Haryana, Karnataka, Kerala, Punjab, Sikkim and Tamil Nadu
2	90-99%	12	Assam, Bihar, Gujarat, Himachal Pradesh, Jammu and Kashmir, Madhya Pradesh, Chattisgarh, Maharashtra, Mizoram, Rajasthan, Uttaranchal and West Bengal
3	81-90%	4	Jharkhand, Manipur, Meghalaya, Uttar Pradesh
4	71-80%	4	Arunachal Pradesh, Nagaland, Orissa, Tripura

Source: Central Electricity Authority

http://www.cea.nic.in/reports/monthly/dpd_div_rep/village_electrification.pdf

(# 16.11 Status of rural electrification in India)

10.8 All India tariff for rural electrification

The tariff for rural electrification varies from state to state, and also varies from metered supply to flat monthly tariffs.

The flat monthly tariffs vary from Rs. 30/- a month to Rs. 60/- per month and the metered supply varies from a low of Rs. 0.60 per kWh to a high of Rs. 3.11 a kWh. The following table presents the tariffs across the major states of India.

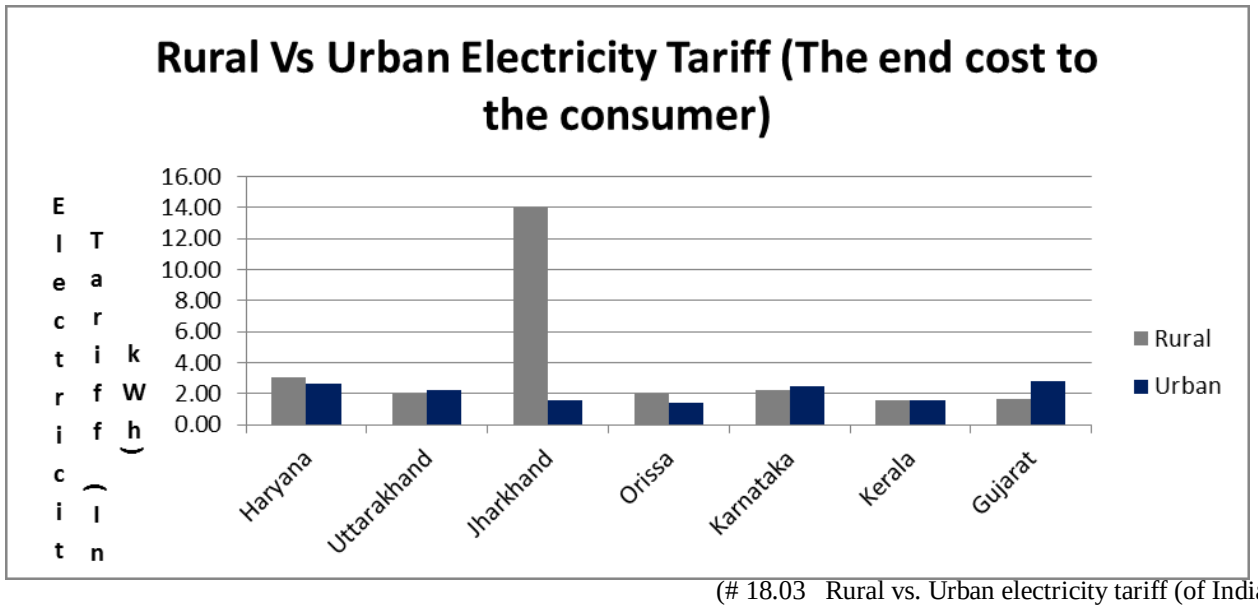
Table: Rural Electricity Tariffs across States in India

State	Base tariff for Rural Consumers (Rs./kWh)
Arunachal Pradesh*	Rs. 2.30/kWh
West Bengal	Rs. 2/ kWh
Karnataka*	Rs. 2/kWh (0-30 units)
Jammu & Kashmir	Metered Rs. 1/kWh (0-30 units), unmetered Rs. 65/- for ¼ KW
Kerala*	1.55/kWh (0-40 units)
Haryana*	Rs. 2.63/kWh (0-40 units)
Sikkim*	Rs. 0.60/kWh (0-50 units)

Bihar	Unmetered Rs. 35/month, metered consumer Rs. 1.2/kWh
Mizoram	Metered Rs. 1/kWh (0-30 units), unmetered Rs. 20/month
Andhra Pradesh*	Rs. 1.45 (0-50 units)
Rajasthan	Rs. 1.95/kWh (0-50 units)
Gujarat	Rs. 1.50/kWh (0-30 units)
Madhya Pradesh	Metered Rs. 3.15/kWh (0-50 units), Unmetered Rs. 3/kWh (0-30 units)
Goa*	Rs. 1/kWh (0-60 units)
Orissa	Unmetered Rs. 30 for 1 KW, metered consumers Rs. 1.40 (0-100 units)
Chhattisgarh*	Rs. 1.80/kWh (0-100 units)
Uttarakhand	Metered Rs. 1.50/ kWh, unmetered Rs. 120/connection for hilly areas and Rs. 250/connection for other areas
Meghalaya	Metered Rs. 1.70/kWh, unmetered Rs. 60/connection/month
Manipur*	Rs. 2.60/kWh (0-100 units)
Maharashtra*	Rs. 2.75/kWh (0-100 units)

- * States where rural and urban domestic tariffs is the same

(16.12 Rural Electricity Tariffs across States in India)

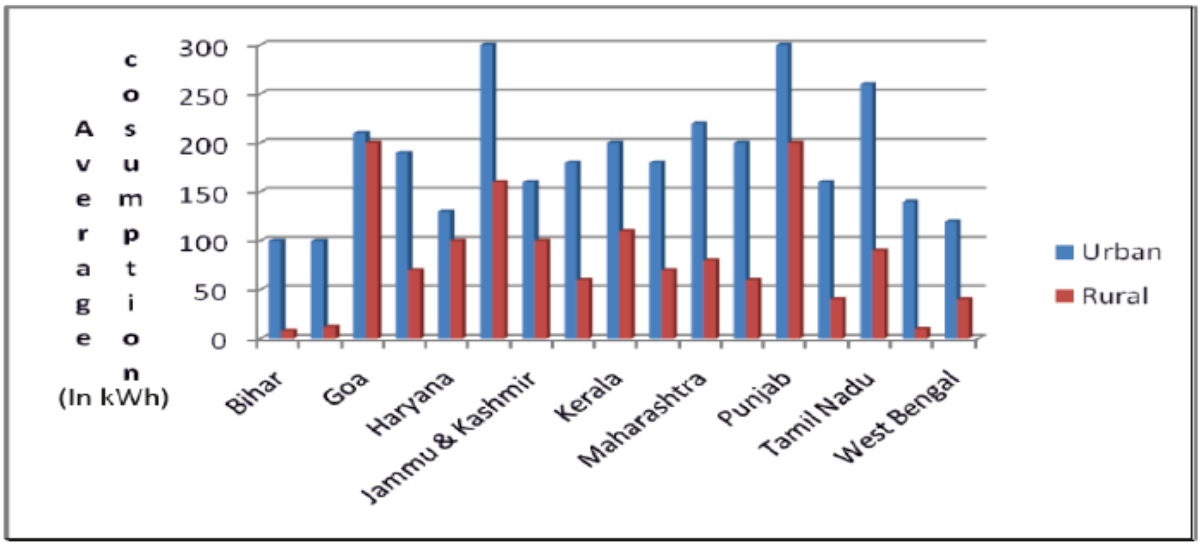


(# 18.03 Rural vs. Urban electricity tariff (of India))

With the exception of Gujarat, Uttarakhand and Karnataka, the cost of electricity paid by the rural consumers was more than what the urban consumer pays. However, in the case of Uttarakhand and Karnataka, the cost which the rural consumer pays is marginally less than what the urban consumer pays, while it is substantially less in the case of the rural consumer of Gujarat. On the other hand, in some states, particularly, Jharkhand, the rural consumer typically pays 8 times more than what the urban consumers pay.

The following figure gives an overview of the power consumption in urban vs. rural areas of select states.

Rural vs. Urban Power Consumption Pattern in some states

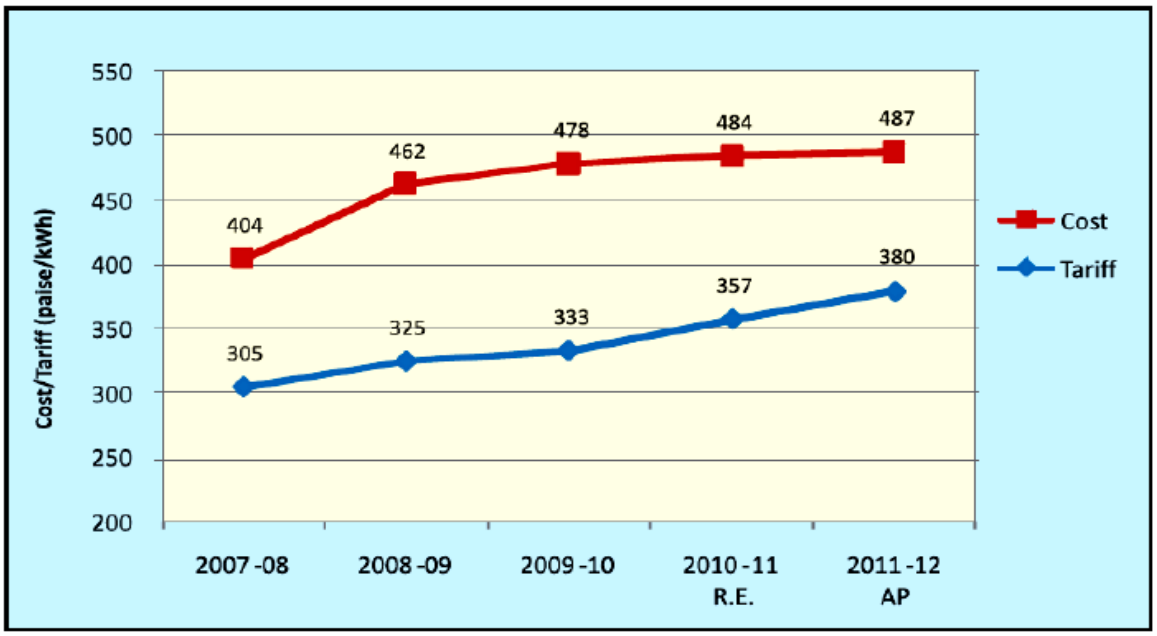


Source: Shifting of Goal Posts: A report on rural electrification, Vasudha Foundation

(# 18.4 Rural vs. Urban power consumption pattern of some States of India)

Following graph represent the average cost of power supply and the average tariff realized from 2007-08 to 2011-12.

Average Cost of Power Supply and Average Tariff Realized (paise/kWh) from 2007-08 to 2011-12



Note: R.E.- Revised Estimate
A.P.- Annual Plan

Source: Planning Commission Annual Report 2011-12.

(#18.5 Average cost of power supplied realized in India)

The graph explains that although the average cost of power supply increased initially but in the later years it did not increased proportionately reaching a constant value over the years whereas tariff shows an increase over the years.

The following table shows the cost comparison of coal vs. other sustainable sources of electricity.

Cost Comparison of various sources of Electricity

Source of Fuel	Generation Cost per kWh (Rs.)	Transmission Infrastructure Cost Per Km for a load of 100kW	Other Maintenance costs/distribution on infrastructure etc (per kWh)	Total Cost of Generation per kWh per km	Total Cost of Generation per kWh at a 5 Km distance from Grid/33KVA line	Total Cost of Generation per kWh at a 10 Km distance from Grid/33KVA line	Total Cost of Generation per kWh at a 15 Km distance from Grid/33KVA line	Life of the Unit
Coal	Rs. 2.00	Rs. 1	Rs. 0.50	Rs. 3.50	Rs. 7.50	Rs. 12.50	Rs. 17.50	30 years
Solar PV	Rs. 9.00	Nil	Rs. 0.20	Rs. 9.20	Rs. 9.20	Rs. 9.20	Rs. 9.20	25 years
Biomass	Rs. 4.25	Nil	Rs. 0.50	Rs. 4.75	Rs. 4.75	Rs. 4.75	Rs. 4.75	15 years
Micro Hydro	Rs. 4.20	Nil	Rs. 0.30	Rs. 4.50	Rs. 4.50	Rs. 4.50	Rs. 4.50	25 years
Wind	Rs. 4.50	Nil	Rs. 0.30	Rs. 4.80	Rs. 4.80	Rs. 4.80	Rs. 4.80	25 years

Sources: (1) Shifting of Goal Posts: A report on rural electrification, Vasudha Foundation;
(2)http://www.climateparl.net/cpcontent/Publications/RE%20Briefing%20Paper%203%20-%20Costs.pdf

(#16.13 Cost comparison of various sources of electricity)

10.9 Country-specific challenges in rural electrification including access and availability

The table below shows that in the year 2011-12, all the regions of India had a fairly large shortfall in supply with respect to demand for electricity. The all India shortage of electricity supply was 8 percent in relation to the demand.

Table: Electricity Demand vs. Supply Status in India (2011-12)

Region	Energy				Peak			
	Requirement	Availability	Surplus / Deficit (-)		Demand	Met	Surplus / Deficit (-)	
	(MU)	(MU)	(MU)	(%)	(MW)	(MW)	(MW)	(%)
Northern	276,121	258,382	-17,739	-6.4	40,248	37,117	-3,131	-7.8
Western	290,421	257,403	-33,018	-11.4	42,352	36,509	-5,843	-13.8
Southern	260,302	237,480	-22,822	8.8	37,599	32,188	-5,411	-14.4
Eastern	99,344	94,657	-4,687	-4.7	14707	13,999	-7,08	-4.8
North-Eastern	11011	9,964	-1,047	-9.5	1,920	1,782	-138	-7.2

Source: Central Electricity Authority, Load Balance Generation Report (2012-13)

(#16.14 Electricity Demand vs. Supply Status in India (2011-12)

While the national average of deficit power supply with respect to demand was 8.8 percent, in some months, it was as high as 11- 13 percent. The burden of the shortage of power supply with respect to demand is currently being imposed on rural consumers.

Some of the challenges faced in Rural electrification of India are as follows:

a. Incomplete coverage:

Only 86% of the villages have been electrified. However, there has been an 85% reduction in the outlay for rural electrification in the Ninth Five-Year Plan as compared to the Seventh Plan.

The rate of electrification of villages has been steadily declining after the Seventh Plan. State agencies are not so keen in making investments in areas of village electrification and pump set energization. They consider it un-remunerative. Also, with increasing subsidies, the returns on

the investment affected the loan repaying capacity of the SEBs. There is not enough focus on this problem and it would take centuries at this rate to achieve the stated rural electrification objectives.

b. Faulty definition/Incomplete Data:

The definition of village electrification as adopted by the Government of India is: "A village will be deemed to be electrified if electricity is used in the inhabited locality within the revenue boundary of the village for any purpose whatsoever". Therefore, electrification of a village does not imply that all the houses in a village have electricity. It is not very clear from the reports scrutinized whether the low level of electrified households is because of lack of purchasing power or because of lack of grid support. However, as per the 1991 census, only 30% of the rural households had electricity.

c. Low demand, low consumption and shift in focus:

The lack of facility for domestic connection in initial stages, uncertainty of power, and load shedding and rostering schedule on an extensive scale dampened the demand for power in rural areas. The survey also indicated a very low consumption of electricity, 880 kWh per annum per consumer. The consumption pattern was 64% for agriculture, 14% for industry, 13% for domestic use, 4% for commercial use and 2% for street lighting. The low consumption can primarily be attributed to unreliable and poor quality of supply.

d. Long and cumbersome procedures:

Long and cumbersome procedures for getting a connection, bill paying facility and repair facility being too far off, were some of the factors that affected acceptability. It has also been observed that, starting from the electrification of village to the procurement of connection for the household, the time factor can vary from a couple of months to a few years.

e. Financially unviable.

Rural India is characterized by small settlements and considering the fact that the energy requirements of these settlements are much lower than compared to the urban and industrial centers, there is high cost of transmission along with severe transmission and distribution losses. Also, while the rural settlements are in close clusters, those in the hilly and forest regions are highly dispersed. Given such sparse nature of demand, the cost of providing power transmission lines becomes very high. Due to the isolated and scattered nature of most rural areas, difficulties in transportation of materials, equipment and machinery were often met because of the lack of accessible road to the remote areas. Also the issues of voltage drop and unreliability in distribution system is often caused because of the long distance of rural villages from the power sources.

f. Active Participation by Local Bodies (non-governmental organizations):

Local Bodies like NGOs, voluntary organizations, village panchayats etc. can be very effective because of their local presence and commitment to rural development, in catalyzing the process of bringing together the government agencies and the rural people. However, a majority of

voluntary agencies and NGOs frequently do not join hands with the government machinery within the framework of a common programme. Without a suitable coordination mechanism, the work of the NGOs is often restricted to sporadic demonstration projects, which makes a

limited impact on improving rural living conditions through sustainable rural development (http://www.fao.org, 10/09/02).

g. Lack of measures for capacity enhancement:

Electricity is seldom rated high by the rural communities in their priority as they often fail to recognize the importance and the linkage of energy in improving subsistence and production. One of the fundamental responsibilities of decentralized energy planning is to facilitate and empower the rural people to recognize the importance of energy and its relationship to their lives and their environment. In this regard, capacity enhancement needs to be an integral part of the planning process. The need is to build a cadre of trained planners, who, in a participatory manner, can assess the needs of the community and can develop a community-based plan for meeting the energy needs in an integrated manner. The inadequacy of trained manpower with professional skills in rural development energy assessment and planning is one of the major hindrances in decentralized planning. Hence, the planning process needs to allocate funds and resources for establishing and operationalizing a comprehensive mechanism for training of trainers (http://www.fao.org, 10/09/02).

h. **Over-emphasis on grid Rural electrification:**

Grid connection has remained the main approach to rural electrification in India. Indeed the latest government programme for rural electrification focuses in particular on a vast expansion of the existing grid to reach all villages by 2012. Most studies show the cost of delivery to rural areas to be around three times generation costs.

As the distance from the grid increases, the cost of grid connection also rises considerably. Overall, therefore, rural electrification has been financially non-viable, has reached the limits of its success and has become a large financial burden on electric utilities.
However, the policy - makers in the country have, over the years, considered that electric supply from the grid as a symbol of progress and consequently have laid over emphasis on it in the planning process. In this regard, the policy-makers have largely been influenced by the success of rural electrification programmes in the developed world. In contrast to the developed countries, in a developing country like India, with its large rural population and the much higher levels of poverty, the provision of grid electricity is economically unviable.

10.10 Energy technology options commonly used in rural electrification

So far the interpretation of rural electrification programs has been the extension of the grid to cover the rural areas, so far not covered. This has certainly helped in making electricity available to a significant section. However, there are several limitations to the approach of rural electrification being treated as a grid extension issue. Only recently, most of the planners and policy makers have realized the futility of trying to achieve 100% electrification through grid extension. There is need for more comprehensive approach to rural electrification.

Rural load is characterized by dispersed population and low demand (resulting in low load densities). This in turn causes high capital costs of grid electrification. In order to cut down on the cost, often there are low voltage lines being drawn over long distances resulting in poor supply conditions. Moreover, the high levels of ATC losses significantly increases the marginal cost on the part of the utility in serving rural loads. All these put together acts as a huge disincentive for utilities to carry out rural electrification. This needs to be seen in the light of the current environment, where the utilities are under pressure to improve performances and reduce financial losses. Evidently, this is not sustainable and there is a need to look for alternatives. Also keeping in mind the future aspects, and to obtain a sustainable energy source, the following renewable energy methods need to be implemented more strictly.
The main Renewable sources of Energy are:

a. Solar Power

India has huge untapped solar off grid opportunities, given its ability to provide energy to vast untapped remote rural areas, the scope of providing backup power to cell towers and it has inherent potential to replace fossil fuels. India is located in the equatorial sun belt of the earth

receiving abundant radiant energy from the sun. In most part of India, clear sunny weather is experienced about 250 to 300 days per year.
Solar energy is ideally suited for providing power to those areas not having power lines connecting it. Large parts of India do not have electricity grid connectivity and it is cheaper to power them through solar energy rather than extending power lines.

b. Wind Power

Wind energy like solar energy is a free energy resource. But it is much intermittent than solar. Wind speeds may vary within minutes and effect the power generation and in cases of high speeds may result in overloading of the generator. Energy from the wind can be tapped using turbines. The total cost can be cheaper than Solar systems but more expensive than Hydro. However, electricity production depends on wind speed, location, and season and air temperature. Hence various monitoring systems are required and most cost expensive.

c. Hydro Power

Hydropower is a renewable, non-polluting and environmentally benign source of energy. It is perhaps the oldest renewable energy technique known to mankind for mechanical energy conversion as well as electricity generation. It represents use of water resource towards initiation of free energy. Out of the total power generation capacity in the country, Hydro power contributes about 25% (January 2011).

d. Wind Hybrid

Wind power represents one of the most widespread and commercially viable renewable energy generation technologies, gaining significant levels of deployment across both the developing and industrialized world. Most of the wind energy deployment is grid connected. Due to supply variations it is less suited to off-grid standalone generation. However, when considered part of a hybrid system, alongside diesel, biomass or solar generation, wind turbines can be economically appealing. Decreasing capital costs as well as government incentives strengthen the viability of wind-hybrid systems. However difficulties in siting of turbines, combined with often undocumented local wind-speed variations, make effective deployment time and information intensive, reducing its suitability even in hybrid- configuration for small scale applications.

e. Bio fuel/Alternative fuel

The electric power demand in most Indian villages lies between 20kw-100kw and the locally available surplus biomass is often sufficient to meet these power requirements. Widespread availability of agriculture wastage, fuel wood, animal dung and wasteland make biofuel and biomass based energy appealing, with biomass gasification representing one of the most promising small-scale electricity generating technologies. The use of biomass gasification technology for rural electrification still remains limited, though with large potential across India.

