SUSTAINABLE
ENERGY FOR ALL

Rapid Assessment
Gap Analysis
Pakistan

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Pakistan:

Rapid Assessment and Gap Analysis

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List of Abbreviations

AEDB	Alternate Energy Development Board
AJK	Azad Jammu & Kashmir
CPPA	Central Power Purchase Agency
DISCOs	Distribution Companies
E&P	Exploration and Production
FATA	Federally Administered Tribal Areas
GSP	Geological Survey of Pakistan
GB	Gilgit Baltistan
HDIP	Hydrocarbon Development Institute of Pakistan
IERU	Implementation and Economic Reforms Unit
KP	Khyber Pakhtunkhwa
MoWP	Ministry of Water & Power
MTOE	Million Tonnes of Oil Equivalent
ENERCON	National Energy Conservation Centre
NTDC	National Transmission and Dispatch Company
OGDCL	Oil and Gas Development Company Limited
OGRA	Oil and Gas Regulatory Authority
PEPCO	Pakistan Electric Power Company
PEC	Pakistan Engineering Council
PSO	Pakistan State Oil
PPIB	Private Power Infrastructure Board
SHS	Solar Home Systems
SNGPL	Sui Northern Gas Pipeline Limited
SE4ALL	Sustainable Energy for All
TCF	Trillion Cubic Feet
UFG	Unaccounted For Gas
WAPDA	Water and Power Development Authority

EXECUTIVE SUMMARY

This report provides rapid assessment and gap analysis of the energy sector in Pakistan to carry forward the process of UN's global initiative 'Sustainable Energy for All (SE4ALL)'. Since the past few decades, energy sector has recieved immense importance given its significant conribution towards economic growth and improvement of overall quality of life of citizens. Rising population trends and depleting conventional energy resrves have further accelerated the debate on energy sector issues and policies, across the world. In 2011, United Nations initiatiated the SE4ALL initiative, which serves as a global forum for all countries to make joint efforts towards achieving its three key objectives; universal access to energy; doubling the rates of energy efficiency and conservation; and doubling the share of renewable energy in the overall energy mix. Since its initiation, many countries have committed to SE4ALL, including 70 developing countries. This has resulted in mobilization of investments, resoucres and advocacy. Pakistan joined this global initiative in the 2013. Prime Minister of Pakistan co-chaired, with Prime Minister of Denmark and Minister for Development of Norway, the 32 member countries Group of Friends of SE4ALL in September 2013.

Inclusive consultation has been undertaken to formulate this report. UNDP and Government of Pakistan (GoP) initiated a consultation process to assess the region-wise energy situation in Punjab, Sindh, Balochistan, Khyber Pakhtunkhwa (KP), Federally Administered Tribal Areas (FATA), Gilgit Baltistan (GB) and Azad Jammu & Kashmir (AJK). Stakeholders from all sectors i.e. public, private, donor agencies, research and academia participated in these consultations. The consultations were intended to identify the regional energy demand-supply gaps, current and future energy plans, potentials for renewable energy sources and the regional challenges. The outcomes of these regional consultations will help in developing the national action plan for energy sector.

These regional consultations concluded with the finding that Pakistan has a huge potential in renewable resources, including hydel, solar and wind along with bio-fuels etc., which can help to improve acceess, affordibility and sustainibility of energy in the country, if utilized properly. Morover, it was emphasied in the consultative process by all stake holders that special attention should be given to energy efficiency and conservation.

Key challenges identified during the consultations include improving the regulatory governance structure, focussing on water-based power generation and conservation, promotion of off-grid solutions, capacity building and knowledge sharing, strengthening micro financing in remote areas, building and appliance standardization, investing in Research and Development (R&D) for renewable technologies, improving the process for approval of PSDP projects, advocacy for energy conservation & efficiency and public sector energy conservation audits. There is need to address these challenges with an aim to achieve the three key objective of SE4ALL.

OBJECTIVE AND METHODOLOGY

Objective

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

- an overview of the energy situation in the country (Section 1) within the context of its economic and social development and poverty eradication;
- assessment of current status in the country in terms of the three SE4ALL goals (Section 2);
- mapping of the on-going and planned initiatives and policies in the energy sector by federal and provincial governments;
- estimation of the main challenges and opportunities vis-à-vis the three goals of SE4ALL for which major investments, policies and enabling environments will be required (Section 3) and;
- Sound basis and background for an Action Plan that may follow as part of the SE4ALL activities in the country.

Government of Pakistan joined the UN's global initiative - SE4ALL in 2013. The Prime Minister of Pakistan Mr Muhammad Nawaz Sharif, Prime Minister of Norway Mr Jens Stoltenberg and the Minister for Development Co-operation of Denmark Mr Christian Friis Bach, co-chaired a 32 member countries Group of Friends on Sustainable Energy for All, and agreed that the three countries would push for sustainable energy for all as part of the post-2015 Development Agenda. The three leaders met on the margins of the 68th session of the United Nations General Assembly and were joined by Mr. Kandeh Yumkella, Special Representative of the Secretary-General and Chief Executive for Sustainable Energy for All.

The three countries have been leading efforts at the United Nations in support of sustainable energy for all. They agreed that energy is the golden thread connecting economic growth, increased social equity, and an environment that allows the world to thrive. They stressed on the fact that sustainable energy is central to eradicating poverty, increasing food production, providing clean water, improving public health, empowering women and addressing climate change

This trilateral statement follows the recent declaration by the General Assembly to declare 2014-2024 the United Nations Decade of Sustainable Energy for All; a testimony of the commitment of all Member States to this crucial issue. The three leaders pledged their full support to the Secretary-General's initiative on Sustainable Energy for All (SE4ALL) as a global partnership that can move the world forward.

The leaders agreed that creating a viable framework for achieving sustainable energy for all will require active engagement and participation by all stakeholders, including governments, private sector, civil society, the UN System and the multilateral development banks, including the World Bank Group.

Mr. Yumkella, the Special Representative, briefed them on the progress of the Sustainable Energy for All Initiative and, on behalf of the Secretary-General, expressed his strong desire to continue meaningful cooperation with the Group of Friends on Sustainable Energy for All, and in particular with the governments of Pakistan, Norway and Denmark.

Being on board with this global initiative, Pakistan first needs to implement the already initiated and planned energy projects and then synchronize them with the objectives of SE4ALL.

Methodology

The methodology adopted for rapid assessment and gap analysis was to conduct a thorough diagnostic of energy sector through a series of regional level consultations. To initiate the diagnostic phase, Ministry of finance coordinated with other government departments such as Planning Commission and Ministry of Water & Power (MoWP). UNDP Pakistan facilitated the consultation process. These consultations eventually operationalized the global SE4ALL in Pakistan to achieve sustainable energy goals for larger economic development, poverty alleviation and improvement in the quality of life of people.

These regional consultations were held in the following four provinces and three regions for mapping the energy position in the country.

- Punjab
- Sindh
- Khyber Pakhtunkhwa (KP)
- Balochistan
- Federally Administered Tribal Areas (FATA)
- Azad Jammu & Kashmir (AJK)
- Gilgit-Baltistan (GB)

Participation of all the regions in the consultation process has facilitated in developing a well-coordinated national cohesive programme for sustainable energy in the country. These regional consultations included participants from government departments, private sector, civil society and development partners. Each consultation workshop was designed to discuss the role played by these regions to deal with the energy crisis and what are their plans. Hence, specifically the outcome of all these consultations was to bring out the following:-

- Past and Present Energy initiatives
- Future plans: What are the existing and potential energy sources and what could be their optimal utilization plans?
- What are the challenges faced by the region in implementation of the proposed future energy initiatives and what could be the possible solutions to address these challenges?

Figure below summarizes the whole process of Pakistan's initiative of moving towards Sustainable Energy for All (SE4ALL).

Fig: DIAGNOSTIC PHASE SUMMARY

Regional Consultations

STAKEHOLDERS

- Federal and Provincial Governments
- Civil Society
- Private Sector
- Research Institutes/Academia
- Development Partners

Diagnostic Report

National Level Consultation

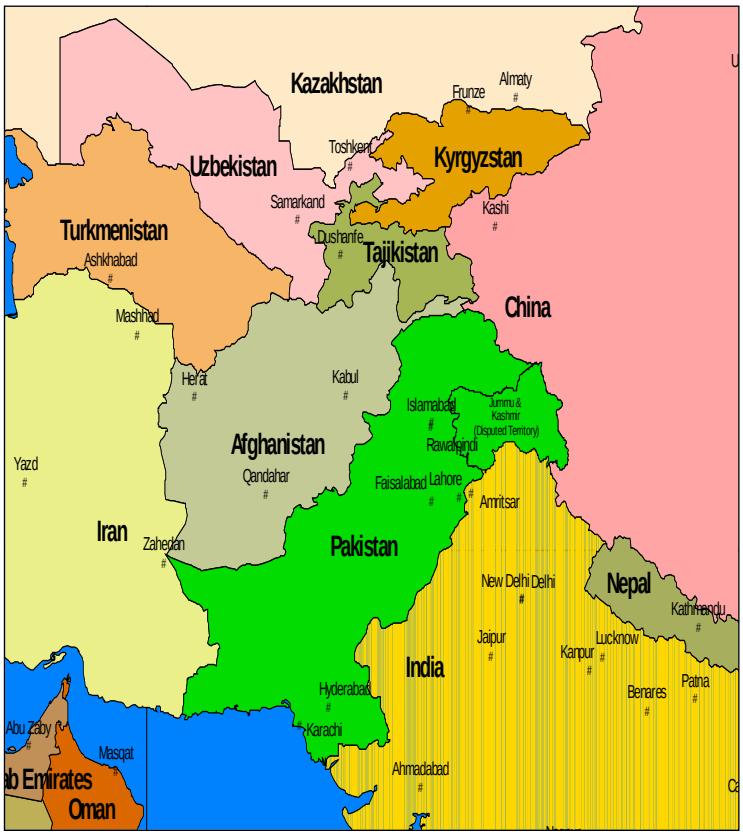
National Programme for Sustainable Energy

SUSTAINABLE ENERGY FOR ALL

SECTION I

INTRODUCTION

1.1 Country Overview



Geographically, Pakistan enjoys an interesting strategic location. It is located at the crossroads of South Asia, Central Asia, China and the Middle East which makes it a potential hub for regional trade and economic integration. The region's trading history is as old as the history of Silk Route in Asia. Moreover, Pakistan has a very rich history, few of the world's most ancient civilizations including the Indus Valley Civilization and Gandhara civilization settled here.

The country came into being, along with the neighbouring India, in 1947 as a dismemberment of British colonial rule in sub-continent. Today Pakistan stands as world's sixth most populous country (2013) and has a population of more than 188 million. It is stretched over an area of 796,096 sq. Km and divided into four provinces (Punjab, Sindh, Balochistan and Khyber Pakhtunkhwa) and three regions (Federally Administered Tribal Areas-FATA, Gilgit-Baltistan and Azad Jammu & Kashmir-AJK). Each having its own distinct cultural identity, the four provinces make Pakistan a culturally rich and vibrant country. Multiple ethnic groups live here and speak different languages. However, Urdu remains the national language and English, the official one.

Most of the population lives in rural areas and employed in the agriculture sector. Traditionally, Pakistan was an agrarian economy. Over the years the economic activity patterns have shifted and industry and services sector have become major contributors to the GDP. Services sector contributes approximately 57% to the economy.

Pakistan is blessed with numerous natural resources including one of the world's highest mountain range, flow of fresh water, fertile lands, deep sea ports and rich reserves of natural gas, copper, coal and iron ores. Moreover, enormous potential of renewable energy sources is found across the country. The country inherited one of the world's best irrigation networks which have helped improve agriculture productivity and achieve associated gains in terms of poverty reduction in rural areas. Pakistan is also one of the few developing countries of the world having nationwide electricity transmission grid and piped gas infrastructure since 1960s and onward.

Table 1: Pakistan's Socio-Economic Profile

Name	Islamic Republic of Pakistan		
Area (sq.km)	796,096		
Capital	Islamabad		
Provinces	04 (Punjab, Sindh, KP and Balochistan)		
Regions	03 (AJK, GB and FATA)		
Social/Demographic Indicators			
	Unit		**Year**
Population	Millions	188.02	2014
Urban	Millions	72.50	2014
Rural	Millions	115.52	2014
Male	Millions	96.54	Based on 2012-13 share in population
Female	Millions	91.47	
Population growth rate	%	1.97	2014
Per capita income	$	1386.2	2013-14 (Jul-Mar)
Labour Force	Millions	59.74	2012-13
Employed	Millions	56.01	2012-13
Unemployed	Millions	3.73	2012-13
Unemployment rate	%	6.2	2012-13
Poverty Head Count ratio (pop. Below USD 1.25 a day)	%	21.04	2008
Total Investment	% of GDP	14.0	2013-14 (Jul-Mar)
National savings	% of GDP	12.9	2013-14 (Jul-Mar)
Economic Indicators			
	Unit		**Year**
Nominal GDP*	$ Billion	245	2013-14
Sectoral Contribution to GDP			
Agriculture	%	21.0	2013-14
Manufacturing	%	13.5	2013-14
Services	%	58.1	2013-14
Other industries	%	7.3	2013-14
Real GDP growth rate	%	4.14	2013-14

Sources: Economic Survey of Pakistan 2013-14
*Pakistan Bureau of Statistics

Pakistan has undertaken significant political and economic reforms. Recently, measures such as social sector development projects and devolution of resources are introduced. Moreover, the country has also shown democratic, political and social resilience despite fragile regional security situation and internal challenges. Rigorous economic reforms have also been pursued over the last couple of decades making Pakistan a dynamic, open and private sector friendly economy. Foreign investments are encouraged and share of international trade in the GDP has also increased significantly. However, Pakistan's economic history is characterised with recurring cycles of high growth and subsequent stagnations. This volatility of economic growth has serious implications for social and economic well-being of people at large. The country is facing serious challenges in the areas of energy sector, human development, harnessing youth potential, security and overall competitiveness and productivity. The 1.9% population growth might prove auspicious for the economy as about 2/3rd of the population is under-30 years of age, i.e. increase in future labour force. However, employment generation and human development remain a critical challenge to utilize this boom. The indicators show a steady but slow improvement and lag behind the other emerging economies. However, the

country has shown impressive progress on poverty gains. During the past decade the poverty rate has fallen from 34.5 percent in 2001-02 to 17.2 percent in 2007-081.

1.2 Energy Situation

Pakistan inherited an almost non-existent energy base at the time of its independence. It is reported that 1.2 million tonnes of oil equivalent energy was available in 1947[2]. At that time, 50 MW of electricity were available for a population of 33 million, connecting only 7% population to the national grid. Non-commercial use of energy had a significant share of the overall energy mix. However, unlike today, the demand from industry, agriculture and transportation was minimal then. Firewood, crop residues and livestock manure were used for heating and cooking by majority of the population residing in rural areas. Growing urbanization and industrialization has raised the energy demand manifold, while the country has been unable to increase the energy supply in proportion. Nonetheless, it is worth mentioning that Pakistan is one of the few developing countries with a nationwide electricity transmission grid and pipeline based gas distribution infrastructure. Currently, 60% of the population is connected to the national electricity grid and 20% has access to piped gas.

Pakistan's energy statistics are given in the table below:

Table 2: Pakistan Energy Statistics

Energy Production (MTOE)	65.07	TPES/GDP (toe/ thousand 2005 USD)	0.61
Net Imports (MTOE)	19.82	TPES/ GDP PPP (toe/ thousand 2005 USD)	0.2
Electricity Consumption (TWh)	79.14	Electricity consumption/ population (MWh/ Capita)	0.45
TPES (MTOE)	84.84	Industry Energy Use (ktoe)	17.8
TPES per population (toe per capita)	0.48	Household Energy Use (ktoe)	34.8
		Percentage of Import Bill (%)	40

Source: International Energy Outlook, 2012 and World Energy Outlook,2013

1.2.1 Energy Mix

- **Primary Energy Sources**

Pakistan is endowed with a variety of primary energy sources both renewable and non-renewable. The country has abundant hydrocarbons, water, wind and solar energy reserves. However, since last few decades, share of Hydel has dropped significantly while shares of other renewable sources of energy have remained negligible.

Conventional and renewable energy sources in Pakistan are:

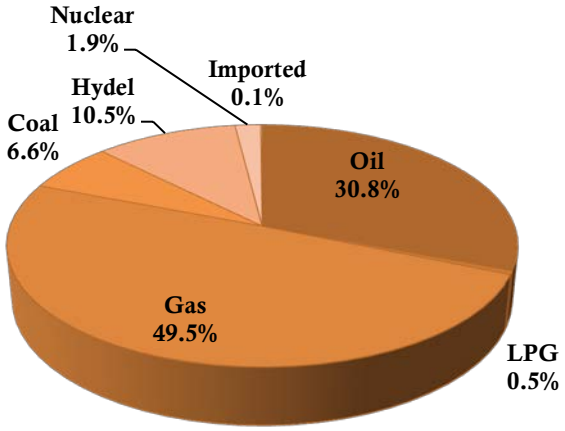
[1] World Bank
[2] Khan, A.N. ,Begum, T., and Sher, M, (2011) Energy crises in Pakistan: causes and consequences. *Abasyn Journal of Social Sciences 4(2)*, pp.341-363

Table 3: Primary Energy Supplies

Conventional Sources	Renewable Sources
Oil	Wind
Gas	Solar
Coal	Hydropower
Nuclear	Biomass/Waste to energy

At present, energy production and consumption in Pakistan is primarily based on conventional fuels. According to Pakistan's Energy Yearbook 2012, energy supplies in Pakistan during the year 2012 were 64.7 million TOE. Oil and gas contributed almost 81% (gas 50% and oil 31%) to the energy supplies. Hydel being another important energy source, held a share of 10.5% in the total mix. However, nuclear energy's share was only 1.9%.

