Sustainable Energy For All

National Action Plan

DECEMBER 2019

Ministry of Planning, Development & Reform
Government of Pakistan

United Nations Development Programme
Pakistan

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Abbreviations

ADB	Asian Development Bank
AEDB	Alternative Energy Development Board
AJK	Azad Jammu & Kashmir
BPDB	Balochistan Power Development Board
CAGR	Compound Annual Growth Rate
CCI	Council of Common Interest
CPEC	China-Pakistan Economic Corridor
CPI	Consumer Price Index
CPPA-G	Central Power Purchase Agency-Guarantee
DISCO	Distribution Company
EPA	Energy Purchase Agreement
ESMAP	Energy Sector Management Assistance Program
FATA	Federally Administered Tribal Areas
FESCO	Faisalabad Electric Supply Company
FF	Foreign Financing
FO	Furnace Oil
GB	Gilgit-Baltistan
GDP	Gross Domestic Product
GENCO	Generation Company
GEPCO	Gujranwala Electric Power Company
GIS	Geospatial Information Systems
GWh	Giga Watt Hour
HDIP	Hydrocarbon Development Institute of Pakistan
HESCO	Hyderabad Electricity Supply Company
HSD	High Speed Diesel
IA	Implementation Agreement
IEP	Integrated Energy Plan
IESCO	Islamabad Electric Supply Company
IFC	International Finance Corporation
IP	Investment Prospectus
IPCC	Inter-Provincial Coordination Committee
IPP	Independent Power Producer
KP	Khyber Pakhtunkhwa
KV	Kilo Volt
KWh	Kilo Watt Hour
LESCO	Lahore Electric Supply Company
LF	Local Financing
LNG	Liquid Natural Gas
LoI	Letter of Intent
LoS	Letter of Support
MCDA	Multi-criteria Decision Analysis
MoE	Ministry of Energy
MEPCO	Multan Electric Power Company
MTOE	Million Ton of Oil Equivalent
MoE	Ministry of Energy (Power Division and Petroleum Division)
MSW	Municipal Solid Waste
MVA	Mega Volt Ampere
MW	Mega Watt
NAP	National Action Plan
NDC	Nationally Determined Contribution
NEPRA	National Electric Power Regulatory Authority
NREL	National Renewable Energy Laboratory
NTDC	National Transmission and Dispatch Company
PAEC	Pakistan Atomic Energy Commission
PEPCO	Pakistan Electric Power Company
PESCO	Peshawar Electric Supply Company
PPA	Power Purchase Agreement
PSLM	Pakistan Social and Living Standards Measurement
PPAF	Pakistan Poverty Alleviation Fund
PPDB	Punjab Power Development Board
PPIB	Private Power Infrastructure Board
QASP	Quaid-e-Azam Solar Park
QESCO	Quetta Electric Supply Company
RE	Renewable Energy
RET	Renewable Energy Technology
RRA	Renewables Readiness A ssessment
PKR	Pakistani Rupee
SEPCO	Sukkur Electric Power Company
SHS	Solar Home System
SPP	Solar Power Project
TESCO	Tribal Areas Electric Supply Company
TFEC	Total Final Energy Consumption
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WAPDA	Water & Power Development Authority
WPP	Wind Power Project

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Message

Dr. Muhammad Jahanzeb Khan, Deputy Chairman, Planning Commission

Energy is the chain that connects the economy, environment and developmental issues. The availability of clean, efficient and affordable energy is key to a prosperous future. Pakistan is at crucial point in its development stages. Expanding its access and transitioning to cleaner technology will not only reduce poverty but improve the quality, and at a more macro scale, increase productivity, competitiveness and economic growth. Even today, more than a billion people have no access to electricity. It is the "energy poor" that suffer the most and lack of basic facilities such as lighting, heating, cooling and cooking has created a "poverty trap". In the past the energy crisis in Pakistan rattled the economy resulting in heavy losses. Every development goal hinges on the ability to improve energy systems. The countries that operated on underperforming energy systems may lose up to 1-2 percent of growth annually.

Globally, energy systems are one of the main contributors to rise in Green House Gas emissions. Current patterns of production, supply and consumption have proved unsustainable and is also a matter of concern for Pakistan due to the adverse effects of climate change in Pakistan. We have observed and suffered the impacts such as rising temperatures, catastrophic floods, and periods of water stress and droughts. And though Pakistan's GHG emissions on a global scale are minimal in comparison to other industrialized countries, sustainable energy is the most viable solution to provide access to off-grid areas in Pakistan which are considerable in number, and to address the current energy shortages seen in the form of long bouts of load shedding.

By 2030, Pakistan has a great opportunity to transform its energy system by improving energy efficiency and incorporating more renewable energy into its mix. The challenge is daunting yet not impossible. It will require major shifts in regulatory regimes in the economy, investment and accelerated development and deployment of new technologies. Other than this there needs to be a change on how we define and perceive energy needs. There must be shifts in human and institutional capacity.

Sustainable Energy for All (SEforALL), initially launched in 2011, is meant to catalyse all stakeholders to take action in achieving one of the most critical SDG goals that is, energy security. Its three main goals: 1. Providing universal access to energy, 2. Doubling the rate of improvement in energy efficiency and 3. Doubling the share of renewables in the energy mix; aim to create policy

Message

Dr. Muhammad Jahanzeb Khan, Deputy Chairman, Planning Commission

synergies that will address this issue in a holistic matter.

Pakistan plans to implement SEforALL by scaling up action, facilitating coordination between stakeholders and the execution of its National Action Plan. We must drive action and commit to this cause of sustainable development. Pakistan has identified its Action Areas and its high opportunity areas in National Action Plan and Investment Prospectus.

If we work diligently and painstakingly, I am confident that SEforALL will empower leaders and broker partnerships. If done consistently, we will be able to unlock finance that can contribute to makes our goals a reality. Innovative financial mechanisms and climate finance can be made available by international donor agencies to catalyze public sector funding mechanisms and encourage private sector investments to meet our capital requirements to provide universal access and facilities such as clean cooking stoves particularly for low income homes. Success depends heavily on fostering public-private partnerships that can accelerate deployment of technologies, promoting research and development and expanding local lending capabilities such as micro finance institutions and local commercial banks through regulatory and incentive frameworks to attract private investment.

With formation of the National Action Plan and Investment Prospectus, I am optimistic that sustainable energy will be at the forefront to meet our future energy needs. A future that we will work towards together to leave a better, stronger and more prosperous legacy for our children.

Message

Mr Ignacio Artaza, Resident Representative a.i. UNDP

Sustainable Energy for All (SEforALL) is a United Nations global initiative which supports countries in creating opportunities for access to energy and improving energy efficiency across various sectors, thus enhancing renewable energy resources.

The goals of Sustainable Energy for All (SEforALL) complements the Government's manifesto to provide energy services at an affordable cost. Sustainable Energy is also closely interlinked with Poverty Reduction objectives and social progress for sustainable development. Access to sustainable energy not only helps in achieving SDG-7 of Affordable and Clean Energy but also facilitates in making progress towards eight other SDGs which are interlinked with SDG-7.

UNDP has been supporting the government in the development of a National Action Plan on Sustainable Energy for All (SEforALL). The National Action Plan will provide the opportunity to achieve the global target set forth in the Paris Agreement, which is to keep global temperature rise well below 2 degree, while pursuing efforts to limit it to 1.5 degree in this century.

In Pakistan, the well-being of 207 million people depends on how effectively land, water, and other resources are utilized. Energy security in Pakistan is critical to sustaining economic growth and creating opportunities for all—affordable, sustainable and reliable energy solutions will largely determine the key areas of economic progress. Together, in consultation with the federal and provincial governments, we have identified potential areas in which considerable investments could be made. The National Action Plan provides better opportunities for partnerships and collaborations with the international private sector as well as effective governance of climate finance. There is significant potential in fostering public-private partnerships to accelerate deployment of technologies, promoting research and development, devising innovative financing mechanisms, and expanding local lending capabilities to attract private investments.

UNDP stands committed to work together with the Government of Pakistan, civil society, national partners and the people of Pakistan to help find solutions to persistent development challenges, including those related to sustainable energy.

Executive Summary

Sustainable Energy for All (SEforAll) is goal seven of the Sustainable Development Goals. SEforAll is an all-encompassing approach linking energy access to other goals. SEforAll National Action Plan is a comprehensive and holistic long-term action plan, aligned with Pakistan Vision 2025 and national energy policies. The plan ensures overall sector-wide coherence and synergy of the collective efforts toward the three goals of SEforAll to be achieved by 2030.

In total, the energy sector offers an investment potential of $66.56 billion under a high growth scenario till 2030 to achieve the SEforAll objectives in Pakistan. The SEforAll three main objectives are:

a) Universal energy access,
b) Doubling the share of renewable energy, and
c) Doubling the rate of energy efficiency.

Access to energy at national level is 73%. There are 32,266 villages in the country which will remain without grid access[1] in coming years. These villages have sparsely distributed population and are in remote locations which is making expansion of grid financially unviable and technically challenging. Provincial comparison of access shows that Sindh has the highest number of un-electrified villages, followed by Punjab, KP, and Balochistan respectively. On the other hand, AJK and Gilgit-Baltistan (GB) compared to the rest of the country have over 90% access to the grid. Contrary to electricity access, access to the gas network is even lower where only 25% of the households have a piped-gas connection. The major source for cooking in households across the country is firewood. AJK and Gilgit-Baltistan do not yet have a piped gas network. Pakistan Social and Living Standard Measurement's (PSLM) survey[2] analysis reveals that 60.6% households are relying on non-commercial source of energy i.e. firewood for cooking.

One of the potential solutions to ensure energy access for areas which are not connected to the grid is through provision of renewable energy resources. Pakistan's Alternative Energy Development Board (AEDB) efforts has contributed over 1200 MW of renewable energy in national grid. It is projected that renewable energy will rise to at least 24% in the power generation mix by 2030. AEDB has successfully attracted local and international companies to invest in renewable energy projects. Globally, the regulatory analysis of AEDB regulatory framework has been ranked high for its performance (RISE, 2016).[3] Additionally, NEPRA-AEDB regulation on "Net-Metering" is proving instrumental while creating the market for solar energy.

Post 18th Amendment; energy has become a provincial subject which constraint the AEDB to work directly in the provinces. Therefore, AEDB supports the provinces to achieve 100% access target through distributed energy sources. The focus is on distributed solar housing solutions for underserved areas across the Pakistan.