For small-scale electrification, particularly community loads in rural areas, biomass gasification represent a sustainable and relatively low cost option for fulfilling basic electricity needs.
While policy and budgetary support for renewable energy have progressively increased over the years, particularly for large scale grid connected power, there continue to exist many barriers that hinder up- scaling of renewable energy deployment.

10.11 Proposed action plan (s) for successful implementation of rural electrification

The key recommendations are summarized below:

1. The specific approach to be adopted in a particular area must take into consideration a host of conditions in terms of characteristic load, indicative demand, capability of local governance systems, and feasibility of local participation, renewable energy potential, extent of grid penetration, distance from the main grid substations and current status of availability of grid power.

2. While there would be inevitable variations in the solutions implemented in various areas depending on local circumstances, this study envisages four broad categories of solutions for rural electrification needs:

(i) Grid Supply with Distribution Strengthening – The key objective under this option would be to strengthen distribution and supply by extending grid connection and local community participation models in metering, billing and collection activities. The nature of demand addressed would be industrial, commercial and rural livelihood.

(ii) Distributed Generation with Grid Back up – The objective would be to augment grid power availability to the rural areas, using local resources, where available. In particular, in areas with low grid penetration and availability of grid power, standalone home systems or a standalone distributed generation facility (mini- hydro biomass, other technologies), could provide workable and economically viable solutions.

(iii) Independent Micro Grids with Local Generation - The objective would be to provide village or a cluster of villages (or hamlets) with electricity to create an independent self-sufficient generation mini distribution network. Such standalone generation and distribution systems would be particularly viable in remote rural areas where providing grid access as well as management of grid based systems is technically infeasible, or is expensive. Local resource availability (biomass, micro-hydro, etc.) is a pre-requisite for this service option.

(iv) Individual home systems - Providing household electrification solution to remote isolated villages where there is no aggregated demand through solar home systems (or any alternate energy source) would be the objective under this service option.

3. This study has categorized the states based on certain objective criteria. In particular, two key criteria identified include:

i. Current availability of grid power;
ii. Penetration of the existing electricity grid

4. In areas where there is fairly good grid penetration and availability of grid power, the key problem is of high cost of service, which in turn is caused by high commercial losses. The commercial losses can be reduced by refocusing on the metering, billing and collection.

5. In states where there is availability of grid power but penetration of grid is low, the focus should be on grid extension only, whereas in areas with high grid penetration and low reliability of supply, there should be Distributed Generation facility with grid back –up to augment the grid supply. In such states small power through distributed generation could effectively complement grid based additions.

6. In other states, with poor network connectivity as well as inadequate sources of grid power the immediate focus has to be on off-grid systems, which could include standalone generation, and distribution systems, as well as home systems. As the study identifies, application of a particular model is not in exclusion of others, and states could select more than one model

based on what suits various parts of the geography of the particular state the best. However the predominant mode of service provision can be identified based on the categorization provided.

7. Implementation of the models relies heavily on the institutional framework that is concurrently implemented, which in turn in dependent on local culture and strength (or practices) of local governance. In areas with strong local governance, there is a potential of formation of cooperatives or the involvement of the village Panchayat in acting as a franchisee for metering, billing and collection. In fact, such local institutions can be the mainstay for local distributed generation by means identified in this report. In areas, where the strength of local governance is relatively lower, a facilitating agency (NGO/ Self Help Group/ Village Nodal Person) to organize the rural populace into a village society who could undertake the activities of a village level franchisee. In areas where the strength or potential of local governance systems is low, standalone generation by entrepreneurs or home systems could provide the default service option till the governance systems develop as a part of wider social development.

8. An aspect of great significance is the financial viability of the proposed arrangements in a particular area. This study demonstrates that under various efficiency and financing assumptions, the alternatives proposed can provide services at lower costs and higher efficiency levels. The key issue that arises is that of sustainability. A key finding of the study was that rural electricity services pose much greater challenges than urban services. Hence, for sustainability of rural services, the issues must be addressed in a deliberate and distinct fashion. After extensive consultation, a common view that has emerged is that the entire institutional mechanism for rural areas should be separate from that for urban areas. This would necessitate separation of main operations from the rural operations, adopting specific policies and plans for rural operations and creation of a state nodal agency that would facilitate the implementation of the entire rural electrification program.

9. While it was initially envisaged that a Nodal Agency would be created for policy, planning, monitoring, and regulation, the expert consultation process revealed the need for including operations within the ambit of the Nodal Agency. The view was that (at least at this stage of development), unless the Nodal Agency has implementation powers, the effectiveness of the Nodal Agency could be compromised. The separation of operations responsibilities from the others can be revisited at a later stage. Based on the above, the key roles of the Nodal Agency (hereon referred to as **Rural Co**) would include:

- Appraise and prioritize projects for funding based in accordance with master plans created;
- Development of project schemes for funding;
- Channelize the capital and operating subsidies;
- Facilitate the necessary institutional capacity building and training;
- Development of standard contractual structures;
- Bid out projects for PPP/PSP
- Regulatory support; and
- Operations of rural electricity systems transferred to it from the parent utility.

In effect the Rural Co would operate as the licensee in the rural areas, but with a greatly enhanced set of roles and responsibilities for successful implementation of the rural electrification program.

10. Going forward, we envisage private sector participation to be a necessity for successful rural electricity service provision. As rural electrification progresses, private entrepreneurship and public private partnerships (PPP) must be encouraged. The policy framework and its implementation through the Rural Co would have a critical bearing of success of private entrepreneurship and PPP approaches. This report envisages the following development stages facilitated by the Rural Co for rapid advancement of rural electrification.

a. Stage 1: Policy and Planning - The main activities in this stage are to establish an *Overall Electrification Strategy* for the State and develop a *Service Master Plan*.

b. Stage 2: Preparatory and Selection phase - *Development of Standard Structures and Instruments* for each service option followed by the *Bid Process* for award of the projects to interested parties.

c. Stage 3: Development Stage - *Contracting and Financing* and *Project Implementation*.
d. Stage 4: Project Operation - *Review and monitoring of Projects* and future *Expansion and Up- gradation*.

11. Subsidies have always been an integral part of rural electricity service provision. The key challenge is to make the subsidies more transparent and efficient. This study concludes that subsidies should ideally be restricted to capital cost financing while operating costs should be paid for by users. Projects that desire subsidies should be qualified based on their ability to pay for operating costs and a part of their operating costs. However in the initial period, a few years of viability gap funding may be necessary for certain projects where long term viability is otherwise not in question.

12. The report identifies in detail the roles of the various agencies involved in the process, highlights of which are provided below:

a. State Government - The State government would have part to play in facilitation of network transfer to the rural local bodies from the state utilities. Creation of State nodal agency as a counter-part body for facilitation of RE projects is also an essential role that the State Government would have to undertake.

b. State Electricity Regulatory Commission - The Commission will have a role in the following:

- Providing policy inputs on rural electrification policy as required by the Act;
- Approving licenses and license exemptions;
- Approving retail and bulk tariffs, where applicable;
- Promoting co-generation and non-conventional energy;
- Waiving the additional surcharge under Section 42(2) of the Electricity Act, 2003 on open access for transactions involving generators undertaking distributed generation in rural areas (where applicable)

c. Nodal Agency or Rural Co - Main facilitator of the implementation program with the roles as identified earlier.

d. Developer/Service Provider- Identify Opportunity, participate in bid process or in negotiations with Nodal Agency, develop Detailed Project Reports, enter into contracts for fuel, arrange financing and undertake financial close, construct ,operate and maintain projects.

e. Local Bodies (Zilla, Taluka and Village Level) /Self Help Groups/NGO - Provide inputs for Master Plan creation and updating, provide fuel supplies from local plantations/fallow land (where applicable), enter into Fuel Supply Agreements, manage local distribution services as franchisee.

10.12 Recommended policy options for successful implementation of rural electrification

a. Increasing promotion of use of Renewable Energy Sources

Renewable energy is currently experiencing increasing vibrancy across all sectors of the economy driven by sustained economic growth and growing global concerns regarding climate change. There are various stakeholders that directly/indirectly contribute towards the promotion of renewable energy, and each one has some aspirations and expectations from this sector, just as they have a significant responsibility. This is in a way laying foundation of a new economy that is inclusive, sustainable and aspires for de-carbonization of energy in a definite time frame. However, there is a long way to go. In order to create an enabling environment, the Ministry as a policy maker will have a significant contribution to make. Renewable struggle to compete in generation cost terms at subsidized tariff rates for grid electrification. However, where full cost of energy delivery is taken into account for serving rural areas with grid power, renewable are often cost competitive.

b. Set up effective institutions to deal with problems.

Most successful programs have a specialized institution that deals with and promotes rural electrification. The exact nature of institutional structure does not appear to be critical, as a variety of approaches have been successful. They include a separate rural electrification authority (**Bangladesh**); setting up rural electric cooperatives (**Costa Rica**); allocating rural electrification to a new department in the national distribution company **(Thailand**); or delegating it to a specialized office within the utility (**Tunisia**). However, there must be a high degree of **operating autonomy** so the implementing agency can pursue rural electrification as its primary objective without significant political constraints.

c. Government commitment and dealing with the political dimension.

All rural electrification programs have subsidies for the capital costs of expansion. This use of public funds for rural electrification often leads to political interference at national and local levels. The politicians regard public funding as giving them rights to interfere, but experience shows that this can be quite damaging. Once technical and financial decision-making is undermined in the implementing agency because of political string pulling, organizational goals are undermined. However, sometimes political pressure can be turned into a positive force as in **Thailand** where local politicians were encourage to raise and contribute funds, so that their constituents could receive electricity before the planned time.

d. Establishment of clear planning criteria for rural electrification.

Grid rural electrification is often a step by step process which starts with the most promising high population growth areas and then moves on to more and more remote populations. Successful rural electrification programs have all developed their own system for ranking or prioritizing areas for rolling out the electricity supply. Capital investment costs, level of local contributions, and density of consumer, are among the factors normally taken into account. In **Costa Rica,** the ranking of communities was based on their population density, level of commercial development, and potential electricity consumption.

e. Subsides for grid expansion capital costs.

In most successful programs, a substantial proportion of the capital has been obtained at discounted interest rates or from outright grants. The program in Costa Rica started with low interest rate loans. In **Tunisia,** all capital expansion costs were covered by government grants. Having access to such low cost financing and subsidies need have no ill-effects on the implementing agency or the rural electrification program. But such loans and grants should never be provided to companies that are not covering their operating and maintenance costs through revenue collection. This will only worsen their financial position that ultimately results in poor customer service.

f. Charging the right price for electricity.

All the successful programs reviewed in the case studies placed a strong emphasis on covering their operating costs through revenue collection. Cost recovery is essential for the long-term effectiveness of rural electrification programs. When cost recovery is pursued, many of the other program elements can fall into place. Rural electrification prices set at realistic levels sometimes even leads to energy costs savings for new customers as they reduce their kerosene lighting costs. Charging the right price allows the electricity company to provide an electricity supply in an effective, reliable, and sustainable manner to an increasing number of satisfied consumers.

g. Lowering the barriers to obtaining a supply.

The initial connection charges demanded by the power distribution companies for new customers are often a significant barrier to the adoption of electricity by rural families. They often are even more important than the monthly electricity bill. Reducing these connections charges, or spreading them over a several years, even if it means charging more per kilowatt hour of electricity, allows larger numbers of low income rural families to obtain a supply.

h. Benefits of community involvement.

Traditional thinking in many utilities is often oblivious to the importance of local community involvement. Rural electrification is seen simply as a technical matter of stringing lines to grateful consumers. The case studies show clearly that rural electrification programs can benefit greatly from the involvement of local communities - or suffer because of its absence. There are many innovative ways to do this. In **Bangladesh** consumer meetings were held before the arrival of the electricity supply, helping to avoid costly and time-consuming disputes over rights of way and construction damage. In **Thailand** community contributions in cash or in kind were often the decisive factor in bringing areas within the scope of the rural electrification program.

i. Reducing construction and operating costs.

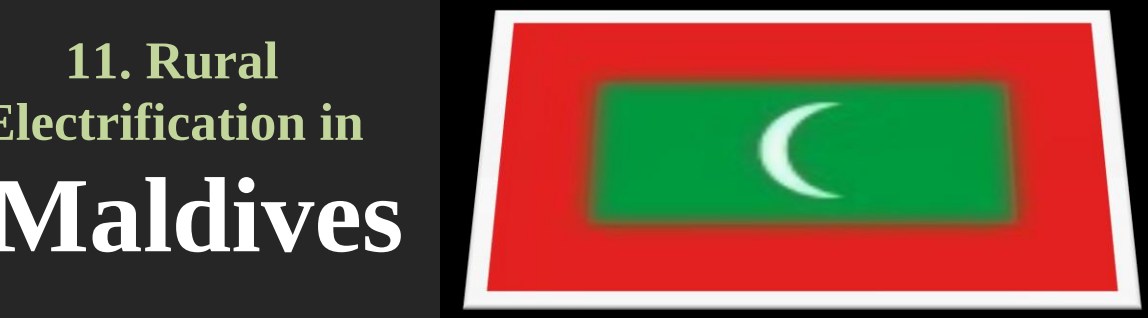
There are major opportunities for the reduction of construction and operating costs of rural electrification in most countries. Where the main use of electricity is expected to be for lights and small appliances, the design standards can be simplified and adapted for the same. This can contribute significantly to the growth of rural electrification coverage.

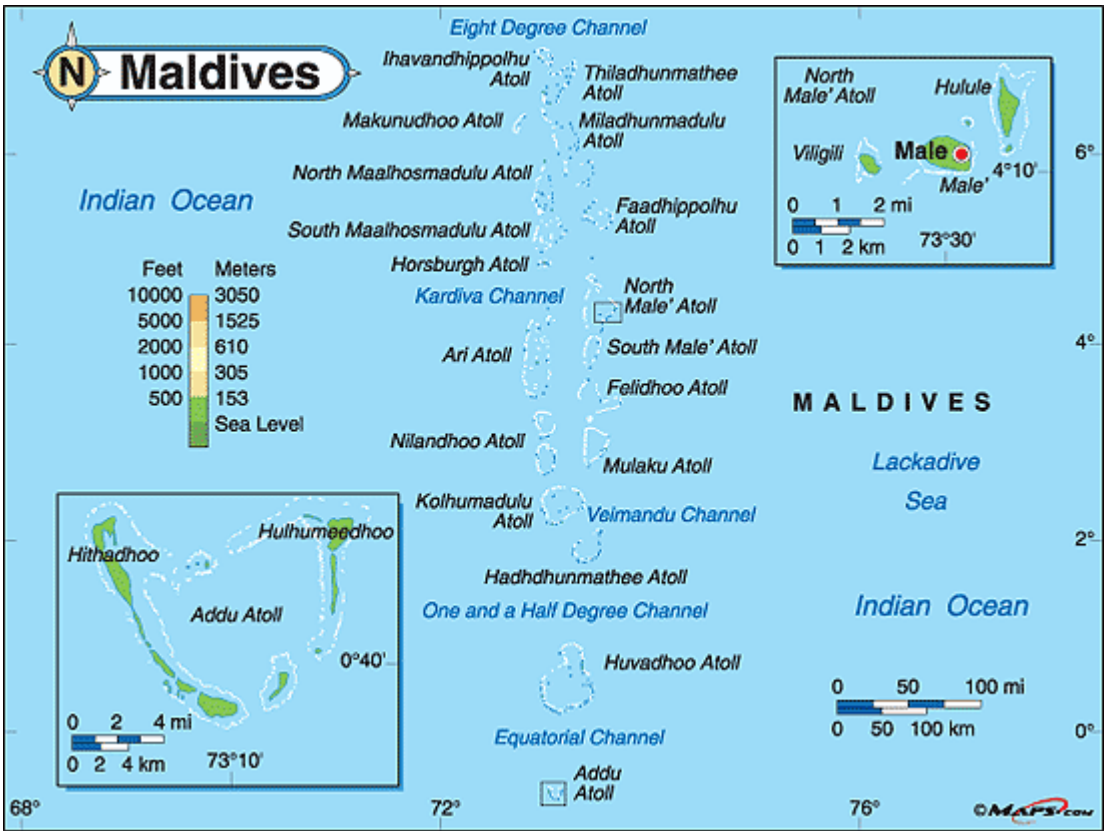
j. Reducing Transmission and Distribution (T&D) losses

Transmission and Distribution losses in India have risen from 25% in 1997-1998 to around 33% in 2003-2004. In countries such as China, Malaysia, and Thailand, they are less than 10%. The State Electricity Boards (SEBs) that bear primary responsibility for distribution face irregularities in billing and rampant theft of electricity. It is estimated that of the total power generated, only about 55% is billed, and around 41% is realized.

Cost recovery has declined from 82% in 1992-1993 to 69% in 2001-2002. While just about everyone agrees on the end-point, (restoring the financial health of the SEBs and power utilities, increasing generation capacity, and lowering T&D losses) how to tread the narrow and difficult political path to achieving that goal remains a challenge.
(Ref. http://www.rexjournal.org/files/documents/02Usha-kumar-Rural-Electrification-in-India-.pdf)

11. Rural Electrification in Maldives





(#17.08 Map of Maldives)

Rural Electrification in Maldives

11.1 BACKGROUND

Maldives is situated in South Central Asia. It's an island. Nearest SAARC Country is Sri Lanka. Its capital is Male.

Maritime Boundaries of Maldives

a. India
b. Sri Lanka
c. British Indian Ocean Territory

Since Maldives does not have access to conventional sources of energy the needs are primarily met through the import of fossil fuels. The 300,000 plus population reside in over 190 islands flung across more than a 100,000 square kilometers of the Indian Ocean. The country depends on an unpredictable global market for its energy resources which puts their economic progress and social development at risk. The entire economy of the country is extremely vulnerable to external shocks caused by fluctuations in the price of fossil fuels. The Government of Maldives identifies that adequate energy supplies are important for food security, delivery of essential public services, social equity and protection of vulnerable groups including women and children, governance and for economic growth throughout all of its inhabited islands and as such the Government considers energy security a right of every citizen and is committed to the provision of energy resources at the lowest cost to all Maldivians.

11.2 Institutional Frame work for the Energy Sector

- **Lead Agency**

Climate Change and Energy Department Ministry of Housing and Environment

- **Regulatory Body**

Maldives Energy Authority

- **Government Institutions and their role in the Energy Sector**

1. The President's Office- Overall policy guidance.
2. Ministry of Finance Treasury- Assists in seeking external and domestic finance to develop the energy sector.
3. Department of National Planning- Develop, coordinate and monitor the Strategic Action Plan of the Government, provide inter-sartorial policy coordination and implement development projects.
4. National Disaster Management Centre- Coordinate emergency relief efforts across sectors and supply fuel and mobile electricity generators in an emergency.
5. Ministry of Economic Development- Assist in the development of business models to promote domestic and foreign investment opportunities for energy sector development.
6. Province offices- Involved in the decentralization of the energy sector.
7. Ministry of Education- assists in mainstreaming energy issues including renewable energy, energy conservation and develops an interest for people to work in the sector.
8. Maldives College of Higher education- Training institution for technical energy sector related programme delivery among others.
9. Attorney General's Office- Assist the lead agency in development of a national legal framework for energy- related acts and regulations.
10. People's Males- Legislature

11. Ministry of Tourism, Arts and Culture- Implements energy regulations as well as offers the opportunity to learn from innovative private sector energy development programs.

12. Marine Research Centre- Collects ocean-related data for exploring possible energy options (OTEC, ocean current, OTE)

13. Environment Protection Agency- Assists in the development of environmentally sound energy sector and its monitoring (Energy-related EIAs).