Figure 1: Energy Mix 2011/12



Source: Pakistan Energy Yearbook 2012, Hydrocarbon Development Institute of Pakistan (HDIP)

a) Hydrocarbons (Oil and Gas)

Hydrocarbons hold the majority share in energy mix and are relatively expensive as compared to hydel source. Furthermore, increased consumption of hydrocarbons in the transport sector has worsened gas shortages in the country.[3] Among hydrocarbons, oil and gas, are two of the key components of the energy mix contributing 80% to the total of 64.7 million TOE of energy production in the country. Total oil potential in Pakistan is 27 billion barrels with recoverable reserves of 248 million barrels; whereas, gas potential is 282 trillion cubic feet (TCF) with recoverable reserves of only 24 TCF.[4]

b) Hydel

[3] Source: 'Pakistan's Energy Crisis -Recommended Solutions'. Pakistan Academy of Sciences (PAS)
[4] POGEE – 11th International Exhibition for the Energy Industry. Expo Center Karachi (May-June 2013)

Hydel is the cheapest and most efficient source of energy. Despite the availability of hydel resources in abundance in the country, lack of substantial initial investments hampers the utilization of this potential source.

c) Coal

Worldwide, coal is considered as one of the cheapest and sustainable fuel for power generation compared to other fossil fuels. Coal reserves of Pakistan are one of the main hydrocarbon reserves which remain untapped. In 1992, the Geological Survey of Pakistan (GSP) discovered around 186 billion tonnes of lignite reserves in Thar coal field. Despite having huge reserves, share of coal in Pakistan's energy mix is only 6.6%. Thar coal deposits are sufficient for generating more than 20,000MW depending on the infrastructure and mining capability. On the basis of calorific value of Thar coal, 200 million tons of Thar lignite can generate 1,000 MW for 40 years which is the life of a power project.[5] Pakistan's current share of coal in overall energy mix is minimal as compared to other parts of the world. Coal based power generation have environmental risks which are being mitigated through improved and modern technology. However, a reasonable share of coal based power generation, can enhance the affordability of cost of electricity by the poor and vulnerable segments of the society which can contribute towards universal access to energy.

d) Renewables

Recently, efforts are being undertaken to ensure a meaningful share of renewables in the energy mix as a result of depleting conventional energy resources and a widening demand supply gap. Facilitation of proper sources for identification and efficient utilization of these renewable sources can help improve energy situation in Pakistan.

The Pakistan Economic Forum (PEF) Report on Energy, 2013 highlights the potential of renewable energy technologies by identifying available opportunities, given that all the available wind, hydro and solar resources are utilized. Their details are as under:

Table 4: Renewable Energy Sources Potential

Wind
• Wind Energy potential of Sindh and Balochistan is more than 50,000 MW. • AEDB has issued 47 LOIs with capacities in the range of 5-350MW for wind power projects. • Pakistan's First 50MW Wind Power project of FFCEL has been inaugurated in Dec 2012 • Another 56.4 MW Zorlu Energy project is expected to be inaugurated. • Four (04) Projects of 50MW (each) have achieved Financial close. • Five (05) projects 50MW (each) have signed Energy Purchase Agreements (EPA) with CPPA and Implementation Agreements (IA) with AEDB. • Seventeen (17) wind power projects 50MW (each) capacity have secured Generation License from NEPRA. • Fourteen (14) projects 50MW (each) have received Tariff for their projects from NEPRA.

[5] The Pakistan Economic Forum (PEF) Report on Energy, 2013

- AEDB expects 900MW capacity wind power projects would become online by 2014-2015.

Hydro

- Current installed capacity: 6,555 MW (including 1,400 MW Run of the River)
- Realizable potential: 17,000 MW, of which 12,000 MW is reservoir based hydel and 5,000 MW is run off river based power generation

Solar

- Potential of over one million megawatts of capacity
- Convert all gas water heating to solar
- Off grid solar solution for remote villages

Source: The Pakistan Economic Forum Report on Energy, 2013.

- **Secondary Energy Source (Electricity) - Power sector**

Electricity is the secondary source of energy, obtained through converting primary energy supplies. Pakistan's Power sector continues to face challenges. Economic growth and rising population have significantly increased the demand for power, while supply is insufficient to meet this demand. As a result of power shortages, the practice of load shedding is institutionalized. Load shedding and other power sector woes have adversely affected the economy's potential.

Total installed capacity of electricity generation in the country is 22,812 MW in 2013.

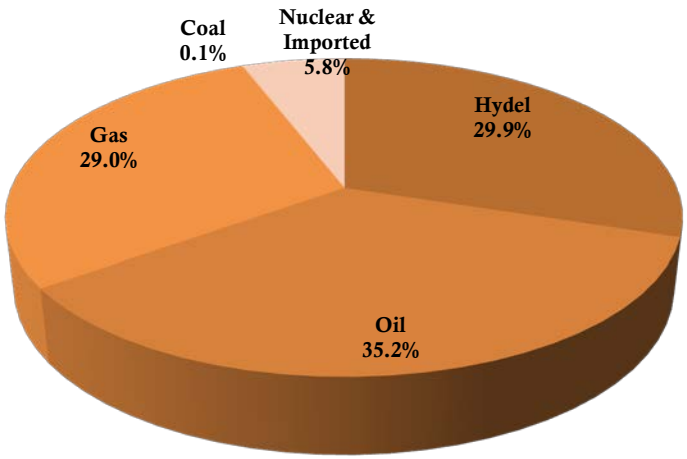
Table 5: Installed Capacity of Electricity Generation (MW)

1. Hydel	6,773 (29.3%)
2. Thermal	15,289 (67%)
3. Nuclear	750 (3.3%)
Total	**22,812**

Source: Pakistan Economic Survey, 2013-14

Gross generation and imports of electricity in Pakistan is 95,365 GWh. Figure below narrates the gross generation and import of electricity by source:

Figure 2: Gross Generation and Imports of Electricity 2011-12



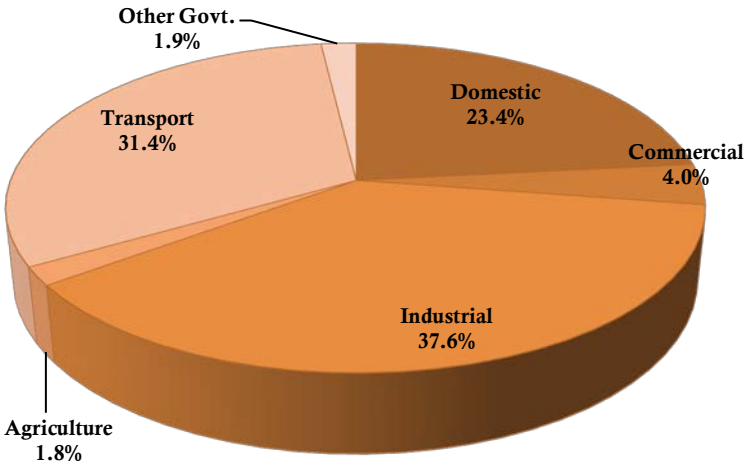
Source: Pakistan Energy Yearbook - 2012

1.2.2 Energy Demand

Energy is considered a key determinant of economic growth. While, energy shortages negatively affect nearly all businesses and virtually every economic sector, it is the small and medium sized enterprises (SMEs) in the manufacturing and services industries that are severely impacted. These entities are insufficiently capitalized to insulate themselves properly from the country's unreliable power supply. Power's variability, therefore, undermines their production capacity and decreases their ability to generate profits.

During the year 2011-12, total energy consumption excluding fuels consumed in thermal power generation amounted to 40.03 million TOE. Out of this, industrial sector consumed 37.6%, while transport, domestic and commercial sectors consumed 31.4%, 23.4% and 4% respectively. Only 1.9% was consumed for other government purposes.

Figure 3: Sector-wise Energy Consumption



Source: Pakistan Energy Yearbook 2012, Hydrocarbon Development Institute of Pakistan (HDIP)

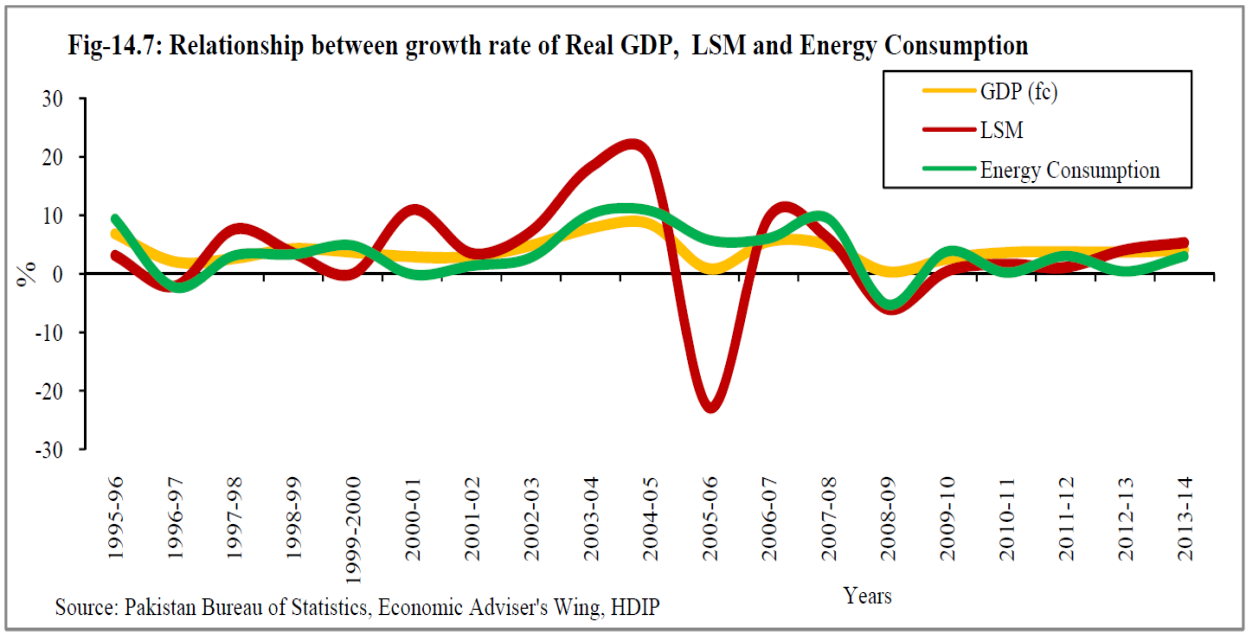
1.2.3 Energy and Economic Development:

The recent recognition of the significance of the relationship between energy and economic progress has captivated the attention of policy makers. Today, it is indisputable, that energy and economic development reinforce each other. Energy consumption is considered a key component for economic growth and measure of wellbeing. Access, affordability and sustainability of energy supplies help eradicate poverty by facilitating socio-economic growth, and increasing employment opportunities. It contributes towards increase in the overall living standards of individuals and societies.

The onset of industrialisation in Pakistan set the trend for increased energy consumption. Since 2007, the country has faced extreme challenges to meet the energy demand from industrial, commercial and domestic consumers. Moreover, underutilization of indigenous natural resources and emergence of governance related issues have worsened the energy situation in the country. Inappropriate planning to resolve the crises has widened the supply-demand gap and has retarded growth in manufacturing and agriculture. Thus, a setback in the economic development of the nation is experienced by the country.

A correlation between GDP and energy consumption can be observed from the figure below. Energy consumption is the amount of energy consumed after deducting the transmission and distribution losses from the total primary energy supplies.

Figure 4: Relationship between growth rate of Real GDP, LSM and Energy Consumption



Source: Economic Survey of Pakistan 2013-14

1.3 Energy Strategy and Relevant Targets

Government of Pakistan and provincial governments are cognizant of the need to improve the energy situation in the country through various policies and projects. In this regard, relevant organizations have been developing and implementing policies from time to time to bring clarity to their future approach towards energy crisis situation in the country. A synopsis of current policies is as under:

I. National Power Policy - 2013

Goals	Targets	Strategy	Principles
1. Build a power generation capacity that can meet Pakistan's energy needs in a sustainable manner.	**Supply-Demand Gap:** Decrease supply demand gap from 4,500 - 5,000 MW today to 0 by 2017	**SUPPLY STRATEGY** **I. Incent Investment through New Econ Model** ▪ Target power and gas subsidy directly only at the abject poor ▪ Provide more expensive but dedicated electricity to users utilizing captive power and generators ▪ Phase out subsidy over period of three years **II. Bring Existing capacity online** ▪ Retire circular debt immediately and clear GST refunds ▪ Set maximum delay limit for payables (RFO 45-60 days / Gas 30-45 days) ▪ Provide financing to plants that lie dormant due to lack of funds or disputes **III. Complete Pipeline Projects** ▪ Bring pipeline projects online on war footing - Prioritize projects that can be brought online in two to three years, particular coal , run-offriver and bio-mass projects ▪ Assign key project manager from Ministry of Water and Power to each pipeline project with the sole responsibility of ensuring project comes online	**I. Efficiency** a) Merit Order b) Transparency & Automation c) Accountability
2. Create a culture of energy conservation and responsibility		**DEMAND STRATEGY** **I. Improve Technology Standards** ▪ Set energy conservation and product labeling standards ▪ Ban imports of non-efficient consumer electronics in Pakistan ▪ Provide Pakistani manufacturers three year time limit to bring products up to par with efficiency **II. Time of Use Tariffs** ▪ Impose specific timings and restrictions for: - Shopping, and other recreational activities, billboard	**II. Competition** a) Infrastructure Development b) Up front Tariff and Competitive Bidding **c)** Key Client Management

		lighting, street lighting, commercial lighting, neon lighting, air conditioning ▪ Introduce 'Time of Use' meters that charges different rates for peak and off-peak electricity usage **III. Pricing Signal** ▪ Provide more expensive but dedicated electricity to heavy users utilizing captive power plants and generators (commercial and residential) ▪ Phase out subsidy over period of three years ▪ Pass true economic cost of electricity generation to consumers over time - Maintain subsidy for abject poor	
3. Ensure the generation of inexpensive and affordable electricity for domestic, commercial, and industrial use by using indigenous resources	**Affordability:** Decrease cost of generation from 12c / unit today to ~10c / unit by 2017	**AFFORDABLE POWER STRATEGY** **I. Move towards cheaper fuel** ▪ Identify expensive RFO and HSD plants and convert them to gas or coal ▪ Shift tariff incentives towards low cost energy sources (hydel–run of the river, gas, coal, nuclear, biomass, etc.) ▪ Proliferate mining across the country and expedite coal projects at Thar blocks **II. Gas Conservation for Power** ▪ Increase price for gas consumption for all users except for poor residential users ▪ Reduce utilization of gas in CNG and UFG in particular-10% gas diversion can generate 2,000 MW ▪ Divert gas to the power sector and ensure firm supply to the power plants	**III. Sustainability** a) low cost energy b) fair and level playing field c) demand management
4. Minimize pilferage and adulteration in fuel supply	**Efficiency:** Decrease transmission and distribution losses from ~23-25% to ~16% by 2017	**SUPPLY CHAIN STRATEGY** **I. Redirect Supply to IPPs** ▪ Reduce allocation to GENCOs until they are at higher efficiency levels ▪ Move fuel allocation from GENCOs to IPPs ▪ Moving 4,000 mtoe from GENCOs to IPPs will save 750 million USD	

		- USD 130 million per month spent on GENCOs produces 650MW - 100 million USD per month at IPPs produces 1,150 MW **II. Accountability Liberalization and Quality Assurance** ▪ Sign performance contracts with GENCOs, PSO, and fuel transporters ▪ Open fuel procurement contracts through tendering to eliminate role of single supplier open decanting by building pipelines (for Muzaffargarh TPS) ▪ Measure the quantity and quality of fuel moving from the port to GENCO ▪ Appropriate full economic, value added cost of quality or quantity loss to the end receiver	
5. Promote world class efficiency in power generation		**GENERATION STRATEGY** **I. Provide Fuel to efficient plants** ▪ Establish plant efficiency through heat rate testing ▪ Prioritize and allocate fuel based upon the efficiency levels ▪ Make allocations and efficiency levels transparent online ▪ Monitor the efficiency of these plants on continuous basis **II. Privatize GENCOs** ▪ Either privatize; or lease GENCOs to private sector on the basis of O&M contracts ▪ Pilot two GENCOS immediately ▪ Prepare the remaining GENCOS for subsequent privatization through corporatization	
6. Create a cutting edge transmission network		**TRANSMISSION STRATEGY** **I. Optimize Transmission** ▪ Sign performance contracts with NTDC - 2.5% are NEPRA allowed losses; 3.6% are the current existing losses ▪ Dispatch based upon economic order ▪ Install transmission effectiveness analysis software and hardware to optimize transmission	

		- Software already exists but has not been utilized due to lack of technical expertise **II. Redefine and redesign national grid** ▪ Build future medium /small sized power plants closer to load centers to minimize line losses ▪ Expand high voltage transmission lines further North beyond Rawat - Majority of new hydel projects will be situated beyond Rawat - High voltage lines minimize losses ▪ Strengthen 220KV rings around large cities to minimize losses ▪ Redesign merit order to also take into consideration transmission losses of plants **III. Incent Private Sector Investments** ▪ Create a new business model based upon whole sales transactions, exchanges and wheeling charges ▪ Incentivize the private sector to make investments in transmission, especially for the new generation plants placed off grid or in areas where the grid is weak	
7. Minimize inefficiencies in the distribution system		**<u>DISTRIBUTION STRATEGY</u>** **I. Performance Contracts (short-term)** ▪ Sign performance contracts with the key stakeholders / heads of the distribution companies (DISCOs) to ensure their accountability with respects to effective distribution ▪ Ensure that performance contracts cover - Reduction in distribution losses (technical losses as well as theft related losses) - Full collections of distribution companies' receivables from consumers using ATC index **II. Smart Metering and Feeder Level Accounting (short-term)** ▪ USAID has funded Smart Meters at all feeders in Pakistan. Project is 65% complete and will finish in two to three	

		months. ▪ Use Smart Meters to Develop an online system of monitoring electricity distribution from CDPs, feeders, transformers and consumer end meters ▪ Manage profit and loss accounts at the feeder level ▪ Hold XEN accountable for P&L and reward or remove **III. Privatization of DISCOs** ▪ Privatize a limited number of DISCOs as pilot and document key learning ▪ Devolve the P&L of the remaining DISCOs to the feeder level and hold XEN accountable to improve performance ▪ Privatize all DISCOs over a period of time	
8. Minimize financial losses across the system	**Financial Viability & Collection:** Increase collection from ~85% to 95% by 2017	**FINANCIAL EFFICIENCY STRATEGY** **I. Collect Receivables** ▪ Automatically adjust already agreed upon amounts owed by provinces and government departments to power sector from the NFC Award and department budgets. ▪ Appoint independent, reliable 'Adjuster' to settle payment disputes with provinces and government departments within a period of three to six months ▪ Agree upon transparent procedure for future billing and collections ▪ Collect GST refunds from FBR and devise a mechanism to avoid future build-ups **II. Punish defaulters and eliminate theft** ▪ Eliminate transmission and distribution theft ▪ Focus load-shedding in areas where collections are low ▪ Pass legislation that allows for defaulters connections to be severed - Defaulters connections are severed after 60 days of non-payment - Defaulters will only be reconnected with prepaid card based meters	
9. Align the ministries	**Governance:**	**GOVERNANCE STRATEGY**	

involved in the energy sector and improve the governance of all related federal and provincial departments as well as regulators	Decrease decision making processing time at the Ministry, related departments and regulators from long to short durations	**I. Reform and Coordinate Planning** ▪ Notify Official Coordination Council between Ministry of Water & Power, Ministry of Petroleum, Ministry of Finance and the Planning Commission. - Ensure information integration between all ministries ▪ Reform the structural and regulatory aspects of NEPRA and OGRA ▪ Restructure Ministry of Water & Power to strengthen functional expertise - Create directorates for each function (Generation, Transmission, Distribution) - Ensure power sector reform (PEPCO, CPPA, NTDC)	

II. Petroleum Exploration& Production Policy 2012

Objectives	Policy Outline
1. **To accelerate E&P activities in Pakistan** with a view to achieve maximum self-sufficiency in energy by increasing oil and gas production.	Policy maintains a system based upon the two different types of agreements to obtain E&P rights in Pakistan: **I.** For onshore operations, a system based upon a **Petroleum Concession Agreement (PCA)** **II.** For offshore operations, a system based upon a **Production Sharing Agreement(PSA)** Policy implementation involves following six steps process: 1. Licensing Process; 2. Exploration and Production Regimes; 3. Regulatory Process and Obligations; 4. Pricing and Incentives for Petroleum Exploration & Production; 5. Implementation and Removal of Difficulties; 6. Conversion to 2012 Policy
2. **To promote direct foreign investment** in Pakistan by increasing the competitiveness of its terms of investment in the upstream sector.	
3. To promote the involvement of Pakistani oil and gas companies in the country's upstream investment opportunities.	
4. To train the Pakistani professionals in E& P sector to international standards and create favorable conditions for their retaining within the country.	
5. To promote increased E&P activity in the onshore frontier areas by providing globally competitive incentives.	
6. **To enable a more proactive management of resources** through establishment of a strengthened Directorate General of Petroleum Concessions (DGPC) and providing the necessary control and procedures to enhance the effective management of Pakistan's petroleum reserves.	
7. To ensure the energy secure of the country by enhancing domestic exploration.	
8. To decrease reliance on imported energy by providing additional incentives to exploration and production companies for enhancing indigenous production.	
9. To undertake exploitation of oil and gas resources in a socially, economically and environmentally sustainable and responsible manner.	