Energy Efficiency is one of the key priorities in the Vision 2025. It supplements the energy access in a cost-effective and efficient manner. Government has recently promulgated National Energy Efficiency & Conservation Act of 2016 which aims at developing the mechanism and procedures for effective implementation of efficiency measures. The National Energy Efficiency Conservation Authority (NEECA) has been created while renaming the ENERCON. Although ENERCON has been established in mid 1980s, the energy efficiency improvements have not taken off very well mainly due to regulatory, institutional and financial barriers.

The NEECA is taking steps in the right direction to improve Demand Side Energy Efficiency (DSEE) measures. NEECA has successfully launched the Standards and Labelling Regime for efficient fans which is saving approximately 25 MW of electricity. Similarly, Zig Zag technology has been introduced for brick kilns by NEECA, wide scale usage of this technology can potentially save 30-40% energy use in the brick kilns industry.

Due to lack of effective Supply Side Energy Efficiency (SSEE) measures and good management practices. Pakistan's energy sector is experiencing the problem of aggregate technical and commercial losses culminating to the circular debt. The transmission and distribution losses of Power and Natural Gas utilities in Pakistan are the highest in the region. The average power distribution losses in Pakistan are about 20% and for some DISCOs, these losses reach to 38%.[4] Pakistan's Unaccounted For Gas (UFG) losses in the gas network for SSGC and SNGPL stands at about 15% and 11.5% respectively. The efficiency gains as well as reduction in transmission and distribution losses both from electricity and gas can save PKR 140 billion annually.

Planning Commission is mandated to prepare short, medium and long-term national development plans for all sectors of economy in coordination with all federal and provincial stakeholders through a consultative process. It also monitors and keep track of different socio-economic indicators, including SDGs targets agreed under different national and international obligation. Accordingly, the task of preparation of National Action Plan (NAP) for SEforAll commissioned by UNDP is being overseen by Planning Commission through a National Steering Committee (NSC) headed by the Federal Minister for Planning, Development & Reform / Deputy Chairman Planning Commission and represented by all stakeholders.

The NSC was constituted of key stakeholders consisting of technical experts, academicians, donor agencies, non-governmental organizations, civil society organizations, corporate sector, officials from the Ministry of Energy (Power and

Petroleum divisions), Ministry of Climate Change, Ministry of Finance, Higher Education Commission, National University of Science and Technology, representatives from development partners and provincial Energy and Planning &Development Departments. Acknowledging the importance of SEforAll, Ministry of Climate Change has given its mandate of "Climate Compatible Energy" to the SEforAll initiative in Pakistan.

Pursuant to NSC on SEforAll decision, consultative meetings were held in four provinces and two regions. SEforAll consultative meetings used a bottom-up approach to gather input from all stakeholders. In this process, stakeholders identified the various on-ground problems to be addressed to create a reliable, affordable and sustainable energy market.

Based on consultations, policy dialogues with federal and provincial governments, interviews of private sector stakeholders, review of plans and policies of different energy sector institutions, financial and technical analysis of financial institutions, and evaluation of international donor agencies programs in Pakistan. A comprehensive and integrated National Plan has been devised to achieve SEforAll goals in short, medium and long term.

SE4AAll goals are tangible; trackable and applicable. National Action Plan operationalize these goals through high-impact opportunity areas. The vision and targets of these three main goals for Pakistan are highlighted as:

Goal # 1 - Universal Access to Energy: The energy access in the country is 73%. To achieve universal access by 2030, over 15 million domestic connections would have to be provided in the next 15 years which makes an average of 1 million connections per year. Similarly, the target for laying down gas pipeline has been kept below 42% for all provinces as providing gas connection to each household, particularly those in far flung areas is going to be economically and financially challenging, even by 2030. Such households will be provided energy for cooking and heating through alternate means including improved cook stoves, solar cookers, biogas digesters, LPG air mix plants and solar heaters.

To achieve these targets the Action Plan envisages to increase in overall final energy consumption from present level of 2016-17 (50 MTOE) to (88 MTOE) during the plan period representing an overall increase of 76%.

Goal # 2 - Doubling the share of Renewable Energy: The share of Hydel power is 24.7% whereas; the share of other renewables (solar, wind and bagasse) is 4.28%. The large hydro projects development till 2020 will be 6,494 MW which will almost double the share of hydel until 2025. On the other hand, the share of renewables (solar, wind and bagasse) on-gird is constrained due to extension and up gradation of the national grid for evacuation of intermittent renewable energy by NTDC. The NTDC will implement a comprehensive power evacuation plan during the plan period to evacuate at least 25% of RE in the final power generation mix.

The off-grid solar is expanding at a much faster rate with small and medium-size companies providing a solar home solution to the houses in urban and rural areas. However, the penetration rate of distributed solar is not very well reported (it is estimated more than 1000 MW). NEPRA recent regulation of net-metering will increase the RE share considerable in foreseeable future surpassing the targets. Similarly, the reverse auction regime for on-grid renewable energy projects may prove instrumental to increase the share of renewable energy in Pakistan. The renewable energy share in electricity is projected to increase from present level of 2016-17 (0.64 MTOE) to 2029-30 (4.8 MTOE) during the plan period representing an overall phenomenal increase of 655%.

Goal # 3 - Doubling the rate of Energy Efficiency: The National Energy Efficiency & Conservation Act 2016 aims at developing the mechanism and procedures for the efficient and effective conservation of energy. Developing a meaningful indicator for energy efficiency would require much more detailed energy consumption, trends and activities data. To achieve the SEforAll Energy Efficiency and Conservation target by 2030, the rate of improvement ought to be doubled. This requires a reduction in primary energy intensity by 3.4% annually by 2030. At the institutional level, NEECA is still in the infancy stage and full-time 'technical team' is required to spearhead the energy efficiency measures in Pakistan. Similarly, the designated energy efficiency cells in provincial energy departments are yet to operationalize effectively.

Some of the 'Priority Action Areas' identified and recommended for National Plan are:

Universal Energy Access

- Launching of a nationwide program for the provision of improved cookstoves through a public-private partnership. In total, 14.03 million improved cook stoves will be required with an overall investment of $657.54 million.
- Pakistan's Integrated Energy Model development for comprehensive planning and evidence-based policy-making in the energy sector will play an instrumental role.
- The power market to be reformed from a single buyer model to competitive power markets and evolving a fully functional market operator by 2022.
- Financial mechanisms such as microfinance, consumer finance, concessionary and soft loans will be promoted for distributed solar systems and energy efficiency retrofits.
- Solar water-heating for areas with no access to the traditional gas network where otherwise it would require billions of rupees in capital expenditure to lay down the pipeline network will be provided through consumer financing.
- Convert 2 million gas geyser consumers to the solar water heater in the SNGPL network can save 15 BCF annually or 41 MMCFD which is about 9% of total natural gas consumption.
- The SEforAll Small Grants Programme of $ 20

million will be established to offer grants up to USD 100,000/- for any initiatives that accelerate the adoption of any of the proposed actions within the SEforALL plan.

Renewable Energy & Energy Efficiency and Conservation

- Strengthening the Alternative Energy Development Board to enable it to fully achieve its objective of development of on-grid and off-grid renewable energy applications in the country.
- The NTDC will implement a comprehensive power evacuation plan during the plan period to evacuate RE based power generation as per the envisaged target.
- Strengthening National Energy Efficiency Conservation Authority and its role [5] to provide effective conservation and efficient use of energy in all sectors of the economy.
- For industrial units and public buildings' energy audits will be made mandatory, and industry-academia partnership-based mechanism will be devised and promoted.
- National level campaigns will be launched for awareness of renewable energy and energy efficiency and conservation by AEDB and NEECA respectively.
- At universities, colleges and poly-technique institutes' courses and the programs will be designed for renewable energy technologies and energy efficiency and conservation mechanism. Similarly, the NEVTA and TEVTA will be further strengthened.
- The capacity building and trainings programs will be designed for Federal and Provincial government officers and staff in collaboration with international organizations to equip with sophisticated financial and legal contractual preparation, energy modeling, project planning and implementation under Public Private Partnership (PPP) mode.
- In-house capacity building for Integrated Energy Planning of the Planning Commission's Energy Wing, line Ministries, and Provincial Energy departments will be developed.
- Sector-wise approach will be developed where industry, transport and domestic sector will be addressed for energy efficiency and conservation.
- To further promote the renewable energy solutions – mechanism such as reverse auction and net-metering will be strengthened. Other innovative mechanisms will also be introduced to support the proliferation of distributed energy generation across the country.

The National Action Plan has been divided into three main sections. The first section provides an overall introduction of Pakistan and its Energy Sector. It provides the vision and targets for SEforAll goals by 2030. The second section is focused on priority action areas. The sub-section discusses enabling action areas which can be achieved a) energy planning and policy b) Business Model and Technology Innovation c) Finance and Risk Management d) Capacity Building and Knowledge Sharing. The third section provides the coordination and follow-up mechanism, and its integration with SEforAll Hubs for Global Tracking Framework.

The Investment Prospectus (IP) – as a separate document, is designed to provide an approach for operationalizing the Action Agenda. The IP identifies and develops a set of implementable programs and projects to enunciate the investments requirements. These projects and programs reflect the potential for investments for private and public investors. The available financing and gaps are identified which can be filled through Public Private Partnership (PPP), private investment, and government and donor financing for short, medium and long-term. In total, the investment potential of $66.48 billion (under a high growth scenario) is identified for SEforALL Action Agenda by combining different investment opportunities in one package at national and provincial levels.

Preamble

Pakistan joined SEforAll global initiative in 2013. Prime Minister of Pakistan along with Prime Minister of Denmark and Minister for Development of Norway, co-chaired, the 32-member countries formed Group of Friends of SEforALL in September 2013.

These three countries have been leading efforts at the United Nations in support of Sustainable Energy for All. All these representatives agreed that energy is the golden thread connecting economic growth, increases social equity, and creates an environment that allows the world to thrive. They stressed on the fact that sustainable energy is a central requirement to eradicate poverty, increase food production, provide clean water, improve public health, empower women and address climate change.

Access to modern and reliable energy services at affordable prices remains essential for sustainable human development, economic growth, higher quality of life, and better delivery of education and health services. Inadequate energy access has hampered economic growth of countries seeking to move out of lower income or lower middle-income status. There are scarcely any production processes or sectors today, involved in creating wealth that does not require energy.

In the absence of energy services, the rural poor must resort to the use of traditional biomass sources—such as wood, charcoal, dung, and waste material, for cooking and heating, jeopardizing their health and safety. Above 60% of Pakistan's population relies on firewood, coal, charcoal, or animal waste to cook their food breathing in toxic smoke that causes lung disease and kills nearly two million people a year - most of them are women and children (UNDP).