14. Maldives Meteorological Services- Data repository and forecasting for renewable energy sources like solar and wind power

15. Ministry of Communication and Civil Aviation- Formulates the national Science and Technology Master Plan

16. Utility Companies- State owned providers of energy and other utility services in the provinces.

17. Maldives Customs Services- collaborates on energy imports and exports to the country.

18. Ministry of Health and Family- Identifies health-impact in relation to energy use and power generation.

- **Local Governance System**

1. Province Offices- Oversee regional utilities in providing energy to the communities and assist in the decentralization of the lead agencies policies and strategies.

2. Atoll Councils- assess needs for power and energy requirements at atoll level.

3. Island Councils- Assess needs for power and energy requirements at island level.

- **Private Sector Involvement**

Fuel importers and distributors; energy technology distributors and engineering companies.

Private power producers (resort islands, Independent power producers, etc.) Energy consultants and engineers.

International Partner Organizations and Bilateral Partners

UNDP, the UN system, GEF, the World Bank Group, ADB, JICA, Bilateral donors and friendly countries for financial and technical assistance.

- **Legal Framework**

Formulate energy Act/Law

Legal framework to provide incentives for renewable energy technologies, energy efficiency and energy conservation

Revision/establishment of Maldives electricity regulation and standards

Establishment of Maldives energy standards

Ensuring inclusion of energy efficiency and conservation measures in the relevant sector codes: water, transport, waste management, heating and cooling, building code and the residential sector.

11.3 The Energy Supply of Maldives

The Government of Maldives is acutely aware of the changing international energy landscape. Growing global populations and strong growth of emerging markets are compelling demand for conventional energy resources and burdening global energy supplies. Energy supplies are at further risk from geopolitical tensions and natural disasters. It is in this increasingly challenging international context that Maldives needs to address the security of its energy supplies.

Energy mix of Maldives

Fuel type	Usage	Remarks
Diesel	86 %	All fuels are imported
Gasoline	07 %	
Aviation fuel	04 %	
Kerosene	04 %	
LPG	01 %	

(# 16.16 Energy mix of Maldives)

Source: USAID/ SARI 2010, Maldives – Energy Sector Overview.

The Maldives in entirely dependent on import of fossil fuels to meet its energy needs. Imported fossil fuels, primarily diesel dominate energy consumption making up 82% of the total primary energy demand. Since the Maldives has not been successful in finding its own oil reserves, the steady supply of petroleum products is strategically critical for continued economic growth and social development for the country. Diesel and petrol are significant inputs to the tourism, fishing and transport sectors that together directly contribute to more than 50% of gross domestic product. International energy prices are therefore closely monitored by the Government to anticipate shocks and introduce appropriate measures such as taxes, levies and/or concessions for vulnerable sectors such as fishing so that the impact of fluctuating international oil prices on the economy is minimized.

The National Energy Policy and Strategy attempts to pave the way to increase renewable and other low-carbon technologies into our energy mix. This would propel the country towards a low-carbon economy through the implementation of an appropriate market strategy that mitigates the demand for fossil fuels in the country.

11.4 Policy Options for Successful Implementation of Rural Electrification

The recommended policy options to successful implementation of rural electrification policies in Maldives are stated as follows:

POLICY 1: PROVIDE ALL CITIZENS WITH ACCESS TO AFFORDABLE AND RELIABLE SUPPLY OF ELECTRICITY

The geography of dispersed islands in the Maldives is such that a national grid to provide power to the population has not been a viable option thus far. Therefore, each island has to install and operate a power to generate electricity to meet its needs albeit at considerable costs. The Government has provided some financial assistance to many of the communities or private parties, that have installed, operate and manage their power house on inhabited islands...The lack of regulation or national standards as resulted in the development of weak individual

island grids those are unsustainable and unreliable. Reliability is further impeded by a lack of technically skilled personnel for maintenance, operation and management. It is not uncommon to find islands with frequent power outages or which are unable to provide 24 hours of electricity either due to mechanical failures or the price and availability of fuel suppliers. Electricity generation for any small island is unsustainable as it is expensive to operate and the costs of the high initial capital investment cannot be recovered. The cost of production is further exacerbated by the fact that transport costs of fuel from storage facilities near the capital island male is added, resulting in huge disparities between islands on electricity tariffs and in the quality of service.

POLICY 2: ACHIEVE CARBON NEUTRALITY IN THE ENERGY SECTOR BY YEAR 2020

As an extremely low-lying small island state situated in the middle of the Indian Ocean, Maldives is one of the most vulnerable countries to the effects of climate change. Many of the islands are already experiencing first hand stronger storm surges, severe erosion and incidents of flooding. On a global scale the efforts to reduce emissions of GHG will not have much effect on reversing the effects of climate change. However, Maldives announced its intention to achieve carbon neutrality at the UN General assembly in 2009 and is committed to meeting this goal as a responsible citizen of the international community.

In 2009 GHG emissions amounted to 1,034,354 tons of carbon dioxide equivalent for the whole of Maldives of which 55.4% is from the production of electricity. The conversion efficiency of diesel to electricity varies from 26-39% and distribution losses throughout the country vary from 5-24% depending on the quality and design of the distribution system on any given island. These variances demonstrate that improvement of energy efficiency coupled with the application of renewable energy technologies is essential in the pursuit to achieve net zero carbon emissions.

POLICY 3: PROMOTE ENERGY CONSERVATION AND ENERGY EFFICIENCY

Greater efficiency and conservation of energy will benefit the country through a reduction in energy imports which directly translates into, savings for the country's foreign exchange reserves, reduced dependence on imported fossil fuels, increase energy security and reducing GHG emissions. On the supply side, measures are needed to increase efficiency particularly in the production and distribution of electricity. Conversion efficiencies in some islands are low and in others distribution losses caused by poorly designed and maintained systems are high. Reducing these variations through regulatory intervention will conserve more energy.
On the demand side, the level of awareness, our lifestyles and outlook need to be encouraged towards placing a greater importance on energy conservation and the wise consumption of

resources. E.g., in the Male' area, which accounts for approximately 62% of the total power generated for all inhabited island in the country, households consume approximately the same amount of electricity as public, government, manufacturing and commerce sectors combined and 75% of household electricity usage is attributed to air-conditioning of homes.

POLICY 4: INCREASE NATIONAL ENERGY SECURITY

Energy security for a small island nation such as the Maldives can only be achieved through the diversification of the country's energy resources to reduce our dependency on imported

fuels. The burden of rising global oil prices is compounded by the fact that the Maldives relies heavily on imports to meet almost all of the country's domestic demand.

All fuel imported into the Maldives is currently stored in facilities in Male' and its neighbouring islands. The 190 or so inhabited islands are located anywhere from 3kilometres o 541 kilometers from the capital Male'. This results in access and cost disparities across the country for fuel, electricity, food and other consumer goods. Provincial hubs are needed to be developed for storage and distribution of fuel and other imported goods such as food to ease both access and reduce cost to all energy producers as well as end-users ad provide a cushioning stock in the event of any unforeseen rises in the international oil prices as well as to increase preparedness for natural disasters. To ensure continuity of supply the energy mix must be considered along with important factors such as the economic cost, environmental impacts, reliability of supplies, convenience to consumers and strategic independence.

POLICY 5: PROMOTE RENEWABLE ENERGY TECHNOLOGIES

In order to minimize the vulnerability of energy supplies to external factors, the use of indigenously available renewable energy resources for energy generation is necessary. This will in turn reduce the pressure on the country's balance of payments.
The Maldives has the potential for utilization of renewable resources such as solar, wind and biomass for energy needs. Pilot projects have been carried out and hybridized systems consisting of combinations of solar, wind, diesel and LPG have shown success in electricity generation that could be implemented nationwide. Commercial use of renewable energy is presently limited to solar photovoltaic panels in navigation lights and telecommunication systems. Solar thermal is used in some tourist resorts for water heating and lighting.

The renewable energy sector does face some barriers such as, a lack of capacities in development, design, implementation and management, lack of financing available for renewable energy applications and renewable energy applications and renewable energy based livelihood projects, as well as a lack of adequate information on the options available in renewable energy technology, renewable energy statistics and research.

FURTHER POLICIES FOR STRENGTHENING THE INSTITUTIONAL AND LEGAL FRAMEWORK OF THE ENERGY SECTOR ARE STATED BELOW:

POLICY 6: STRENGTHEN THE MANAGEMENT CAPACITY OF THE ENERGY SECTOR

The lead agency for the energy sector the Ministry of Housing and Environment and the regulatory authority the Maldives Energy Authority needs to develop local capacity to manage the energy sector effectively and to keep abreast with technological developments and good governance practices. There is insufficient capacity as the needs of these two institutions have not been regularly assessed or catered for. The Maldives Energy Authority is severely understaffed.

POLICY 7: ADOPT AN APPROPRIATE PRICING POLICY FOR THE ENERGY SECTOR

In Maldives, the energy pricing structure follows a top-down approach. The Trade Ministry sets energy prices, which are implemented by most local bodies with minor adaptations. However, electricity pricing is a little more diffused for the provincial utility companies that determine electricity tariffs which are then approved by the Maldives Energy Authority.

The lack of a proper regulatory mechanism has led to non-cost reflective price, making it difficult for companies that operate in the energy sector to become financially feasible. In addition, non-targeted subsidization of electricity production in the past has diverted the states scarce financial resources.

The Maldives Energy Authority needs to be strengthened to deliver the functions of regular review of pricing policies and to take action against noncompliance under this policy.

POLICY 8: ENSURE CUSTOMER PROTECTION

Existing regulations do not include adequate measures to protect the customers' rights and to safeguard their interests.

POLICY 9: ENHANCE THE QUALITY OF ENERGY SERVICES

The sector lacks standards to ensure that energy services meet quality requirements. The variation of the quality of energy services and prices particularly electricity throughout the islands of the Maldives produces inequalities in access as well as quality.

11.5 Proposed Strategies for Successful Implementation of the Rural Electrification Policies

STRATEGIES FOR POLICY 1:

1. Upgrade the capacity of utility companies to manage electric power infrastructure on islands and to improve the efficiency and quality of services.
2. Engage private sector participation to develop, manage and sustain electricity services.
3. Source national and international investments to develop and sustain energy sector.
4. Establish a transparent mechanism to provide targeted subsidies to vulnerable groups to ensure access to basic energy at affordable prices.
5. Introduce incentives to power sector developers by facilitating access to grants, concessional finance and duty concessions to ensure affordability of energy supply.

STRATEGIES FOR POLICY 2:

1. Develop and implement plans for the energy sector to include forecasts of energy usage by different sources, GHG emissions and status of carbon neutrality.
2. Establish, apply and monitor targets to maintain energy source composition, efficiency and losses to achieve and sustain carbon neutrality.
3. Promote carbon capture and sequestration (CCS) by conducting research and development of CCS projects necessary for the reduction of GHG emissions.
4. Ensure compliance of energy sector utility companies and other energy service providers with safety standards issued by Maldives Energy Authority as well as environmental standards stipulated by the Environmental Protection Agency.
5. Establish an environmental division in every energy sector utility company staffed by qualified personnel able to conduct environmental safety audits of existing and new

facilities to ensure compliance with the standards and regulations under the National Environment Act.

STRATEGIES FOR POLICY 3:

1. Implement advocacy and awareness programs to foster healthier and greener attitudes and behavior in our society.
2. Encourage energy efficiency in both the supply side and demand side through financial and other incentives/disincentives in respect of energy end-use and mandatory measures such as appliance energy labeling, building codes and energy audits.
3. Engage and facilitate private sector participation in providing expertise and specialized services to increase energy efficiencies across sectors.
4. Carry out awareness programs on energy efficiency and conservation as a priority and on a sustainable basis.
5. Identify all areas for improvement and provide technical advice in fuel conservation and efficiency in different modes of transport, including marine and air transportation.
6. Introduce incentives to encourage greater use of electric vehicles and vessels by establishing charging stations using renewable energy sources.
7. Encourage utilization of waste heat from power generation for other applications (e.g. water heating, air conditioning, desalination).

STRATEGIES FOR POLICY 4:

1. Enhance national energy security by promoting indigenous renewable sources of energy while reducing the reliance on imported fossil fuels.
2. Ensure fuel diversity in electricity generation through diversification in power generation technologies that do not use hydrocarbon fuels.
3. Develop and maintain fuel reserves in strategic locations of the country.
4. Identify feasible regions and open the fuel market for investors.
5. Prepare for emergency supply needs by developing a reserve stock of energy.
6. Diversify sources of fossil fuel imports.
7. Encourage diversification in fuel consumption in the transport sector.
8. Facilitate the implementation of a nationwide electricity grid.

STRATEGIES FOR POLICY 5:

1. Promote the use of economically viable, environmentally friendly, renewable energy resources.
2. Promote renewable energy sources and their advantages to the public through mass media, workshops and through a renewable energy information centre.
3. Facilitate and provide research opportunities for locals and international parties through the establishment of a platform for information exchange on potential renewable energy resources and their application within the country.
4. Seek concessionary external financing to improve the economic feasibility for renewable energy projects that are environmentally and socially sound.
5. Assist the development of the renewable energy sector in increasing its contribution to the energy supply through the introduction of incentives and/or access to green funding that will attract the participation of the private sector.
6. Facilitate research and development and technology transfer programs to aid the exchange of innovative ideas.

11.6 Strategies for Policies Strengthening the Institutional and Legal Framework of Energy Sector

STRATEGIES FOR POLICY STRENGTHENING 1:

1. Improve the capacity of the Ministry that is mandated for the energy sector in a sustainable manner ensuring continuity of capacity development to strengthen the Ministry in developing integrated long-term energy plans and conducting policy analysis for the energy sector.
2. Improve the capacity within the Provincial Utility companies to enhance and expand their contribution to energy supply development.
3. Develop and manage a national energy database.
4. Develop management capabilities of the energy sector institutions through appropriate training, empowerment and proper delegation of authority.

STRATEGIES FOR POLICY STRENGTHENING 2:

1. Empower Maldives Energy Authority (MEA) to regulate the energy sector and the pricing policy.
2. Formulate and implement pricing strategies to achieve a cost-reflective pricing policy for all commercial energy products (electricity, petroleum products, etc.).
3. Formulate and implement optimal energy supply expansion plans for the energy sector to ensure cost-reflective prices.

STRATEGIES FOR POLICY STRENGTHENING 3:

1. Protect the rights and interests of energy utilizing customers through the formulation and adoption of a law/or regulations.
2. Empower and support MEA to ensure fairness to the customers of various energy products and services.

STRATEGIES FOR POLICY STRENGTHENING 4:

1. Standardize the quality of services provided by energy suppliers through the formulation and adoption of a law and/or regulations.
2. Introduce disincentive mechanisms to maintain a minimum standard of quality in the supply of energy products and services.

11.7 Tariff

There are also important inequalities in terms of tariff rates between on one hand the capital and the other big islands and on the other the small outer islands. The current price of electricity ranges from US$ 0.12 to US$ 1.16 per kWh. While the lower prices are for larger systems operated by STELCO, for smaller systems the prices are high due to scale and operational inefficiency.
(ref: Sustainable energy for all – Maldives)

11.8 Challenges

Maldives ranks as the most vulnerable amongst 24 countries in Asia-Pacific on the Oil Price Vulnerability Index. Due to the depletion of its biomass reserves, the country's population relies more on kerosene and LPG for cooking than on biomass.

Electrification is estimated at 93% with 197 out of the 199 inhabited islands having access to electricity though only 82 in a continuous manner. The highly dispersed territory does not allow for the installation of a single national grid. The transmission and distribution systems experience high losses due to bad maintenance. The national utility and private power producers suffer from 13% and 24% losses respectively. State Electric Company STELCO also suffers from financial losses due to high oil prices and its transportation costs, and high costs for maintaining increasing staff in the islands.

Strengthening the link between poverty reduction and energy policies with a focus on increasing access to electricity among the poorest which are concentrated in rural areas (outer islands) is the main challenge in Maldives. Support could be given to the increase in the access to electricity in outer islands via the establishment of decentralized systems powered by RE.

(ref: Sustainable energy for all – Maldives)

11.9 CONCLUSION

Before we go for energy secured and successful rural electrification in Maldives, we need to ensure that rich and developed countries immediately minimize Global warming and compensate Maldives to save itself from getting vanished from the world map because of rise of sea level.

(Ref: Maldives National Energy and Policy Strategy, Ministry of Housing and Environment (2010)

12. Rural Electrification in Nepal

Rural Electrification in Nepal

12.1 Background

Nepal is a comparatively narrow strip of territory dividing India from China, landlocked Nepal has an area of about 140,800 sq. km (54,363 sq. mi), extending 885 km (550 mi) se–nw and 201 km (125 mi) ne–sw. Comparatively, the area occupied by Nepal is slightly larger than the state of Arkansas. In its length lie some 800 km (500 mi) of the Himalayan mountain chain. Nepal is bounded on the n by China and on the e, s, and w by India, with a total boundary length of 2,926 km (1,818 mi). Nepal's capital city, Kathmandu, is located in the central part of the country.

As per publication "Rural electrification in Nepal, cooperative concepts in rural electrification" by Er. Prabal Adhikari, about 88% (which is 85% as per other author) of Nepal's Population remains in the villages and many have become fortunate to use the electric power so far (though it is increasing). Although Nepal has spent a huge quantum of money in rural

electrification they have become unable to address the real problems of commercialization in this field so far. They need to develop suitable and sustainable models associated with electric distribution in villages which should be not be too detailed and sophisticated, nor too simple for reliable and qualitative performance. The implementation of co-operative concept is an excellent choice which can ensure the benefits of electricity to rural people as well as the utility. Rural electric co-operative models should be, beyond doubts, an integral part of the national energy policies and distribution system.

12.2 Current rural electrification programmes and objectives in Nepal

a. Electric Cooperatives for Rural areas

It is a socialistic approach to make people responsible for local management of electric energy distribution by the process of "participatory management." This concept in energy management may also be called democracy partnership comprising of diverse civil societies scattered throughout the villages of the country. Unlike other co-operatives, electric co-operatives are not profit-driven basically. They exist primarily to provide service to their consumers. In fact, it is not merely a users' organization, but it is a way of life in which economic activity attains momentum by self-managing and distributing the electrical energy for their own benefits. It is also a concept of competitive marketplace particularly in the distribution sector of electricity which should operate on sound business policies and practices although it is basically a not-for-profit organization as already mentioned above.

b. Essentials of electric co-operatives

i. Financial sustainability

ii. Open and voluntary membership to power consumers.

iii. Transparency and accountability.

1. Democratic control or mutually agreeable decisions

2. Return of surplus or savings, if any, to members

3. Subjective and field-oriented trainings on electricity distribution system and general safety rules.

c. Community Rural Electrification Programme (CREEP) Nepal

The idea of community based **Rural Electrification (RE)** was first developed in the USA in the 1930s. In Asia, Bangladesh was the first country to establish rural electrification whereby small entities manage electricity distribution on community levels. By now, RE programs have been established and are successfully managed in several Asian countries, such as India, Vietnam, the Philippines and Nepal.

In Nepal the government together with the national utility – **Nepal Electricity Authority (NEA)** initiated a first pilot area for grid extension, where the community contributed 20% of the total investment cost for the extension. Recognized as a successful vehicle for rural electrification, the **Community Rural Electrification Programme (CREP)** was officially launched in 2003/04 to increase the grid-connected electrification rate in areas without access to electricity.

NEA, a 100% state-owned commercial entity whose field of operation includes generation, transmission and distribution, is obliged to electrify Nepal. Since grid-extension to remote areas is commercially not viable, a by-law was passed in 2003/04 by the board of directors of NEA, stipulating the modalities for the CREP.

Rural Electrification via Grid-extension

In CREP, 80% of the project costs are carried by the government, whereas the remaining 20% of the costs have to be covered by the communities. To apply for the subsidy the community has to form a legal entity which is registered on a district level. For the application this **Community Rural Electrification Entity (CREE)** submits the official request. The **Community Rural Electrification Department (CRED)**, a department within NEA which is authorized to manage the programme, then initiates a survey and cost estimate for the grid-extension. The results of the survey are given to the CREE, which then has to deposit the 20% share of the total costs. With a revision of the by-law the in-kind contributions by the community are part of the investment calculation accounted within the 20% community share. Once the money is in the bank account of NEA, the 80% government subsidy is released and the process (tendering, construction, commissioning) starts. Investment costs for the extension cover up to the service then drop. The last meter and metering device is on individual household investment. Household meters are sold by NEA at a standardized price with after sales services applied. The CREEs are audited on an annual base.

Business model of Community Rural Electrification Entities (CREE)

Once the grid is extended, CREEs acting as 'community utilities' buy the electricity in bulk from the NEA at a reduced price (3.5 NRP/kWh plus 0.10 NRP line rent) and sell the electricity on household meter base to its consumers. The bulk meter is situated at the entry point to the village, thus all transmission losses are on account of NEA. Once a month the meter is jointly read by CREE and NEA staff and the bulk consumption (time of day tariffs) invoiced to CREE.