III. Policy for Development of Renewable Energy for Power Generation, 2006

Policy Scope:

- Small hydro of 50 MW or less capacity
- Solar photovoltaic (PV) and thermal energy for power generation
- Wind power generation.

Other RE power generation technologies—such as those based on municipal waste and landfill methane recovery, anaerobic or pyrolytic biomass gasification, co-firing or cogeneration utilizing agricultural crop residues, bio-fuels, wave, tidal, geothermal energy, and fuel cells—are also relevant to current and future renewable energy use in Pakistan. However, these are not dealt with in this policy.

Objectives	Strategy	Roadmap
1. Energy Security **2.** Economic Benefits **3.** Social Equity **4.** Environmental Protection	1. Increase the deployment of renewable energy technologies (RETs) in Pakistan so that RE provides a higher targeted proportion of the national energy supply mix, i.e., a minimum of 9,700 MW by 2030 as per the Medium Term Development Framework (MTDF), and helps ensure universal access to electricity in all regions of the country. 2. Provide additional power supplies to help meet increasing national demand. 3. Introduce investment-friendly incentives, and facilitate renewable energy markets to attract private sector interest in RE projects, help nurture the nascent industry, and gradually lower RE costs and prices through competition in an increasingly deregulated power sector. 4. Devise measures to support the private sector in mobilizing financing and enabling public sector investment in promotional, demonstrative, and trend setting RE projects. 5. Optimize impact of RE deployment in underdeveloped areas by integrating energy solutions with provision of other social infrastructure, e.g., educational and medical facilities, clean water supply and sanitation, roads and telecommunications, etc., so as to promote greater social welfare, productivity, trade, and economic wellbeing amongst deprived communities. 6. Help in broad institutional, technical, and operational capacity	Renewable energy development in Pakistan is conceived under a phased, evolutionary approach constituting a strategic policy implementation roadmap. This roadmap will initiate with lenient policy measures and incentives to attract investment in this relatively new business area, remove existing barriers to project implementation, and 'hand-hold' reasonable-sized pioneering projects through to successful commercial operation. Business confidence and domestic industry capacity grows; it is planned that the policy environment will graduate into a more competitive and deregulated RE market environment, with significantly expanded scale of activities envisioned in the medium and long terms.

	building relevant to the renewable energy sector. 7. Facilitate the establishment of a domestic RET manufacturing base in the country that can help lower costs, improve service, create employment, and enhance local technical skills.	

IV. Energy Conservation Policy

An energy efficiency and conservation policy draft is being prepared through stakeholder dialogues to ensure commitment and ownership of all relevant sector players.

National Energy Conservation Centre (ENERCON) serves as the national focal point for energy conservation and efficiency activities. It has been mandated to increase availability of energy by reducing energy waste, improving efficiency, minimize national dependency on imported crude oil and promote cleaner energy technologies such as renewable energy.

With a view to effectively achieve this vital and challenging mandate of energy efficiency in all sectors of the economy and to streamline the institutional framework, an introduction of a legal and statuary instrument for promotion of Energy Efficiency (EE) and Energy conservation (EC) is being drafted for approval from the Council of Common Interests (CCI) and Economic Coordination Committee (ECC). Numerous opportunities and windows of energy efficiency and conservation are readily available to be exploited.
EC and EE legislation is successfully implemented in several countries of the world as a basic policy instrument and cornerstone for energy policies. Energy Efficiency and Energy Conservation requires credible Law which has been provided through the Pakistan Energy Efficiency and Conservation Bill, 2013 (PEEC Bill"). The Bill provides for a mechanism for the establishment of institutions and procedures to ensure effective conservation of energy and its proficient use.

PEEC Bill was approved in principle by the Cabinet in its meeting held on 28th September, 2009 and subsequently, the bill was introduced in the National Assembly on 26th January, 2011. The bill drafted by Ministry of Water and Power provides for the establishment of institutions and enunciation of mechanisms and procedures so as to provide for effective conservation and efficient use of energy. For this purpose a board is to be set up with the functions of:

(a) Be custodian of national policy for energy conservation and ensure proper utilization, planning and management of energy in all sectors of national economy;
(b) Coordinate, supervise and carry out enforcement of the provisions of this ACT;
(c) Create awareness and disseminate information related to efficient use of energy resources;
(d) Coordinate integration and inculcation of energy conservation concerns in national development plans and policies;
(e) Approve energy efficiency standards and ensure their enforcement and compliance;
(f) Direct the ENERCON in the conduct of research and development, and preparation and execution of demonstration projects and national programs on energy conservation;
(g) Recommend to the Federal Government the adoption of measures directly or indirectly conducive to energy conservation;
(h) Promote investment by the public and private sectors in energy conservation through partnership or otherwise;
(i) Encourage and facilitate import and local manufacture and indigenous technologies for the promotion of energy conservation through all legal and policy support; and
(j) Institute national energy conservation/efficiency and management awards for various categories of energy consumers for the promotion and encouragement of energy conservation.

SECTION II

CURRENT SITUATION WITH REGARD TO SE4ALL GOALS

2.1 Energy Access vis-à-vis Goal of SE4ALL

"Energy is a necessary input to improving quality of life and economic growth. Access to reliable and affordable energy sources can reduce poverty, improve public health, and improve living standards in myriad ways."

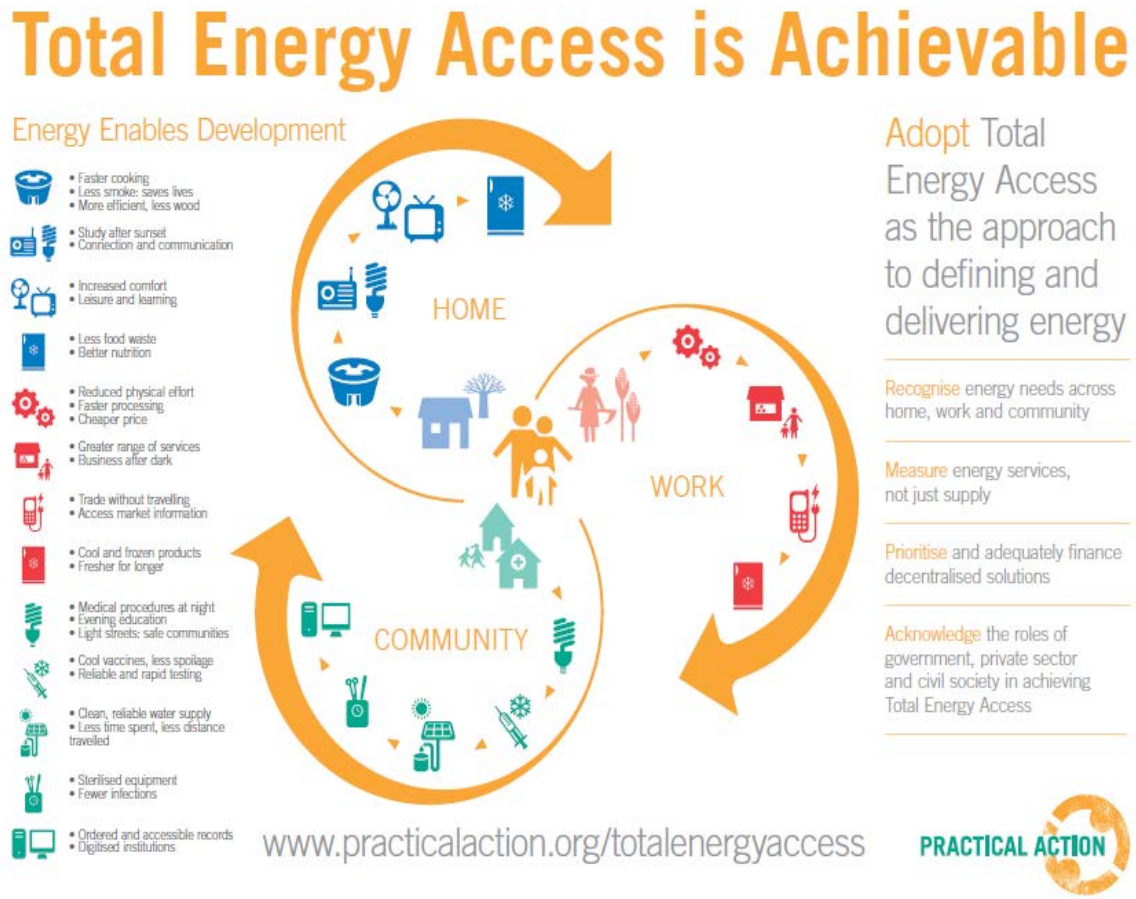
Columbia University's Centre on Global Energy Policy[6]

[6] **Total Energy Access** has the potential to eradicate energy poverty and transform lives of the poor especially living in the developing countries. The fact that access to a reliable source of energy can help in bringing social cohesion and socio-economic development is being widely accepted now. UNDP's target to achieve Universal Energy Access by 2030 should follow a strategy, in which the needs and demands of poor are identified and addressed. It is essential to understand at the grass root level that who has access to energy across households, businesses and communities, and how this energy is used. In order to employ this approach, energy should be measured properly. It is a reprehensible reality that billions of people in less privileged countries use energy from off-grid sources, therefore, measuring grid electricity access is not the answer.

Collaborative efforts of governments, donors, civil society and the private sector are needed to define Total Energy Access as a strategy to provide access to energy to billions of the poor people who are deprived of it

[6] Practical Action: Poor People's Energy Outlook, 2013

Figure 5: Total Energy Access

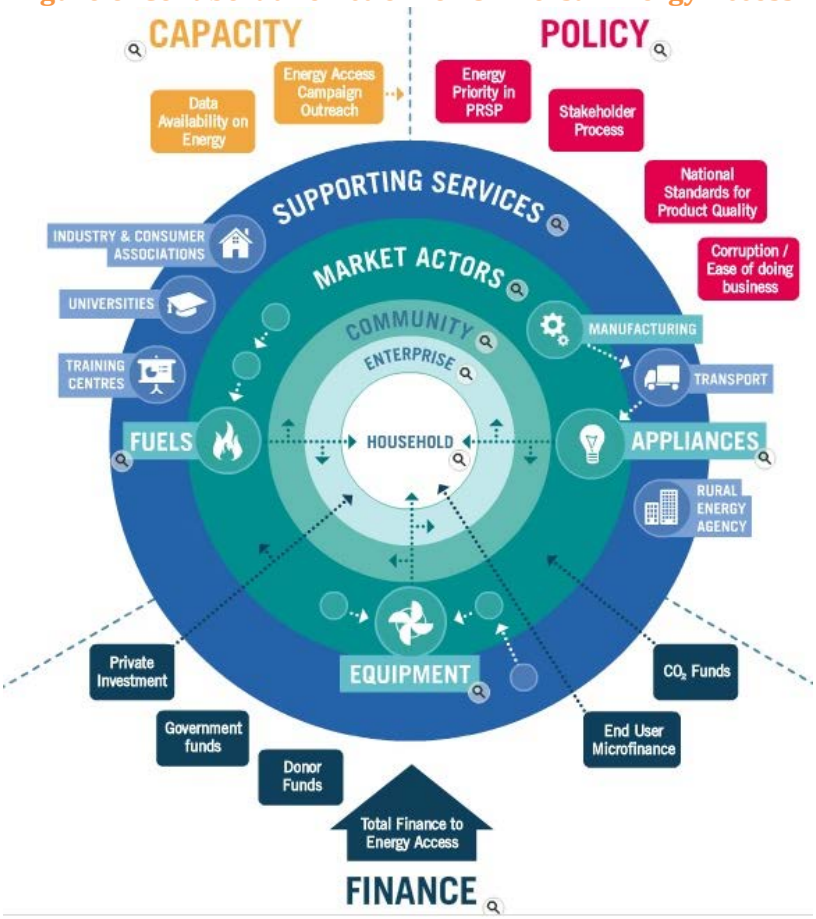


Source: Poor People's Energy Outlook 2013

[7]. Total energy access approach should involve a wide range of organizations in order to assess the potential of a country for making rapid progress towards Universal Energy Access. A collaborative effort should be carried out to ensure greater access to energy services and appliances for people belonging to low socio economic strata.

[7] Practical Action: Poor People's Energy Outlook, 2012: Energy access ecosystem

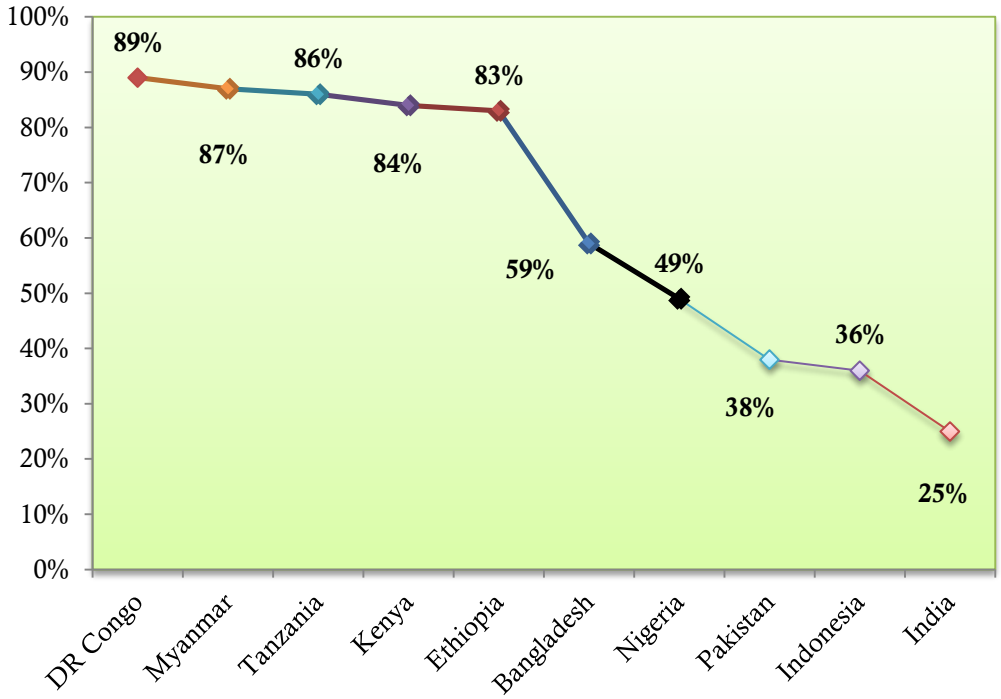
Figure 6: Collaborative Action for Universal Energy Access



Source: Poor People's Energy Outlook (PPEO), 2012

Access to modern energy is essential for the provision of clean water, sanitation and healthcare, as well as reliable and efficient lighting, heating, cooking, transport, and telecommunication services.. Pakistan is among the top 10 countries with the highest proportion of people without electricity access according to IEA's statistics for 2012, as evidenced by the graph below.

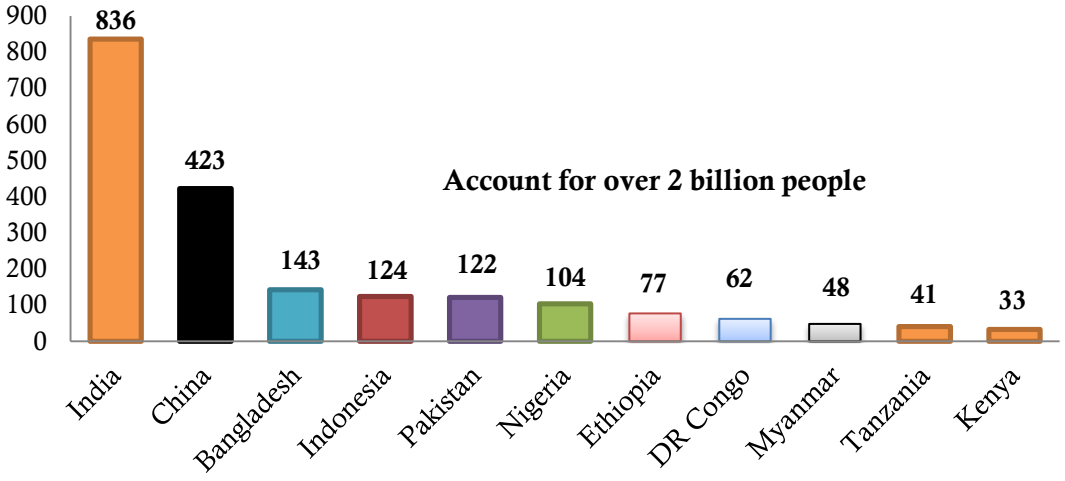
Figure 7: Proportion of people without Energy Access



Source: International Energy Association (IEA) Statistics for 2012

Moreover, Pakistan is also among the Top 10+1 countries with largest number of people using solid fuels for cooking as shown below in Graph.