Gender-defined role of women in energy utilization in households and communities is the key component of Sustainable Development Goals as well as Sustainable Energy for All / SDG#7. Implementation of this action plan will not only pose a positive impact on the reduction of biomass and fuel wood to mitigate adverse climate change impacts but also will lessen the burden of women; asa collection of woods remains the sole responsibility of women. Energy access to modern and efficient technologies will improve the socio-economic status of the women in Pakistan. Moreover, provision of cleaner and renewable energy sources in rural areas of Pakistan will bring employment and entrepreneurial opportunities.

Despite this irrefutable importance of energy, 1.1 billion people - one in five globally- lack access to electricity to light their homes or to carry out their businesses. Without access to modern energy which is the goal # 7 of Sustainable Development Goals, it is not possible to achieve the overall SDGs. Whether reducing poverty, improving women's and children's health, or broadening the reach of education the role of energy access is central to all goals.

In recognition of the critical need to improve global access to sustainable, affordable and environmentally sound energy services and resources, UNDP, in partnership with other agencies, launched the Sustainable Energy for All (SEforAll) Initiative with the goal of engineering an energy transition to ensure that everyone has access to clean and affordable energy by 2030. Planning Commission as the focal agency for the SEforAll initiative has ensured collaboration with all the stakeholders through a consultative process to build the ownership of the NAP. In this respect, Energy Wing of the Ministry of Planning, Development and Reforms acted as a secretariat to SEforAll National Steering Committee. The targets as defined by the SEforAll initiative include:

1. Ensure universal access to modern energy services;
2. Doubling of global rate of improvement in energy efficiency, and
3. Doubling the share of renewable energy in the global energy mix.

Broadly, the SEforAll NAP has been disaggregated in ten (10) action areas, in order of following priority:

1. Modern Cooking Appliances and Fuels
2. Distributed Electricity Solutions
3. Grid Infrastructure and Supply Efficiency
4. Development of Large-Scale Renewable Power Projects
5. Sustainable Development of Hydropower
6. Enhancing Industrial and Agricultural Efficiency
7. Sustainable Transportation
8. Energy Efficiency and Building Appliances
9. Super-Efficient Equipment and Appliance Deployment
10. Business Model and Technology Innovation

The NAP targets will be achieved through the combined efforts of federal and provincial governments, private sector, development partners and civil societies, where:

- Federal & Provincial Governments will align their annual development programs with NAP targets and will facilitate its implementation through augmentation of complimentary sub-sectoral plans in an integrated way.
- The private sector provides business and technical solutions and drives investment.
- Civil society organizations advocate and monitor public policy and businesses actions.
- Development Partners will facilitate in raising the financing required to implement the NAP.

The Methodology

The methodology devised for National Action Plan is multitiered following the SEforAll Action Agenda template conceived under SDGs Global Framework context. The mixed method approach i.e. qualitative and quantitative adopted to conduct a thorough energy sector review and analysis.

A series of regional level consultative meetings, interviews with experts and stakeholders were conducted. During the review of literature phase, the research reports and official documents were reviewed.

The process started with the constitution of SEforAll National Steering Committee and with convening of its first meeting on May 16, 2016. The meeting was chaired by Minister for Planning, Development, and Reforms. The meeting was attended by participants from all concerned ministries, provincial energy departments, civil society organizations, NGOs and donor agencies (See Annex-I for Constitution of Steering Committee).

National Action Plan builds-up on the findings of earlier report 'Rapid Gap Assessment' and 'Country Situation Assessment'. The process started with government's declaration of partnership with the SEforAll initiative towards the three goals of SEforAll. The first substantial step was an engagement for Rapid Gap Assessment Report which was diagnostic in nature. To initiate the diagnostic phase, Ministry of Finance coordinated with other government ministries such as Planning Commission and Ministry of Energy (former Ministry of Water & Power and Ministry of Petroleum and Natural Resources), Energy Sector Regulators (NEPRA and OGRA), and Provincial Energy Departments.

Ministry of Planning, Development, and Reforms as a focal ministry has overseen the task of preparation of National Action Plan and Investment Prospectus. A National Steering Committee chaired by Minister Planning Commission and represented by all stakeholders at federal and provincial level. These consultations eventually operationalized the global SEforALL goals in Pakistan to achieve 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 two regions for analysis and mapping the energy access, renewable energy, and energy efficiency and conservation in the country.

- Punjab
- Sindh
- Khyber Pakhtunkhwa (KP) / FATA
- Balochistan
- Azad Jammu & Kashmir (AJK)
- Gilgit-Baltistan (GB)

Participation of all the regions in the consultation process has facilitated in developing a well-coordinated nationally cohesive Action Agenda for sustainable energy in the country. In addition, these regional and provincial consultations included participants from government departments, private sector, civil society and development partners. These consultative meetings were designed to discuss the role played by these regions to deal with the energy crisis and respective plans. Hence, the outcome of all these consultations was to bring out the following:

- Status and Targets for SEforAll till 2030
- Priority Action Areas to meet the targets
- Identification of challenges faced by the country in the implementation of the proposed future energy initiatives
- Evolving Coordination and follow-up mechanism

In the process of formulation of NAP, the sustainability parameters of the plan have been given due consideration. These include environmental, economic, and social dimensions. Moreover, the externalities, and socio-economic cost has been analyzed and viable financing options has been discussed. The priority actions areas have been developed through the systematic analysis which factors-in the on-ground situation and challenges expected to these action areas.

Introduction

Sustainable Energy for All (SEforAll) initiative is an important component of Sustainable Development Goals. This initiative is an all-encompassing approach linking energy access to other goals. SEforAll National Action Plan provides a comprehensive and holistic long-term vision, aligned with National Vision 2025 and national energy policies notified from time to time.

The Plan ensures overall sector-wide coherence and synergy of the accumulated efforts toward the three goals of SEforAll to be achieved by 2030 as summarized below:

a) Universal energy access ,[1]
b) Doubling the share of renewable energy, and
c) Doubling the rate of energy efficiency.

Pakistan's vision 2025 and other national and provincial development plans are broadly in line with goals of SEforAll including access to energy, doubling share of renewable energy, and doubling the rate of energy efficiency and conservation.

Geographically, Pakistan occupies a strategic location. It is located at the crossroads of South Asia, Central Asia, China and the Middle East, which makes Pakistan 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.

Pakistan is world's sixth most populous country with a population of 207.07 million.[2] 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). However, FATA is being merged into KP.

The rural population is 61% of the total population which is employed by the agriculture sector. Traditionally, Pakistan has been an agrarian economy. However, over the years the economy has shifted towards industry and services sector. These have become major contributors to GDP, contributing approximately 80.5% to the economy.[3]

Pakistan has undertaken significant political and economic reforms with the devolution of power to provinces after the 18th amendment. The management of resources and planning have been devolved to the provinces with greater autonomy. These reforms have enhanced the deliverance capacity at provincial level. Moreover, the country has also shown democratic, political

Fig 1 **Map of Pakistan**

Source: Geological survey of Pakistan.

and economic resilience despite the turmoil in the region.

Pakistan's macroeconomic reforms and investment friendly policies has transformed Pakistan into a dynamic, open and private sector friendly economy. Foreign direct investments are encouraged and the share of international trade in the GDP has also increased significantly. China-Pakistan Economic Corridor (CPEC) is a recent development initiative, poised to bring economic, social and regional benefits for the people of Pakistan. Under this initiative, USD 52 billion will be invested on country's infrastructure – the share of energy sector portfolio out of this amount is USD 36 billion (See Annex XX for detail project list).

Pakistan's economic history is characterized by recurring cycles of high growth and subsequent stagnations. This volatility of economic growth has serious implications for the social and economic well-being of people at large. However, the recent performance of the economy has largely been positive. The economy has maintained growth in real GDP over 4% consecutively in last four years.
The following table provides an overview of

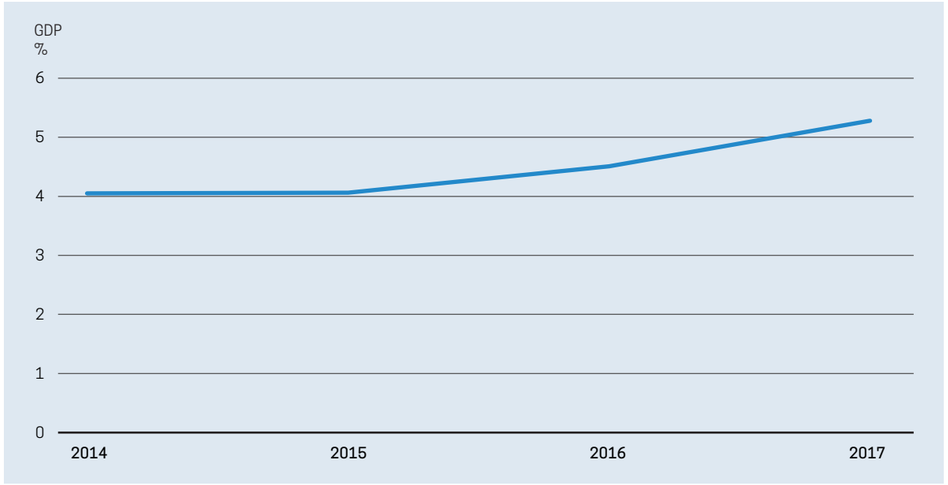
economic and social indicators of Pakistan;

Table 1 Socio-Economic Indicators

Islamic Republic of Pakistan			
Area	796096		
Capital	Islamabad		
Provinces	04 (Punjab, Sindh, KP and Balochistan)		
Region	03 (AJK, GB, and FATA)		
Social / Demographic Indicators			
			Years
Population	Millions	207.07	2017
Urban		36.83%	2017
Rural		63.62%	2017
Male	Millions	106.4	2017
Female	Millions	101.31	2017
Population Growth rate	%	2.4	2017
Per Capita Income	$	1629	2017
Labor Force	Million	61.0	2014-15
Employed	Million	57.4	2014-15
Unemployed	Million	3.62	2014-15
Unemployment rate	%	5.9	2014-15
Economic Indicator			
	Unit		**Years**
Nominal GDP	S Billion	271	2015-16
Sectoral Contribution to GDP			
Agriculture	%	19.53	2016-17
Industrial Sector	%	20.88	2016-17
Services	%	59.59	2016-17
Real GDP growth rate	%	5.28	2016-17

Source: Pakistan Bureau of Statistics & Economic Survey of Pakistan, 2017

Fig 2 Pakistan's real GDP growth



Source: Eocomic Survey of Pakistan 2017

Overview of Pakistan's Energy Sector

Pakistan's primary commercial energy supplies have been increased to 80 million tonnes of oil equivalent (Table 2). The existing primary commercial energy supply mix during 2016-17 has increased by 7.6%. According to Pakistan Energy Year Book 2017, the share of oil and gas is 34.4% and 37.9 % respectively, followed by 9.7% from hydroelectricity and 8.1% from coal. The nuclear share is 2.1%, renewable electricity is 0.8% and imported electricity 0.1%. This shows that Pakistan energy mix has diversified over the last five years.