The CREE has some flexibility in setting the tariffs but is not allowed to charge higher prices than applies the regular NEA consumer tariffs which are graduated according to the consumption and utilization of electricity (industries and small enterprises pay a higher tariff than households). From the gross income (bulk price minus retail price) the CREE has to cover all management, repair and maintenance costs from the point of village distribution. The basic tariff for households is NRP 4.0/kWh which applies for the first 20 kWh. The minimum monthly charge for electricity is 80.00 NRP. Many communities indeed apply the 80.00 NRP as a minimum tariff but some CREEs adjust this tariff for low-income households who pay a lower 'social tariff'. The higher tariffs cannot be adjusted. Apart from that, household meters are checked by CREE on a regular basis and bills are issued accordingly. Depending on the size, a CREE has up to 6 employees: bookkeepers, technicians and the general management. The financial sustainability of a CREE depends on the number of consumers, the electricity load and the existence of industries or small enterprises. As a rule of thumb with a minimum of 200 households the CREE can act financially viable.

Achievements

Two years after the introduction of the CRE Programme the first six communities were connected to the national grid. Since then a total of 129 communities benefited from the 80/20 governmental subsidy schemes for rural electrification. An additional 90 projects are under construction and 20 underway in the pipeline.

One of the main reasons for NEA to engage in the CREP is the extremely high rate of non-technical losses, which usually account for 60% - 70% of NEA's electricity generation. Selling the electricity in bulk to the communities, handing over the responsibility for tariff collection, administration and accounting, reduces the probability of revenue losses by far. Additionally, it lowers the general administrative burden for NEA. Seeing that the programme is a successful instrument for further grid-extension and thus rural electrification, the government has not terminated the programme's lifespan. It is expected that CREP will continue for a number of more years.

12.3 Action plan (s) for successful implementation of rural electrification policies

Urgent need of implementation of Electric Cooperatives in Nepal

All our activities in power sector reform are lying in cold storage due to lack of proper punishment-reward scheme. In our present case, both are equally right: we are honest at the work assigned and yet nobody encourages; we are fraudulent and still nobody bothers. This trend has completely eroded the work culture in Nepalese offices and so is the case with our electrical sector also. A work culture cannot be established without motivating components involved with it. The co-operative model deserves the capability of self-motivation and the system of reward and punishment will automatically be set up to come into effect since all its consumers are the genuine bearers, and the bearers know where the shoe pinches.

Use of ABC cables in rural electrification to control direct hooking from LT lines has been a subject which is proposed a lot and practiced very little although there may be many reasons after it. However, it is true that electricity business cannot be elevated without reducing system loss to an acceptable limit. Reducing the loss will ever be an uphill task to the Nepal Electricity Authority (NEA) unless the village people wake up themselves with a sense of collective responsibility for constant vigilance.

Lack of honesty at work and the financial indiscipline within the organization is the major cause to degrade the fate of any utility. To certain extent, even we are afraid of being exposed. The practice of co-operative models in rural electrification immediately flourishes an era of transparency and public exposure in all activities related to the power distribution. Certainly, time has come to introduce effective reform programs associated with rural electrification for the sake of corruption control. This is possible by means of co-operative societies only and it's high time to launch them.

In Nepal's present context, a rural electric co-operative concept will also help combat domestic violence and develop village-level alternative dispute resolution trend by providing them a joint forum to work together for the common cause of local development. Rural electric co-operative will be very popular program in Nepal because people of all political spectrums can work together in such co-operative models by calling it whatever they prefer like "Abhno Gaun Aphain Banaun (United Marxists & Leninists' Let's- Make -Our –Villages- by –Ourselves Program)", "Garibsanga Bishweshwar (Nepali Congress's popular program, Bishweseshwar Prasad Koirala- with- the- Poor)" or "Gaun Pharka Abhiyan (Old party less Panchayat System's slogan-based program Let's- Turn- to- Villages) ". For all this to kick off,

the nation should not only advocate the need of such co-operatives, but also devise good legislative and administrative strategies required for their smooth operation.

Reasons for co-operatives in rural electrification

Rural electrification in Nepal should go ahead with the co-operative concepts as practiced by other developing countries with backgrounds similar to Nepal and also in the developed countries like the USA, because -

(a) Rural electrification has been a sad experience in Nepal with high investment and low return, thereby not operating in a financially sustainable manner in itself.

(b) There are high distribution losses since rural feeders are normally too long with enough voltage drops below the standards, backed by undue political pressure to stretch them farther and farther. Implementation of the rural electrification design is usually guided by the exciting political mathematics rather than by the engineering mathematics.

(c) Direct hooking from the nearby LT lines and other kinds of electricity theft has caused rural system loss to be quite formidable to fight.

(d) Difficulty in periodic vigilance due to remote and uncomfortable location of villages has revealed the necessity of local electric co-operatives.

(e) Revenue collection percentage is very poor in rural sectors.

(f) Ordinary rural people are economically, socially and even politically suppressed and hence they are not involved in the decision-making roles in key processes of social transformation. Electric co-operatives may serve as their homes where all of them are treated as equally rightful members and hence discharge their duties seriously as their own household tasks.

(g) All consumers involved in the co-operative service will develop corruption-free system due to well-coordinated check and balance.

(h) Our movement in the business of electricity so far is like that of a ship in stormy ocean, knowing no destination where to harbor. Modern electric co-operatives follow a straight-forward path only, since they are chosen to work upon the performance target basis, a concept which the NEA is about to practice in some of its distribution branches as Distribution Centers with a certain degree of autonomy to them.

(i) Present procedural measures to receive electricity connections have added much to the inconvenience for villagers. For example, we ask them to submit the attested copies of certificates pertaining to land, citizenship, etc. to get new lines. An Illiterate villager may choose better not to take a meter connection than to undergo all such difficult tests.

12.4 Energy technology options that are commonly used in rural electrification

a. Micro-hydro in Nepal

A micro hydropower plant is part of a larger programme seeking to promote renewable energy sources to provide reliable, low-cost electricity to rural communities in Nepal. The rural population is highly dependent on traditional bio fuel for heating and cooking, this form of

energy being a threat to both the environment and the population. Supported by UNDP, the Rural Energy Development Programme is seeking to promote renewable energy sources by building small hydropower and solar heating (cooking stoves) systems to provide reliable, low-cost electricity to a large number of isolated, rural communities.

The highlights of the project are mentioned as follows:

- ✓ The project has so far provided almost 1 million Nepalese access to electricity from renewable energy sources.
- ✓ By the end of 2012, 15 percent of Nepal's electricity will be generated from micro and mini hydropower plants.
- ✓ For each new micro hydropower system, 40 new businesses are created.
- ✓ Since 1996, nearly 400 micro-hydro power plants have been built in the most remote and impoverished areas of Nepal, bringing electricity for the first time to nearly half a million people.

Launched in 1996 as a small pilot initiative in five remote hill districts, the programme was subsequently scaled up via the national Hydropower Development Policy of 2001, which focused on rural development via low-cost hydropower systems. The lessons learned from this programme helped formulate Nepal's National Rural Energy Policy in 2006 and its subsequent national five-year plans.

As of 2010, the programme had:

- connected 59,000 households to micro hydropower installations;

- constructed 317 new micro hydropower plants, with 5.7 megawatts of installed capacity; and

- installed nearly 15,000 improved cooking stoves, 7,000 toilet-attached biogas plants, and 3,200 solar home heating systems.

By the end of 2012:

- modern energy services will have been made available to almost a million people in remote rural areas of the country; and

- 15 percent of Nepal's electricity will be generated from micro and mini hydropower plants.

The primary beneficiaries of the programme, which is now being extended to all 75 districts, are rural communities, with particular attention to vulnerable women and indigenous people. Over the next 20 years, the government wants to expand the share of electricity generated from micro and mini-hydro plants to 15 percent.

In addition to improving access to energy services, the programme has made possible significant progress in rural development. Research conducted by UNDP and Nepal's

Alternative Energy Promotion Centre found that improved access to electricity in rural areas led to:

- an eight percent increase in household incomes in 2009
- reduced average annual household spending on energy to US$19, compared to US$41 spent by non-electrified households; and
- the creation of 40 new businesses for every new micro hydropower station brought on line.

In addition to supporting business formation and raising rural incomes, this research found increases in school enrolment rates (particularly for girls), and improvements in child and maternity health, in water quality and access to modern sanitation, as well as in environmental quality. Reductions in time spent gathering water and firewood also allowed women to more actively participate in socio-economic life.

In this and other ways, the programme demonstrates the benefits that can come from rural development programming that takes an integrated approach to economic, environmental, and social development challenges.

ref: Rural Energy Development Program in Nepal, UNDP (2012)

12.5 Recommended policy options for successful implementation of rural electrification

a. Learning from Bangladeshi co-operatives and others

Bangladesh has achieved a grand, admirable success in rural electrification by adopting US-based co-operative models upon the consulting services provided by the NRECA International.

It led to the creation of a Rural Electrification Board (REB), which forms the co-operative Board of Directors (PBS Board) from the locals of various sectors including two women advisors also. REB has the right to dissolve the PBS Board at any time for its non-performance or fraudulent practices, if any. There are 67 rural electric co-operatives, called the Palli Bidyut Samities (PBS), instituted to function in different rural areas of Bangladesh. REB invests in transformers and transmission/distribution lines. In PBS, all consumers are its members. Nevertheless, employees are employed on annual contract basis and there is the total ban on the formation of Trade Union / CBA since such activities are believed to destroy the working environment of the co-operatives.

Since too many cooks may sometimes spoil the food, REB always stands with the role of a watchdog to confirm that nothing wrong has gone with the PBS anywhere. More than 3 Crore rural people are benefited from the PBS services and system loss has significantly fallen down.

NRECA's other example of success in rural electric co-operatives can be observed in Guatemala, where the co-operative was developed as a pilot project, "Electricity for Progress."

In Sri Lanka, all village hydro development units are operating as co-operatives without any concern to the Ceylon Electricity Board. They take membership fees and distribute the power generated to its members on no-tariff basis.

In India, 33 rural co-operatives, called RECS, are operating quit satisfactorily.

Before replicating any models, it will be wise to visit and study them to find whether they will be applicable to our country or not.

b. Pico/Micro/Mini & Small hydro in Co-Operative ring

Large hydro projects, as experience has taught, cannot be judged as suitable models of power exploitation for us as per Nepal's economic status, security measures and difficulty in national grid extension. All small-scale generations, at some particular phase of the development, should be allowed to enter into the ring of electric co-operatives. The Government of Nepal is required to issue clear guidelines and streamlining processes regarding it. Besides such guidelines and policy-framings, there must be a workable understanding among the Government, the co-operatives and the local power producers.

Local generations should come up to form a separate rural grid as far as possible so that rural co-operatives would find it easy for control. If we aim at extending the national grid only to all our rural areas, we will simply reach the goalpost of fiasco.

Cost-effective and environment-friendly electricity generations at Pico / micro / mini or small scale need to be prioritized in villages and operated as franchise-full co-operatives to distribute the power to the people of such remote areas. So far in Nepal, we have practiced various combinations such as grid-connected rural electricity generation and distribution as well as off-grid rural generation and off-grid integrated supply system. There are quite a large number of micro hydro projects currently functioning for villages and thus the scope of electric co-operatives in rural areas is certainly very wide.

c. Proposed Electric Models for Nepal

The co-operative concept in Nepal's rural electrification is suggested to be implemented and completed in the following three phases, each of them as a model in itself:

1. Phase I: Selling bulk power to registered co-operatives:

NEA reserves the right of generation, transmission and distribution with itself and only sells the bulk power to a registered electric co -operative at a suitable rate. The co-operatives issue the membership to its villagers and power is sold to them at reasonable rate as per guidelines provided. However, major maintenance works of the distribution network are to be performed by the NEA itself.

In this first phase, co-operatives are not allowed to look after the distribution network because they are still raw and not experienced, lacking adequate technical knowledge, trainings or the efficient workmanship. We may even call it a warm-up period, requiring a lot to acquire and observe. However, NEA treats it as a bulk consumer, and all our consumers of that particular area then maintain the commercial relationship with the co-operative only.

Villagers themselves will be active to eliminate direct hooking and other types of energy thefts. Consequently, the system loss will be decreased. Still another significant achievement for the NEA will be increase in revenue collection which helps to boost its economic status.

New service connections, metering, billing, revenue collection and theft vigilance in the rural

areas take place smoothly under the co-operative management. The era of the old and long-existing mentality that consumers should run after us for their grievances gets virtually terminated and the consumers' satisfaction comes out.

2. Phase II : Handing over LT tines and distribution system along with bulk power sale:

There should be some mechanism through which the rural electric co-operatives are adequately funded. The Government should allocate the budget directly to reach the co-operatives and the donors' assistance may be very helpful for it. This second model gives the franchise to sell the electric power purchased from the NEA to its member and to perform all necessary works of maintenance regarding lines and transformers. The Government may nominate its representative also for these co-operatives. Part of the funds available needs to be spent in the trainings of their employees and these co-operatives are not expected to produce the electricity by them or buy it directly from the IPPs.

3. Phase III: Offering greater autonomy to electric co-operatives:

The rural electric co-operatives will be assigned the following franchises:

(a) Construction of new distribution liner or extension of the existing ones with prior approval from the concerned authority.

(b) Maintenance of the electric network within their areas.

(c) Purchase grid power from the NEA or off-grid power directly from IPPs.

(d) Generate electricity up to small scale by them.

If more than one co-operative is formed in the same rural area, there will take place an internal competition based on locking in prices, service conditions etc. among all such market participants and the access to the transmission and distribution network is ensured to them on a non-discriminatory basis.

Government should develop funding strategies to these co-operatives and there should be formed Bangladeshi Rural Electricity Board-like body to assist them in fulfilling their primary requirement.

However, the Government should be prepared to take new responsibilities them such as providing necessary information to these co-operatives and guarding the rural people against the abuses of marker power.

These proposed models may anytime be viewed as independent models and may even be applied without the sequence above if we are sure that we can succeed directly at the higher stage.

Studies of south Lalitpur Rural Electric co-operative and Lamjung Electricity Association may be quite relevant to earn some Nepalese experiences in the concerned field.

12.6 International experience - efficient use of energy is a win-win-win option:

1. Private households and industries reduce their cost for energy consumption,
2. Utilities may plan for less capacity additions and require less investment capital,
3. Less consumption of natural resources conserves the environment and climate.

Benefits of the efficient use of energy can be derived from all primary and secondary energy sources, i.e. fuels, electricity as well as for biomass and other renewable energies. Given the present situation in Nepal the approach of NEEP addresses two different issues. It will support the Government of Nepal to introduce a policy framework towards the efficient use of energy and it will demonstrate the benefits of energy efficiency for private households and the industry. Besides the NEEP working areas of households and industry there are other working areas which are relevant for energy efficiency such as public and private buildings, the transport sector and investment in infrastructure. These working areas are not covered during the present phase of NEEP

The NEEP approach of the ongoing phase consists of three components:

a. Nepal Energy Efficiency Programme

Within the framework of bilateral Development Cooperation between Nepal and the Federal Republic of Germany, the joint implementation of "Nepal Energy Efficiency Programme (NEEP)" has been agreed upon in 2009. The lead executing agencies for the implementation are the Water and Energy Commission Secretariat (WECS) and the German Development Cooperation – GIZ. NEEP is a Technical Cooperation programme with an eight-year horizon and a first phase ending in 2014. It is conducted on behalf of the German Federal Ministry of Economic Cooperation and Development (BMZ).

Nepal suffers from the current supply crisis in the electricity sector, as well as from price hikes for commercial energies. At the same time international and regional data comparisons clearly indicate that Nepal has a high specific energy consumption related to GDP. The traditional use of biomass as the backbone of energy supply in the rural areas is inefficient and contributes in some regions to deforestation. The objective of NEEP is to broaden public and policy understanding to use energy efficiently to balance the energy demand and supply and thereby contribute to a sustainable energy management and climate protection.

b. Policy Advice towards Energy Efficiency.

NEEP will support the drafting of an Energy Efficiency Strategy (EEST) as well as a Biomass Energy Strategy (BEST). Both Strategies will be complementing the National Energy Strategy. In many countries Energy Efficiency/Conservation Policy is an integral part of the Energy Policy and of the respective development plans. The policy sets the regulatory framework and incentives for the energy sector and the energy consumers to balance supply and demand on low or moderate economic cost.

The Implementing Agency for this component is WECS with the support of AEPC for drafting the Biomass Energy Strategy.

c. Energy Efficiency in Households.

This component is concerned with the introduction of Minimum Efficiency Performance Standards (MEPS) for electric household appliances follow the experience of the introduction of the CFL in the Nepalese market. The Implementing Agencies are NBSM and NEA. Many of the imported electric household appliances such as refrigerators, light bulbs and rice cookers are already efficiency labeled and give the consumer some indication of the electricity consumption.

Another part of this component is the dissemination of improved cooking stoves (ICS) for more efficient use of biomass in rural households and the efficient use of electricity in

predominantly urban households. The Implementing Agency is the AEPC with support from FECOFUN. The dissemination of ICS will be implemented within the framework of the National Rural & Renewable Energy Programme (NRREP). The NEEP approach has a pilot character for new ISC-models and dedicated target groups.

This Component consists out of 2 subcomponents, which focus on energy efficiency on household levels:

i. Subcomponent 1 - Energy Standards & Labels for electrical appliances in Grid Connected Households

NEEP component "Energy Efficiency in Grid Connected Households" aims to increase consumer demand for high-efficiency electrical appliances and to remove the most inefficient products from the market by introducing a standard (MEPS) and labeling system for electrical household appliances. The labeling of energy efficient appliances (ELS) is considered important product information for the consumers' purchase decision enabling private households to take criteria of 'energy consumption' and 'overall costs of operation' into account.

ii. Subcomponent 2- Improved Cooking Stoves for Rural Households

With close to 90 % of the total national energy consumption biomass (wood, dung) is by far the most important primary energy source in Nepal. Nearly two thirds of the biomass, is used for cooking. Unfortunately, the traditional utilization of firewood and dung for cooking in mud stoves or simple three-stone stoves is characterized by low fuel efficiency and inadequate venting of smoke resulting in high levels of indoor air pollution (IAP) with severe health implications especially for women and little children who spend between 2-7 hours per day in the kitchen. The inefficient use of biomass also contributes to the increasing deforestation and forest degradation in parts of the country.

d. Energy Efficiency in Industries.

Nepalese industries offer a huge potential to cut production cost by using energy more efficiently. In order to tap on this potential NEEP supports the capacity development of the Energy Efficiency Center (EEC) under FNCCI, qualifies energy auditors for the industry and conducts pilot energy audits. In addition, NEEP supports cooperation and networking with other regional institutions regarding services for the industries and technology providers. It is expected that industries will invest in modern, cost and energy saving technologies as recommended in the energy audits. NEEP will also provide information to banks to enable them to offer financial services to the industries for investments in energy efficient technologies.

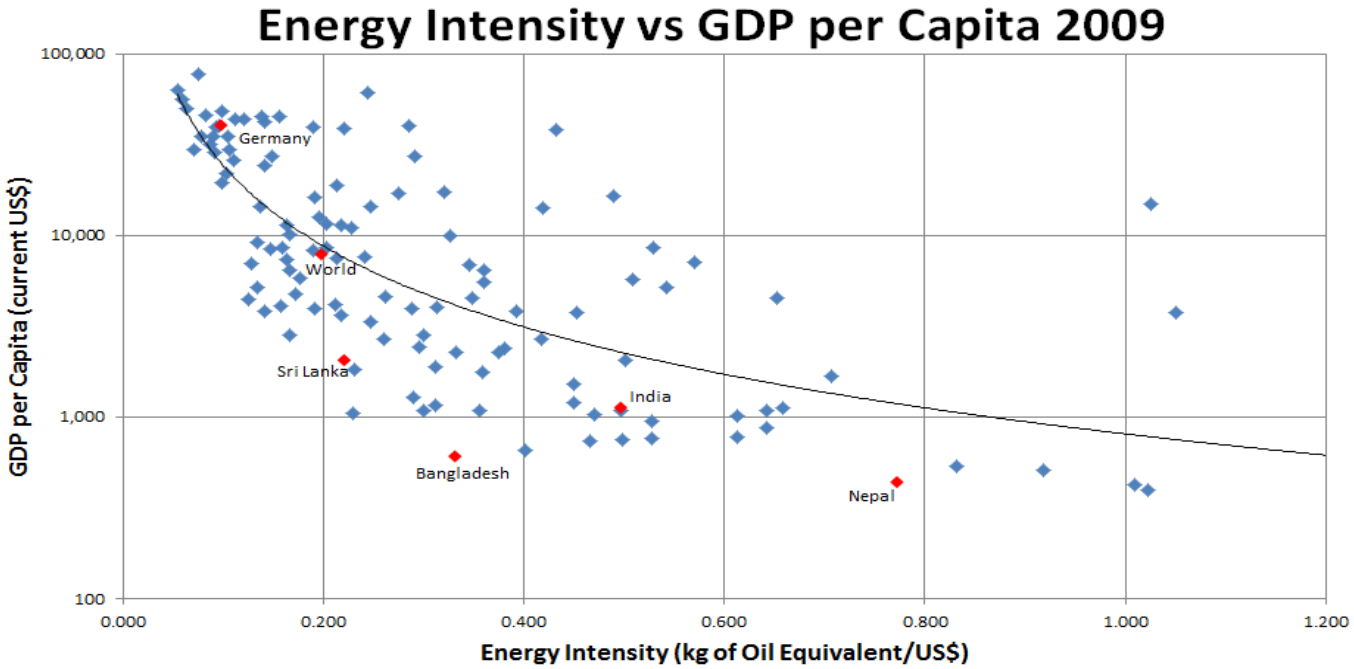
The Energy Efficiency Center (EEC) under FNCCI is the implementing partner of NEEP component-3. EEC is a not for profit autonomous body which aims to provide energy efficiency services to the Nepalese industrial sector.