Figure 8: Number of people using solid fuels for cooking



According to the International Energy Agency, in 2011, 72% of Pakistan's population was without access to modern energy, a figure which they predict will rise to over 100 million people by 2030, with Pakistan rising from among the top 10 to being among top 5 countries with the highest proportion of population without access to modern energy.

Pakistan is also plagued with the enormous challenge of frequent load shedding, which in many areas is reported to be for 14 consecutive hours.

2.2 Energy Efficiency vis-à-vis Goal of SE4ALL

Pakistan's industry is energy intensive because of high energy losses, wastage throughout the value chain, and lack of investment in replacing obsolete technology and infrastructure. Their observation is corroborated by the fact that Pakistan's industry uses 15% more energy than India and 25% more than the Philippines for each dollar of GDP. Pakistan's position falls further when compared to other more energy efficient countries such as South Korea, Japan and Sweden. Low energy productivity in not just putting additional pressure on the energy situation, it is a factor affecting industrial competitiveness and the cost of doing business.

This bleak situation is appalling yet it presents an opportunity for Pakistan, as it reflects a very high potential for energy efficiency improvements in Pakistan's energy sector. According to several assessments conducted by ADB, the United States Agency for International Development (USAID), the GIZ, World Bank, Joint UNDP Energy Sector Management Assistance Program (ESMAP), HBI and JICA; 15%-25% of the total energy consumed in Pakistan can be saved using new technologies, combined with effective demand side management. These international agencies, as well as the national agencies (ENERCON and HDIP) place Pakistan's total energy savings potential at 11.16 million tons of oil equivalent (MTOE), (inclusive of savings in end uses as well as energy transformation), or 18% of primary energy use (FY2008)8. This corresponds to a reduction in net oil imports by half. Adjusting the ADB numbers for the current year the total energy savings potential comes up to 11.65 MTOE. The National Energy Conservation Centre (ENERCON), projects that annual energy savings of up to 25% are possible in all sectors which corresponds to approximately $3 billion/year.

Table 6: Investment Requirement for 10 Years Demand Side Energy Efficiency

Sector	Energy Consumed, FY2008		Energy Savings, FY2019		Investment Required
	('000 TOE)	(TJ)	('000 TOE)	(TJ)	($ Million)
Domestic	8,046	355,659	2,074	91,696	1,288
Commercial	1,456	64,337	347	15,348	84
Industry	16,804	742,776	2,445	108,081	2,450
Agriculture	804	35,531	331	14,623	472
Transportation	11,567	511,297	1,906	84,224	685
Other Government	736	32,520	42	1,851	
Subtotal, Demand Side	39,413	1,742,119	7,145	315,822	4,980

In this regard the Government is making its utmost effort to increase energy supplies. However, increasing supply capacity is expensive and time consuming. Most planned / fast track power generation and natural gas supply additions are at least a few years away. Increasing supplies through conservation and efficiency improvements are thus the best, least-cost and climate-friendly way of bridging the energy gap and securing energy provision in the short and immediate run.

Energy efficiency is recognized for its effective role in meeting energy and economic challenges in a number of countries – in particular, Japan, Korea and Singapore, and can be deployed productively for addressing the energy and economic issues faced by Pakistan today. Differing from the approaches that simply expand / increase energy supply (such as building new power plants), energy efficiency decreased the demand supply gap by prioritizing actions that reduce the need for energy in the first place. Such reductions in the energy demand (without effecting productivity) can be achieved through: (a) decreasing energy losses in the supply chain - an approach commonly referred to as supply-side energy efficiency (SSEE); or (b) by increasing efficiencies of the energy consuming devices, thereby consuming less energy for the same level of service (e.g. while operating buildings, tools, products, and machinery). This strategy is known as demand-side energy efficiency (DSEE).

Energy prices in Pakistan are high and are expected to continue to increase (because of tariff rationalization and removal of subsidies), at least until such time that the present energy mix is changed to cheaper domestic resources. Properly designed and implemented DSEE programs will reduce energy expenses for all energy consumers, and are most beneficial to the end-user. Further, DSEE has been identified as the most cost effective means of reducing the global carbon dioxide (CO2) inventory, and along with it the implied threat of climate change linked to the increased CO2 emissions. Asia Least Cost Greenhouse Gas Abatement Strategy (ALGAS) Study conducted for the Global Environment Fund (GEF), identified that reduction of greenhouse gases through energy efficiency improvements in Pakistan are the most economical projects, as there is a net positive return on the investments, even without accounting for the additional benefits and CDM credits associated with CO2 reductions. In the scenario of the global fight for cleaner environment, reduction of

greenhouse gases, the imminent threat of climate change and the energy shortages, Energy Efficiency today offer an opportunity to transform the character of energy service by bringing in greater sustainability, affordability, reliability and environment friendly energy at the doorsteps of every consumer.

Among the approaches of the Energy Efficiency stated above SSEE imperatives often take precedence in resource planning and related investment decisions (allocation), especially because they are bundled up and are often in the public sector. By contrast, DSEE which may require interventions at hundreds or thousands of homes, businesses, industrial sites, and government facilities, is left on its own to be managed under the market conditions in a lassie fare. Although the assignment is somewhat daunting, yet the value of DSEE cannot be ignored as it is here that lie the greatest potential for conservation, efficiency improvements and "increasing supplies" at the least cost. The end use efficiencies have been approached globally policy measures, making financing available, awareness and strict enforcement of energy efficiency standards.

Attempts by Pakistan to translate energy efficiency and energy conservation potential into realized savings have not been fully successful in the past due to financing barriers and limited political commitment. ADB conducted an assessment of Pakistan's energy efficiency situation and concluded that Pakistan needs to integrate energy efficiency into the overall energy strategy and mainstream energy efficiency into development planning and investment if the energy crisis is to be managed in the short run. Lack of financing was found to be a key barrier to energy efficiency and ADB recommended that the Government needs a flexible public sector financing mechanism to deliver priority projects in energy efficiency. These projects will result in energy savings, lower energy intensity, and increase industrial competitiveness.

ADB also noted that there is no integrated platform for energy sector strategy and policy making as the overall planning and investment approval mandate is with the Planning Commission, while the Ministry of Water and Power and the Ministry of Petroleum and Natural Resources are responsible for their respective subsectors. Energy efficiency covers multiple sectors and requires an institutional structure that is functional and effective. It is to address such concerns that the Energy Efficiency and Conservation Bill had been initiated, to strengthen enable ENERCON deliver at all levels.

In the last five years a number of interventions in the sector have been considered and a number of "programs" and "Action Plans" (costing millions of dollars as well as years of research) were prepared – some of which were also approved (signed) by the government at the time. However, due to different priorities, probably necessitated by the circumstance at the time, these program and plans were never implemented.

Key elements for a successful Energy Conservation and Efficiency Program identified in the reports prepared by various donors suggest that any successful EE program must be based on the following components: (i) EE policy and regulation, (ii) Mainstreaming the EE in the Energy and Economic decision making; (iii) Dedicated and strong institution to lead and facilitate, having the necessary political commitment; (iv) EE standards and building codes; (v) Utility based DSM market activities; (vi) Innovative financing mechanisms, (vii) Development of national, provincial and local institutional capacity; (viii) Linkages with global EE programs; (ix) EE information systems; (x) Awareness of EE means and benefits; and (xi) Recognition of EE achievers.

It is imperative to realize that any energy efficiency plan can only be successfully implemented for results if there is the necessary political commitment at the highest levels and proper "enabling environment" provided for all stake holders – be it the energy suppliers, equipment manufacturers and suppliers, consumers, consultants and contractors or energy service companies (ESCOS) who will need to be facilitated and provided with the necessary enabling environment and government support / regulation.

2.3 Renewable Energy vis-à-vis Goal of SE4ALL

Pakistan is blessed with an abundance of renewable energy resources but so far this potential has only been harnessed through large hydroelectric projects and few wind and solar projects.

Renewable Energy accounts for 180 MW of Pakistan's present power output, with small to medium size hydropower plants offering the greatest renewable energy source for Pakistan. The solar potential is estimated over 100,000 MW. Possibilities also exist in promoting greater use of wind, solar and biomass project.

The Ministry of Water and Power in 2006, prepared the first ever Renewable Energy Policy of Pakistan, with the vision of mainstreaming renewable energy in the development plans of the country.

According to this policy the wind and solar energy will be developed in the country to meet at least 5% of the total installed capacity through RE resources by 2030 (i.e. 9700 MW). Furthermore, 7,874 remote off-grid villages in province of Sindh and Balochistan will be provided electricity through Renewable Energy. Biodiesel will be gradually blended with petroleum diesel to achieve a maximum share of 5% by volume of the total diesel consumption in the country by the year 2015 and 10% by 2025.

2.3.1 Potential of Alternative and Renewable Energies (AREs) in Pakistan

Pakistan has large, economically viable resources in Wind, Solar, Biomass, Waste, Geothermal, and Hydel power, waiting to be harvested. AEDB with the help of renowned international experts /agencies such as United States National Renewable Energy Laboratories (NREL), GIZ from Germany and Risoe from Denmark has identified the RE potential as follows:

Table 7: Potential Capacity of Renewable Sources

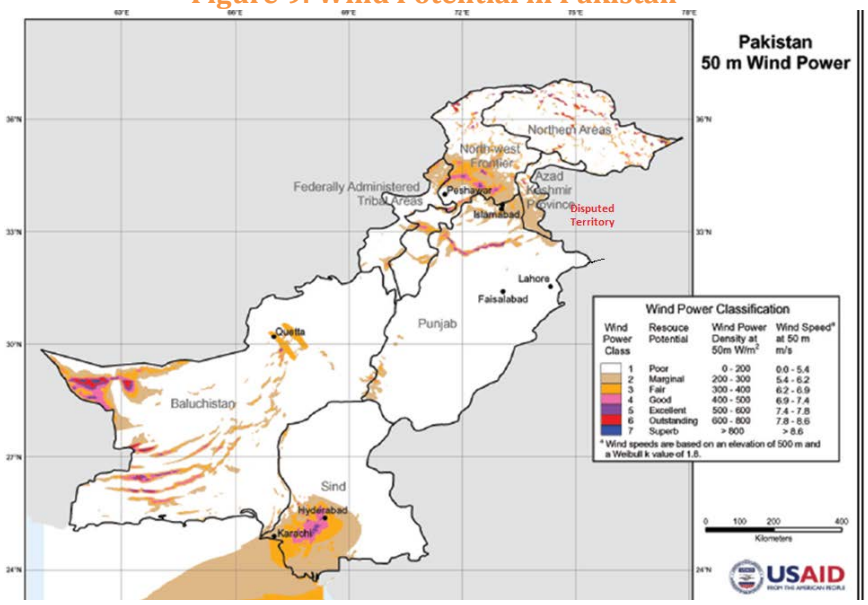
Source	Potential
Wind	340,000 MW (Theoretical)
Solar	2,900,000 MW (Theoretical)
Hydro (Large)	60,000 MW
Hydro (Small)	3,100 MW
Bagasse Cogeneration	1,800 MW

Waste to Power	500 MW (Theoretical)
Geothermal	550 MW (Theoretical)

a) Wind energy potential

The wind map of Pakistan developed by National Renewable Energy Labs (USA) has identified that wind with good to excellent speeds is available in many parts of the country, establishing a total potential of about 340,000 MW (Figure 9). The Gharo - Keti Bandar wind corridor, in the South of Pakistan, having an approximate potential of 50,000 MW is the most attractive to investors at this point due to good resource potential as well as its close proximity to major load centers and the national grid. Ground da ta for other potential areas in the country is also being gathered and verified.

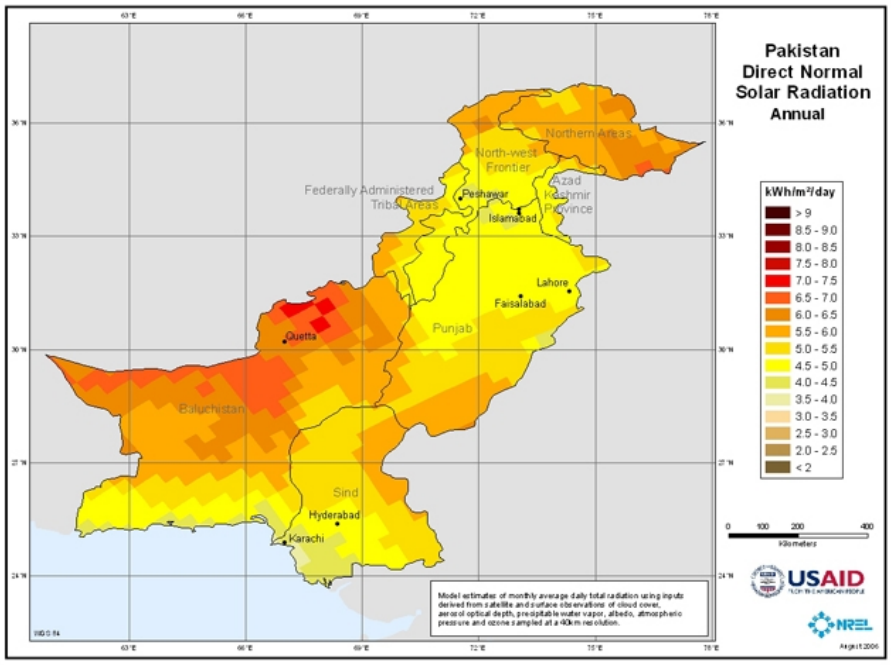
Figure 9: Wind Potential in Pakistan



b) Solar energy potential:

Pakistan has immense solar resources, suitable for both Photovoltaic (PV) and thermal i.e. Concentrated Solar Power (CSP) applications. The Annual Direct Normal Solar Radiation (which indicates the potential for CSP) is in the range of 7 to 7.5 kWh/m²/day in many parts of Balochistan and between 6.5 to 7 kWh/m²/day in other parts of Balochistan; 5 to 5.5 kWh/m²/day in Southern Punjab and Northern Sindh and around 4.5 to 5 kWh/m²/day in rest of Pakistan. The Annual Flat Plate Tilted at Latitude Solar Radiation indicates immense potential for PV, which is in the range of 7 to 7.5 kWh/m²/day in most of Balochistan; 6 to 6.5 kWh/ m²/day in most of Sindh, Southern Punjab and Gilgit-Baltistan and in the range of 5.5 to 6 kWh/m²/day in rest of the country.

Figure 10: Solar Potential in Pakistan



c) **Small Hydropower Potential:**

The total hydro-power resource in the country has been estimated at over 50,000 MW. Most of the resources lie in the North of the country, which offers sites for large scale (100 MW to 7,000 MW) power projects. Smaller (less than 50 MW) sites are available throughout the country (Table 1)

Table 8: Small Hydro Potential in Pakistan

S. No	Area	No. of Potential Sites	Potential Range (MW)	Total Potential (MW)	Remarks
1.	Khyber Pakhtunkhwa	125	0.2 to 32 MW	750	Small / Micro based on Natural Falls / Flow
2.	Punjab	300	0.2 to 40 MW	560	Canals
3.	Gilgit – Baltistan	200	0.1 to 38 MW	1300	Natural Falls
4.	Sindh	150	5 to 40 MW	120	Canal Falls
5.	Azad Jammu & Kashmir	40	0.2 to 40 MW	280	Natural Falls
	Total			**3100**	

Figure 11: Small Hydro Potential in Pakistan

d) Biomass/Bagasse/Waste to Energy potential:

Pakistan produces huge amount of municipal waste (Karachi 9,000 tons/day and other cities about 2,000 to 6,000 tons/day) and agriculture waste in the form of Bagasse, Cotton Sticks and Rice Husk. Converting this waste to energy can generate upto 3,000 MW of power. Pakistan offers lucrative opportunities in this sector in which a number of projects are already under preparation.

Pakistan being the agricultural country is having huge prospects for energy plantation i.e. Jatropha Curcas, Castor, Sukh Chain etc. Around 35 Million Hectares of marginal / degraded land is available in different parts of the country that is best suited for this purpose.

Figure 12: Waste to Energy Potential in Pakistan

e) Geothermal Potential / Resource

Pakistan also possesses a good regime for Geothermal energy. Many hot water springs, some generating surface water temperature upto 83^{0}C lie in the North of Pakistan. Geothermal sites have also been identified in Balochistan and Sindh. Although detailed surveys have not been conducted, it is estimated that over 2,000 MW of Geothermal resources can be commercially tapped.

f) Other Renewable Energy Applications

Renewable technologies for off-grid application are probably the most profitable and ready for implementation activities. AEDB estimates off-grid applications to have a potential of over 10,000 MW of RE.

- **Water Pumping**

260,000 electricity operated agriculture water pumps (tube-wells) currently have a sanctioned load of over 2,500 MW, and another 850,000 Diesel Water Pumps consume 72,000 TOE of Diesel annually. They offer an opportunity to be replaced with Solar Powered Efficient Pumps.

- **Solar Village Electrification**

The Government plans to provide electricity to all. However, there are more than 40,000 villages which are so far from the grid that it becomes costly and uneconomic to extend the grid to these locations. These villages are prime candidates for village electrification using renewable energy, for

which the Government has launched Rural Electrification Program (REP), using Solar Home Systems (SHS).

- **Street Lights**

Pakistan has over 500,000 Street Lights with a sanctioned load of over 400 MW. Most of these Street Lights are based on 80W, 125W and 250W Sodium Lights. They offer opportunities to be replaced with Efficient Solar Lighting.

- **Solar Water Heaters and Geothermal Heat Pumps**

Piped natural gas is available to only 22% of the population. About one third of the gas in domestic sector is used in space heating and water heating. The Government is encouraging use of Solar Water Heaters and Geothermal Heat Pumps in domestic and industrial sectors. This provides a big market for investors.

- **Domestic Biogas Plants**

As per Livestock Census of Pakistan, the Livestock population in the country is above 62 million. The dung from the livestock can be used for producing biogas by installing biogas digesters at domestic as well as commercial scale. A study carried out by UNDP estimates that around 20 million households in the country are not connected to Piped Natural Gas and around 05 million of them have appropriate potential to benefit from Domestic Biogas Plants.

2.3.2 Current Status of ARE Development in Pakistan

In order to promote AREs in the country, AEDB has undertaken various supportive measures. These measures have resulted in creating enabling environment, building confidence of investors, developers and lenders and establishing linkage among the provincial and federal government departments to undertake integrated approach for promotion and development of AREs. An overview of projects initiated by AEDB in this regard is given at Annex-III.