Oil, gas and electricity, coal and LPG are the major sources in final energy consumption respectively. Furthermore, final energy consumption in 2016-17 (50.12 MTOE) is 63% of primary energy supply during the same year.

Table 2 Primary Energy Supply by Source

Primary Energy of 2016-17		
Source	**Unit TOE**	**% Share**
Oil	27,366,526	34.4
Gas	30,163,334	37.9
LNG Import	4,455,734	5.6
LPG	1008,673	1.3
Coal	6,482,401	8.1
Hydro Electricity	7,681,699	9.7
Nuclear Electricity	1,670,560	2.1
Renewable Electricity	636,825	0.8
Imported Electricity	118,480	0.1
Total	79,584,246	100

Source: Pakistan Energy Year Book 2017

Table 3 **Final Energy Consumption by Source 2017**

Final Energy Consumption 2017

Source	Unit TOE	% Share
Oil	17,904,977	35.7
Gas	17,031,100	34.0
Coal	6,097,816	12.2
Electricity	7,779,939	15.5
LPG	1,308,471	2.6
Total	50,122,304	100

Source: Pakistan Energy Year Book 2017

Pakistan's Power Sector Vision & Reforms

Pakistan's Power sector supply-demand gap has declined from 2013-2018. The government of Pakistan has an absolute resolve to end energy crisis in the shortest possible time. Government has initiated energy sector reforms, which include multidimensional policy measures and programs in collaboration with international financial institutions (such as World Bank, Asian Development Bank, and International Monetary Fund). Through these reforms, vertically integrated energy sector is being unbundled and privatized for good governance and efficient management of energy to provide secure and sustainable energy at affordable price.

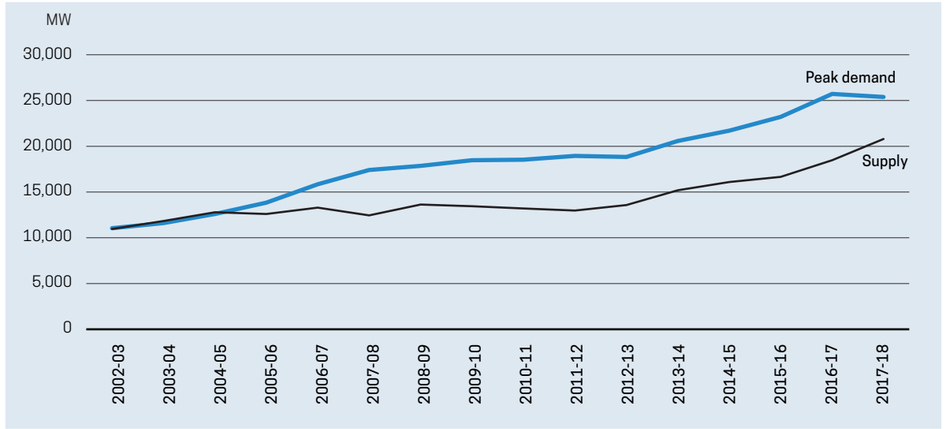
The governance and structural reforms of the sector has been initiated with a special emphasis on the performance of Distribution Companies (DISCOS) and government owned Generation Companies (GENCOS). Similarly, National Transmission and Dispatch Company (NTDC) have been reformed with the creation of CPPA (G) and plans are made for the least cost generation plan. NEPRA capacity building has been developed and plans are underway to unfold multi-year tariff regime for all DISCOs to avoid delays in tariff determination. However, the privatization of the DISCOs is one of the big challenges for the government to improve the in the coming years.

Considering the gravity of the current energy sector problems, both long-term and short-term measures are being taken. The Power division of Ministry of Energy (former Ministry of Water and Power) is addressing the electricity sector of Pakistan. It has focused on increasing electricity supply from a diverse source such as gas, oil, coal, hydro and nuclear. Power Policy of 2015 was launched to set some clear standards and resolve the electricity problem through tariff rationalization to arrest circular debt, energy conservation, changing energy mix, and strict punishment for electricity pilferages.

To meet the energy requirements of the country, Ministry of Energy (former-Ministry of Petroleum and Natural Resource) is importing LNG as a medium-term solution. Whereas, hydel and coal power plants development are envisioned as long-term strategy.

The power supply of the country is dominated by thermal power, as it constitutes around two-third

Fig 3 **Historic Demand Supply Position (2002-03 to 2017-18) Installed Capacity**



Source: Planning commission of Pakistan/NTDC

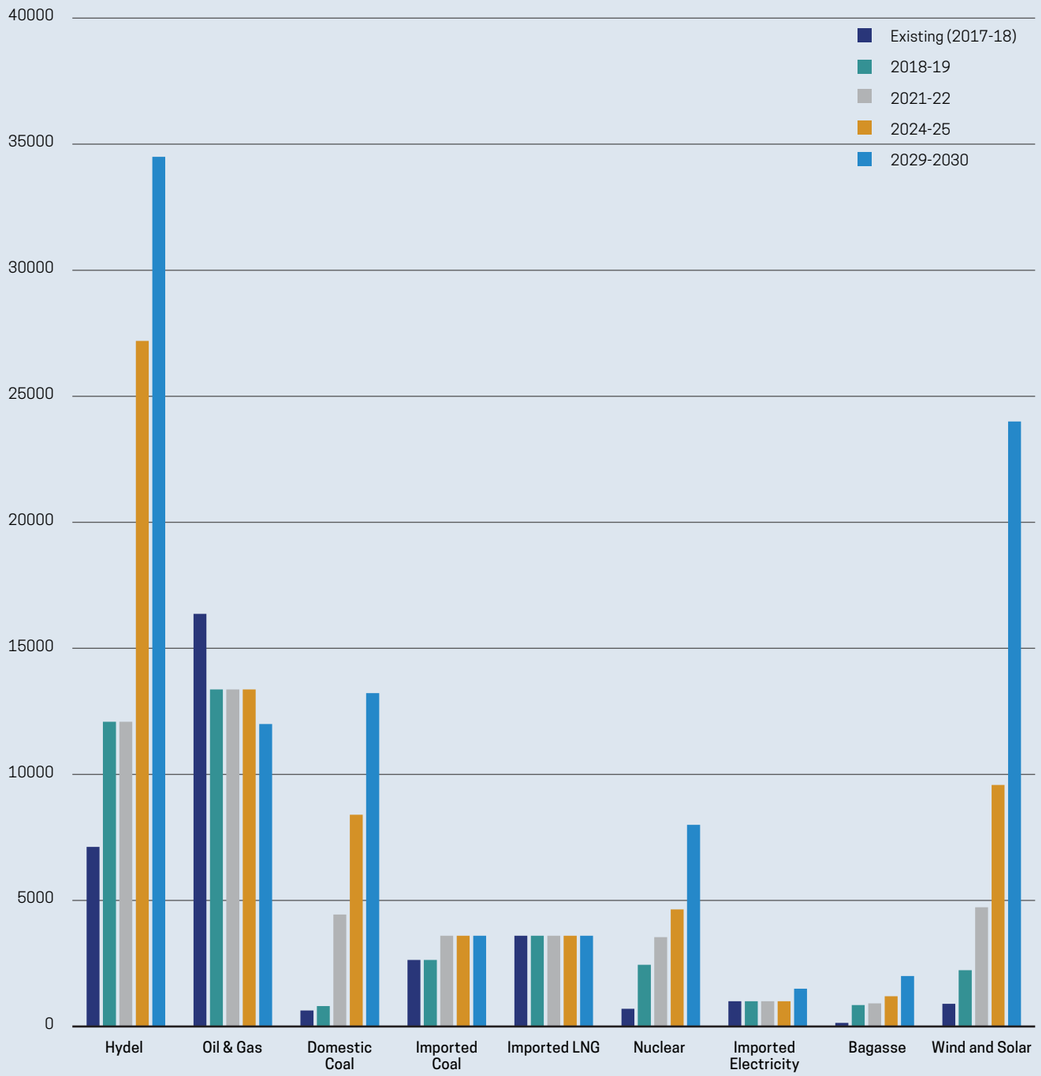
of the total installed capacity. On the other hand, renewable energy (including hydroelectricity) constitutes 28.3% of the entire power generation mix of the country. Without the inclusion of hydroelectricity, the share of renewables (solar, wind, biomass) is 2.2% as it has been since 2005 that the investment by private and public sectors has opened-up in the renewable energy market in Pakistan. As new generation capacity has been added to the system, it has reduced the load-shedding. Further, to eliminating the load-shedding, not only the generation but also the transmission and distribution systems will be strengthened. Given the current scenario and government plans the power mix of Pakistan can be seen in figure 4.

Financially, country's power sector is still struggling to address the persistent problem of circular debt. In absence of the comprehensive governance reforms, the circular debt will be a major burden on Pakistan's overall economy and more specifically power sector viable operations. Another factor which distorts the power sector operations is the power sector subsidy – "Tariff Differential Subsidy" which was PKR. 136 billion in FY 2015-16. Though, government had plan to phase out the power sector subsidy. However, given the nature of political-economy of the power sector, institutional dynamics and population living under the poverty line; the total phase out of power sector subsidies may continue in the near future.

Energy Sector Progress (2013-18)

The recent investment of $36 billion for power sector under the China-Pakistan Economic Corri-

Fig 4 **Pakistan's Power Generation Mix 2017-2030 - NEPRA**



Source: NEPRA State of Industry Report 2016

dor (CPEC) will increase the energy access.[4] CPEC and other government investment has increased the electricity supply by 7,882 MW.