As of now, NEEP has identified eight energy intensive industrial sectors, including manufacturing and service industries. The eight sectors are: Hotel, Metal, Food and Beverage, Cement, Pulp and Paper, Cold Storage, Soap and Chemical and Brick industries. NEEP baseline study among 200 sample industries of above eight sectors indicates that, energy saving potential in these eight sectors is around 15% in electrical and 30% in thermal energy.

The EEC and NEEP services to industry will help in saving considerable amount of energy and cost, with additional benefits of saving resources and emission reduction. It will also help Nepalese economy in reducing the costly import of petroleum products and coal.

12.7 Country-specific challenges in rural electrification including access and availability

About 87% of Nepal's total primary energy supply comes from biomass which is generally being used in the household level for cooking and space heating purposes by traditional stoves with very low energy efficiency of less than 10%. Efficiency of other energy usage is also far from satisfactory. Nepal has the highest energy intensity (i.e. amount of primary energy consumed per unit GDP) in South Asia, which is 4.5 times higher than the world average, 1.8



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http://search.worldbank.org/data?qterm=gdp&language=EN&format=

times higher than India or China, 3.5 times higher than Bangladesh.

(# 18.6 Energy intensity vs. GDP per capita 2009)

The current way of energy use in Nepal is not cost effective economically and it is environmentally unfriendly; and principally not sustainable. Because of country's large gap between the supply and demand of electricity, greater focus has been given on generating more electricity i.e. more focus on supply side of it, though it is not happening as per expectation. No serious attention has been paid into demand side management and energy efficiency. No comprehensive energy efficiency strategy as well as integrated energy policy is in place so far.

a. Energy efficiency is the most effective energy resource for reducing the supply gap, carbon emissions and reliance on expensive imports of petroleum products. It is the goal of efforts to reduce the amount of energy required to provide products and services. The Energy Efficiency increases the energy security and reduces the level of per capita energy consumption and overall power system peak demand. Reducing peak demand improves the electricity system's reliability and reduces the load-shedding hours. Energy efficiency is not just 'an energy saving', it is rather 'producing more with less', i.e. consuming efficiently, working efficiently.

Urbanization and economic growth in Nepal have led to a large increase in demand for modern energy services in residential, commercial, public and industrial sector. The demand will increase even faster with social and economic development. Energy efficiency in buildings as well as in industries is vital to energy security in Nepal. It has been widely accepted that energy efficiency has the greatest potential of cost effective CO_2 reduction among all energy consuming sectors.

b. Objective of the Component

The main objective of this component is to support the government particularly WECS in formulating energy efficiency strategy and policies and raising awareness on energy efficiency and demand side management of energy.

c. Rationale of Energy Efficiency Strategies and Policies

Because of the misconception that energy efficiency might slow the economic growth, priority might be given first to ensure economic growth and deal with energy saving later. A well-conceived energy efficiency strategy will not only allow them to achieve the goal of economic growth with much lower energy consumption but also enable them to improve the living standards and quality of life, while making human and financial resources available for other aspects of societal development such as education, healthcare and others.

Energy efficiency is widely recognized as the "low-hanging fruit" for achieving energy security, inclusive development, and transition to a low-carbon economy. Investment in energy efficiency could be very attractive as the incremental capital investment is recovered in a reasonable time period, energy costs are lowered, and energy productivity is enhanced, thus helping nations and businesses to be better prepared against any sharp hikes in fossil fuel prices. The general objective of energy efficiency could be to ensure a certain level of production and services with energy consumption optimized with respect to the cost. Nepal has faced the added challenge of achieving the target of production and services while confronting energy supply constraints. The deficit in energy supply can very well be met by minimizing the "wasted energy." Wise investment in end-use efficiency can help avoid huge capital investments in power plants that have a long gestation period and are expensive to operate as well.

Despite the growing awareness about the merits of energy efficiency, and energy efficiency programmes, Nepal is still far from realizing the significant energy efficiency potential because of a number of policy, institutional, informational, technical, financial, and market barriers that have not been effectively tackled. Taking account of the specific socioeconomic context of Nepal, energy efficiency policies need to be designed and implemented to address those barriers effectively. Though, there is not an energy efficiency strategy of Nepal yet, there are already some government policy interventions regarding the energy efficiency. The current Three Year Plan (2010-2013) has already mentioned the need of energy efficiency and

government's commitment to move further for better efficiency in the energy sector. The plan has specifically highlighted energy efficiency issues under the headings of industry, hydroelectricity, alternative energy, and environment & climate change. Furthermore, the same

Three Year Plan has made a reference to number of other government's decision-documents where energy efficiency falls under the priority actions, plans and programmes of the government. For example, National Electricity Crisis Mitigation Action Plan 2008 has clearly outlined specific action and policy measures to be taken for better energy efficiency. Likewise,

Ten Year Hydropower Development Plan 2009, National Climate Change Policy 2011, National Water Plan 2005, and National Adaptation Programme of Action (NAPA) 2010 have also highlighted the need of energy efficiency for better energy management. Periodic energy auditing and reporting; public awareness and sensitization; development of standards; certification and labeling; energy efficiency codes; incentive (both technical and financial) for energy efficiency measures are some of the proposed measures already mentioned in these documents. There seems a clear need of bringing all these efforts and decisions together in order to formulate a national energy efficiency strategy which becomes an integral part of national energy strategy.

12.8 Country-specific challenges in rural electrification

a. Challenges of CREP

One of the most pressing issues of the CREP is that, even though the envisaged time-frame for finalizing grid-extension (from the date the community settles the 20% contribution on the bank account) is one year, the actual time for construction sometimes exceeds two or even three years. CRED is closely cooperating with the National Association for Community Electricity Users Nepal (NACEUN), representing villagers on governmental level to accelerate the process. Since 80% of the investment costs are provided by the government via NEA, the government declares that ownership of the assets belongs to NEA. This sometimes leads to friction when it comes to upkeep or maintenance. CREE has the obligation to manage the electricity distribution as a small community based utility. In order to be able to fulfill its tasks CRED/NEA offer trainings for the participating communities. These trainings however are not conducted regularly and only cover the basic needs i.e. financial and administrative issues and technical know-how for operation and maintenance of the village grid. It is seen as most crucial by all stakeholders that each CREE employee receives proper training. An additional challenge is that some communities do not nominate the right target person to participate in the training and some participants use the training certificate (especially the technical training) for better access to an employment abroad (which then fosters migration). Financial viability of a CREE depends upon the number of customers and especially the number (or existence) of small industries and small enterprises, which increase the load factor and also pay a higher tariff for consumption. It is therefore seen as most critical to promote the use of productive end-use applications. In less frequent cases where the load factor has become very high, the tariff structure can contribute to overload problems. With a monthly minimum charge of 80.00 NPR which has to be paid regardless of the actual consumption, the majority of households who use electricity essentially for lighting purposes and TV, have no incentive to save electricity. Last, but also most critical is that many villages lack the ability to collect the 20% share the community has to put as a down payment before the grid-extension starts.

12.9 Conclusion and Recommendations

Nepal shouldn't blindly replicate the foreign electric cooperative models without any suitable modification in them. It is advisable to implement the concept of rural electric co-operatives as pilot projects in some districts only at the first trial. After they are known to have achieved success as per targets, they should be carried out in other districts of the country to make rural electrification really a fruitful experience in Nepal.

It should go for energy efficiency and conservation programme together with renewable energy especially for off grid locations.

Its massive hydro projects can be used for electricity trading with other SAARC countries. This will be economically beneficial for Nepal and again help energy sustainability in the region.

Ref: Rural Electrification in Nepal :Co-operative Concepts In Rural Electrification by Er.PrabalAdhikari. http://wecs-neep.gov.np/ Nepal Energy Efficiency Program

13. Rural Electrification in Pakistan

(#17.09, Map of Pakistan)

Rural Electrification in Pakistan

13.1 Pakistan Overview

The Islamic Republic of Pakistan is a country located in South Asia. It is bordered by Afghanistan and Iran to the west, India to the east, Arabian Sea and Gulf of Oman to the south, and China to the northeast.

It lies adjacent to Tajikistan but it separated by Wakhan Corridor. Pakistan shares its marine

border with Oman.

It has 4 provinces namely Sindh, Panjab, Baluchistan and NWFP. Its capital is in Islamabad.

13.2 Power system in Pakistan

WAPDA (Water & Power Development Authority) was established in 1958 and having a massive agenda, which included generation, transmission and distribution of power along with irrigation, drainage and flood control etc. Then it was divided with expansion of power supply system.

Electricity in Pakistan is generated, transmitted, distributed, and retail supplied by two vertically integrated public sector utilities: Water and Power Development Authority

(WAPDA) for all of Pakistan (except Karachi), and the Karachi Electric Supply Corporation (KESC) or simply K-Electric, for the city of Karachi and its surrounding areas. Under PAEC (Pakistan Atomic Energy Commission) there are two nuclear power plants KANUPP and CHANUPP, and 20 independent power producers (IPPs) and other small power producers (SPPs) that contribute significantly in electricity generation in Pakistan.

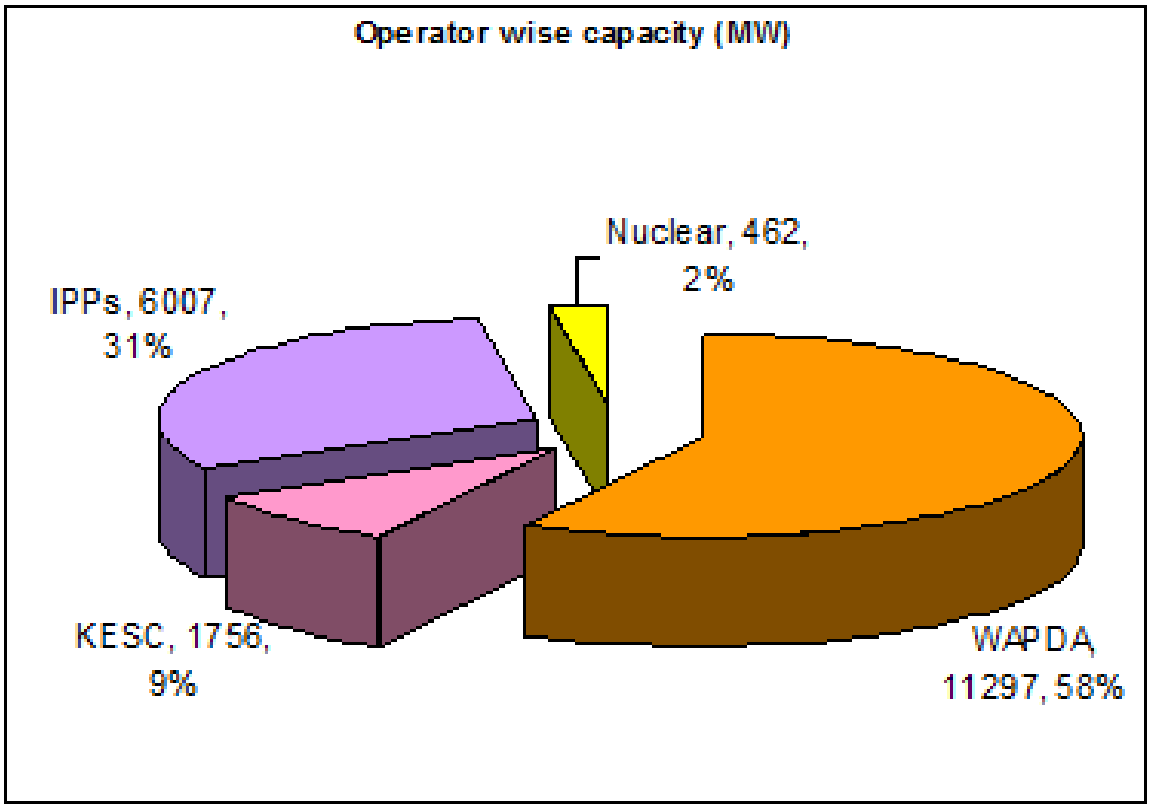
Transmission: There 12436 km transmission line of ranging from 220 kV to 500 kV.

After the transmission, Power is handed over to Eight Distribution Companies(DISCOs) to transfer this power to the consumers of Pakistan.1. PESCO: Peshawar Electric Supply Company, Peshawar, NWFP;2. IESCO: Islamabad Electric Supply Company, Islamabad;3. GEPCO: Gujranwala Electric Power Company, Gujranwala, Punjab;4. LESCO: Lahore Electric Supply Company, Lahore, Punjab;5. FESCO: Faisalabad Electric Supply Company, Faisalabad, Punjab;6. MEPCO: Multan Electric Power Company, Multan, Punjab;7. QESCO: Quetta Electric Supply Company, Quetta, Baluchistan;8. HESCO: Hyderabad Electric Supply Company, Hyderabad, Sindh.

At the substations, transformers reduce the voltage to a lower level for distribution to commercial and residential users. This distribution is accomplished with a combination of sub-transmission (33 kV to132 kV) and distribution (3.3 to 25 kV).Finally, at the point of use, the energy is transformed to low voltage.

The safe and reliable transmission and distribution of electricity was a problem in Pakistan. Losses from the transmission and distribution network were high. Their weak grid and poor conductor material were the main causes of the loss. Other reasons were low time to time, theft of electricity, infrastructure and substantial resistive losses and sub-par maintenance of network.

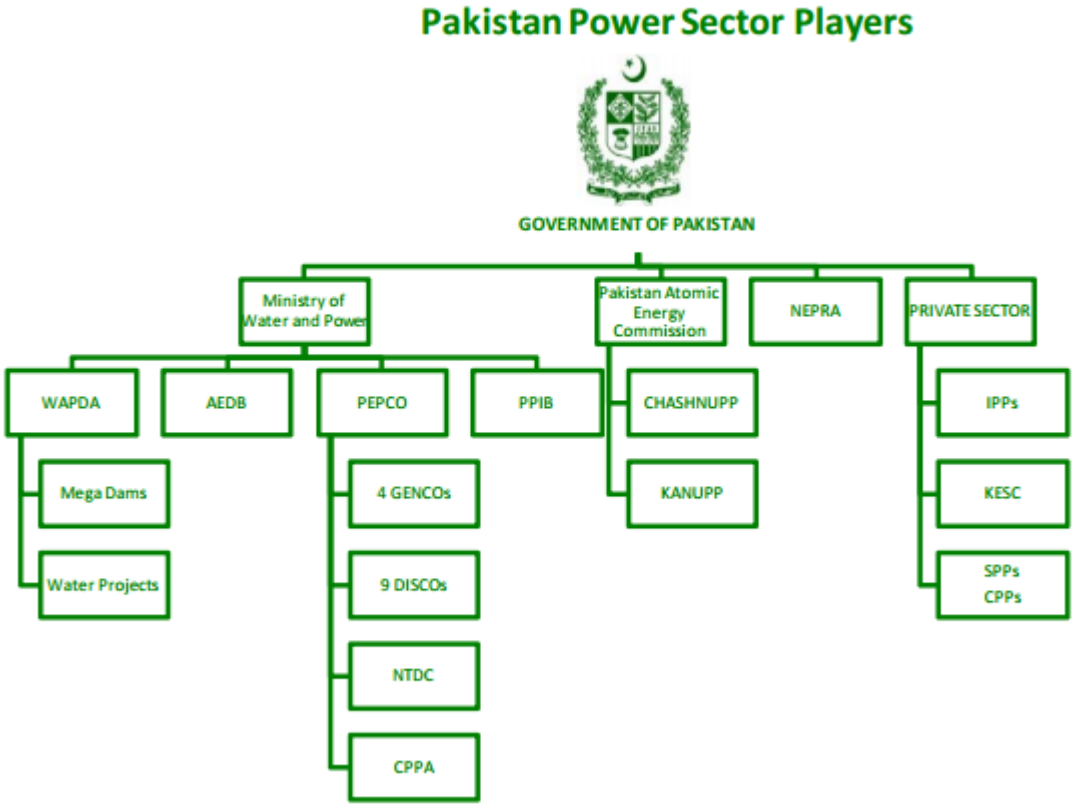
The electricity customers in the Pakistan are over 13 million.



(# 18.7 Operator wise Capacity in MW and Percentage)

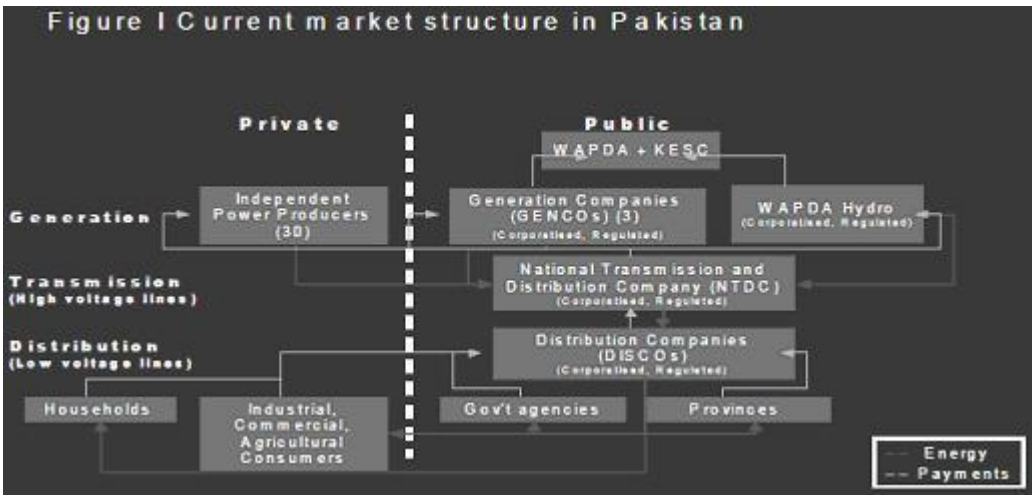
Besides these utilities, there are five central government agencies with responsibilities in the power sector, as given below in the table

Government Agencies	**Responsibilities**
Ministry of Water and Power	Take care of the sector's affairs and manage issues of energy policy.
Private Power and Infrastructure Board (PPIB)	To facilitate private investors in the power sector; provide guarantees on behalf of government; assists the regulatory authority in determining and approving tariffs; and also an implementing agency for power policy.
National Electric Power Regulatory Authority (NEPRA)	To ensure fair competition and consumer protection.
Alternative Energy Development Board (AEDB)	To promote the exploitation of alternative energy resources such as small scale hydro plants, wind power and off grid generation plants.
Privatization Commission	Deals with privatization issues.



(# 16.16 Pakistan Power Sector Players)

Current market structure in Pakistan



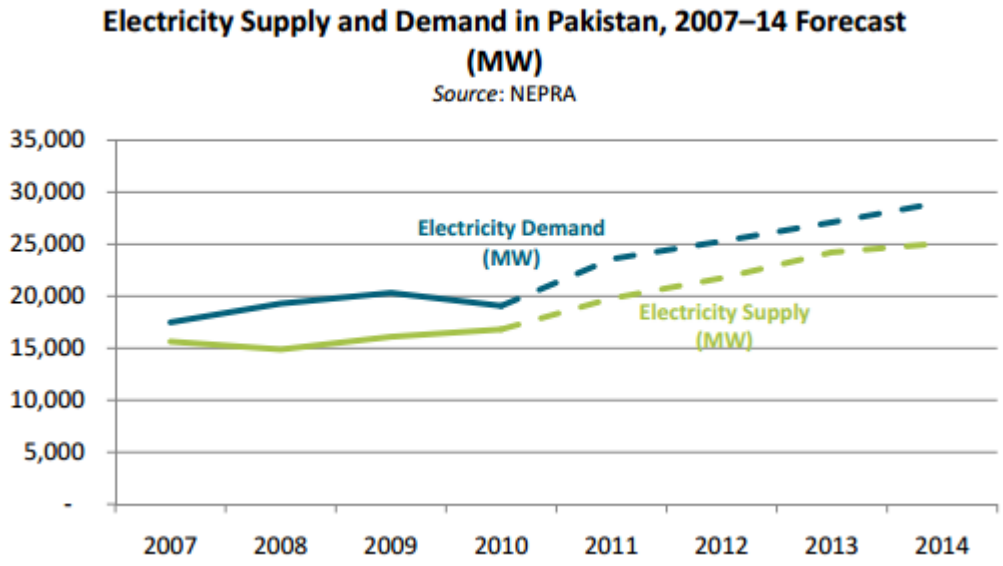
(#16.17 Current market structure in Pakistan)

1. Pakistan Electric Power Company Private Limited (PEPCO) a separate agency within WAPDA is made responsible for the restructuring and preparation for privatization for the generation and distribution companies in due course through the Privatization Commission. Private sector participation is being encouraged to promote competition in the generation and distribution parts of the industry, while, NTDC would remain under state control and be responsible for national dispatch, transmission, and system planning as a 'single buyer'.