A brief account on status of developments so far made in different AREs is as follows.

Progress so far made in Wind Power Sector in Pakistan

Currently, 33 Wind Power Projects of around 2350 MW capacity are in process of development. 2 projects of cumulative 106 MW is commercially operating, 3 projects of 50 MW each are under construction and nineteen projects of cumulative 1290 MW are expected to achieve financial close by 2013/14.

Progress so far Made in Solar Power Sector in Pakistan

At present, 24 solar Power Projects of 792.99 MW capacity are in process of development. 4 projects of cumulative 67 MW have completed their feasibility studies.

Progress so Far made in Biomass /Bagasse / Waste to Energy Sector in Pakistan

So far, 10 Biomass/Bagasse/Waste to Energy Power Projects of 206 MW capacity are in process of development. 1 project of 12 MW is about to finalize its security documents, another 12 MW project has obtained tariff and generation license, whereas remaining 5 projects are in process of developing feasibility studies.

Sugar industry is deploying bagasse to generate electricity to meet its electricity demand. A few of them are also considering installing captive cum grid spill over power plants. 2 sugar industries have

installed 35 MW capacity power plants and supplying surplus electricity to the grid. A few more projects are in process of development.

Progress so far made in Small Hydropower Sector in Pakistan

Small Hydropower is considered as one of the lucrative options for generation of electricity. The sector has been mainly handled by the provincial governments. At present 128 MW is operational in the country, 877 MW is under implementation and around 1500 MW is available for development.

Government investment in Developing Infrastructure for Evacuation of Power

The sites for wind and solar power projects are remotely located. In most areas, the national grid is not that strong enough that may ensure evacuation of power from the power plants. Since, power evacuation is the responsibility of the federal government; the GoP has so far invested around US $ 20 million. An investment of US $ 150 million is being channelized by the GoP to evacuate power from the upcoming ARE power projects.

Provide quantifiable goals- maybe link to the first section

2.4 SE4ALL GOALS

1.1 Goals

- Energy access: To achieve Universal access, the is need to provide electricity for remaining 38% population of Pakistan either renewable energy or connecting through national grid.
- Energy efficiency
- Renewable energy: deployment of renewable energy technologies (RETs) in Pakistan so that RE provides a higher targeted proportion of the national energy supply mix, i.e., a minimum of 9,700 MW by 2030

SECTION III

CHALLENGES AND OPPORTUNITIES FOR ACHIEVING SE4ALL GOALS

3.1. Institutional and Policy Framework

In Pakistan, energy sector has long been dominated by State investments. It's only recently that the sector is gradually opening for private investors. Unbundling of electricity system was undertaken in 1990s i.e. distribution of electricity was unbundled from the production. This resulted in substantial participation of private sector in power generation, and establishment of independent electricity regulator and decentralized distribution networks. The following table summarizes the role of different existing and newly formed entities in this regard:

ENTITIES	ROLE
National Electric Power Regulator (NEPRA)	Licensing and regulation of generation, transmission and distribution of electricity
Ministry of Water and Power	Overall sectoral development and policy formulation
4 GENCOs (Public Sector) 28 IPPs (Private Sector) WAPDA (Hydel) 2 Nuclear KESC CPPs	Power generation
9 Regional Companies (DISCOs) KESC	Power Distribution
National Transmission and Dispatch Company (NTDC)	Power Transfer from Generators to DISCOs
National Power Control Center	Manager of the National Grid/ Load shedding
Pakistan Electric Power Company (PEPCO)	Management Company for DISCOs, GENCOs and NTDC
Central Power Purchase Agency (CPPA)	Clearing House for sale and purchase of electricity
Private Power Infrastructure Board (PPIB)	Public private partnership in power generation
Alternate Energy Development Board (AEDB)	Promotion and execution of alternate energy projects
SEC	SEC is an attached department of Pakistan Council of Scientific and Industrial Research (PCSIR), concentrating on designing of solar thermal appliances. SEC has designed and developed solar flat plate water heating system in 1980s. SEC has also installed 500 gallon per day capacity solar desalination system near Gwader, Balochistan Province for disinfection and purification of drinking water.

PCRET	research and development activities in various fields of renewable energy technologies, which include photovoltaics (PV), solar thermal energy (STE), wind energy (WE), biogas and biomass (BG/BM), microhydel power generation (MPG), fuel saving technologies (FST), etc

Similarly, oil and gas sector has also gone through major transformation and considerable foot print of private sector is visible now in this sector. Substantial de-regulation of oil pricing and marketing has been undertaken. Oil and Gas development Corporation Limited (OGDCL) is the largest public sector upstream organization. Pakistan Petroleum Limited (PPL) is also an upstream organization. Pakistan State Oil (PSO) is the largest downstream oil marketing company which is under the control of the Government. Private sector contribution has also increased significantly in E&P sector, with several multinational oil marketing companies gaining a reasonable share in the market. Sui Northern Gas Pipeline Limited (SNGPL) and Sui Southern Gas Company (SSGC) have a monopoly in gas transmission and distribution in the country. Oil and Gas Distribution Authority (OGRA) is the regulatory body for this sector and Ministry of Petroleum and Natural Resources is responsible for overall sectoral development and policy formulation.

Owing to the onset of severe electricity and gas load shedding in the country, energy sector issues have captured attention of politicians and academics since 2007-08. Reliance on imported fuels have resulted in considerable increase in energy prices which in turn has led to increase in cost of businesses, pressure on household budgets especially of lower middle income groups and burden on national exchequer in terms of subsidies. The current Government has accorded the highest priority to energy sector and has responded through various initiatives at policy, programme and project levels. The structural and governance issues including unfavourable fuel mix, technical and administrative energy losses and non-recovery of billed amount are considered the fundamental constraints in the development of energy sector. Hence, considerable importance is being given to improve energy sector governance and attracting private sector investments. Efforts are being made to resolve energy sector governance issues, increase private sector investment, move towards indigenous fuel based energy generation, including renewable, and overwhelming participation of provincial governments in energy generation projects.

Energy and Development:

Vision 2025

'Energy security' through holistic and integrated approach espousing principles of availability, efficiency, affordability and competition is one of the priority areas of Vision 2025.

Objectives

- To have good quality of life and high living standard for all citizens across regions, gender and rich and poor compatible with emerging economies such as Malaysia. In addition, depending on domestic resources, reducing poverty and investing in job creation and youth centric programs are at the heart of the vision.
- To achieve an annual average growth rate of 7 to 8 percent that is inclusive and endogenous as well, by bringing about knowledge based science & technology driven and ICT intensive

transformation, up scaling regional connectivity and intensifying entry into the global economy.
- To bring about structural transformation of economy from low productivity to high productivity export oriented and globally competitive industry and services, and from agriculture to diversification in agro based industry.
- To build institutions and social capital (trust, peace, tolerance and social justice) commensurate with requirements of high growth economy.
- To have energy security through integrated policy aimed at supply augmentation, improving infrastructure, demand management, competitiveness, efficiency, incentivizing investments and exploration.
- To transform agriculture and rural economy, ensure food and water security, value addition, research and modernization, promoting rural enterprises and best practices of water management.
- To place private sector as driver of economic growth and ensuring enabling environment through better public management and good corporate governance.

Energy Governance:

The Energy sector in Pakistan is being looked after by various organizations like Ministry of Petroleum and Natural Resources (MPNR), Ministry of Water and Power (MoWP), PAEC, PPIB, AEDB, provincial energy departments and energy sector related regulatory bodies i.e. OGRA, NEPRA and PNRA. The work being performed by various energy sector entities has to be coordinated and compiled for formulation of integrated energy sector policy and plans.

3.2. Programs and Financing

Details of source-wise energy initiatives in Pakistan is being provided as Annex-I. However, Annex-II provides the list of federal authorities controlling/administering these energy initiatives.

3.3. Gaps and Barriers

1. Regulatory Governance

Improvement of regulatory quality is essential to develop sound energy market, develop and enforce energy efficiency and conservation standards and promote renewable energy. Capacity building of NEPRA and OGRA is imperative to strengthen the regulatory framework in order to meet the current needs and evolving dynamics of the energy sector. Mandatory systems and technical capacity audit of regulators is recommended to be initiated in order to identify the weaknesses and targeting of reforms in key areas. High priority is needed to improve energy sector governance and transparency. It was highlighted that the capacity enhancement and improvement of regulatory quality at NEPRA and OGRA will help achieve goals of SE4ALL.

2. Water based Power Generation & Conservation

Pakistan is rich in its hydel resources making it the cheapest source of energy in the country. There is a huge potential of small hydro power generation besides the mega projects including Diamer Bhasha and Dasu. The development of hydropower projects is required to enhance clean and affordable energy supply. Promotion of policies for private investment for power generation through both the

entry of new players as well as expanding existing capacity of those IPPs systematically adhering to energy mix targets and least-cost generation plans can further help.

Hydel power development by private producers on the IPP modality initiated by PPIB needs to be up scaled and expedited. Allocation of resources needs to be prioritized to expand generation capacity from hydel energy resources. Among medium to long-term solutions, mega projects on hydel generation address key issues of base load, reliable and affordable power should be developed on PPP basis.[9] Private Power Infrastructure Board (PPIB) has identified the following medium and long-term hydropower projects to enhance hydropower generation in the country:

Table 9: Medium and Long-term Hydro Power Projects

Medium Term Hydropower Projects	Capacity (MW)	Year
Tarbela IV extension	1,410	2017
Tarbela V extension	1,250	2017
Dasu (Hydro) First Phase	2,160	2017/18
Gulpur Hydropower Project (Ponch River, AJK)	100	2018
Patrind Hydropower Project (Kunhar River, AJK)	148	2018
Long Term Hydropower Projects	**Capacity (MW)**	**Year**
Diamer Basha Dam	4,500	2020
Dasu 2nd Phase	2,160	2018/19
Karot Hydropower (Jhelum River Punjab)	720	2020
Suki Kinari (kunhar River, KPK)	840	2020
Kohala Hydropower (Jhelum River AJK)	1,100	2020
Mahl Hydropower project (Jhelum River)	590	
Rajdhani Hydropower project (Ponch River)	132	
Nekherdim Paur Hydropower Project	80	
Turtonus Uzghor Hydropower Project	58	
Athmuqam hydropower Project - raw site (Neelum River)	350	
Kotli Hydropower Project	100	

Source: PPIB

The short-term expansions expected to generate additional 2,000 MW by 2016.

3. Promotion of Off-grid solutions

In remote areas of the country, the development, transmission and distribution of on-grid systems can be very costly. These areas are already rich in renewable energy resources. As per global practices, the promotion of off-grid solutions can be the best option to meet local energy needs. Off-grid solutions in coordination with the local communities can bring dual improvements in the economy. Firstly, it will help to meet the energy needs of surrounding areas further bringing improvements in social development through creating employment opportunities for local people.
Some of the rural energy users (households, productive and public uses) will be served by grid connections during the next decade (see Box 1 for the potential social benefits of rural electrification). But large numbers will remain unconnected because of the high costs of grid extension when serving

[9] Power Position Paper - June 2013. Economic Reforms Unit, Ministry of Finance

new loads. Off-grid electrification can provide an alternative solution for many low-demand users - at lower cost than grid extension - and a growing market niche for small types of rural energy service companies. Off-grid grid rural electrification can provide power for domestic uses (lighting, cooling, TV, radio, communication), productive uses (e.g., water pumping, fencing, cooling, mills, sewing machines, etc.) and public uses (e.g., schools, health stations, police stations). Power may be supplied through two basic distribution options: village minigrids (serving tens or hundreds of users) or isolated systems (serving just one or two users). And power may be generated from a variety of resources, using diesel-, biomass-, wind-, PV-, or small hydro-generators, or hybrid combinations of these. Depending on the characteristics of a specific use (i.e. willingness to pay and load profile) and the local supply options, the least cost solution for a rural off-grid system may consist of any combination of the above options. 10 These off-grid solutions can be optimized by using different renewable sources and distribution options depending on the kind of usage required. Some of the possible options are given below:

Table 10: Promotion of Off-grid Solutions

Energy Resource	Off-Grid Distribution options	Usage
1. **Solar** 2. **Small hydro generators** 3. **Diesel** 4. **Biomass** 5. **Wind**	1. Solar Home Systems (SHS) 2. Village Mini-grids 3. Isolated systems	1. Domestic use (lighting, cooling, communication etc.) 2. Productive use (water pumping, mills, machines etc.) 3. Public use (education, health etc.)

Solar Home System (SHS): A SHS typically includes a photovoltaic (PV) module, a battery, a charge controller, wiring, fluorescent DC (direct current) lights, and outlets for other DC appliances. A standard small SHS can operate several lights, a black-and-white television, a radio or cassette player, and a small fan. A SHS can eliminate or reduce the need for candles, kerosene, liquid propane gas, and/or battery charging, and provide increased convenience and safety, improved indoor air quality, and a higher quality of light than kerosene lamps for reading. The size of the system (typically 10 to 100 Wp) determines the number of 'light-hours' or 'TV-hours' available.

Village minigrid: Agglomerated consumers far from existing utility grids may be served by isolated minigrids. Because the distribution system is similar whether served by a central grid, a local diesel generator, a local renewable energy source, or hybrid systems (RE with diesel back-up) these minigrids may be 'upgraded' in the future through grid connection (ESMAP 2000d). The capital costs for a low-voltage distribution line are typically around $5 per meter and the costs of an electricity meter may be around $100. The resource used for generating electricity will vary according to village load profile, availability of renewable resources, and fuel transportation costs. In most cases, either a diesel generator, a wind-diesel-hybrid, or a small hydropower plant will be least cost, depending on local conditions. In choosing among these or other options, service providers, regulators, and/or rural households need the knowledge and tools to find the least-cost options (on a lifecycle basis) for a given level of service.

[10] "Expanding access to electricity in remote areas - Off-Grid Rural Electrification in Developing Countries". World Power 2000

Isolated systems have the choice of technology that is best suited to the location – fossil, small hydro, other renewable energy, or a hybrid.

4. Micro Financing in remote areas for Renewable Energy

Provision of micro financing facilities in remote areas for renewable energy will help in utilizing the potential renewable sources. These will also facilitate the off-grid solutions to meet the domestic energy needs in remote areas. State Bank of Pakistan may develop an effective framework for promotion of micro finance for renewable in consultation with all stake holders.

5. Capacity Building & Knowledge sharing

Capacity Building and Knowledge Sharing are the important tools for achievement of the SE4ALL goals by the stake holders involved in energy sector including public sector, business community, civil society and households. Higher Education Commission of Pakistan may develop a research agenda for energy development and sustainability for compliance by all universities. Yet, there are few universities, offering energy sector courses and programs. Capacity building of public sector energy players must be pursued. Policy discourses and international experiences can also help disseminate knowledge on energy sector.

6. Gender inclusive Energy Policies/Strategies

Energy policies are extremely gender sensitive in terms of their impact on men and women, having different roles and responsibilities regarding energy usage. Therefore, there is a need for a strategy that aims to produce a body of first-hand information and experiences to show the positive impacts energy access projects/markets have on the livelihoods of poor men and women. Gender sensitive interventions varying from rural electrification programs to biogas to cook stove projects also have a strong focus on energy entrepreneurship.

Mainstreaming gender into energy policies can be carried further through:

- developing a gender baseline survey to identify gender needs for biogas and improved cook stove technologies
- gender sensitive Energy Access Programme/Projects with a focus of activities on biogas programme
- a draft handbook with gender mainstreaming tools and methodologies is to be developed
- workshops aimed at capacity building as well as stimulating linking and learning among participants are imperative
- inclusion of gender in loan and business documents more specifically gender sensitive micro financing schemes
- promotion material and radio broadcasts for awareness raising

Such policies addressing gender and energy issues may result in better outcomes in terms of energy sustainability and creating opportunities for human development.[11]

[11] http://www.energia.org

7. Building & Appliance Standardization

Buildings consume around one third of global energy, majority of which is for domestic purposes. Energy consumption by domestic sector in Pakistan is 45.9% as compared to 25-30% and 40% in China and UK respectively. Although there is a strong need for the development of new energy sources to deal with the current energy crisis However, bringing innovations in the existing building designs can help in reducing the energy burden. These innovations may include improved architectural designs, energy-efficient building materials, standardized electrical appliances and implementation of building energy efficiency codes,in collaboration with Pakistan Engineering Council (PEC), National Energy Conservation Centre (ENERCON) has developed a Building Energy Code of Pakistan. The implementation of energy code for buildings can result in 25-30% of energy saving in new buildings. [12]

Development and effective implementation of energy efficiency codes – legislation to promote energy efficiency in the country can play a critical role towards meeting energy needs in the country. This should include building energy codes, standardization and labelling of electrical appliances, equipment and machinery.[13]

8. R&D on Renewable technologies

There is a need to promote and invest in research and development on renewable technologies to address the energy needs and demands in next 20-30 years and beyond. R&D on renewable technologies will help in further addressing the issue of depletion of conventional resources and increasing the share of renewable energy in energy mix. Policy for Development of Renewable Energy for Power Generation (2006) can be revised with prioritizing the R&D factor in its strategic policy objectives. Many studies have highlighted the importance and exploration of shale and tight gas reserves in Pakistan. There are about 586Tcf of shale gas reserves in the country.[14] Import of technology for shale gas exploration can be helpful to meet the future energy needs in the country.

9. Improved process for approval of PSDP Projects

There is a need to accord priority to energy sector projects in PSDP budget in terms of approval and execution process, public investments, release of project finances and completion of on-going projects. There is a significant through-forward of PSDP projects in energy sector which needs to be rationalized and streamlined. There is a need to expedite and simplify the process for energy sector projects.

10. Advocacy for Energy Conservation and Efficiency

Demand management and power conservation have particularly been unaddressed. Strict demand side measures have not been implemented fully to show desired results and this phenomenon has contributed significantly towards minimizing power shortages. The current level of unaccounted for gas losses (UFG) is on average 11 percent due to commercial and technical losses. Similarly power sector generation, transmission and distribution losses have burdened the national exchequer and

[12] Sohail Ahmed and Moin-ud-Din Qureshi, "Energy Efficient buildings in Pakistan". "A scientific journal of COMSATS – **SCIENCE VISION** *Vol.16 and Vol. 17 (January 2010 to December 2011)*

[13] Power Position Paper - June 2013. Economic Reforms Unit. Ministry of Finance

[14] Abbas Bilgrami. June 2013. "Technically Recoverable Shale Oil and Shale Gas Resources: An assessment of 137 Shale Formations in 41 Countries outside the United States. The Pakistan Potential Shale Gas Reservoir Properties".

raised the power sector tariff. The Government is pursuing companies at the highest level to reduce losses benchmarking international standards through investment measures, managerial and administrative improvements, and through building the capacity of the companies. Energy conservation and efficiency at consumption levels has also been dismal. Despite the media campaigns for raising awareness about energy conservation, energy wastage is a common practice by domestic, commercial as well as industrial consumers.[15] There is a need to build strong and effective campaigns for promotion of energy conservation and efficiency in the country.