During the last five years budgetary allocation in the Public Sector has also been consistently increased this is 126% increase at Federal and 154% at provincial level as summarized below:

Table 4 **Public Sector Development Program- Last Five Years Allocations for Energy Sector**

Million Rupees

	2013-14	2014-15	2015-16	2016-17	2017-18	Total	% increase
National Development Program	153,210	164,390	197,907	267,095	345,620	1,128,222	126
Provincial Development Program	106,110	115,600	142,227	205,020	270,000	838,957	154

On physical side, government has remained successful to have power generation capacity additions7000 MW (out of which 1500 MW of Solar and Wind projects were also inducted) in the system. The project completed during the last five years (2013-18) includes:

- Three LNG power plants (Bhikki, Haveli-Bahadur, Baloki (3600 MW),
- Chashma 3 & 4 Nuclear (340) MW each,
- Guddu Gas (400) + MW,
- Nandipur Gas 100 + MW,
- Sahiwal Coal (1320 MW),
- Various Wind/Bagasse (350 MW),
- Patrind HPP Hydel (147 MW),
- Faisalabad Gas (250 MW),
- Neelum Jhelum (969 MW)
- Tarbella 4 Extension (1410 MW)
- Port Qasim Power Plant (1320 MW) (in completion phase)

To address energy efficiency and conservation, the Federal Government has passed National Energy Efficiency and Conservation Act and created an Authority (National Energy Efficiency and Conservation Authority) to promote energy efficiency and conservation in Pakistan.

Country's energy sector is being redefined. With the given reform agenda, it is expected that in future the energy sector will transform and evolve with privatizations, mergers, and consolidations as well as disaggregation of vertically integrated utilities. Resultantly, the sector will see new opportunities and challenges at all levels of the unbundled energy market. This will demand the more proactive role of sector's regulators (NEPRA & OGRA).

Additionally, the government has initiated number of projects to import energy from energy rich

central Asian Countries. In these projects Government of Pakistan is partnering with the other countries in the region for greater prosperity and development in the region.

KEY ISSUES

- Reliance on oil and gas in the energy mix
- Under Utilization of renewable resources
- About 27% of the population lack access to electricity
- Circular Debt hampers smooth functioning of the system
- Nascent regulatory frameworks
- Weak governance of DISCOs, GENCOs and Gas Companies
- Majority of the population lack access to clean cooking facilities
- Energy conservation and efficiency requires special emphasis
- Off-grid electricity solutions have yet not proliferated

Turkmenistan-Afghanistan-Pakistan-India Gas Pipeline Project (TAPI) supply natural gas from the Yoloten, Osman and adjacent gas fields in Turkmenistan to Afghanistan, Pakistan and India. It is supported by the Asian Development Bank (ADB), "a 56-inch diameter 1,680 kms pipeline with design capacity of 3.2 billion cubic feet of natural gas per annum (BCFD). The first gas flow is planned by the end of 2019"[5]

Iran-Pakistan Gas Pipeline Project will supply natural gas from South Pars gas field in Iran to Pakistan. More specifically, the project includes "laying of 42-inch diameter 1,800 km pipeline with design capacity of 750 million cubic feet of natural gas per day (BCFD) from Iran. 1,150-km long pipeline from the Iranian field to Iran-Pakistan border is being completed by Iran whereas the Pakistani portion of 781 kms is under consideration for implementation".[6] However, due to US sanction on Iran no significant progress on this project has been achieved.

CASA 1000 (The Central Asian-South Asian) is $1.6 billion project with the aim to export 1300 MW hydroelectricity from Tajikistan and Kyrgyzstan to Pakistan and Afghanistan.

Analysis of Key Issues of Pakistan's Energy Sector

The above discussion reveals that Pakistan's energy mix is currently heavily dominated by oil and gas with a share of 72.3% in overall primary energy supplies. In Power Sector, the majority of electricity generation in the country is through thermal sources. Renewable energy (including hydroelectricity) contribution in the electricity generation is 28.3%. It is expected that by 2030, Pakistan's energy mix will significantly change in favor of renewable energy. It is expected that significant increase will be observed in the generation of electricity through solar and wind sources.

A sizable population in the country is still deprived of clean and affordable electricity and other energy sources. Off-grid renewable energy solutions can play important role in bridging this gap in access to clean and affordable energy. However, it is important to improve the governance of energy sector with a special emphasis on the performance of DISCOs and GENCOs and strengthening regulatory capacity of NEPRA and OGRA.

The NEPRA regulation on "Net-Metering" is creating the market for solar housing system, where any household with solar system installed; meeting basic condition can sell excess electricity to the DISCOs and KE. Similarly, the competitive markets (reverse auction) regime for renewables are put in place.

The analysis shows that the importance assigned to renewables by various government agencies varied from time to time. Among few policy-makers there are doubts of affordability and reliability of renewables, whereas, some believe there is a potential for further reduction in cost and address the technical challenges.

The analysis of renewable tariff shows that indicative upfront tariff, as well as cost-plus tariff for wind and solar power projects has decreased drastically. Although, the cost of power generation from non-renewable sources are disputed especially when it comes to infrastructure development of coal and LNG imports – as costs are not sufficiently internalized. Development of these projects from public finance will shrink the fiscal space and additional challenge to governance of the system. This may jeopardize the government efforts to achieve energy security of the country.

Governance reforms in the energy sector can help overcome circular debt and other pilferages in the system. The circular debt is a domino effect of Aggregate Commercial & Technical (ACT) losses – lines losses, electricity theft and poor recovery by DISCOs which creates a shortfall of cash within the Central Power Purchase Agency (CPPA-G) that it cannot pay to power supply companies. With the installed capacity of 32,612 MW in FY 17, the circular debt figure was hovering around 566 billion , where additional 533 billion is parked with Power Holding Company. For power sector, an increase in supply to the grid in the absence of major governance reforms in the energy sector can exacerbate the circular debt situation and so as for access to the electricity.

At the macro level, the circular debt makes power sector management and operations unsustainable. This result in increased load-shedding and less access to electricity at the national level to all sectors of the economy. Similarly, the surging PSO circular debt negatively impacts all sectors of the economy including power sector which consumes a major share of oil imports.

Pakistan's Vision 2025 and Key Policies for the Energy Sector

Pakistan's Vision 2025 (Pillar – IV) is focused on the energy-water and food security. The energy sector has been given high priority which shows government's firm commitment. While addressing the energy sector, the Vision document emphasizes ensuring uninterrupted access to affordable and clean energy.

GUIDING POLICY-FRAMEWORK

- Vision 2025
- Power Policy 2015
- Petroleum Exploration and Production Policy 2012
- Policy for Development of Renewable Energy, 2006
- National Energy Conservation Act 2016

Pakistan is yet to achieve its access goal, as the national electrification coverage ratios over 86% whereas access to piped gas network is as low as 25%. The main goals as stated in the Vision 2025 for Energy sector are :[7]

- Eliminate current electricity supply-demand gap, and cater to growing future demand by addition of 25,000 MW by 2025;
- Optimize energy generation mix between oil, gas, hydro, coal, nuclear, solar, wind and biomass – regarding its indigenousness, economic feasibility, scalability, risk assessment and environmental impact;
- Complete two major hydropower projects: Diamer- Bhasha Dam and Dasu Dam;
- Tap Pakistan's huge potential for alternative energy;
- Maximize distribution efficiency and cut wasteful losses through investment in transmission and distribution infrastructure and effective enforcement of controls;
- Address institutional fragmentation and decay of the sector due to poor capacity;
- Focus on demand management and conservation to ensure prioritization in allocation, elimination of wasteful use, incentives to use more energy efficient equipment and appliances and achieve better balance between peak and off-peak hours;
- Introduce institutional reform and strengthen regulatory frameworks to improve transparency and efficiency;

Moreover, the government has already initiated a project in collaboration with different agencies for the development of an "Integrated Energy Development Plan" that offers a highly structured framework to simulate results and analyze strategic options such as:

- Least-cost energy systems and compositions;
- Cost-effective responses to restrictions on emissions;
- Long-term energy balances under different scenarios;
- Impact of new technologies;
- Benefits of regional cooperation;
- Effects of regulations, taxes, and subsidies.

Power Generation Policy 2015, and Policy Framework for Private Sector Transmission Line Projects 2015 was launched to attract new investments for development of new power generation projects and augmentation of transmission network in the country. The Private Power and Infrastructure Board (PPIB) was processing around 37 IPPs with cumulative capacity of 15,469MW based on multiple fuels (Annex V)

The IPP projects which are at different stages of processing / implementation includes:

- Sixteen (16) Hydro IPPs of 6,430 MW
- Thirteen (13) Coal based IPPs of 9,491 MW Five Imported Coal based Project of 4,423 MW Seven Thar Coal based Projects of 4,950 MW One Cogeneration (Bagasse/Imported Coal) Project 118 MW
- Three (03) R-LNG based power projects of 3,633 MW
- Handling / facilitating 900 KM Long, 4000 MW Capacity, ±660 kV Matiari-Lahore HVDC (High Voltage Direct Current) Transmission Line Project, first ever transmission line project of the country in private sector, being sponsored by Subsidiary of State Grid Corporation of China.

Petroleum Exploration and Production Policy 2012 focuses on achieving self-sufficiency in energy by increasing oil and gas production. The salient features of the policy include:

- To increase competitiveness in the upstream sector through foreign direct investment (FDI).
- Promotes the on-shore exploration and production (E&P) activity by providing globally competitive incentives.
- Proactive resource management through the strengthening of Directorate General of Petroleum Concessions (DGPC) is also on top agenda.
- Emphasizes on training in the E&P sector meeting international standards and creating favorable conditions for retaining them within the country.

Energy Conservation Policy draft is being prepared through stakeholder dialogues to ensure commitment and ownership of all relevant sector players. National Energy Efficiency and Conservation Act has been passed and National Energy Efficiency and Conservation Authority (NEECA) has been established. Although, NEECA is still in its infancy and government is in process of developing the organizational structure, policies, laws, and regulations at multiple levels. For this purpose, the government has already engaged international donor agencies and development partners. In addition, there have been extensive advocacy initiatives underway to sensitize the provincial governments, public and private sector and people at large, by NEECA.

Policy for Development of Renewable Energy for Power Generation, 2006 has a mandate for small hydropower up to 50 MW or

less. In addition, other Renewable Energy technologies – solar, wind, geothermal, tidal, wave, waste-to-energy from municipal waste and landfill, anaerobic or pyrolytic biomass gasification, co-firing or cogeneration utilizing crop residues. Following are the key responsibilities assigned to Alternative Energy Development Board (AEDB) under this policy:

- Help ensure universal access to electricity in all regions of the country;
- Increase the deployment of renewable energy technologies (RETs) in Pakistan so that RE provides a higher targeted proportion of national energy supply mix
- Help meet the increasing power supply through renewable energy;
- 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;
- Devise measures to support the private sector in mobilizing financing and enabling public sector investment in promotional, demonstrative, and trend-setting RE projects;
- Optimize impact of RE deployment in underde veloped 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., To promote greater social welfare, productivity, trade, and economic wellbeing amongst deprived communities;
- Help in broad institutional, technical, and opera tional capacity building relevant to the renewable energy sector;
- Facilitate the establishment of a domestic RET manufacturing base in the country that can help lower costs, improve services, create employment, and enhance the local technical skills.