2. Responsibility for the energy sector policy remains with the government.

As of 2013 massive long-standing electricity shortages continued with long-standing failure to provide reliable service and rampant corruption being met by public protests, unauthorized connections, and refusal by consumers to pay for intermittent service. The 2010 Pakistan floods and 2005 Kashmir earthquake also caused massive damage to the power stations, power distribution and transmission and other energy infrastructures. Electricity generation in Pakistan has shrunk by up to 50% in recent years due to an over-reliance on fossil fuels. In 2008, availability of power in Pakistan falls short of the population's needs by 15% Pakistan was hit by its worst power crisis in 2007 when production fell by 6000 Megawatts and massive blackouts followed suit. Load Shedding and power blackouts have become severe in Pakistan in recent years. The main problem with Pakistan's poor power generation is raising political instability, together with rising demands for power and lack of efficiency and conservation measures.

Also, there is a massive lack of funds, which means supply is lagging behind demand that is increasing at the rate of 7 percent per year, and the gap is going to increase in the years to come, as shown in the chart below.



(#18.8 Electricity Supply & Demand in Pakistan, Forecast 2007 – 14)

13.3 Current rural electrification programmes, objectives and review of energy technology options

The Government of Pakistan (GoP) plans to electrify some 7,000 remote villages (to serve around 10 million citizens) in Pakistan through the Alternative Energy Development Board (AEDB) using off-grid renewable energy technologies. It is unlikely to be economic to serve these remote communities through expanding the national electricity network in the coming decades. Renewable energy experience in the country to date includes electricity from solar home systems provided to 4,700 houses, wind electricity from small turbines provided to 500 households, and some 40,000 households supplied from around 400 micro hydel plants.

7876 of un-electrified villages in Pakistan cannot be connected to the national grid for another 20 years due to their distance from the national grid, which rendered these villages technically and economically unavailable. Hence, the Government of Pakistan (GOP) tasked Alternative Energy Development Board (AEDB) to provide the basic energy services to these villages.

AEDB, established to promote environmentally friendly alternative/renewable energy resources in the country, designed and launched the Rural Electrification Programme (REP) to provide electric lighting, means of communication and clean drinking water facilities to the villages identified by WAPDA. The programme is fully funded by the GoP with an estimated cost of Rs. 1.167 billion.

(http://www.aedb.org/parl.htm)

The procedure followed by AEDB to implement the "Off-grid Rural Electrification Program of the Government of Pakistan" has involved the Provincial authorities in its design and implementation. An outline of this process is presented below:

- AEDB asked the Provincial authorities of Sindh and Baluchistan to select 100 villages in one district each to be electrified using solar home systems as per the PC-1 submitted to the Government of Pakistan.
- The final selection of villages has been arrived at through discussions between AEDB and officials of the Provinces. The main considerations in the selection were needs identification by provincial and district authorities, generally based on needs as well as political priorities, and technical feasibility and financial resources availability on the part of AEDB. Two clusters of villages in Sindh were electrified in the first round and none from Baluchistan due to financial resources not being available from the Federal Government to the level expected.
- AEDB set the technical standards for the procurement, put out the tenders, evaluated the bids, and awarded the contracts as per Government of Pakistan rules. Provincial authorities were invited in the bid evaluations.
- AEDB has been supervising the installations as they are being carried out and will monitor the systems to make sure they are operated and maintained by the supplying company over the one year agreement period.
- At the end of this one year period, AEDB intends to hand over the installations to the respective Provincial authorities for operation and maintenance of the systems.
- Individual households which have received electrification through the OS systems have signed for the receipt of equipment, which belongs to the Government of Pakistan, and have agreed to use and operate them without abuse.
- The equipment supply companies have formed user groups, of around 100 households each, with the help of AEDB for system maintenance and tariff collection. They have trained a number of local operators to carry out routine maintenance. Operators were selected for training by the village committees and district Nazim.

  The Pakistan Council of Renewable Energy Technologies (PCRET), under its mandate to carry out research and development, dissemination, training, and promotion of renewable energy technologies, has installed a large number of off-grid energy systems in rural areas. Funded through a series of PC-1 submissions, PCRET has

constructed over 300 micro-hydel systems, 134 micro-wind systems, and 650 kW of solar PV systems. Programs are currently ongoing to construct 550 kW of micro-hydro projects using Low Head High Discharge turbines and 60 kW of solar PV systems. PCRET works with community organizations and the private sector to install Off-Grid Supply (OS) technologies. It is currently not in the mandate of PCRET to carry out large scale-up of solar home systems or micro-hydel.

Till February 2008, total number of electrified villages by **WAPDA** in the country has risen to 125495 from the meager number 609 villages in 1958.

The province-wise status of village electrification is as under:

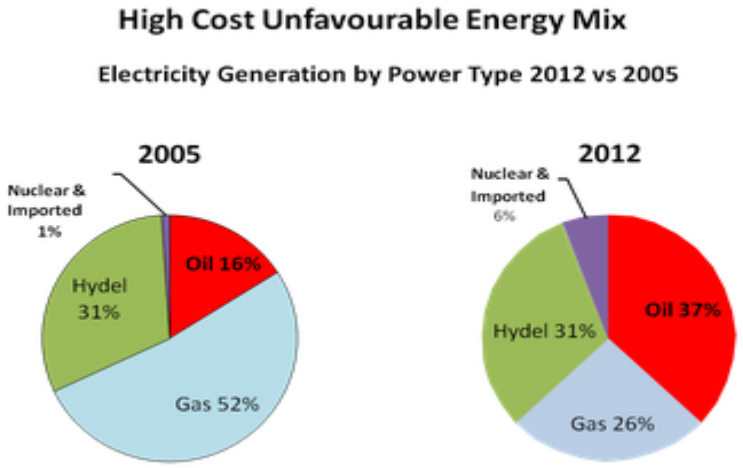
	Punjab	**Sindh**	**NWFP**	**Baluchistan**	**Total**
Villages Electrified	71979	21799	24416	7301	125495

(http://www.wapda.gov.pk/htmls/power-development.html)

Also, in northern Pakistan alone there is an estimated potential of 300 MW for micro hydropower plants with installed capacities below 100 kW each. Only about 10 MW of that potential had been tapped by a total of some more than 300 projects co-financed by Aga Khan Rural Support Programme (AKRSP) PCRET, European Union (EU) and private developers. Now, with the assistance of the Asian Development Bank and within the scope of Malakand Rural Development Project, 100 micro hydropower plants with ratings ranging from 5 to 50 kW are under implementation with in and around Malakand Division of the North-West Frontier province (NWFP).

13.4 Costs, incentives and tariff structures

As mentioned earlier, electricity production in Pakistan is high due to staggering demand, increase in oil prices and inefficiency in the production, leading to high tariffs by the consumers and subsidies by the government.



(#18.9 High cost unfavourable energy mix (Oil))

During the period 2006-2012, the circular debt grew by a staggering Rs. 788 billion to Rs. 872 billion (nearly 4% of the GDP) at June 2012 according to recent study published by the

Planning Commission of Pakistan. Notwithstanding the non-collection problems, about 62% of the cumulative increase in the debt has been attributed to the pricing and subsidy issues as shown below.

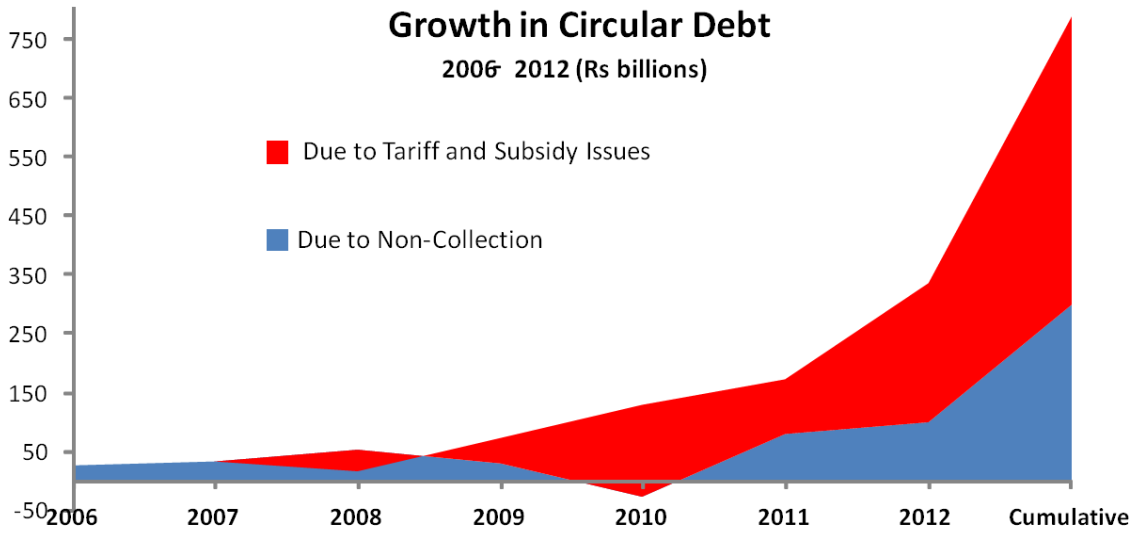
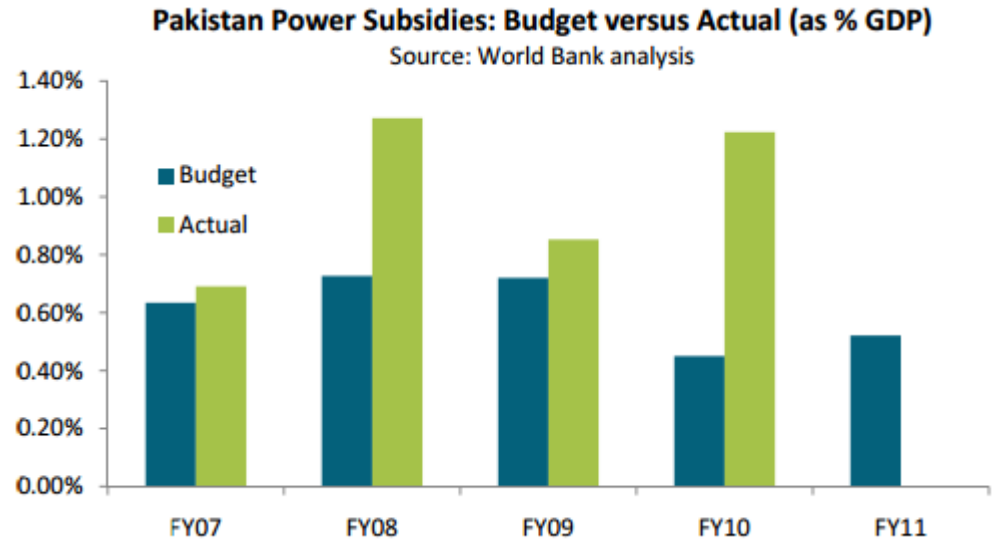


Figure 4

(#18.10 Growth in Circular debt)

The rising cost of electricity generation, along with the high technical and commercial losses of DISCOs, meant notified tariffs were not able to cover costs. In turn, the fiscal difficulties faced by the government in covering this difference have been a growing source of financial strain.



(#18.11 Pakistan Power subsidies vs. actual)

Brief description of electricity tariff structure in Pakistan

For residential customers, Pakistan's electricity tariff adopts an incremental block tariff (IBT) structure,where a unit price increases in the amount of electricity use. There are many rationales for the IBT in Pakistan, but the main one is to protect lifeline (or extremely small) users.7 For example, as of March 2008, an electricity user was charged Rs 1.4 per kilowatt

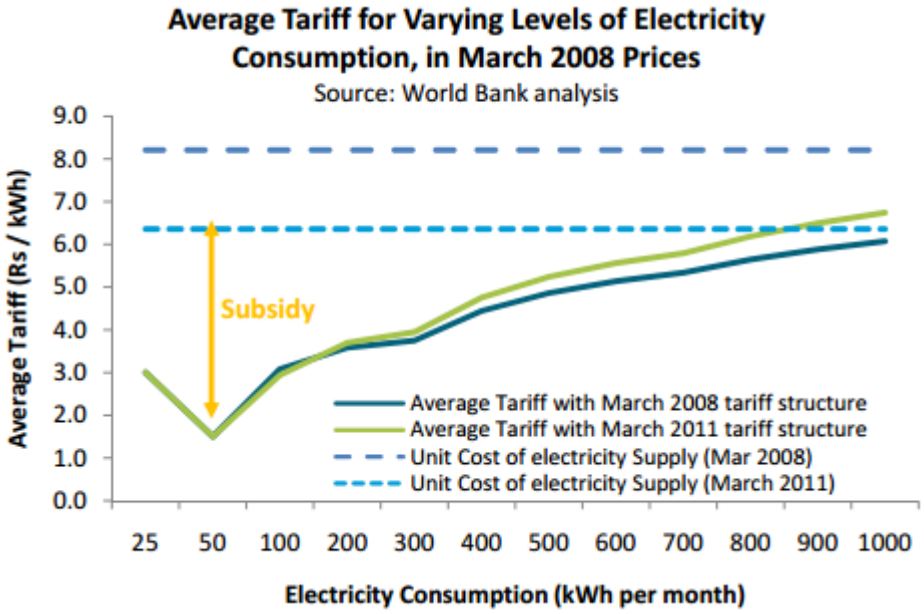
hour up to 50 kWh per month. Above this amount, the user faced a charge of Rs 3.08 per kilowatt hour for the first 100 kWh per month; then Rs 4.08 until 300 kWh; then Rs 6.53 until 700 kWh; and finally Rs 7.79 for use above that level (see Table below). There is also a minimum charge of Rs 75 for a single-phase connection and Rs 150 for a 3-phase connection applied to all customers (including lifeline customers).

Electricity Tariff Structure for Residential Users, Nominal Prices (March 2008 and March 2011)

	Notified consumer tariffs (Rs/kWh)		
kWh/month	March 08	March 11	% increase
Up to 50	1.40	1.87	34
0–100	3.08	4.45	44
101–300	4.08	6.73	65
301–700	6.53	10.65	66
Above 700	7.79	13.29	74
	Average cost of electricity supply (Rs/kWh)		
	8.21	9.57	

Source: Pakistan Electric Power Company (PEPCO).

(#16.18 Electricity Tariff structure for Residential user)



(#18.12 Average Tariff for varying level of electricity consumption)

The agrucultural tariff in rural areas is also included:

AGRICULTURE TARIFF

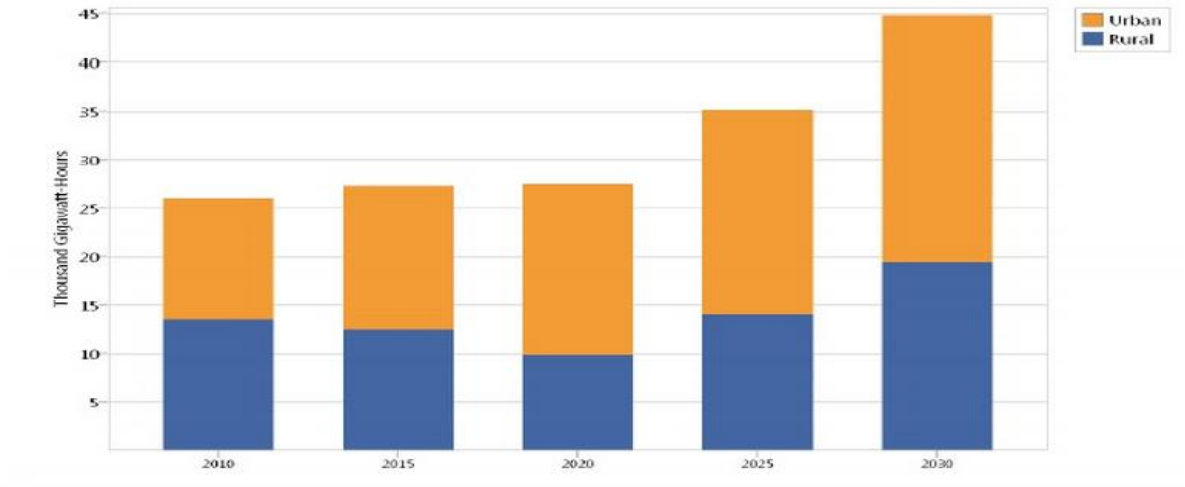
D-1(a)	SCARP less than 5 kW	-		8.47
D-2	Agricultural tube Wells	105.00		5.31
			Peak	**Off-Peak**
D-1(b)	SCARP and Agricultural more than 5 kW	200.00	10.11	4.55
The consumers having sanctioned load less than 20 kW san opt for TOU metering				

(#16.19 Agricultural Tariff (Pakistan))

Monthly tariff for **off-grid solar** home systems, mostly in the rural areas, are currently Rs. 150, Rs. 200, and Rs. 300 for 40W, 80W, and 120W systems. This is used to cover the cost of routine maintenance as well as the salary of the village operator. It does not recover the capital costs in any way. Users have been paying these tariffs as long as the service is satisfactory.

13.5 Country-specific challenges in rural electrification including access and availability

Energy is not that abundant in the urban areas, and hence it is even worse in the rural areas. Fortunately, the initiatives taken by the government, especially regarding solar energy in those rural areas, have provided some electricity there. The following figure shows the projected rural and urban demand in the near future.



Rural and urban electricity demand projection developed by LEAP

(#18.13 Rural & Urban electricity demand projection by Leap)

Installed Capacity:

Electricity – total installed capacity: 21,103 MW (2012)

Electricity – Sources (2013)

fossil fuel – 13,637 MW – 65% of total

hydro – 6,654 MW – 31% of total

nuclear – 812 MW – 4% of total

Electricity production:

Electricity – production: 88.42 TWh (2005)

Electricity – production by source (2003)

fossil fuel: 65% of total
hydro: 31% of total
nuclear: 4% of total
Electricity – consumption: 74.62 TWh (2004)

There is a deficit exceeding 6000 MW, and the government came up with two policy decisions to decrease it: pay half a trillion rupees (just under $5 billion) to energy companies and announce a new power policy of a tariff hike. Both steps were aimed at resolving problems plaguing the companies belonging to the energy chain and bringing change to Pakistan's

energy mix to optimize the average cost of electricity generation.
Pakistan's government also paid Rs260 billion in cash to independent power plants (IPPs) to clear outstanding debt. It also issued bonds to pay off liabilities pertaining to state-owned companies such as exploration and production firms and oil and gas marketing entities. After clearing the debt of the IPPs, it was expected that they would be able to generate 1,700MW in additional electricity.

In the rural areas, there have been solar panels, and in some areas hydro power stations set up that have given access to a small percentage of the total population. However, a lot more steps need to be taken, as explained later, to make Pakistan have access to electricity in all areas.

13.6 Proposed action plan (s) for successful implementation of rural electrification policies

A comprehensive three-pronged strategy is required:

A. Restructuring and rationalization of generation sector

B. Consolidation of distribution channels

C. Investments in hydel, coal and nuclear energy

The most important part of this strategy would be a **restructuring and rationalization** plan for the generation sector. This should include the following steps:

The government should attach the highest priority to importing electricity from the neighbouring countries as a temporary measure to minimize the adverse impact of high cost energy mix. Around 1500MW or even higher could be available from India & Iran and has the potential of reducing the 4000-7000MW shortfall by 30-50%.

The government should aim to convert another 2500-3000MW idle capacity in the thermal sector into coal-based plants to bring down national average cost. Last year, Ukraine completed conversion of six thermal power plants to allow them to use coal instead of natural gas to reduce its dependency on gas imports from Russia. To achieve this, the IPPs owned by the domestic companies should be bought by the federal government to because they are not economically viable. A one-time cost restructuring cost would be a better option compared to throwing money into what seems to have become a bottom less pit. Some of the larger public sector oil-based plants should also be converted into coal-based operations to the maximum possible extent. The residual financing gap should be financed through tariff hikes and additional direct income and property taxes with the target of raising an amount equivalent to at least 0.5% of the GDP. For this purpose, a financial emergency may be declared in

accordance with article 235 (1) of the constitution and the federal government should help the provincial governments to raise more revenues as they currently lack the capacity to do so.

The level of **transmission and distribution** (T&D) losses which have ranged around 22% is another critical aspect. The public ultimately pays for these losses through higher prices and power outages. In comparison to other Asian countries, these losses are extremely high. For example, T& D losses are only 3.6% in South Korea; 8% in China; and just 7% in OECD countries.