11. Public Sector Energy Conservation Audits

In addition to awareness raising on energy conservation and efficiency among the masses, it is also required to take some measures to identify the outcome of these awareness campaigns. Public Sector Energy Conservation Audits is one of the example of such measures. Quantitative findings through energy audits can provide substantial practical guidelines for identifying cost saving opportunities in energy efficiency and conservation. Energy audits of public sector organizations can play a key role depicting our dedication towards energy efficiency and will also set an example for the private sector to follow the suit.

[15] Power Position Paper - June 2013. Economic Reforms Unit. Ministry of Finance

3.4. Way Forward

Current energy crisis needs to be addressed through policy initiatives planned to target any or all of these areas/challenges:

1. To improve Regulatory Governance in the country
2. To focus on water based power generation & conservation measures
3. To promote off-grid solutions
4. To provide micro financing facilities in remote areas for Renewable Energy
5. To invest in capacity building & knowledge sharing
6. To create Building & Appliance Standardization
7. To promote R&D on Renewable technologies
8. To improve the process for approval of PSDP Projects
9. To improve advocacy for energy conservation and efficiency
10. To ensure Public Sector Energy Conservation Audits periodically

3.4.1 Proposing Sustainable Energy Utility (SEU) as a Future Course of Action

Sustainable Energy Utility (SEU) has emerged as a pioneer model to address the end-users energy efficiency problems. The SEU solves the problem of end-users dealing with fragmented array of distributors, contractors, energy services companies and also to secure finances for provision of sustainable energy services. It was first established in state of Delaware and developed by Centre for Energy and Environmental Policy, University of Delaware, USA.[16]

Sustainable Energy Utility model operationalizes into an independent and financially self-sufficient entity which is responsible for delivering energy efficiency and conservation, and customer-based renewable energy to end users. The SEU is all inclusive as it targets all fuels types and all sectors of the society. The model is major departure from supply-side and demand side policies which addressed either only certain types of fuels or certain types of end users categories.

SEU model has been recognized for its efficacy by US Department of Energy and White House. It has been recognized as a viable platform to for sustainable energy and energy efficiency. So far, SEU has "created over 1,000 jobs and saved more than $148 million in bills in its single bond installment. After paying off the full capital cost of the new technologies and associated borrowing, monitoring and verification costs, participants will realize a net savings of $38 million."[17]

Internationally, Asian Development Bank recommended SEU use to its Member States at its 2011 Clean Energy Forum. This model has been adopted in US as well other countries including China, India and South Korea are working on replicating this model for energy efficiency and low carbon/no carbon strategies. Please find details of the model as well finances and revenue generated by the model in in Annex – IV)

3.4.2 Future Targets for Harnessing Alternate and Renewable Energies (AREs)

[16] Dr. John Byrne, Director Center for Energy and Environmental Policy, University of Delaware is acknowledged as the architect of the Sustainable Energy Utility concept.

[17] Source: http://ceep.udel.edu/energy-sustainability/energy-projects/ Date taken: July 9, 2014

3.4.2.1 Energy Integration Plan of AREs for On-Grid Applications

Keeping in view the potential of various AREs, to target installation of at least 4,130 MW of power (around 10% of total installed capacity) through alternative and renewable energies by 2018, the resource wise targeted distribution of ARE into national grid is given in Table 2 below.

Table 11: ARE: Resource-wise Energy Integration Plan 2018 for on-grid applications

Resource	Total (MW)
Wind	1750
Small Hydel	180
Solar PV	1000
Biomass / Waste to Energy	800
Total	***3730***

For the year 2025, the installed capacity of AREs should be at least 7500 MW (10% of total installed capacity). The resource was targeted distribution of ARE into national grid is given in Table 3 below:

Table 12: ARE: Resource-Wise Energy Integration Plan Vision 2025 for on-grid applications

Resource	Total (MW)
Wind	3500
Small Hydel	500
Solar PV	2000
Biomass / Waste to Energy	1500
Total	***7500***

The target set-forth for 2018 and 2025 would require an investment of around US $ 7 billion and US $ 13.5 billion respectively from the private sector in the power generation sector. In order to attract the private sector investment, the government would have to announce lucrative policies and incentives. In order to ensure evacuation of power and develop required infrastructure, the government would have to invest in strengthening / improving the national grid. As per rough estimates, the government would have to invest around US$ 3 billion.

The government is encouraging the large industries, SMEs, commercial and domestic customers to put up their own energy generation units based on AREs. Special incentives may be given to such customers who opt for such applications. Moreover, the government is promoting concept of Net Metering all over the country. The general public is being encouraged to install small scale renewable energy (solar, biomass and wind) based power units at their houses for net metering. It is estimated that around 3,000 MW ARE power can be installed in the country under the net metering. This would not require any upfront investment by the GoP. Related policies and regulatory regimes are being placed.

One of the main focuses of the Government is to reduce the T&D losses in the national grid and release the grid from the extra burden. The transmission and distribution grid is being continuously upgraded. Moreover, the GoP is planning to relieve the grid from certain percentage of the following loads:

i. Tube well; the farmers would be encouraged to install solar water pumps. Subsidy schemes should be announced for such farmers who opt for installing solar water pumping systems.
ii. Street Lights; the street lights are planned to be gradually replaced with the solar street light systems
iii. Commercial load; the government is planning to shift the billboard lighting, search lights, outdoor lighting, peripheral lighting and other commercial lightings to solar.
iv. Rural Electrification; the GoP is considering to electricity remote areas of the country through solar energy applications.

The Government shall also encourage the end customers to deploy Distributed Generation options (Net Metering, Wheeling, Banking etc.) through AREs.

3.4.2.2 Energy Integration Plan of AREs for Off-Grid Applications

The off-grid applications of the AREs have definite prospects for development in Pakistan. Introducing such applications will definitely be prospective for Pakistan as this will not only supplement the initiatives of provisioning of electricity to every household, but would also facilitate in grid strengthening and effective management of the load. However, such interventions require some additional support for prompt promotion and dissemination. International experience indicates that off-grid applications have only been successfully deployed under a subsidy mechanism of the national governments.

There are lot many options which can be considered while devising integrated plan. However, current focus has been laid down to following applications and a target has been set forth for introducing certain quantity of these applications by 2018 and 2025:

Table 13: Energy Integration Plan for off-grid applications

Energy Integration Plan of AREs for Off-Grid 2018	
Technology	**Total (Qty)**
Solar Home Systems	16000
Solar Water Heaters	30000
Solar Pumps	2320
Heat Pumps	1295
Solar Street Lights	4700

Energy Integration Plan of AREs for Off-Grid Applications –2025	
Technology	**Total (Qty)**
Solar Home Systems	26900
Solar Water Heaters	84000
Solar Pumps	8520
Heat Pumps	5545
Solar Street Lights	14800

It is further planned that:

- Biogas plants be promoted in domestic, agriculture and industrial sector. Around 100,000 Biogas plants can be installed in the country.
- Water cleaning can be done through ARE applications.
- Industrial and domestic sectors can be encouraged to install captive power plants running on AREs.
- Hydrogen fuel cell technology can be promoted in domestic and commercial sectors.
- Battery charging systems in remotest areas can also be introduced for meeting energy needs.

AEDB is proposing the GOP to announce some subsidy package for promoting the end consumers to opt for such applications. The proposed figure appears to be large, but the economic impact of introducing such technologies would be of that level that the financial impact of the subsidy would come out to be very minimal. Current estimates indicate that meeting targets to introducing these applications as per given targets would have financial impact of Rs. 7.6 billion and the subsidy amount @ 70% of total cost comes out to be Rs. 5.3 billion spread over five years. The quantum of Financial Impact and the proposed 70% subsidy spread over 12 years based on current prices is expected to be Rs. 19.5 billion and Rs. 13.6 billion respectively.

3.4.3 Additional Steps to be undertaken for Promoting ARE Sector in Pakistan

The GoP would have to attract private sector investment in the province on war footing basis to achieve these targets. In order to facilitate the private power sector the GoP is recommended to establish energy corridors all over country deeming the suitability, practicality and viability of specific resource and request the investors to invest in setting up power plants.

In addition to above, a list of steps is prepared and stated below that the GoP needs to undertake for facilitating the private sector:

Table 14: Steps for Promotion of ARE in Pakistan

Step	Description	Suggested Measure
ARE Resource Data of most parts of Pakistan be made available	On-Ground ARE Resource mapping has not been done in most parts of the country. Due to this, prompt project initiation is not possible.	ARE Resource Mapping be done in conjunction with AEDB and PMD and resource data be made available to private sector
Provincial Governments to allocate land/sites for projects	Without allocating land/sites, projects cannot be initiated	Provincial govts. may allocate/land to the projects at competitive and attractive packages.
Upfront Tariff be announced for all AREs.	NEPRA has not yet announced Upfront Tariff for solar, biomass and small hydro power projects.	GoP may push NEPRA to immediately announce Upfront Tariff

Anomalies in Upfront Tariff for wind power projects (WPPs) be removed.	The structure of Upfront Tariff announced by NEPRA for WPPs needs to be improved to address bankability, practicality and viability issues. The Upfront Tariff structure may be attractive enough for the private sector projects and encourage them to bring most efficient turbines and equipment and allow them to execute their projects within minimum possible timeframe.	NEPRA may be asked to revise Upfront Tariff for WPPs make it attractive enough keeping in view best practices around the globe.
Standard EPAs for biomass, solar, wind upfront tariff be made available	Due to delay at part of CPPA, the EPA documents could not be finalized / standardized	GoP may direct concerned departments to develop standard EPA and IA documents
Grid Interconnection facilities for ARE Projects be made available	Power Purchaser(s) (CPPA/NTDC/DISCOs) have indicated inability to evacuate power from upcoming ARE power projects due to constraints at grid.	GoP may direct NTDC/DISCOs to develop the grid infrastructure on war footing basis enabling it to evacuate all upcoming power to national grid. The GoP may make prompt funds allocation for this purpose. Financing options from the donors may also be explored.
CPPA & DISCOs to issue Power Acquisition Request (PAR) and Certificate of Availability of Grid	Due to grid constraints, CPPA & DISCOs have refused to issue PAR and grid availability certificates. Owing to which, the IPPs are unable to proceed with applying for tariff and Gen License	CPPA & DISCOs may be requested to issue PAR and certificate for grid availability
Grid Code addendums for solar and small hydro power be issued	Grid Code of NEPRA is designed for conventional power projects (thermal & hydel). Addendum was issued to allow wind power. Issuance of addendum is required to allow connecting solar and small hydro power	CPPA may be asked to take action at their end for approval and announcement of addendums for solar and small hydropower.
Project financing related issues	High Interest rates being charged by commercial Bank for development of ARE projects. Circular debt, Pakistan's credit rating, country risk and domestic unrest, limited financing	GoP may establish and empower Alternative Energy Development Fund for make available financing for the ARE projects

Local Manufacturing of Plant and Equipment	Exemption of taxes on the import of raw material for manufacturing of plant and machinery locally is not available. This is discouraging the industry.	FBR may be asked to issue exemption of taxes on the import of raw material for manufacturing of plant and machinery
NEPRA Rules are for Distributed Generation (Net Metering, Wheeling & Banking) be announced	NEPRA has not yet announced rules/regulations, technical mechanisms and agreements that may allow transactions under Distributed Generation	NEPRA may be asked to announce the NEPRA Distributed Generation Regulations along with the mechanisms and agreements.
Mandatory inclusion of ARE in Grid System of DISCOs & NTDC	DISCOs and NTDC have not included AREs in their power generation and distribution plans.	GoP may make it mandatory for every DISCO & NTDC to include 10-15% of their total power capacity in their system coming from AREs
Institutional Strengthening and Capacity Building of Federal and Provincial Govt. departments	Departments in Federal and Provincial Govts. lack manpower required to undertake the mandate and targets assigned to it. Specialized training of manpower is also available.	GoP may allow inducting professionals in respective Federal and Provincial Govts. departments. Also, GoP may also allow specialized training to the employees of these departments through various means.
Establish an Institute for Alterative & Renewable Energy Technologies (IRET)	There is no specialized dedicated institute established for research, development and training in AREs. Due to which dedicated R&D and specialized human resource in the sector is scarce.	GoP may establish IRET that would render services of R&D, training and capacity building in the country and in the region.
Levy Green Energy Tax	Availability of funds for ARE development and deployment is limited.	GoP may impose a Green Energy Tax on consumption of fossil fuels in all the sectors of economy. The tax may also be imposed on large industries, commercial sector, hotel industry etc. The revenue generated from this tax may be consumed for development of ARE sector in the province.
Carbon Credits through Clean Development Mechanism (CDM) and Nationally Appropriate Mitigation Actions (NAMAs)	ARE projects have an added benefit that they qualify for earning carbon credits. CDM and NAMA are the regimes that can be exploited in this regard.	GoP may encourage private sector companies to look for CDM option while designing their projects and endeavor to get their project qualified and registered for earning CERs.

	Moreover, GoP may develop NAMAs in various sectors so that technical/financial assistance can be sought in the country and the province from developed nations.

While devising these targets, it has been kept into consideration that AREs cannot be developed for replacing / overstepping conventional energy because of intermittency and time specific availability. The AREs can be developed to supplementing conventional energy supplies in the country.

Annex 1 –Matrix of Existing Programs (Source-Wise) for Achievement of SE4ALL Goals

1. Thermal

Region	Projects	Capacity (MW)
Short Term/Current Energy plans		
Sindh	Nooriabad Gas based Power Project	100
Balochistan	Completion of Balochistan gas projects • Jhal Magsi (15 mmcfd) • Zarghun- Quetta pipeline (20 mmcfd)	
Medium Term Energy plans		
Punjab	Local Coal project	200 (Mid 2016)
	Imported Coal	2,700 (Mid 2017)
Balochistan	Coal-based Gaddani Power Park	?
	Setting up of local coal-based mine mouth power plant	50 MW
Long Term Energy plans		
Balochistan	Installation of more mine-mouth coal fired power plants at coal sites	
	Cross border import of electricity and Gas - 1000 MW from Zahedan to Quetta - Gas import from Iran - TAPI gas pipeline and CAOP	

2. Hydel

	Short Term (2012-2015)				
Region	**Project name**	**Capacity (MW)**	**Cost**	**Status**	**Project completion**
Sindh	Guddu	43			
	Sukkur	34			
	Run of the River Hydro at Rohri Canal	5-10			
Khyber Pakhtunkhwa (KP)	Daral Khwar HPP, Distt Swat	36.6	6.958	Under construction	Dec-15
	Ranolia Khwar HPP, Distt Kohistan	17	4.277	Under construction	Dec-15
	Machai Canal HPP, Distt Mardan	2.6	1.198	Under construction	Jun-14
Balochistan	Feasibility of electricity generation based on Micro Hydro projects				
FATA	Micro hydel				

	power stations				
	Gomal Zam Dam (WAPDA Project)	17			
	Kurram Tangi Dam (WAPDA Project)	83.4			
	Mohmand Dam Project	745			
	Ketho Weir NWA	18			
AJK	HEB				
	Qadirabad	3			2013-14
	Rehra	3.2			2013-14
	Battar	4.8			2013-14
	Hillan	0.6			2013-14
	Ranger-II	0.45			2013-14
	Guin Nallah	0.25			2013-14
	Sharda	3			2013-14
	Dhannan	1.7			2013-14
	WAPDA - 1 project	969			2013-14
	Medium Term (2013-2018)				
	Project Name	**Capacity (MW)**	**Cost**	**Status**	**Project completion**
Punjab	Small Hydel Run of Canal	100			Mid 2016
	Micro Hydel Run of River	600		Policy in process	
	Micro hydel Power plants	120		Policy in process	
Khyber Pakhtunkhwa (KP)	Matiltan HPP, Swat	84	15.25	PC-Is approved by ECNEC. Pre-construction activities in progress	2018
	Lawi HPP, Chitral	69	12.235		2018
	Karora HPP, Shangla	9.3	3.16	MC Selected	2017
	Jabori HPP, Mansehra	6.5	2.33		2017
	Koto HPP, Dir	31	8.81	MC Selected	2017
	Sharmai HPP, Dir	150	33.36	PC-Is submitted to ECNEC for approval as PPP Projects	2018
	Shusghai HPP,	144	28.78		2018

	Chitral				
	Shogosin HPP, Chitral	132	26.955		2018
AJK	PPC/PPIB				
	Riali-II HPP	4.8			2016
	Dachhor Miran	3			2016
	Jagran-III HPP	35			2016
	Ghail	0.8			2016
	Bheri	2.87			2016
	Riali-III	3.07			2016
	Jhing-II	6.05			2016
	Chitter Pari	1			2016
	Kathai-III	1			2016
	Patrined	147			2016
	Batdara	10.2			2016
	Luat	49			2016
	Naushera	2			2016
	Kathai-II	4.6			2016
	Sahng	10			2016
	Sankaya HPP	7.00			2015
	Khari-II	2.5			2015
	Raili-I	1.6			2015
	Hotreri	5.4			2016
	Dakhari	2.2			2015
	Gulpur	100			2016
	HEB				
	Chamfall HPP	6.5			Upto 2016
	Bhedi Doba HPP	1.0			Upto 2016
	Up-gradation of Kundal Shahi HPP from 2.0 MW to 3 MW	1.0			Upto 2016
	Galetar HPP	1.0			Upto 2016
	Sandoa Cross HPP	1.75			Upto 2016
	Jagran- II	48.0			Upto 2016
	Jhing	14.4			Upto 2016
	Patikka	0.500			Upto 2016
	Kel	0.750			Upto 2016
	Project name	**Capacity**	**Cost**	**Status**	**Project completion**
Khyber Pakhtunkhwa (KP)	**Phase – I**				
	Arkai Gol HPP Chitral	79	27.65	Feasibility study in	2020

				progress (Completion 2014)	
	Barikot-Patrak HPP, Distt Dir	65	22.75		
	Patrak-Shringal HPP, Distt Dir	46	16		
	Shigo Kach HPP, Distt Dir	96	33.6		
	Ghorband HPP, Distt Shangla	14	4.9		
	Nandihar HPP, Distt Batagram	10	3.5		
	Mujigram Shogohore HPP, Chitral	51	17.5		
	Istaru Buni HPP, Distt Chitral	52	18.2		
	Balakot HPP, Distt Mansehra	300	105		2022
	Naran HPP, Distt Mansehra	190	66.5		
	Gharit Swir Lasht HPP, Distt Chitral	334	116.9		
	Booni Zait HPP Chitral	176	61.6		
	Jamshill More Lasht HPP Chitral	260	91		
	Laspur Miragram HPP, Distt Chitral	133	46.55		
	Batakundi HPP Mansehra	105	36.75		
	Phase – II				
	Kari Mushkar HPP Chitral	446	174.75	Feasibility study to be initiated (Completion 2016)	2022
	Tor Camp Godobar HPP Chitral	409	153.37		
	Gabral Kalam HPP Swat	110	41.25		
Balochistan	Development of micro Hydel power projects.				
AJK	**PPC/PPIB**				
	Ashkot	40			2017-20
	Gumatnar	40			2017-20