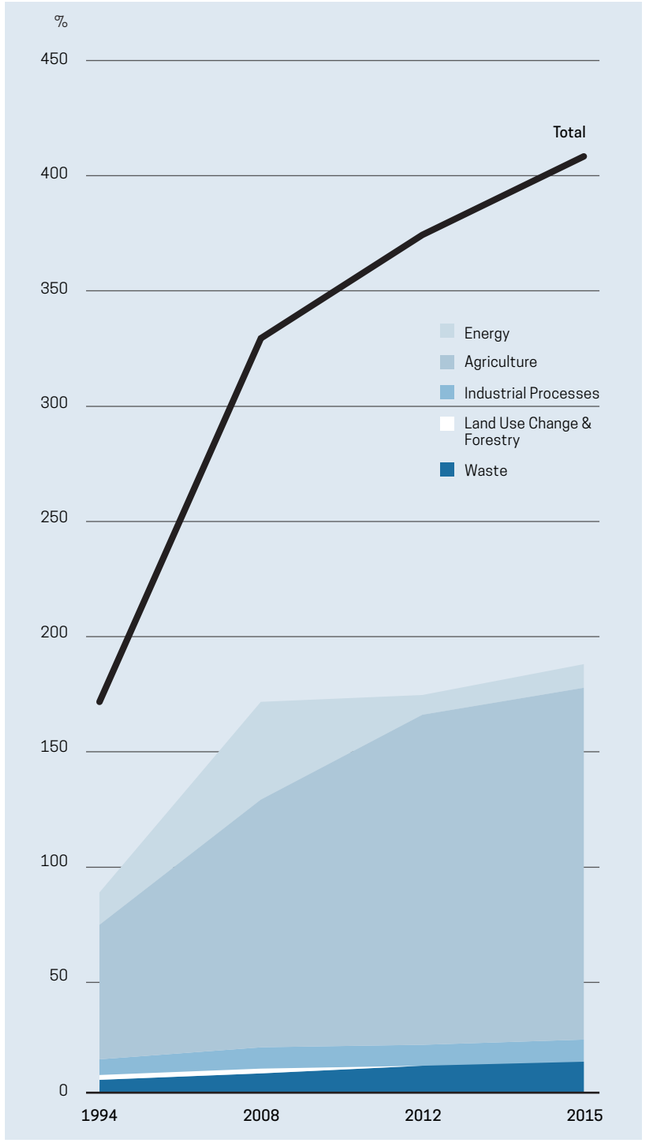
Additionally, there is a requirement to review and analyze the renewable energy policy 2006 to incorporate the evolving changes in sector internationally.

World Bank Regulatory Analysis (RISE)

According to World Bank report entitled "Regulatory Indicators for Sustainable Energy" providing a comparison for SEforAll at the global level, Pakistan's score on renewable energy is 77 which is higher than other countries in the South Asia and even more than some of the developed countries in the world.[8] On energy access and energy efficiency, the score is 59 and 38 respectively. The good score for all these indicators is more than 66, where both energy access and energy efficiency require improvement.

Pakistan performance on renewable energy sources is commendable. The investors' confidence and interest in investing in developing renewable power plants have improved. It is expected that renewable installation will surpass the previously announced government target (2005) of producing 9700 MW from renewable energy (Solar, Wind and small Hydro) by 2025. This requires in-depth sectoral regulatory analysis with areas where policies can be improved, regulation can be enforced, and infrastructure can be developed.

Fig 5 **Inventory of GHG Emission (MT Co2-Equivalent)**



Source: Nationally Determined Contributions of Pakistan

Pakistan's Nationally Determined Contributions (NDC)[9]

Pakistan is a signatory of the international climate agreement at the U.N. Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP21) in Paris in December 2015. The Ministry of Climate Change in collaboration with other ministries has outlined post-2020 climate actions intended to take under the Paris agreement.[10]

The NDC document submitted by Government of Pakistan has also incorporated the major projects such as CPEC, projecting the future economic growth and the subsequent GHG emissions. It is also strategically aligned with "Vision 2025".

According to Ministry of Climate Change, the total GHG inventory of Pakistan (2014-15) is 405.06 MT CO2-Equivalent. From 1994-2015, the overall increase in emission is approximately 123%with 90% of emissions are solely attributed to energy and agriculture sector (See Fig. 4). The emission profile is dominated by energy sector with the major share of 46%out of total emission, and there

will be significant growth in its share in future.
The 27% of population is without access to energy and projected population growth rate of 2.4%. Population is expected to increase to 102 million by 2030. In 2014, Pakistan's per capita oil equivalent use was reported to be 482 kg (including traditional biomass fuels) which is one of the lowest ranked across the world. Similarly, Pakistan greenhouse gas emissions are very low; between 0.1-4.0 tons CO2-equibvalent per capita/year. However, the expected population growth along with economic development the future emission may increase.

Pakistan is going through major economic transformation. The government accordingly has sets GDP growth target of 7% till 2025 in "Vision 2025", and same for an extended period until 2030. The addition of 25,000 MW of electricity in the grid is envisaged by 2025, with major policy shift in the energy mix for renewable energy. The currently planned addition of 10,400 MW is in the pipeline to eliminate the current demand-supply gap in 2018. The projected emissions for the GDP growth through energy sector by 2030 are calculated as 898 MT CO2-equivalent out of the total 1,603 MT CO2-equivalent.

Pakistan's vulnerability to adverse climate change is well established. The Global Climate Risk Index[11] has categorized Pakistan in top ten severely climate-affected countries in the world, with imminent adverse impacts. National Disaster Management Authority (NDMA) assessment revealed that climate catastrophe resulted in an economic loss of USD 4 billion. The floods (2010-2014) resulted in losses of USD 18 billion, 38.12 million people were affected, 3.45 million houses damaged, and 10.63 million acres of crops destroyed.[12] in addition, federal expenditure related to climate was between 5.8 and 7.6%of total expenditure in 2015.[13]

The scenarios based economic analyses by the Ministry of Climate Change shows that:

- 20% reduction is projected emission by 2030 requires an overall investment of USD 40 billion.[14]
- A reduction of 15% GHG emissions requires USD 15.6 billion and reduction of 10% requires USD 5.5 billion.

Most of these investments will be channelized toward the mitigation; concentrated efforts will be required for energy and agriculture sector. The emissions share of energysector is more than 50% (898 out of 1,603 MT CO2-equivalent) and it has the most potential for mitigations and adaptation in Pakistan. Therefore, it is estimated that Pakistan's adaptation efforts require between U$ 7 to U$ 14 billion/annum. More specifically in the energy sector, the focus of these mitigations and adaptions will be directed towards energy efficiency and conservation measures.

PART-1

VISION AND TARGETS UNTIL 2030

1

Vision and Targets Until 2030

Pakistan has achieved 73 % of energy access where the target for 2030 set by the Government under SEforALL is 100%.

The gap of 27% will be fulfilled through a major policy shift and reforms in energy sector of Pakistan. The government has already initiated a number of projects to achieve this target (see Energy Access Section for details).

In 2005, Government of Pakistan tasked Alternative Energy Development Board (AEDB) to deploy minimum 9,700 MW of renewable energy in the national grid by 2030 (MTDF 2005-10). Renewable Energy share in national grid is above 1,200 MW which come to 4.28 % of the installed capapcity. The power sector's future demand projections will rise, so as the share of renewable energy by 2030. The government has attracted local and international companies to invest in renewable energy projects. According to AEDB the share power generated through renewable energy in national grid will grow more than 15% by 2030. Government has already taken initiative such as net-metering, reverse auctions, and energy exchange which will disrupt the existing energy markets with more penetration of renewable energy.

The energy efficiency potential of Pakistan is estimated around 15-20% of primary energy use.[1] Government has established NEECA (National Energy Efficiency and Conservation Authority) after enactment of NEECA Act of 2016. NEECA has initiated a number of programs and campaigns to raise the awareness for Energy Efficiency. NEECA is in process of developing a full-scale institution along with designated the

Table 5 Energy Access, Renewable and Efficiency

SEforAll Pakistan's Target	Status 2017	Target	Gap	Remarks
Energy Universal Access	73%	100%	27%	Regional Matrix
Energy Efficiency[2]	1.5 %	18%	16.5%	NEECA Established
Renewable Energy Share[3]	4.3%	15%	----	Government's Target

provincial energy efficiency agencies.

1.1
Energy Access Target until 2030

In total 27% of the population still lives in an area where electricity is yet to reach. This means 55 million people or 8.8 million households (with an average household size of 6.35[4]) are living without access to electricity. A comparison of electrification coverage ratio across countries in the neighboring region shows that Pakistan is behind China, Sri Lanka, and Nepal - all of which have electrification coverage ratio above Pakistan's. India also has a higher rate compared to Pakistan but owing to its large population, a number of people without electricity in India (244 million) far exceeds the population in Pakistan without access to electric grid (See table 5).

According to State of Industry Report 2016, more than 32,000 villages in the country continue to remain without electricity grid forcing the residents to use traditional sources of energy, including firewood, kerosene, and diesel, for meeting their lighting, heating and cooking requirements. For most of these villages, sparsely distributed population and remote location have made expansion of grid financially unviable.