Ironically, the privatized KESC has experienced much higher level of T&D losses (around little more than 30%) compared to the public sector distribution companies. These losses are due to a host of factors including old-age generation plants, low-voltage transmission and distribution lines, weak grid infrastructure, inaccurate metering and billing, and outright theft. It is obvious that the experiment to improve distribution through setting up different regional companies also failed.

Consolidation of distribution companies at the provincial level via four companies (other than the KESC) and making the provincial governments a major stakeholder should be considered provided the companies are run by autonomous boards consisting of professionals from the private sector. The distribution network requires political and administrative support of provincial governments, professional management as well as huge capital investments. Privatization is high unlikely to be a successful policy to meet the challenges in the electricity distribution in the medium term. Moreover, large companies backed by the provincial governments would have a better chance of attracting capital and support from foreign governments.

While some make a case for the so-called intermittent or alternative energy sources like solar and wind power, the supply from these sources is highly variable and can only supplement the three main sources of energy (fossil fuels, hydro, and nuclear). Therefore, in the long term, the government must not allow any more oil-based power plants and should focus on hydel (specially through smaller dams), coal, and nuclear energy because only a radical shift in the current energy mix can provide a lasting solution to Pakistan's crippling energy crisis.

13.7 Recommended policy options to successful implementation of rural electrification

1) Pakistan's 'Policy for Development of Renewable Energy for Power Generation' (2006) spells out the financial and fiscal facilities to encourage private sector investment in off-grid electrification projects. However it does not elaborate the governance and institutional framework for investment into off-grid electrification from the public sector or for projects carried out under public private partnership - the most likely ways rural electrification is going to be financed to scale.

2) Field surveys at 11 communities served by solar PV, micro-wind energy and micro and mini hydropower lead to the following conclusions:

a. OS technologies can meet basic electricity needs of rural off-grid communities if they provide reliable supply and can be made available at an affordable tariff;

b. User households see significant benefits even from the limited energy services available from OS systems and pay monthly tariff when the systems work well;

c. Organization of consumers into User Groups provides a cost effective way to collect tariff and carry out routine maintenance through a local operator;

d. Strong technical back up by the vendor, in case of equipment breakdown, is required for OS programs to operate sustainably;

e. NGOs can provide social mobilization to organize communities to implement energy

projects and initially provide technical back up but may not always be counted upon to provide long term support.

3) The governance and institutional framework most suitable for scaling up OS in Pakistan, to supply communities which will not be connected to the national grid, is likely to be one which builds on successful experiences in the country and will be based on partnerships between government, private sector, and communities.

4) Based on successes in Pakistan and globally, it is recommended that scale-up of OS be carried out in Pakistan through three main models: a) Fee-for-Service ESCO Concession for solar home systems and micro-wind turbines; b) Community-based mini-grids for micro-hydel, solar/wind powered drinking water projects, and to include wind energy and solar wind hybrids as appropriate; and c) Private sector ESCO investment and management of mini-hydel.

5) It is recommended that this current study be followed up with a design exercise to develop a large-scale national level OS project to include these modalities. A program to supply 500,000 households with solar energy and to generate 50 MW of power to supply mini-grids is expected to need an investment in the order of US$300 million. Additional investments will be required to carry out capacity building of the relevant actors.

6) Fee-for-Service ESCO modality is best suited to reach some 500,000 remote un-electrified rural households in Baluchistan and Sindh with solar home systems and micro wind turbines to a lesser extent.

7) Community-based micro-hydel should be promoted in the Northern Areas and Chitral as well as in other mountain communities by expanding PPAF's current program.

8) A private sector ESCO modality is relevant to expand mini-hydel projects in mountainous districts of the country. ESCOs would provide towns and larger load centers with larger power plants. It is recommended that a subsidy be provided to private companies supplying off-grid consumers at a level which allows them to generate commercial returns on their investment without having to charge a tariff higher than WAPDA. It is expected that around 50 MW of off-grid micro- and mini-hydel might be generated through the community-based and ESCO modalities.

9) The responsibilities and mandates of the main institutional actors under the ESCO and community-based modalities are proposed to be as follows:

o AEDB

a) Providing overall leadership to expand energy access to rural communities through OS technologies;

b) Clustering of communities for supply by Fee-for-Service ESCO concessions in consultation with Provincial Authorities and WAPDA;

c) Designing tender documents for procurement and evaluating bids;

d) Monitoring of supplied technology, installations and maintenance of systems by ESCOs before handover to Provincial authorities;

e) Providing programmatic support for community-based mini-grid electrification (micro-hydel, wind energy, biomass-based energy, solar minigrids, solar and wind water pumping and hybrid technologies);

f) Designing a subsidy program to support privately-owned mini-grid systems.

o Provincial Authorities

a) Identifying off-grid electrification needs in districts;

b) Providing input to the design of ESCO concessions and evaluation of tender documents;

c) Monitoring of operation and maintenance of OS systems by ESCO over the contract period;

d) Carrying out environmental and regulatory approval process for OS systems;

e) Monitoring of supply reliability and evaluation of reasonableness of tariff in community-managed or privately-owned mini-grid systems.

o PPAF

a) Managing a program to provide subsidy support for community-based mini-grid electrification (micro-hydel, wind energy, biomass-based energy, solar mini-grids, solar and wind water pumping and hybrid technologies);

b) Including energy activities in future portfolios of community infrastructure projects;

o PCRET

a) R&D support for local manufacture of different OS systems as appropriate-

b) Setting up technical standards;

c) Establishing test centers and testing methodologies as per standards;

d) Training for capacity building of equipment manufacturers and operators.

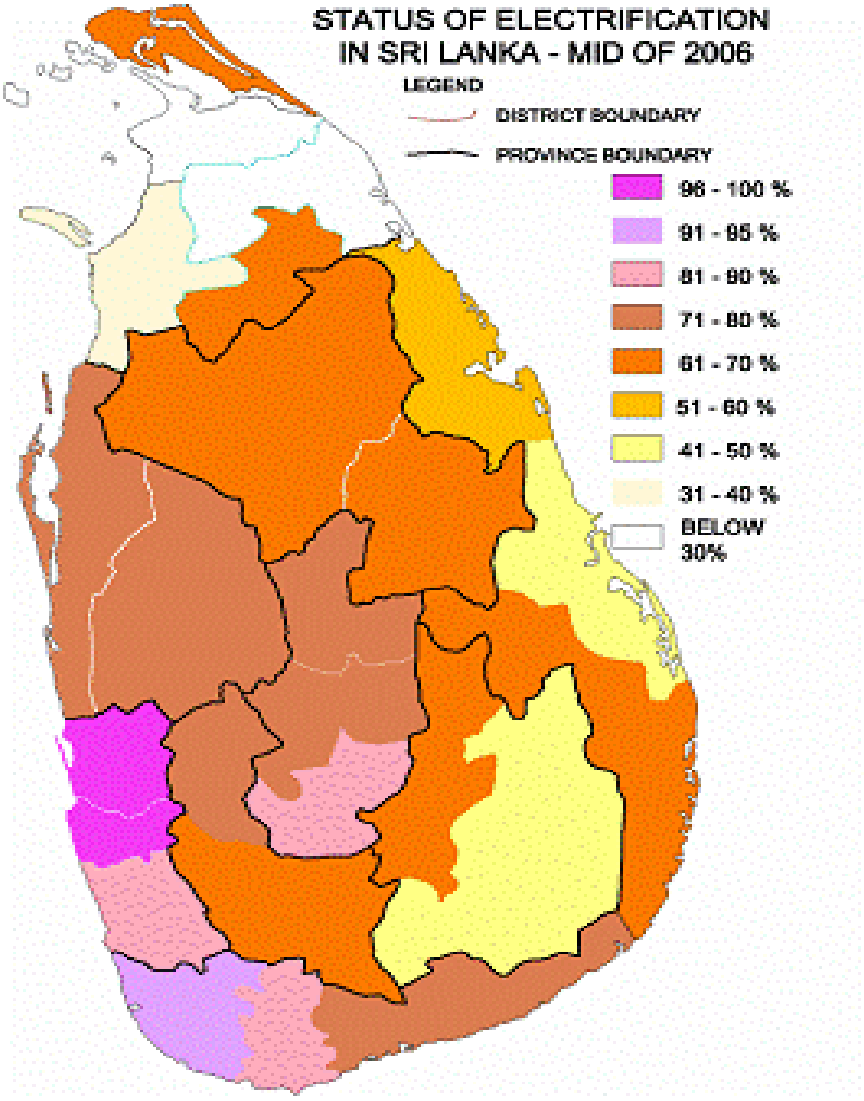
10) It was recommended that two pilot activities be carried out within the current study to demonstrate a sustainable governance and institutional framework for ESCO and community-

based energy activities. The first proposed 'ESCO pilot' would entail working with one of the supply companies active under AEDB's "Off-Grid Rural Electrification Program" to determine what monthly user tariff would need to be charged and other conditions put in place to transform this procurement into a Fee-for-Service ESCO Concession. The second 'Community-based pilot' would work with a recently installed solar powered drinking water project by one of the PPAF partners to put in place effective governance and technology backup systems to operate it in a sustainable manner. The results of these Pilot Activities are given in the next section.

Only a massive and determined state intervention by a strong political leadership involving a) radical restructuring of the power generation sector, b) consolidation, reorganization, and recapitalization of the distribution networks, and c) mega investments in hydel, coal, and

nuclear energy (secured through friendly foreign governments and other sources) can provide a lasting solution to the energy crisis which is too big and complex for the private sector to manage given the ground realities of the political economy of Pakistan.

14. Rural Electrification in Sri Lanka



(#17.10 Map of Sri Lanka)

Rural Electrification in Sri Lanka

14.1 Sri Lanka Overview and Current rural electrification programmes

Sri Lanka is situated in South East of Asia. It is surrounded by India (but no physical border) and Indian Ocean.
It has a population of 20.33 million (2012) and has total population of 20.33 million (2012).

It's GDP (current US $ is 59.42 billion (2012). Last year it was 6.40%. Its Income level places it in Lower middle income

Almost five years after the end of the three-decade civil conflict, Sri Lanka is now focusing on long-term strategic and structural development challenges as it strives to transition to an upper middle income country. Key challenges include ensuring that growth is inclusive, realigning public spending and policy with the needs of a middle income country, ensuring appropriate resource allocations for the various tiers of government, and enhancing the role of the private sector, including provision of appropriate incentives for increasing productivity and exports.

The Sri Lankan economy has seen robust annual growth at 6.4 percent over the course of 2003 to 2012, well above its regional peers. Following the end of the civil conflict in May 2009,

growth rose initially to 8 percent, largely reflecting a "peace dividend", and underpinned by strong private consumption and investment. While growth was mostly private sector driven,

public investment contributed through large infrastructure investment, including post war reconstruction efforts in the North and Eastern provinces. Growth was around 7 percent in 2013, driven by a rebound in the service sector which accounts for approximately 60 percent of GDP. With nearly 2 million Sri Lankans living abroad, overseas employment has contributed with foreign exchange and remittances in the order of 10 percent of GDP in 2013. Overall, unemployment at 4 percent is low, although youth unemployment (ages 15-24) at around 17.3 percent and low female labor force participation at 30 percent do pose a challenge.

Economic prosperity has been broadly shared. Real per capita consumption of the bottom 40 percent grew between 2002 and 2009 by an average of 4.3 percent annually, compared to 2.6 percent of the top 60 percent. As a result, inequality in per capita consumption expenditure fell during this period, as reflected by a decline in the Gini coefficient from 0.41 to 0.36. Shared prosperity has been associated with dramatic declines in poverty. Among rural, urban and estate sectors, poverty reduction has been particularly dramatic in the estate sector, where it however remains highest at 11 percent.

Sri Lanka has met the Millennium Development Goal (MDG) target of halving extreme poverty and is on track to meet most of the other MDGs, outperforming other South Asian countries. Whereas South Asia as a whole is on track or an early achiever for nine of the 22 MDG indicators, Sri Lanka manages this for 15 indicators. Among the targets achieved early are those related to universal primary education and gender equality? Sri Lanka is expected to meet the goals of maternal health and HIV/AIDs. Progress on reaching the goals related to malnutrition and child mortality is, however, slower. Indicators are mixed on the environment: while Sri Lanka is an early achiever on indicators of protected area, ozone depleting substance consumption, safe drinking water and basic sanitation, it has stagnated or is slipping backwards on forest cover and CO_2 emissions.

Sri Lanka experienced a big decline in poverty between 2002 and 2009 – from 23 percent to 9 percent of the population. Despite the very positive story of poverty reduction and shared prosperity, important development challenges remain in Sri Lanka. Pockets of poverty continue to exist, specifically in the districts of Batticaloa (in the Eastern Province), Jaffna (in the Northern Province), Moneragala (in Uva Province) and in the estate sector.

An estimated 9 percent of Sri Lankans who are no longer classified as poor live within 20 percent of the poverty line and are, thus, vulnerable to shocks which could cause them to fall back into poverty.

14.2 Climate-related hazards- a significant threat to economic and social development

Extreme variability of rainfall is the defining feature of the country's climate. With climate projections indicating a rising rainfall trend in the wet zone and decreasing rainfall trend in the dry zone, the risks associated with water-related climate variability are expected to intensify. Less and less frequent precipitation in the already dry areas could increase the frequency and duration of droughts while higher and more variable rainfall is expected to increase the frequency and intensity of floods, affecting monsoon-dependent areas in particular. Climate change is expected to significantly impact agriculture, water resources, energy, environment and fisheries in Sri Lanka.

14.3 Review of institutional structures for rural electrification in Sri Lanka

Electricity generation in Sri Lanka is primarily run by hydro power and thermal heat, with sources such as photovoltaic and wind power in early stages of deployment. It has attained sufficient generation and is almost load crises free.

In Sri Lanka, the primary energy contributions in 2009 to national energy supply were 51% from biomass, 44.8% from crude oil and petroleum products, and 3.6% from hydroelectricity and other renewable sources. The use of non-conventional energy resources, NCRE, (small-scale hydropower, biomass, biogas and waste, solar power and wind power) in Sri Lanka is of a relatively smaller scale (<1%) and therefore its contribution is presently of low significance in the macro energy picture.(http://www.diva-portal.org/smash/get/diva2:602710/FULLTEXT01)
Sri Lankan government has formulated many policies and laid stress on rapid and effective implementation of the Rural Electrification projects. The Ministry of Power and Energy of the Government of Sri Lanka is the ministry tasked with the implementation of the government policies related to Electricity and Energy Sectors. There are three major institutes, affiliated with the Ministry, that oversee the energy generation and distribution in Sri Lanka. They are:

a. The Ceylon Electricity Board (CEB), It is the largest electricity company in Sri Lanka, with a market share of nearly 100%. It controls all major functions of electricity generation, transmission, distribution and retailing in Sri Lanka.

b. Lanka Electricity Co. (Pvt) Ltd. (LECO) is a private limited liability Company registered under the Companies Act No.17 of Sri Lanka for Distribution of Electricity. Present shareholders of LECO are CEB, Urban Development Authority (UDA), Government Treasury and four Local Authorities (LA). This company was incorporated for the electricity distribution in Sri Lanka.

c. LTL Holdings (Pvt) Limited, along with the affiliates under its wings, is the largest power sector engineering company in Sri Lanka. This organization started three decades ago to produce an indigenous transformer, a vital piece for the country's electricity distribution system, has now developed into a giant in the engineering sphere in Sri Lanka with an impressive array of achievements.
Presently the main authority conducting and governing the Rural Electrification projects is the planning and distribution division of the Ceylon Electricity Board (CEB). The funds for Rural Electrification Schemes are brought in by the government as well as international and national development banks. Therefore the actual number of schemes available depends highly on availability of funds.

14.4 Analysis of the current rural electrification programmes

Many rural electrification schemes have been completed up to year 2007 electrifying 79% of the total households in the island with funds received from various lending agencies. The Government of Sri Lanka attaches great importance to rural electrification with a vision to accelerate the work in order to achieve an electrification level of 85%.

The Rural Electrification Project RE6 presently ongoing at a cost of US Dollars 52 million with the assistance from the ADB envisages electrification of 700 schemes in all provinces of the country for socio economic development of the rural regions. About 150,000 consumers are expected to be directly benefited from the project that has a progress of 88% at present with the balance work expected to be completed by year 2008.

The Government of the People's Republic of China provided a loan of US Dollars 24 million for electrification of 400 schemes in several regions of the country to which electricity had not been extended in the past. The construction work of this project RE7 was carried out by a turnkey contractor from China completing the work entrusted to them well within the scheduled time and the balance work is being carried out by the CEB with their own &

contract construction force. About 75,000 rural households have benefited by this project which is now nearing completion. The table below gives the rural electrification schemes completed up to September 2007.

Province	**Schemes Proposed**	**Schemes Completed**
Southern Province	1296	914
North Central Province	658	589
Central Province	1416	1143
Uva Province	319	138
West South Province	765	317
West North Province	319	170
Eastern Province	525	407
Sabaragamuwa Province	910	601
North Western Province	913	626
Northern Province	78	27
Total	**7199**	**4932**

Further negotiations are being carried out with the USA, India, China & Kuwait by the Ministry of Power & Energy and the CEB for the funding of the future projects RE8, RE 9, RE 10, RE11 & RE 12 to be formulated in order to provide electricity supply to about 350,000 remote consumers to uplift rural economy & social development. The Millennium Challenge Account of the USA is expected to fund the project RE8 to be launched at a cost of about US Dollars 25 million in order to provide direct & indirect benefits to about 30,000 households in the Northern & Eastern provinces & boundary villages.

The project RE9 expected to be funded by the Kuwait fund has been configured with economic development in view to serve distant rural regions in need of industry for socio economic reasons. The cost of this project is expected to be US Dollars 17 million with direct benefits to about 30,000 rural households.
The project RE10 has been planned to be constructed with funds from the People's Republic of China at a cost of US dollars 54 million the construction work being expected to be carried out by a turnkey contractor from China. Project is expected to bring many social & economic

benefits to more than 100,000 rural households.

The future energy policy is aimed at serving the needs for service & economy related activities of the country with a study on the various alternative forms of energy available and its development. Also considered is the environmental impact of energy generation & use promoting electricity for economic & environmental reasons as a clean & safe form of energy for consumption.

(http://www.sari-energy.org/pagefiles/countries/sri_lanka_energy_detail.asp#ruralelectrification)

Rural access to energy has come about both as a direct outcome of specific policies as well as a result of broader policies of rural development. Specific policies include the National Energy Policy which addresses the basic energy needs of the nation and sets out strategies to be followed to fulfill such needs. Much broader, macro level policies relating to Rural

Development and energy accessibility are captured in the "Mahinda Chinthana"- The long term plan for the future of the nation, presented by the governing regime and in the Ministerial Policies.

14.5 Analysis of the costs, incentives and tariff structures

The current monthly end-user electricity tariffs effective from 20 April 2013 are as follows:

End User Tariff, 20 April 2013

Revised Electricity tariffs effective from 20 April 2013.[23]

User	Unit (kWh)/Time range	Tariff (Rs./kWh)	Fixed Charge (Rs./kWh)	Fuel Adjustment Charge (% of Total Energy Charge)	Max. Demand Charge (Rs./kVA)
Domestic (D-1) (If the consumption is between 0-60 kWh per month)	000-030	3.00	30.00	25	N/A
	031-060	4.70	60.00	35	
Domestic (D-1) (If the consumption is above 60 kWh per month)	000-060	10.00	N/A	N/A	N/A
	061-090	12.00	90.00	10	
	091-120	26.50	315.00	40	
	121-180	30.50			
	≥181	42.00	420.00		
Religious (R-1)	000-030	1.90	30.00	N/A	N/A
	031-090	2.80	60.00		
	091-120	6.75	180.00		
	121-180	7.50	180.00		
	≥181	9.40	240.00		
General Purpose (GP)	GP-1: ≤210	19.50	240.00	25	N/A
	GP-1: ≥211	21.50			
	GP-2: Day (05:30-18:30)	20.50	3,000.00		1,100
	GP-2: Peak (18:30-22:30)	25.00			
	GP-2: Off-peak (22:30-05:30)	14.50			
	GP-3: Day (05:30-18:30)	19.50			1,000
	GP-3: Peak (18:30-22:30)	24.00			
	GP-3: Off-peak (22:30-05:30)	13.50			

(#16.20 End User Tariff, 20 April 2013 (Sri Lanka))

Domestic Purpose Tariff

Consumption of 210 units in 31 days

Since the billing period is 31 days, the applicable blocks will be 0-31, 32-62, 63-93, 94-124, 125-186 and 187 and above.