	ArjaTaien Dhalkot	36			2017-20
	Karot HPP	720			2017-20
	Azad Pattan HPP	640			2017-20
	Kohala	1100			2020-2025
	Sehra HPP	130			2020-2025
	Mahl	590			2020-2025
	Chakothi-Hattian HPP	500			2020-2025
	HEB				
	Dowarian	40			Upto 2025
	Nagdar	35			Upto 2025
	Shounter	48			Upto 2025
	Jagran - IV	22			Upto 2025
	Jari	4			Upto 2025
	Balmi	2			Upto 2025
	Kappa Banamula	4			Upto 2025
	Dukhari	2.2			Upto 2025
	Hajira	1.6			Upto 2025
	Hariyola-Zaminabad	12.4			Upto 2025
	Padhar-Sewer	2.62			Upto 2025
	Kotli	100			Upto 2025
	Saher Plandri	2.5			Upto 2025
	Ziarat.	3			Upto 2025
	Malkian Sarsawah	2.2			Upto 2025
	Bango Aronta	2.1			Upto 2025
	Kalamula	2.2			Upto 2025
	Rajdhani	132			Upto 2025

3. Solar

Region	Projects	Capacity (MW)
Short Term/Current Energy plans		
Punjab	Solar Cholistan	Unlimited 1000 MW (Mid 2015)
	19 private sector projects	690
Sindh	Solar project	100
KP	Solar power plant (under construction)	12
	Solar Electrification of 100 villages	
	Conversion of Civil Secretariat to Solar based electrification	
Long Term Energy plans		
Punjab	Solarization of QA Library ~ Specs Finalized	

	Solarization of schools and BHU	
Balochistan	The PV solution – solar homes, streetlights & tube wells	
	Setting up of up to 1 MW Solar Power plants in 5 different towns/ districts of Balochistan	5

4. Other Renewable Sources

Region	Projects	Capacity (MW)	Status
Short Term/Current Energy plans			
Punjab	**Bagasse** Optimization (Up gradation)	800 MW (End 2015)	
	Biomass< 20 MW Plants Exclusion Zones	2,500 MW (End 2015)	
	Biogas	34 million animals	Policy in process
	Geothermal	Unlimited	
	Wind power		Estimation in process. 3 wind masts installed
Sindh	Khairpur Waste to Power Plant	20	
	03 Biomass projects at - Karachi - Khairpur - Others (Hyderabad, Sukkur, Mirpurkhas)	 500 MW 120 MW 120 MW	
	Jhimpeer and Gharo	10,000 MW	
KP	Community based 306 mini and micro **Hydel projects**	32.7	
	Feasibility study for Wind potential and Construction of Wind Power Plant	10 MW	Under Construction
	Feasibility & construction for Power Generation Plant based on Biomass	2 MW	
Balochistan	Solar energy projects in Provincial PSDP - Solar Home System in all districts – already in Surab, Khuzdar and Kalat - Solar Electrification in Nawab Ghous Baksh Memorial Hospital Mastung - Solar Powered Street Lights in Quetta and Mastung - Solar tube wells • Within 2 years, standalone solar home systems to 76 houses per district • Conversion of 5 WSS into Solar • Conversion of 200 subsidized agri tubewells to solar • Feasibility of electricity generation based on Micro Hydro projects • Solarization of 100 BHUs		
	Solar Power Plant for Awaran	?	

	Electricity generation based on Micro Hydro projects			Feasibility checking
		Small Hydel≤50MW: *8 Projects* in public sector under various stages of development in Punjab & KP Expected by 2016: 80 MW Expected by 2018: 200 MW	80 MW	Total Hydro energy potential is estimated over 50,000 MW *Small Hydro Potential* KP: 750 Punjab: 560 Sindh: 120 GB: 1,300 AJK: 280
		Geo-Thermal		Potential capacity over 5,000 MW
FATA	Micro hydel power stations			?
Medium Term Energy plans				
Balochistan	Mega Solar Energy Project, Quetta		300	Mutual Agreement signed with Concentrix Solar, Korea. Completion expected in 2017.
	Desalination plants in coastal areas of Balochistan			Installation process
Long Term Energy plans				
Balochistan	Power generation through **wind** energy			
	Development of micro **Hydel** power projects			
FATA	Tapping the flow of FATA Rivers for multipurpose Hydro Power Projects in FATA			
AJK	Solar + Wind (06 projects)		10	

Energy Plans in Gilgit Baltistan (GB)

	Capacity (MW)
Existing Plans (2013-18)	
Current Plan GB ADP 2013 - 2018 (84 Nos.)	112 MW
Current Plan PSDP KA&GB 2013 - 2018 (04 Nos.)	60 MW
Current Plan through WAPDA 2013 - 2018 (03 Nos.)	37 MW
Expected Generation by 2018	306 MW
Medium Term Plan (upto 2020)	
Projects proposed for medium term plan up to 2020 PSDP KA&GB	65.0 MW
Projects proposed for medium term plan up to 2020 through WAPDA	120 MW
Projects proposed for medium term plan up to 2020 GB ADP	100 MW
Generation by 2020	591 MW

Long Term Plan (2020-25 and beyond)	
Projects proposed for long term plan from 2020 – 2025 and beyond	296 MW
Generation by 2025	816 MW

Annex-II: Federal Administrative Authorities/Agencies

The above energy projects are being controlled/administered by the following federal agencies:

	Energy Projects		Capacity (MW)
Hydel			
Short Term/Current Energy plans			
WAPDA	05 Dams - Under construction 03 Canal projects - Under construction 05 Hydropower projects 12 small & medium dams		? ? 5,788 MW 43.35 MW
PPIB	New Bong Escape Hydropower Project		84 MW
AEDB	08 small hydro projects		80 MW
Medium Term Energy plans			
WAPDA	03 projects		377 MW
Long Term Energy plans			
WAPDA	4 dams		?
PPIB	12 projects		6,571 MW
Thermal			
Short Term/Current Energy plans			
PPIB	Commissioned Projects	27 IPPs	6,935
		KAPCO	1,638
	Upcoming Projects	Uch II Power Project	414.5 (2014)
		Grange Holdings Power Project	163 (2015)
		Star Power Project	134 (2016)
		Kandra Power Project	120 (in process)
Long Term Energy plans			
PPIB	Sindh Engro Thar Coal Power Project		1,200
Other Renewables			
Short Term/Current Energy plans			
AEDB	**Wind:** 34 IPPs at various stages of development - 2013 (FFC and Zorlu (Turkey) commissioned - 2014 - 2015 - 2016 - 2017 **Total**		 106 MW 150 MW 380 MW 500 MW 789 MW **1,925 MW** *Potential Capacity for Wind is 340,000 MW.*
	Bio Energy: bagasse to power plants operational *15 Projects* in advanced stages *04 LOIs* issued to Biomass & Waste to Energy IPPs *05 LOIs* issued under Co-Generation (Biomass/Bagasse) *01 LOI* under process.Potential: 1,500-2,000 MW in 2		 34 MW 294 MW 48 MW 143 MW

	years	15 MW *Potential Capacity:3,000 MW waste to energy potential*
	Solar: *<u>On-grid:</u>*24 IPPs 792.99 MW Solar PV LOIs issued by AEDB *<u>Net Metering:</u>* NEPRA finalizing framework 3,000 MW domestic solar PV in 3 years *<u>Off-Grid:</u>* **i.** 4,000 rural homes electrified (solar PV). **ii.** 7,000 villages can be electrified subject to funding. **iii.** 64.5 MW solar PV panels imported. 16,715 solar water heaters 1,429 solar water pumps	**Potential Capacity:** *<u>Solar Thermal :</u>* o 7 - 7.5 kWh/m²/day in many parts of Balochistan o 6.5 - 7 kWh/m²/day in other parts of Balochistan; o 5 - 5.5 kWh/m²/day in Southern Punjab and Northern Sindh o 4.5 - 5 kWh/m²/day in rest of Pakistan *<u>Solar Photovoltaic (PV):</u>* o 7 to 7.5 kWh/m2/day in most parts of Balochistan; o 6 to 6.5 kWh/ m2/day in most parts of Sindh, Southern Punjab and GB 5.5 to 6 kWh/m2/day in rest of the country
	Small Hydel<u>≤</u>50MW:*8 Projects* in public sector under various stages of development in Punjab & KP Expected by 2016: 80 MW Expected by 2018: 200 MW	80 MW Total Hydro energy potential is estimated over 50,000 MW *<u>Small Hydro Potential</u>* KP: 750 Punjab: 560 Sindh: 120 GB: 1,300

		AJK: 280
	Geo-Thermal	Potential capacity over 5,000 MW

Annex III: List of ARE Power Projects initiated in the Private Sector and their expected COD

Wind Power Projects				
S.No	**Name of Company**	**Location**	**Capacity (MW)**	**Proposed Expected Timeline COD**
1	FFC Energy Ltd.	Jhampir, Sindh	49.5	May-13
2	Zorlu Enerji Pakistan Ltd.	Jhampir, Sindh	56.4	Jul-13
3	Foundation Wind Energy-II (Pvt.) Ltd	Gharo, Sindh	50	Oct-14
4	Three Gorges First Wind Farm Pakistan (Pvt.) Ltd.	Jhampir, Sindh	50	Jan-15
5	Foundation Wind Energy-I Ltd	Gharo, Sindh	50	Jan-15
6	Yunus Energy Ltd.	Jhampir, Sindh	50	Jun-15
7	Sapphire Wind Power Company Ltd	Jhampir, Sindh	50	Jun-15
8	Tapal Wind Energy (Pvt.) Ltd	Jhampir, Sindh	30	Jun-15
9	Gul Ahmed Wind Power Company Ltd	Jhampir, Sindh	50	Aug-15
10	Hawa Holding Limited	Jhampir, Sindh	50	Aug-15
11	Metro Power Company Ltd	Jhampir, Sindh	50	Aug-15
12	Tenaga Generasi Ltd.	Gharo, Sindh	50	Oct-15
13	Hyro China Dawood Power (Pvt.) Ltd	Gharo, Sindh	50	Oct-15
14	United Energy Pakistan Ltd	Jhampir, Sindh	100	Oct-15
15	Master Wind Energy (Pvt.) Ltd	Jhampir, Sindh	50	Dec-15
16	Zephyr Power Ltd	Gharo, Sindh	50	Dec-15
17	Sachal Energy (Pvt.) Ltd	Jhampir, Sindh	50	Dec-15
18	Pakistan Wind Energy Generation Pvt. Ltd.	Jhampir, Sindh	10	Dec-15
19	Wind Eagle Ltd.	Jhampir, Sindh	100	Mar-16
20	NBT Wind Power Pakistan (Pvt.) Ltd	Jamshoro, Sindh	500	Mar-16
21	Finergy (Pvt.) Ltd.	Jhampir, Sindh	50	Mar-16
22	Abbas Steel Group	Gharo, Sindh	100	Jun-16
23	Titan Energy Pakistan (Pvt.) Ltd.	Jhampir, Sindh	10	Jun-16
24	Hydro China Xiebei Engineering Corporation	Jhampir, Sindh	300	Aug-16
25	China Sunnec Energy (Pvt.) Ltd	Jhampir, Sindh	52.4	Aug-16
26	System Wind Energy	Gharo/Jhampir/ Jamshoro	150	Dec-16
27	Burj Wind Energy (Pvt.) Ltd	Gharo/Jhampir/ Jamshoro	14	Dec-16
28	Hartford Alternate Energy	Jhampir, Sindh	50	Dec-16
29	United Energy Pakistan Ltd.	Gharo/Jhampir/ Jamshoro	350	Mar-17
30	Tricon Boston Consulting Corporation	Jhampir, Sindh	300	Jun-17
31	Associated Technologies Ltd.	Gharo/Jhampir/	100	Jun-17

		Jamshoro		
32	Western Energy Ltd.	Gharo/Jhampir/ Jamshoro	15	Jun-17
33	Anadolu Wind Pakistan	Gharo/Jhampir/ Jamshoro	200	Oct-17
34	Trident Energy (Pvt.) Ltd.	Gharo/Jhampir/ Jamshoro	10	Dec-17
35	Zaver Petroleum Corporation Ltd.	Gharo/Jhampir/ Jamshoro	50	Dec-17
	Total Capacity		**3247.3**	
Solar Power Projects				
S.No	**Name of Company**	**Location**	**Capacity (MW)**	**Proposed Expected Timeline COD**
1	First Solar (Pvt.) Ltd.	Kalar Kahar, Punjab	2	Mar-15
2	DACC Associates	Cholistan, Punjab	50	Jan-15
3	Techaccess FZ LLC	Chau Saidan Shah, Punjab	10	Jan-15
4	Wah Industries Ltd	Wah Cantt, Punjab	5	Jul-15
5	Associated Technologies (Pvt.) Ltd	Cholistan, Punjab	30	Jan-16
6	Bukhsh Energy (Pvt.) Ltd	Cholistan, Punjab	10	Jan-16
7	Avelar Solar	Cholistan, Punjab	50	Apr-16
8	Sunlux Energy Ltd	Jamber Town, Punjab	5	Sep-16
9	Sapphire Solar Power Company Ltd	Jhampir, Sindh	10	Sep-16
10	Transtech Paksitan	Cholistan, Punjab	50	Sep-16
11	Solar Gen	Pir Khara Shareef Punjab	50	Sep-16
12	Realforce Ruba Pakistan Power (Pvt.) Ltd	Lahore Raiwand Road	20	Sep-16
13	Global Strategies (Pvt.) Ltd	Cholistan, Punjab	10	Oct-16
14	Hecate Energy	Southern Sindh	50	Oct-16
15	Jafri & Associates	Southern Sindh	50	Oct-16
16	Solar Blue	Southern Sindh	50	Oct-16
17	Integrated Power Solutions	Southern Sindh	50	Oct-16
18	Forte Pakistan (Pvt.) Ltd.	Cholistan, Punjab	0.99	Oct-16
19	Hecate Energy	Cholistan, Punjab	150	Oct-16
20	Dawood Group	Gharo	10	Oct-16
21	Zahir Khan & Brothers (ZKB)	Cholistan, Punjab	10	Oct-16
22	Table Rock (Pvt.) Ltd.	Cholistan, Punjab	100	May-15
23	Safe Solar Power Pvt. Ltd.	Bahawalpur, Punjab	10	
24	Techaccess FZ LLC – 2	Pind Dadin Khan	10	Jun-15

Total Solar Power Projects			**792.99**	
BIOMASS / BAGASSE POWER PROJECTS				
S.No	**Name of Company**	**Location**	**Capacity (MW)**	**Proposed Expected Timeline COD**
1	SSJD Bioenergy Ltd.	Mirpur Khas, Sindh	12	Oct-15
2	Lumen Energia (Pvt) Ltd.	Jhang, Punjab	12	Jan-16
3	Biomass Power Generation Ltd	Faisalabad, Punjab	12	Oct-16
4	Green Sure Environmental Solutions	Mardan, Khyber Pakhtunkhwa	12	Oct-16
5	JDW Sugar Mills Unit-II	Rahim Yar Khan, Punjab	26	Feb-14
6	JDW Sugar Mills Unit-III	Ghotki, Sindh	26	Feb-14
7	Shahtaj Suger Mills	Mandi Bahauddin	15	Dec-14
8	Hamza Suger Mills	Rahim Yar Khan, Punjab	15	Dec-14
Total Capacity of LoIs Issued			**130**	

Annex IV: Sustainable Energy Utility (SEU) Model

The myth that greater and greater quantities of energy must be consumed by people or nation to promote economic and social welfare is one of the principle obstacles to a sustainable energy future (Basalla, 1980). Undoubtedly, there is a need of a new framework for sustainable energy development which acknowledges the independence of economic growth and energy consumption (Lovin, 1976). The basic objective is to deliver energy services to end-users rather than to maximize the electricity sale. The "energy services" as defined by Goldemberg and Johansson (1995) means "the desired and useful products, processes, or services that result from the use of energy, for instance …comfortable indoor climate, refrigerated storage, transportation, appropriate temperatures for cooking...etc." Energy service perspective makes end-user should become the beneficiary of the energy system. In essence, there is a need of a bottom up approach with variety of interchangeable energy sources and conversion processes for energy services provision.

Historically, in US Integrated Resource Planning as vertical integrated authority was responsible for demand-side management and energy efficiency (Eto, 1996; Kreith, 1993). US electricity sector reconsidered the energy efficiency model on introduction of competition in retail electricity market coupled with unbundling of vertically integrated utilities. Reason being that utilities abandon their energy efficiency program and energy efficiency funding declined from $1.76 billion in 1993 to @0.92 billion in 1998 (York and Kushler, 2002).

Following the same unbundling for Pakistan's energy sector which has been long dominated by state Investment. The vertical integrated electric supply system gradual unbundling has paved the way for private investors at energy production side. As the distribution of electricity was unbundled from the power production side, this resulted in establishment of independent power sector regulators and decentralized distributed networks. The same has been followed in Oil and gas sector which has been transformed through deregulation of oil pricing and marketing. Also, there are several multinational oil marketing companies gaining a reasonable market share in the field of exploration and production.

With the gradual unbundling and private sector participation in Pakistan's energy sector, it can be clearly delineated that private sector in well managed way is able to market and deliver energy products e.g. electricity, natural gas and others. However, energy users for improved energy efficiency in order to lower their energy bills have to deal with the number of distributors, contractors, and energy services companies. The same process goes with attaining renewable energy. The silent majority of these end-users have little or no access to finance to secure sustainable energy options. Therefore, the traditional mechanism to provide sustainable energy services has inherent flaw from both supply and demand side. It also discourages potential users of sustainable energy services to attain these services.