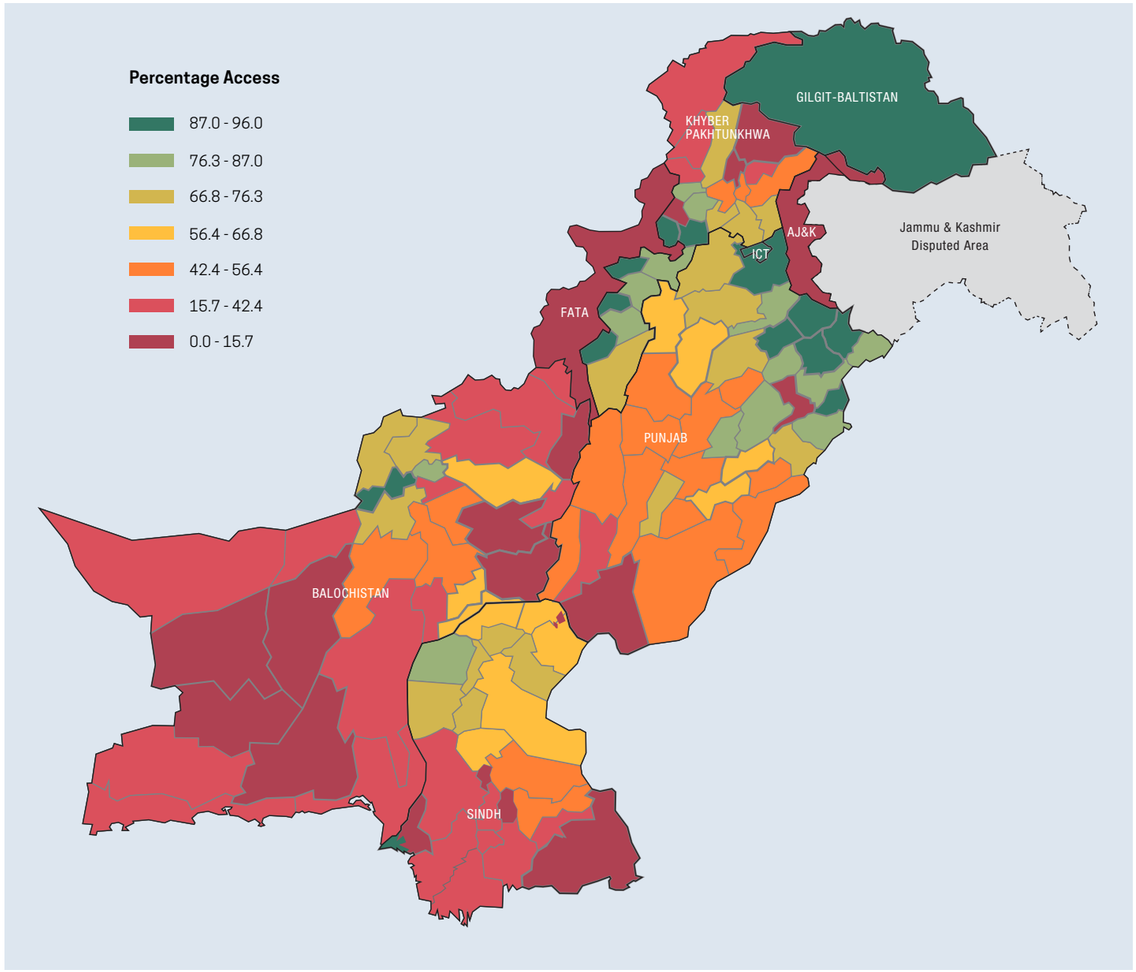
Among the provinces, Sindh has the highest number of un-electrified villages, followed by Punjab, KP, and Balochistan. On the other hand, AJK and Gilgit-Baltistan compared to the rest of the country have more than 90% electrification. In GB, the electricity access has seasonality issues; in summer, there is excess due to high river flow whereas, in the winter there is less flow resulting in less electricity generation. The region is not connected to National Grid. Therefore, the shortage or excess of electricity in the region cannot be managed.

Table 6 Comparison of Electricity Access 2016

Region	Population without electricity millions	National electrification Coverage Ratio %	Urban electrification rate %	Rural electrification rate %
Bangladesh	60	62%	84%	51%
India	244	81%	96%	74%
China	0	100%	100%	100%
Nepal	7	76%	97%	72%
Pakistan	51	73%	90%	61%
Sri Lanka	0	99%	100%	98%
Other Asia	29	35%	66%	24%

Source: International Energy Agency - Energy Database 2016

Fig 6 Village electrification



Source: NEPRA State of Industry Report / UNDP
Note: Some district data was not available so we assumed it to be 0

Districts in central and south Punjab, including Jhang, Rahim Yar Khan, and Bahawalnagar, are found to have the lowest electrification coverage ratio while Gujrat, Hafizabad and Sialkot have less than 30,000 households which are not electrified – most of these are temporary settlements. In Sindh, districts like Tharparkar, Sanghar, Dadu, and Thatta have more than 150,000 households

without electricity.

1.1.1
Limited Access: Load Shedding

It is pertinent to note that the connection to the grid does not equate to the availability of electricity. Most the villages officially listed as electrified, continue to experience long hours of blackouts thus being forced to spend more than half of the day without electricity. According to the Solar Consumer Perception study conducted by IFC Lighting Pakistan program (2015), 73% of the country's population experience few hours of blackouts. Thus, the goal for the government is to achieve 100% electricity access in all the regions and to ensure 24 hours of uninterrupted supply of electricity to the customers.

1.1.2
Electricity Access Targets-Methodology

The methodological approach to estimating baseline and progression on access assumes:

- The baseline year for electricity access is 2016-17. Based on Pakistan Bureau of Statistics (PBS) data, the total population was 207 million, representing approximately 32.59 million households (at the national average of 6.35 people per household). Consumption per capita for the baseline year was 446 kWh with access level at 73%, i.e. 151 million people have access to the electric grid.
- Population Growth. Based on 2017 population of 207 million, compounded annually by the average annual growth rate of 2.4%, the projected population will be about 270 million in 2030.
- Progression for Access to Electricity: Between the years 2006 and 2015, the number of sanctioned connections in the country increased on average by 0.76 million connections per year. The total domestic consumers, as of end June 2015, were 20.15 million. With these many connections, the electricity access in the country (through on grid connections) is 73%. To achieve universal access by 2030, over 15 million domestic connections would have to be provided in the next 15 years, an average of 1 million connections per year (See Annex IX).

Targets for each province and region are based on the capacity of the concerned distribution company in the region to extend grid for rural electrification and the rate of increase in connections in the last 5 years. In regions, such as Balochistan and Sindh where the present electrification coverage rate is less than 60% and the geographical and political situation makes an extension of the grid to these areas challenging, the target for electricity access grid network has been kept below 100%. The remaining households will be electrified through distributed generation. The aggregated targets for the country are summarized in (Annex IX). The national average of household electrification through gird electricity will remain below 100%. However, the distributed electricity through renewable energy (solar) will be used a major source to achieve 100% electrification in areas where grid connectivity is not possible.

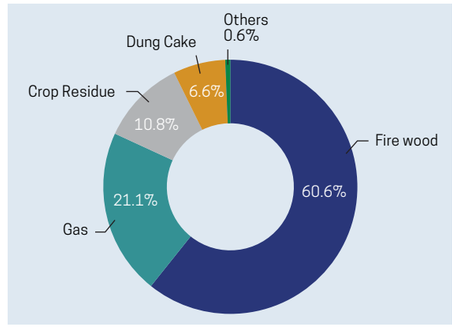
1.1.3
Access to Modern Fuel

Traditional fuels like firewood, dung and crop residues currently contribute a major share in meeting the everyday energy requirements of rural and low-income urban households in Pakistan. Analysis of Pakistan Social and Living Standards Measurement shows (112 million people) continues to rely on the use of biomass. As shown in the figure 7 below, almost 60% of the country's population uses wood for cooking, followed by gas (22%), crop residuals (11%) and dung (7%). Both KP and Sindh have more than 60% of the population burning firewood for cooking.

1.1.4
Piped Gas Network Status

Access to the gas network is only 25%. The high capital cost of laying gas pipelines in some regions such as AJK and Gilgit-Baltistan, households are relying on either expensive LPG cylinders (transported from down-country) or burning of firewood for fulfilling their heating and cooking requirements. Sindh has the highest number of households with gas connections followed by Punjab, KP, and Balochistan. The figure 8 shows piped gas network access.

Fig 7 **Percentage of population using traditional sources of fuel for cooking**



Note: There is almost no use of electricity, kerosene oil, and charcoal/coal for cooking

Source: PSLM Data 2014-15

As of the end of June 2015, 7.6 million households had gas connections. The remaining population continues to use LPG cylinders, firewood and crop residue for cooking and heating. In its latest determination, SNGPL has been mandated to add 250,000 new domestic connections annually while domestic connections sanctioned by SSGCL has increased by an average of 60,000 annually over the last few years. The criterion for sanctioning gas connection varies from one region to another based on the population density, geography, and the socio-political context.[5]

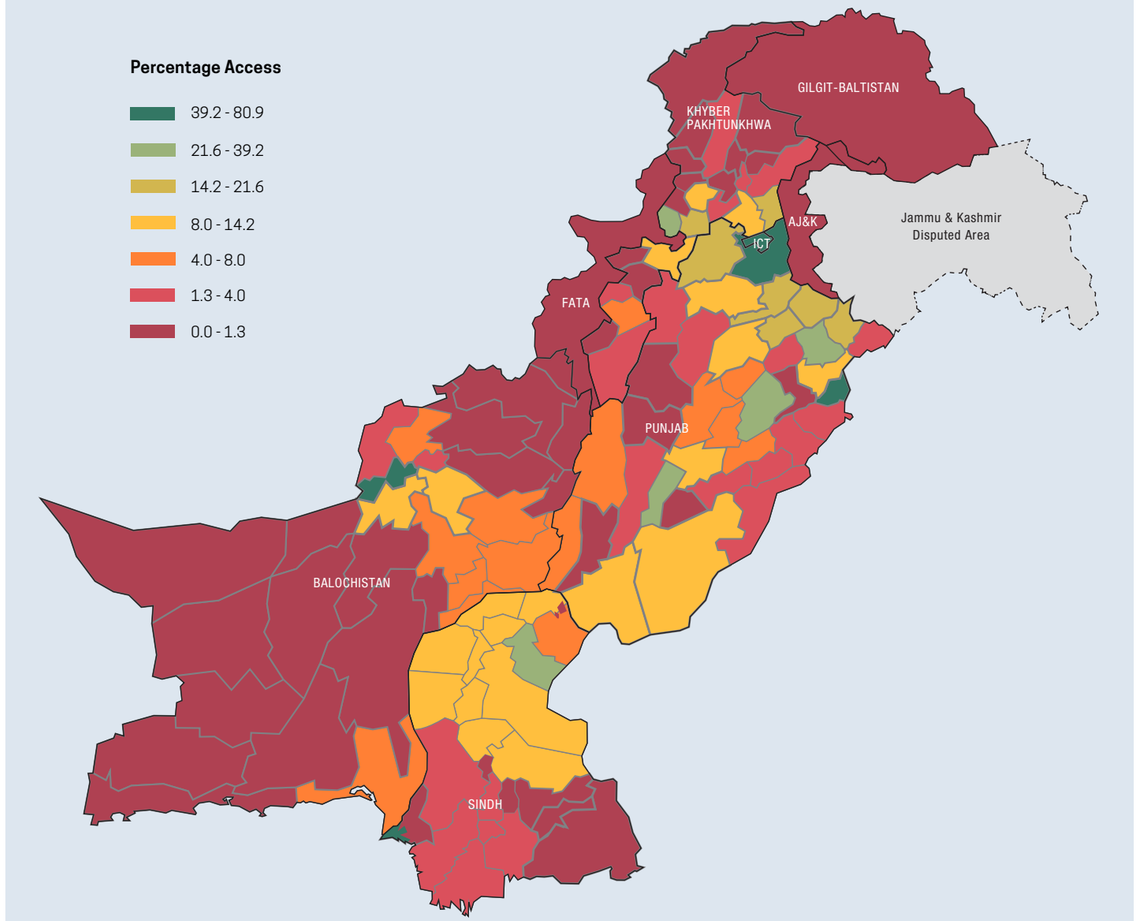
Extension of Piped Gas Network

As per the government's plan, gas connections will increase gradually. Assuming a 5% annual increase in connections, the total domestic connections are going to increase to (See Table 6):

- 9.75 million by 2020,
- 12.38 million in 2025, and
- 15.81 million by 2030.