	Units		Price	Energy charge	FAC	FAC	Total
The Charge For First 62 Units (Up To 62 Units)	62	X	10.00	620.00	40%	248.00	868.00
The Charge For Next 31 Units (Up To 93 Units)	31	X	12.00	372.00	40%	148.80	520.80
The Charge For Next 31 Units (Up To 124 Units)	31	X	26.50	821.50	40%	328.60	1150.10
The Charge For Next 62 Units (Up To 186 Units)	62	X	30.50	1891.00	40%	756.40	2647.40
The Charge For Remaining 24 Units (Up To 210 Units)	24	X	42.00	1008.00	40%	403.20	1411.20
Fixed Charge (Above 186 Units)							420.00
Total Charge				4712.50		1885.00	7017.50

(#16.21 Domestic purpose Tariff)

ELECTRICITY SALES BY PROVINCE IN GWh(million kWh)

Province	C.E.B. 2011	Percentage Change 2011/12	C.E.B. 2012	Percentage of Total 2012	Monthly Av.Sales kWh/Cons. 2012
Colombo City	1239	0.6%	1247	11.9%	645
North Western	1003	4.6%	1049	10.0%	132
North Central	356	7.6%	384	3.7%	94
Northern	199	7.0%	213	2.0%	94
Region - 1 Total	2797	3.4%	2892	27.6%	178
Western-North	1659	5.8%	1755	16.8%	270
Central	739	5.0%	776	7.4%	99
Eastern	446	5.9%	472	4.5%	107
Region - 2 Total	2844	5.6%	3003	28.7%	160
Western-South II	1019	5.2%	1072	10.2%	253
Uva	370	3.0%	381	3.6%	79
Sabaragamuwa	457	6.3%	485	4.6%	93
Region - 3 Total	1846	5.0%	1938	18.5%	136
Western-South I	511	5.3%	537	5.1%	186
Southern	759	5.5%	801	7.6%	105
Region - 4 Total	1269	5.4%	1338	12.8%	127
Bulk Sup. to LECO	1267	2.7%	1302	12.4%	-
TOTAL	10023	4.5%	10474	100.0%	175

(#16.22 Electricity sales by Province in GWh)

REVENUE FROM ELECTRICITY SALES BY PROVINCE IN m.Rs.

Province	C.E.B. 2011	Percentage Change 2011/12	C.E.B. (With FAC) 2012	Percentage of Total 2012	Ave.Price Rs./kWh 2012
Colombo City	24,206	21.7%	29,464	18.1%	23.63
North Western	11,684	22.5%	14,313	8.8%	13.65
North Central	4,239	27.8%	5,415	3.3%	14.11
Northern	2,642	30.5%	3,449	2.1%	16.20
Region - 1 Total	**42,771**	**23.1%**	**52,642**	**32.3%**	**18.20**
Western-North	21,352	20.9%	25,824	15.8%	14.71
Central	8,933	23.7%	11,049	6.8%	14.24
Eastern	5,337	25.9%	6,719	4.1%	14.22
Region - 2 Total	**35,622**	**22.4%**	**43,591**	**26.8%**	**14.51**
Western-South II	13,367	22.8%	16,412	10.1%	15.31
Uva	4,294	19.1%	5,112	3.1%	13.42
Sabaragamuwa	5,194	23.4%	6,411	3.9%	13.21
Region - 3 Total	**22,854**	**22.2%**	**27,935**	**17.1%**	**14.41**
Western-South I	7,500	24.4%	9,332	5.7%	17.36
Southern	8,767	23.5%	10,828	6.6%	13.52
Region - 4 Total	**16,267**	**23.9%**	**20,159**	**12.4%**	**15.07**
Bulk Supply to LECO	**14,859**	**25.4%**	**18,628**	**11.4%**	**14.31**
TOTAL	**132,373**	**23.1%**	**162,956**	**100.0%**	**15.56**

(#16.23 Revenue from sales of electricity by Province)

14.6 Country-specific challenges in rural electrification including access and availability

First the energy consumption per capita for lighting and cooking was found.

Average per capita per month consumption of energy for lighting and cooking

Province	Per Capita LPG (kg)	Per Capita Kerosene for cooking (ml)	Per Capita Kerosene for lighting (ml)	Per Capita Electricity units (kWh)	Per Capita Firewood (kg)
Western	2.49	722.27	2,438.82	27.06	26.54
Central	2.24	501	1,825.88	16.17	40.15
Southern	2.04	327.88	1,478.54	14.76	23.75
Northern	3.08	1,828.62	1,668.84	18.75	28.81
Eastern	2.84	865.64	1,642.54	17.01	33.51
North West	1.89	403.77	1,653.84	17.07	42.02
North Central	1.99	305.56	1,363.56	14.71	34.3
Uva	2.45	376.05	1,274.21	13.16	28.75
Sabaragamuwa	1.92	310.5	1,518.30	14.75	30.07
Total	2.36	569.28	1,629.37	18.84	31.94

Sources: CEPA and Central Bank Consumer Finances and Socio Economic Survey 2003/04

(#16.24 Average per capita P/M consumption of energy for lighting & cooking)

14.7 Key Issues, Strategies and Targets in the energy sector

Issue	Strategy	Indicator	Present status	Interim Target	Target for 2016
Access to electricity	Invest on grid extensions and off-grid energy systems	Households electrified	Grid: 75% Off-grid: 4%	Grid: 80% Off-grid: 6% by 2010	Grid: 85% Off-grid: 10%
Electricity tariff rationalization, debt and targeted subsidies	Introduce cost-reflective tariffs, re-structure sector debts to minimize burden, a common subsidy for energy used for lighting	CEB profitability, level of debt reflected in tariffs, elimination of cross-subsidies	Large cross-subsidies to household electricity customers, kerosene	Remove both electricity and kerosene subsidies and replace with a targeted subsidy for energy use for lighting by 2008.	

Fuel diversity and energy security in bulk power energy	Moratorium on oil/oil-related fuel burning power plants, diversification to coal and NCRE	Resource diversity, average production cost of electricity, share of indigenous energy for electricity production	Hydro: 37.7% Oil: 58.2% NCRE: 4.1%	Hydro: 21.4% Oil: 3.3% Coal: 65.2% NCRE10.0% by 2015	Hydro: 19.9% Oil: 2.2% Coal67.3% NCRE: 10.7%
Renewable energy for electricity generation	Relieve grid constraints, arrange finances to accelerate NCRE development	Share of NCRE on the grid, impact on average generation cost	NCRE share: 4.1%	NCRE share: 7.5% by 2010 10.0% by 2015	NCRE share: 10.7%
Transmission and distribution network development	Invest on T&D to ensure safety, quality and reliability of supply	Compliance with reliability indices, optimum network losses. Statutory limits on quality of supply	Widespread violations of reliability criteria	Essential reliability levels will be established by 2010	Endeavour to reach international norms of reliability and supply quality
Supply-side energy efficiency	Accelerate investments and management efforts to reduce technical and non-technical losses	Technical loss in transmission, technical loss in distribution, non-technical losses.	Total T& D loss 16.7% of net generation	Total T& D loss 13.5% of net generation Total	Total T& D loss 12.0% of net generation
Demand side energy efficiency	Mandatory labeling of appliances, consumer education, energy efficiency services, CFL popularization, investments on energy efficiency	Energy Efficiency (EE) codes and appliance labeling-efficiency appliance popularization, customer investments on energy efficiency	Two devices carry EE labels, One EE financing project	All appliances labeled by 2010, selected appliance-labeling mandatory by 2008, EE building code mandatory by 2009	All codes and labels will be mandatory
Energy sector knowledge management, planning and funding	Development of integrated national energy plan, enhanced energy sector database and analyses, establish SLEF to channel	Publication and regular updates of the integrated national energy plan, publication of Sri Lanka energy balance,	Sub-sectoral plans only, Energy balance published, SLEF operational	Provincial energy bureau by 2007, Integrated national energy plan by 2008, Disaggregated energy	Continuation of work to ensure development and dissemination of knowledge

	funds to energy and NCRE, facilitate rural energy development	establishment of SLEF, establishment of provincial energy bureau.		demand database by 2008, formally constitute SLEF	on the energy sector.
Reforms and regulatory development	Establish a state-of -the art operations management, energy accounting and management information system for CEB	Accurate energy accounting across CEB divisions, transparent dispatch of power plants	Transfer metering, inadequate dispatch procedures based on off-line, manual systems	Boundary metering installed by 2008, transparent dispatch system operational by 2008	

14.8 Review of energy technology options commonly used in rural electrification

Bio mass based electricity generation can supply firm energy to the national power system like the conventional thermal power plants. Furthermore, it offers multi-dimensional non-energy benefits to rural socio economic development and deserves an incentive price, to attract potential private sector developers to invest in the industry. Accordingly, the Government has granted cost based, technology specific three-tiered tariff for the bio mass power generation. A summary of details of the Dendro power projects by the end September 2007 is shown below:

Description	Number of Projects	Capacity MW
In operation	2	2.0
Letter of Intent issued	7	18.55

(http://www.sari-energy.org/pagefiles/countries/sri_lanka_energy_detail.asp#ruralelectrification)

14.9 Rural Energy Programmes - Energy Conservation Fund

Energy Conservation Fund was developed. The mission of the Energy Conservation Fund is to

(a) Promote efficiency of energy use in domestic, industrial, transport, commercial and other sectors;
(b) Control and minimize energy wastage of all consuming sectors; and
(c) Explore the potential alternative energy resources and undertake technology development for commercial use.

Global Village Energy Partnership (GVEP)

The Global Village Energy Partnership Program (GVEP) was announced as one of Presidential Initiatives announced at the Sustainable Development Summit in Johannesburg, South Africa in August 2003. The GVEP Program seeks to reduce poverty and enhance sustainable development through the accelerated provision of modern energy services to those un served or underserved. This is made possible through a partnership of developing and industrialized country governments, international development agencies, donor organizations, private firms, consumers, NGOs and others committed to addressing energy-poverty. To move forward with its participation in GVEP, the Government of Sri Lanka (GOSL) has designated the Ministry

of Power and Energy as its lead ministry for coordinating the development of its initial rural development program under GVEP.

Wood Energy Sources

Traditional biomass fuel, primarily wood fuel, continues to play an important role in the energy balance of Sri Lanka. the share of traditional biomass fuel in total primary energy consumption for the year 2001 is estimated at about 50-51 percent by the Energy Conservation Fund of Sri Lanka. The contributions of wood fuel and other biomass (crop residues, etc.) are estimated to be about 49 percent and 1.5 percent, respectively. Available statistics also suggest that between1981-1995 the average annual growth in traditional biomass fuel consumption was about 1.9 percent. The household sector is by far the largest consumer of traditional biomass fuel and accounts for about 81 percent of total consumption. The second largest consumer is the industrial sector (tea, coconut, rubber, brick, lime and pottery industries), followed by the commercial sector (hotels and restaurants, bakeries and local food vendors).
(http://www.powersrilanka.com/Sri%20Lanka%20-%20Power%20sector.pdf)

Energy from Renewable

The energy policy document of the government of Sri Lanka has set a target to reach a minimum level of 10% of electrical energy supplied to the grid to be from non-conventional renewable energy in 2015.The use of non-conventional energy resources, NCRE,(small-scale hydropower, biomass, biogas and waste, solar power and wind power) in Sri Lanka is of relatively smaller scale, but steps from the Ministry of Environment and Renewable Energy are quite encouraging, even though it is questionable if they can reach the target of 10% by 2015. However, it is good to see so much focus on solar and wind power development, dendro (biomass) power, as well as direct and indirect subsidies to promote rural electrification through renewable energy.

14.10 Action plan (s) for successful implementation of rural electrification policies

While the provision of energy is the main component of rural energy access, the affordability of energy at rural level remains a key factor in the ultimate, tangible outcomes of energy usage. Clearly, rural economic development and enhancement of living standards are intrinsically linked with the degree of access to energy at affordable prices.

Fix own political/religious situation on area, or else all other efforts will go in vain.
Further investment in renewable energy sources, as well as a good governance framework.

A lot of thought is being put on community participation, but a backup is also necessary because this will not always work out. Back up can be by persuading the community leader to be on our cause, which will lead the whole community to follow; giving the communities a taste of electricity for longer periods of time (via presentations, etc.) or in some cases, it might have to be against their will.

Some plans to keep in mind for successful implementation of rural electrification policies are:

- Using existing financial infrastructure for awareness building, microfinance and technical support.

- A financing model that offers both installation and financing as a package deal through the same well established NGO.
- Sufficient front end funding to set up the programme and build capacity.
- Quality assurance to ensure that all installed systems are installed properly
- Government support for the programme

14.11 Policy options for successful implementation of rural electrification

Sri Lanka recently revised National Energy Policy and Strategies consists of (a) Energy policy Elements (b) Implementing Strategies and (c) Specific Targets, Milestones and Institutional Responsibilities.

The major guiding policy elements are the following:

1. Providing Basic Energy needs

2. Ensuring energy security

3. Promoting energy efficiency and conservation

4. Promoting indigenous resources

5. Adopting an appropriate pricing policy

6. Enhancing energy sector management capacity

7. Consumer protection and ensuring a legal playing field

8. Enhancing the quality of energy services

9. Protection from adverse environmental impacts of energy facilities

The country as a whole is on the right track in achieving rural development through Rural Electrification as one of the major energy sources. However it is recommended to further invest on renewable energy sources to provide energy to the rural community on a long term basis and in a sustainable manner.

Apart from that, a good governance framework should be introduced to the administrative officials and the politicians who work on rural development projects. The governance framework should direct these officials to make the most economically viable decisions while considering the technical feasibility as well. As such decisions would save cost and reap the maximum economic returns. At the same time the governance framework should give importance for the reporting side of every project, as the funds invested might have been financed by the treasury with much difficulty be it a grant or a loan.

Also, there should be well integration of all the rural development projects, thereby limiting

duplication of tasks and reducing extra costs. Sometimes when there are too many projects that are conducted independently in one area there could be dilemmas as well as confusions.

(http://www.worldbank.org/content/dam/Worldbank/document/SAR/Saesm-paper-Sri-Lanka-Energy-Thilani-Navaratne.pdf)

Last Updated: Mar 31, 2014 (The World Bank website)

Proposition: Community participation in planning for electrification is likely to lead to more successful and sustainable schemes. Careful preparation is needed and locally appropriate guidelines prepared, and an external facilitator is recommended.

6. Energy Management - In communities that have been electrified, electricity becomes the most important source for energy services, such as lighting, radio and motive power for small enterprises, though it is common for fuels like kerosene to continue to be used. Its role in improving productivity is particularly significant. Decentralized schemes are often limited by the peak demand they can supply, so energy management measures to spread the load over time are desirable (demand side management).

8. Market aspects - The experience of most countries is that the market for decentralized rural electrification installations of all types has required *initial stimulation* to make it attractive to developers, consultants, manufacturers and financiers. The initial attraction for private developers may be in relation to specific productive end users - e.g. grain milling in Nepal and Zimbabwe where the power unit is also used for battery charging or for domestic electricity supplies. PV schemes may also be attractive for loan financing on an individual basis, since the equipment may be removed if payments are not made. However, except in wealthier areas with an income per head of more than say $1000 per year, community electrification on its own is generally not an attractive investment unless supported by an element of grant subsidy.

Recent experience of the privatization of some schemes in Nepal into the hands of private entrepreneurs is that the new owners have made them profitable by reducing costs, such as staffing levels, and raising tariffs. The advantage in these cases is that the load had already become established following installation by the state.

14.12 CONCLUSION

Rural electrification is highly desired by rural communities. It has developmental benefits in the right circumstances (co-ordinated with other development activities) and its expansion is a political priority. A target of facilitating wide coverage of basic lighting and radio supplies (e.g. through low cost solar PV) should be complemented by higher power (diesel/micro hydro) systems for areas with higher potential demand. Conventional centrally-managed approaches have been expensive and unsustainable. Attention is needed to ways of reducing the capital costs and of managing the schemes so that they cover their costs to the greatest extent possible, with greater degrees of local ownership and management. In the last few years successful initiatives in different countries have explored new methods of extending electrification to the rural population at least cost, and making use of available renewable resources. This experience should be shared to make best practice available to all. ITDG wishes to link its various technical information networks to other networks, to share this type of experience in the interests of the currently unserved 2 billion potential rural electrification consumers.

15. Conclusion and Recommendation on Rural Electrification of SAARC Countries

The main concern or priorities for SAARC Countries should be on reliable energy supply with quality. Unless and until they have sustainable energy and off course secured energy means , the member countries cannot go for successful rural electrification programme. The SAARC ring as proposed in SAARC Energy meetings is very essential to balance energy need, supply with economic gain for the region.

For rural electrification, each country has its unique culture, terrain, grid connectivity, renewable sources etc. So they have to design for 100% electrification as per their individual requirement. The priorities should be as under.

Common steps for sustainable rural electrification and for the whole Country:

a. **Grid connected electricity**
   Demand growth at field level (ground level) to be analyzed and 10 to 20 years area wise load growth to be planned.

   This should be reviewed every 3 to 5 years depending on actual Load growth and its variation.

   On this Load growth planning, Generation and Transmission infrastructure is to be planned. Generation planning on Load growth.

   With development of SAARC grid concept this should be kept in planning

   Time has come for planning **Continuous** and **Quality** electricity supply. Remember economic losses due to power interruption are very high.

   Plan and implement in sequence

   Generation - Transmission – Distribution

   Most important aspect is use superior quality equipments and materials in electrical system as a whole.

   The above two are mandatory for sustainability.

   For very large Country like India and Pakistan, the Master plan should be Z
   Even if fund constraint exists but Transmission system, one wise but with integration facilities.

   Revenue is a very important factor so

   Ensure System and technical losses practically as low as possible. Remember theft is not the only issue. Even if Voltage is less for technical reason, the Technical losses will be higher. Quality electricity also means fewer losses.

   Harmonics, Power Factor should be all well addressed.

Theft – 2 types, electricity theft and electrical equipment theft from the lines.
It's a common problem in this zone. How to minimize. Create Accountable system, all points well metered. Pay the electrical people. Give them yearly targets. If it is achieved give handsome bonus. If failed then financially penalized.

Revenue – ensure minimum 98% Bill collection. This is possible. It was found in Bangladesh

Create public awareness against theft and to pay bills.

Metering – May consider Prepaid meters in Government offices, residences , Consumers where Bill collection may be difficult.

For large concentrated load, go for Smart grid. Smart metering etc. This will minimize interruption and ensure Load management. Bill will also be recovered and Losses will be less.

Electrical department staffs. Since there job is hazardous and essential so pay the handsomely. This will create handsome result.

Consumer service

Consumer service both before getting connection and after getting connection is always important.

Energy efficiency & conservation. Ensure it round the year. Follow awareness and other programs. Each country to have its own master plan for Energy efficiency & Conservation like that of electrical system master plan.

Similarly prepare Long term Renewable energy master plan.

So each country to have 3 types of effective Master plan.

Maintenance. Both preventive and precautionary maintenance should be ensured for whole year.

Cyber security. Create own system for maximum cyber security.

b. Renewable energy

First we have forget the concept that Renewable means Costly and unaffordable. We have to make all understand that our fossil fuel reserve is fast depleting. Only we will be left with Renewable. No matter how rich is a country in its energy resources, the energy demand is increasing at a geometric rate. Our comfort level is going up with economy so we have to start utilizing renewable resources as much possible.

Identify areas for off grid electrical system and easily develop RE.

Create power generation on grid with renewable.

Develop 2 way meters and allow Net metering

Utilize fossil fuel as economically as possible.

Irrigation. Diesel is too expensive or highly subsidized. So think and plan for replacement of al Diesel based irrigation with Solar irrigation in phases.

Develop mini grid with renewable
Grids should be constructed 20 years load growth. As with time land is going to become more expensive.

c. **Energy Efficiency – The 3rd Fuel**
Energy efficiency and conservation are now main agenda on energy. Even Europe, USA have formed Alliance to save energy USA, Alliance to save energy Europe and working together to conserve energy. It has been found that cost of saving 1MW of electricity is less than half the cost of producing same amount of electricity and it takes more than 3 (three) years to produce electricity at large scale. Energy savings/efficiency also minimizes Global warming which is a challenge to world community. That's why many call it 3rd Fuel.

The problem with many Countries is that the Tariff is highly subsidized and not cost based. As a result Customers are not ready or willing to invest in Energy efficiency. But despite that most of the SAARC countries have done well with energy efficiency. India is first in the race. Bangladesh has recently taken up and as created a separate organization "Sustainable & Renewable Energy Development Authority (SREDA" to look after Renewable and Energy efficiency. Pakistan has Ministry of Alternate energy and is working. Other SAARC Countries are working also. Initially it can be started with efficiency in electricity system as a whole and then involve Customers.

The SAARC countries should give equal importance on Energy efficiency and conservation.

d. **CCS or ICS** Electricity theft is a tough task of the Utilities. Again for women and children health at home and to save biomass Clean Cook Stove or Improved Cook Stove should be made popular at rural level. This will minimize tendency of heating through electricity which is very costly.

These means will make successful Rural electrification in all SAARC Countries and will lead us to prosperity and make rural life more comfortable.