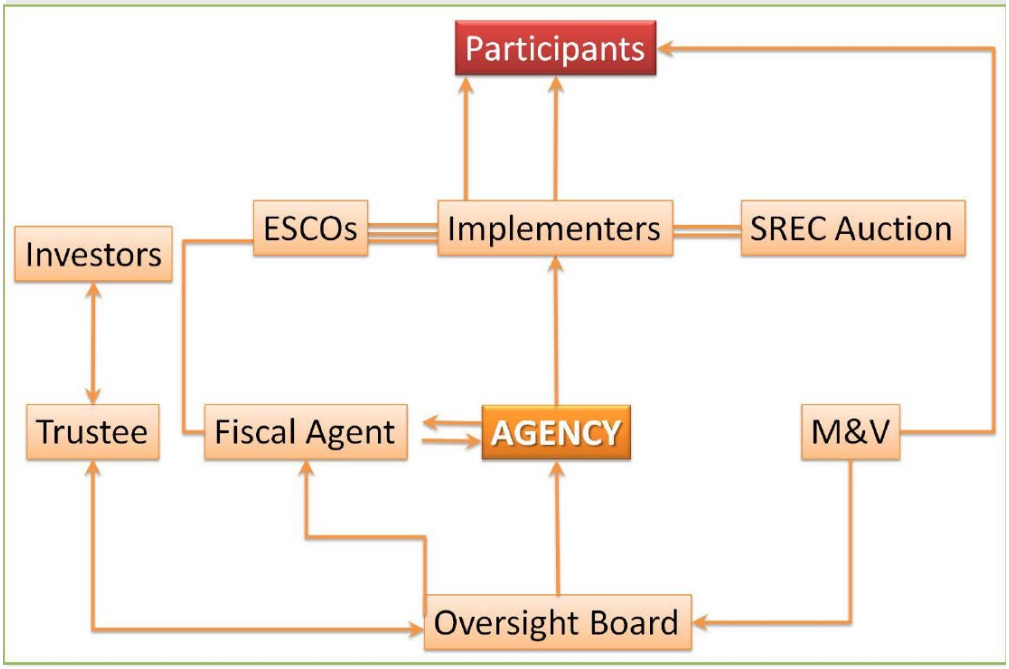
SUSTAINABLE ENERGY UTILITY (SEU) has emerged as a pioneer model to address the end-users energy efficiency problems. The SEU solves the problem of end-users dealing with fragmented array of distributors, contractors, energy services companies and also to secure finances for provision of sustainable energy services. It was first established in state of Delaware and developed by Centre for Energy and Environmental Policy, University of Delaware, USA.[18]

[18] Dr. John Byrne, Director Center for Energy and Environmental Policy, University of Delaware is acknowledged as the architect of the Sustainable Energy Utility concept.

Sustainable Energy Utility model operationalizes into an independent and financially self-sufficient entity which is responsible for delivering energy efficiency and conservation, and customer-based renewable energy to end users. The SEU is all inclusive as it targets all fuels types and all sectors of the society. The model is major departure from supply-side and demand side policies which addressed either only certain types of fuels or certain types of end users categories.

Operationally, SEU establishes a point-of-contact for efficiency and self-generation as conventional utilities are the point-of-contact for energy supply. Organizationally, the non-governmental organization selected through competitive bid is the point-of-contact for efficiency and self-generation in SEU model. It has direct interest to help resident and businesses to use less energy and generate their own clean energy. The non-profit umbrella entity which can be setup at city or provincial level based on the implementation context. It relies on "third party management model, competitive contracting, and performance incentives to deliver sustainable energy services across all sectors and customer classes. SEU is publically accountable with self-sufficient financing mechanism; with access to range of funding sources and revenue streams. Nevertheless, it can achieve energy saving without raising taxes or utility."[19] The proposed SEU model which was presented for the US is shown in Fig .1.

Figure 1. Overview of the SEU Model Structure



Source: Free Foundation for Renewable Energy and Environment Policy Brief No.1 January 2013

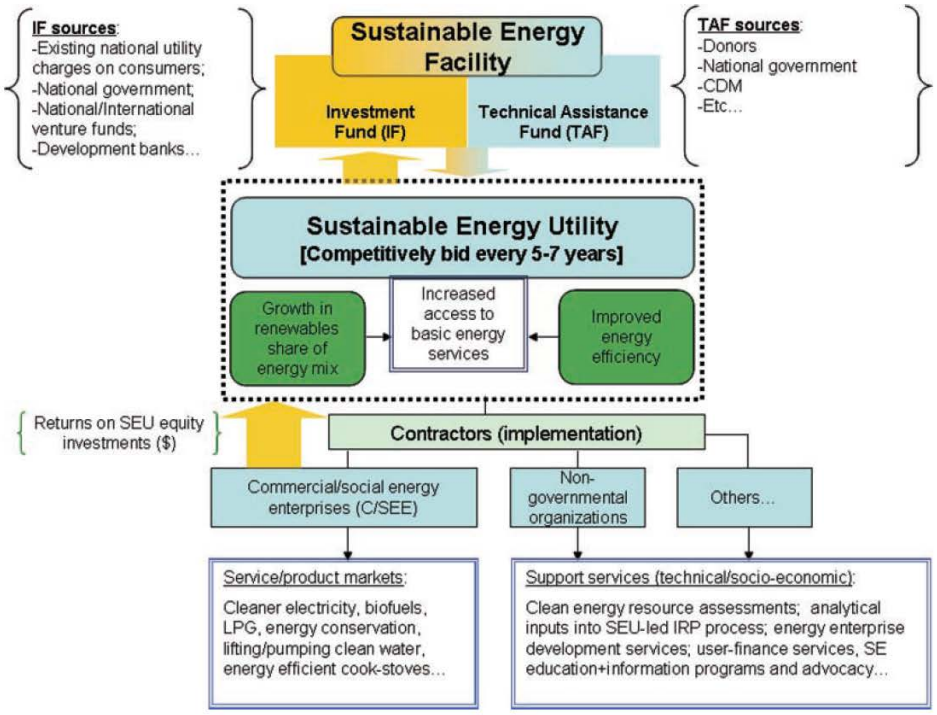
The model later modified for developing world see Fig 2.[20] The model with variation according to city or provincial needs can be replicated in case of Pakistan. Similarly, the organizational and operational structure for specific needs can be adopted for better management.

[19] Source: http://www.seu-de.org/docs/2007_DE%20Senate_SEU_Task_Force_final_report.pdf
[20] Professor Lawrence Agbembiese, Research Professor Center for Energy and Environmental Policy, University of Delaware. Paper title "A Framework for Sustainable Energy Development Beyond the Grid Meeting the Needs of Rural and Remote Populations.

SEU model has been recognized for its efficacy by US Department of Energy and White House. It has been recognized as a viable platform to for sustainable energy and energy efficiency. So far, SEU has "created over 1,000 jobs and saved more than $148 million in bills in its single bond installment. After paying off the full capital cost of the new technologies and associated borrowing, monitoring and verification costs, participants will realize a net savings of $38 million."[21]

Internationally, Asian Development Bank recommended SEU use to its Member States at its 2011 Clean Energy Forum. This model has been adopted in US as well other countries including China, India and South Korea are working on replicating this model for energy efficiency and low carbon/no carbon strategies.

Figure. 2 Organizational Structure and Funding of a Sustainable Energy Utility



Source: Agbemabiese, L. (2009) A Framework for Sustainable Energy Development Beyond the Grid Meeting the Needs of Rural and Remote Populations

[21] Source: http://ceep.udel.edu/energy-sustainability/energy-projects/ Date taken: July 9, 2014

PROPOSED ENERGY PROJECTS

(in Rs. Million)

Sr. No.	Name of the Project	Approval status	Estimated Cost		Expenditure upto 30.06.2014	Throw-forward as on 01.07.2014	Allocation 2014-15		
			Total	Foreign Aid			Foreign Aid	Rupee	Total
HIGHLY PRIORITIZED PROJECTS									
	Bunji Hydro Power Project (7100 MW) (PCII) (Gilgit)	Un-approved	1595320.000	629180.000	0.000	1595320.000	0.000	200.000	200.000
	Construction of Diamer Basha Dam Project (4500 MW) (Land Acquisition)	ECNEC 20.08.2009 (RUP Rs 101 B)	60000.000	0.000	39901.644	20098.356	0.000	@15000.000	15000.000
	Construction of Diamer Basha Dam Project Lot 1 to 5 (4500 MW)	ECNEC 20.08.2009	834205.000	312943.000	7402.140	826802.860	0.000	10000.000	10000.000
	Dasu Hydro Power Project Stage-I (2160 MW) (Distt. Kohistan, Khyber Pakhtunkhwa)	ECNEC 27.09.2002	486093.300	358825.000	8428.612	477664.688	1000.000	3423.000	4423.000
	Golan Gol Hydro Power Project (106 MW) (Chitral)	ECNEC 02.09.2002	28217.614	13798.456	9690.895	18526.719	1000.000	5850.000	6850.000
	Harpo Hydro Power Project Skardu (Gilgit Baltistan)	ECNEC 28.03.2014	9522.801	7974.013	132.388	9390.413	300.000	100.000	400.000
	Neelum Jhelum Hydro Power Project (969 MW) (China, Kuwait, Saudi Arabia, IDB and OPEC)	ECNEC 03.07.2013	274882.590	158367.180	125400.640	149481.950	13500.000	16938.000	30438.000
	Refurbishment & Up-gradation of Generation Units of Mangla Power Station (310 MW)	ECNEC 31.12.2013	52224.307	31728.853	891.000	51333.307	500.000	760.000	1260.000
	Tarbela Fourth Extension Hydro Power Project (1410	ECNEC 16.08.2012	83601.040	65865.368	15105.445	68495.595	5000.000	3926.000	8926.000

	MW) (Swabi)								
	Warsak Hydroelectric Power Station 2nd Rehabilitation (242.96 MW)	Un-Approved	24539.608	12070.175	0.000	24539.608	10.000	82.000	92.000
	OTHER PROJECTS								
	320 MW CCP Project UAE Gifted Faisalabad	ECNEC 09.12.2010	16348.120	0.000	154.082	16194.038	0.000	500.000	500.000
	525 MW Combined Cycle Thermal Power Plant at Chichoki Malian by GENCO-II (Sheikhupura)	ECNEC 23.06.2006	33924.000	27865.000	2721.000	31203.000	0.000	2000.000	2000.000
	Conversion of FO / Gas Fired Boilers to Coal of 850 MW Units 1 to 4 Thermal Power Station, Jamshoro (ADB) (Study)	Un-Approved	51845.000	47057.000	100.000	51745.000	0.000	1000.000	1000.000
	Installation of New Coal Fired Power Plants having Capacity 2x660 MW at Jamshoro (ADB)	ECNEC 18.04.2014	177175.000	199590.000	350.000	176825.000	3300.000	6000.000	6000.000
	750 MW CCPP at Shahdra, Multan & Faisalabad	Un-Approved	75000.000	52500.000	0.000	75000.000	0.000	300.000	300.000
	1X660 MW Coal Fired Plant Lakhra (JICA)	Un-Approved	88587.500	0.000	0.000	88587.500	0.000	100.000	100.000
	Installation of 5 MW Solar Power Plant for Tehsil Moola, District Khuzdar	Un-Approved	500.000	0.000	0.000	500.000	0.000	@ 100.000	100.000
	220KV Chakdara Substation	Under Process	3230.000	2584.000	550.000	2680.000	0.000	300.000	300.000
	2nd Source of Supply 220 KV Islamabad University Substation	Under Process	27015.000	1494.000	10.000	27005.000	0.000	100.000	100.000
	33 KV Transmission Line from 132	Under Process	126.000	0.000	63.000	63.000	0.000	63.000	63.000

	KV Grid Stations Thana Bula Khan District Jamshoro HESCO to Dureji, (Sub Station at Dureji)								
	500 KV Transmission System for Dispersal of Power from Thar Coal Project (China / Any Source)	Approved	5512.000	2599.000	10.000	5502.000	0.000	10.000	10.000
	Addition of 500 / 220 KV Substation T/L for strengthen of existing NTDC System and to enhance the Transmission Capacity of new 500 & 220 KV Substation at Lahore (Japan)	ECNEC 09.12.2010	24528.000	13450.000	7150.230	17377.770	700.000	2220.000	2920.000
	Evacuation of Power from Wind Power Projects Jhimpir and Gharo Wind Cluster	Under Process	12572.660	5534.460	514.000	12058.660	0.000	5047.000	5047.000
	132 KV Karakh Grid Station with Transmission Line (Quetta)	CDWP 21.03.2011	729.160	0.000	0.000	729.160	0.000	100.000	100.000
	132 KV Pasinzai Grid Station with Transmission Line (Quetta)	CDWP 21.03.2011	196.000	0.000	0.000	196.000	0.000	100.000	100.000
	132 KV Pringhabad Grid Station with Transmission Line (Quetta)	CDWP 21.03.2011	230.000	0.000	0.000	230.000	0.000	45.000	45.000
	500 KV Islamabad West	Under Process	10044.000	6026.000	0.000	10044.000	0.000	10.000	10.000
	Alliot Switching Station and its Interconnection with Sukhi Kianan HPP	Under Process	19008.000	11405.000	0.000	19008.000	0.000	10.000	10.000
	Construction of	CDWP	456.920	0.000	0.000	456.920	0.000	200.000	200.000

	132 KV G.S. Barshore & 132 KV Alizai - Barshore Transmission Line	15.08.2012							
	Construction of 132 KV Grid Station Abdullah Rehman Zai & 132 KV SDT Gulshan Abdul Rehman Zai Transmission Line	Under Process	248.000	0.000	0.000	248.000	0.000	50.000	50.000
	Construction of 132 KV Grid Station at Zard, Ghulam Jan & 132 KV D/C Mangochar Zard Ghulam Jan Transmission Line (20Km) (NTDC)	Un-Approved	448.205	0.000	0.000	448.205	0.000	@200.000	200.000
	Construction of 132 KV Grid Station for New International Airport Islamabad alongwith Feeding Transmission Line (Federal Share)	CDWP 18.06.2012	332.500	269.000	0.000	332.500	0.000	332.500	332.500
	Interconnection Scheme for Import of Power from CASA-1000	Under	33949.000	18716.000	0.000	33949.000	0.000	4000.000	4000.000
	Jetty + Infrastructure at Gaddani (CPEC)	Un-Approved	70000.000	0.000	0.000	70000.000	0.000	@ 1000.000	1000.000
	Power Evacuation from Gaddani to National Grid (Faisalabad) (CPEC)	Un-Approved	150000.000	0.000	0.000	150000.000	0.000	@ 2820.000	2820.000
	Power Evacuation from Gaddani to National Grid (Lahore) (CPEC)	Un-Approved	150000.000	0.000	0.000	150000.000	0.000	@ 10000.000	10000.000
	Power	ECNEC	2318.00	1648.0	0.000	2318.000	300.00	200.000	500.000

	Distribution Enhancement Project (Tranch-III) (STG-ELR-DOP-Rehabilitation Capacitor Installation & Energy Efficiency (FESCO)	09.12.2010	0	00			0		
	Power Distribution Enhancement Project (Tranch-III) (STG-ELR-DOP-Rehabilitation Capacitor Installation & Energy Efficiency (GEPCO)	CDWP 22.11.2012	1125.000	938.000	0.000	1125.000	250.000	450.000	700.000
	Power Distribution Enhancement Project (Tranch-III) (STG-ELR-DOP-Rehabilitation Capacitor Installation & Energy Efficiency (HESCO)	CDWP 28.08.2013	2622.000	2503.000	0.000	2622.000	250.000	750.000	1000.000
	Power Distribution Enhancement Project (Tranch-III) (STG-ELR-DOP-Rehabilitation Capacitor Installation & Energy Efficiency (IESCO)	ECNEC 09.09.2013	2633.390	2033.390	0.000	2633.390	250.000	550.000	800.000
	Power Distribution Enhancement Project (Tranch-III) (STG-ELR-DOP-Rehabilitation Capacitor Installation &	CDWP 20.08.2013	2346.000	2217.000	0.000	2346.000	250.000	200.000	450.000

	Energy Efficiency (LESCO)								
	Power Distribution Enhancement Project (Tranch-III) (STG-ELR-DOP-Rehabilitation Capacitor Installation & Energy Efficiency (MEPCO)	CDWP 22.11.2012	3306.920	2987.320	0.000	3306.920	250.000	500.000	750.000
	Power Distribution Enhancement Project (Tranch-III) (STG-ELR-DOP-Rehabilitation Capacitor Installation & Energy Efficiency (PESCO)	ECNEC 09.09.2013	2088.195	1688.195	0.000	2088.195	250.000	550.000	800.000
	Power Distribution Enhancement Project (Tranch-III) (STG-ELR-DOP-Rehabilitation Capacitor Installation & Energy Efficiency (QESCO)	CDWP 14.12.2012	10470.000	8732.340	0.000	10470.000	250.000	100.000	350.000
	Conversion from 66KV to 132KV of Yazman Grid Station, Bahawalpur(MEPCO)	Un-Approved	300.000	8732.340	0.000	300.000	0.000	100.000	100.000
	Ghilgo Grid Station, Orakzai Agency	CDWP	145.953	0.000	0.000	145.953	0.000	10.000	10.000
	Construction of Small Dams in Distt. Mansehra, KPK	Un-Approved	300.000	0.000	0.000	300.000	0.000	150.000	150.000
	Construction of 100 Small Dams in Balochistan (Package-III 10	Un-Approved	3600.000	0.000	0.000	3600.000	0.000	172.700	172.700

	Dams)								
	Construction of Basool Dam, Tehsil Ormara, District Gwadar	Un-Approved	5400.000	0.000	0.000	5400.000	0.000	50.000	50.000
	Chanalization of Nullah Deg, Punjab	Un-Approved	800.000	0.000	0.000	800.000	0.000	200.000	200.000
	Makhi Farash Link Canal Project (Phase-II) for Water Supply to Thar Coal	Un-Approved	9000.000	0.000	0.000	9000.000	0.000	200.000	200.000
	Study for Rain Water Harvesting, Hill Torrents Management	Un-Approved	300.000	0.000	0.000	300.000	0.000	50.000	50.000
	Extension of Pat Feeder (Package-III)	Un-Approved	2370.000	0.000	0.000	2370.000	0.000	50.000	50.000
		Total	**4,449,737**	**2,011,321**	**218,575**	**4,231,162**	**27,360**	**68,149**	**121,229**
	Solar Cholistan. Unlimited 1000 MW (Mid 2015) - Punjab								
	Solarization of QA Library ~ Specs Finalized								

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