Thus, by the end of the plan period, 42% of the population will be provided access through piped gas network.

Fig 8 **Percentage gas access across Pakistan**



Source: SNGPL / SSGC / Petroleum Division and OGRA
Note: Some district data was not available so we assumed it to be 0

Additionally, in areas where pipe gas access is not possible, the improved cook stoves will be provided. See the following Table 7 for short, medium and long-term access to improved cook stoves in all provinces and regions.

In Punjab, a new housing scheme will be given gas connection if the cost of providing the connection is less than PKR. 54,000 per customer. On the other hand, in KPK and Sindh, the cost threshold is PKR. 108,000 while in Balochistan it is

Table 7 **Projection of Piped Gas Connections**

Year	Connections	Access to Piped Gas Network
2015	7,671,709[6]	26%
2020	9,705,829	31%
2025	12,387,371	36%
2030	15,809,773	42%

PKR. 200,000 per customer. Even with these differences in cost, it will not be financially or economically viable to extend piped gas network to several remote locations.

Improved Cooking Stoves (ICS) Target: A total of 14.03 million households will be given the alternate source of cooking over the next 15 years to reduce usage of traditional fuel for cooking. The targets have been determined based on the methodology (see footnotes 22)[8]

1.2 Renewable Energy Target Until 2030

Government of Pakistan has set the target of at least 15% of total power generated from Renewable energy in national grid by 2030.[9] At institutional level, AEDB (Alternative Energy Development Board) has been mandated with this task. Additionally, AEDB has been directed to electrify 7,874 remote villages in the province of Sindh and Balochistan through renewable energy technologies but could not implement the task due to funding constraints.[10] These villages will now be electrified through projects implemented by the provincial governments.

The estimates or data for the use of traditional biomass are not reported anywhere in the government energy statistics, such as the official data source of Energy Year Book of Pakistan. The table gives the estimates for the share of renewable energy in the total final energy consumption in Pakistan. According to unofficial estimates (Table 10), a substantial amount about 17 MTOE of traditional biomass is consumed annually in Pakistan, which comes down to about 31% share of renewables (including hydroelectricity, solar and the wind) in TFEC. Doubling this share would be quite unrealistic and extremely difficult as it would require reaching a target of 62% of TFEC while simultaneously reducing the share of tradition biomass.

> A total of 14.03 million households will be given the alternate source of cooking over the next 15 years to reduce usage of traditional fuel for cooking.

On the other hand, the share of renewable energy without traditional biomass stands at about 6.5% in 2017 and it will reach 13% of TFEC in 2030 to satisfy the SEforALL objective. Thus, doubling this share without considering traditional biomass will

Table 8 Improved Cooking Stoves Target

Improved Cooking Stoves Target

Region	Target	2016-2020 Short-term	2020-2025 Medium-Term	2025-2030 Long -Term	Total (Millions)
Punjab	6.70	1.34	2.01	3.35	6.70
Sindh	2.00	0.40	0.60	1.00	2.00
KP	2.58	0.52	0.77	1.29	2.58
Balochistan	1.381	0.276	0.414	0.691	1.38
FATA	0.09[7]	0.03	0.03	0.03	0.09
AJK	1.007	0.201	0.302	0.504	1.01
GB	0.274	0.055	0.082	0.137	0.27
Total	14.03	2.79v	4.18	6.97	14.03

Source: Author Estimate based on OGRA / SNGPL and SSGC data

be more rational and realistic target for the SEforALL objective for Pakistan. The figure shows the current as well as a future target for the share of renewable energy in TFEC for Pakistan. Over the last 25 years, the TFEC in Pakistan increased by Compound Annual Growth Rate (CAGR) of about 3% from 22 MTOE in 1990 to 50 MTOE in 2017.[11] If TFEC is projected to increase at a current rate of 3% for the next 15 years, it will reach around 88 MTOE by 2030. The SEforALL objective thus requires that renewables share contribution about 13% Primary Energy Supplies in 2030.

Worldwide, the costs of these clean energy technologies are constantly declining, and their efficiencies are improving; some of these technologies have already reached grid parity in Pakistan. One of the mechanisms is 'Reverse Auction', which has been already approved in Pakistan. Under reverse auction / Competitive bidding tariff regime, the solar and wind tariffs can be reduced even further. Renewable energy technologies are the most suitable options for generating clean electricity for both the large scale – grid connected plants and an excellent choice for the off-grid applications.

1.2.1 Biomass

The NAP targets to implement biomass-based co-generation projects of about 2000 MW exploring the following potentials:[12]

I. **Sugar Mills:** A total of 17.1 Million tonnes/year of bagasse is generated in the 84 existing sugar mills in the country. Out of 83 functional sugar mills in Pakistan, 44 are located in Punjab, 32 in Sindh and 7 In KP.[13] 90% of this amount of bagasse is used as fuel in cogeneration plants to meet the energy demands of the sugar mills. The majority of these plants utilize low-pressure steam boilers, which are inefficient and don't optimize the use of bagasse. The total installed power capacity for all 84 existing cogeneration plants is estimated at 830 MW. There is a substantial potential for implementing new high-pressure cogeneration plants using bagasse generated at the sugar mills.[14] The results of the sugar mills analysis show that the new high-pressure cogeneration plants at 84 sugar mills could have a combined power capacity output of 1,844 MW - 2.2 times higher than the total power capacity of all existing low-pressure cogeneration plants.

Table 9 Estimated Share of Renewable Energy in Total Final Energy Consumption

Year	Unit	Value
TFEC (Without traditional Biomass)	MTOE	50.12
TFEC (With traditional Biomass)*	MTOE	67
Hydro Electricity	MTOE	2.62
Other Renewables (Solar and Wind)	MTOE	0.64
Traditional Biomass Estimates	MTOE	17
Total Renewables (Without Biomass)	MTOE	3.26
Share of Renewables (Without Traditional Biomass)	%	6.50%
Total Renewables (With Biomass)*	MTOE	20.26
Share of Renewables (With Traditional Biomass)*	%	31%

Source: Utilizes data from Energy Year Book, 2017 - *Author's Own Estimates

II. **Municipal Solid Waste (MSW) Landfills:** There is a potential use of MSW for energy generation at the landfills in Pakistan. The World Bank study proposed anaerobic digestion of biogas of MSW as it has a higher electrical efficiency and lower environmental impact than the direct combustion technology. The amount of MSW produced in 16 landfill sites can generate around 360 MW of gross power capacity in the anaerobic digester-based power plants. Additionally, Punjab Power Development Board assisting 40 MW waste to energy power project at Lakhodair landfill site Lahore. Sindh Solid Waste Management Board conducted study 11000 tons per day waste availability in power generation project has been initiated by Sindh Energy Department.

III. **Rice Mills:** The results of the rice mills analysis show that with a biomass fuel of 1.86 million tonnes/year, 1062 GWh (potential capacity of 162 MW) can be annually generated.

1.3 Energy Efficiency Target Until 2030

There is a compelling case for Pakistan to invest and achieve energy efficiency to improve the economy of the country. According to ADB studies (2009), there is a potential of 11.09 MTOE saving potential in energy sector. It is evident that

big energy efficiency gains translate into higher economic growth as witnessed in the case of China. Government of Pakistan could save 11.09 MTOE through improvements in the energy intensity, without compromising on GDP growth.

According to the European Commission, the cost of "negawatt" hours is much lower than of generating megawatt hours. In other words, it is much cheaper to conserve one unit of energy than it is to generate one unit of energy. Negawatt-hour is a unit of energy representing an amount of energy that can be saved as a direct result of energy conservation or increased energy efficiency. Pakistan's energy requirements would significantly increase if it has to achieve higher economic and GDP growth and thus requires huge investments in generation, transmission and distribution networks. For a country like Pakistan, it would be extremely difficult to manage the financing of huge infrastructure projects and considering energy efficiency as an option is inevitable.

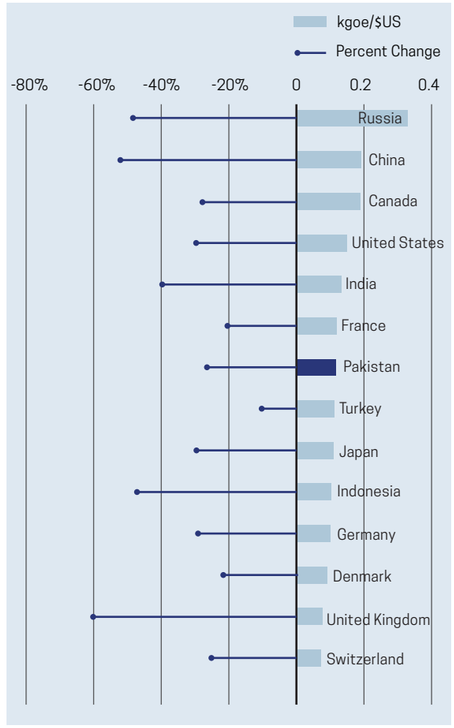
The energy efficiency has been based on indicators of energy intensity in terms of primary energy and uses PPP (Purchasing Power Parity) for GDP. The target for energy efficiency under SEforALL is to double the rate of improvement of energy efficiency. Therefore, it is important to identify and assess the current rate of improvement of energy efficiency in Pakistan which has to be doubled by 2030.

The primary energy intensity of Pakistan has decreased by 1.7 annually since 2000. In order to achieve the SEforALL target, this rate of improvement requires to be doubled by 2030, which means that there has to be a reduction in the primary energy intensity by 3.4% annually or by about 50% over the next 14 years.

The passage of recent National Energy Efficiency and Conservation Act of 2016, which has created National Energy Efficiency Conservation Authority (NEECA) will vest authority to initiate and enforce all energy efficiency and conservation measures across the country. The establishment of NEECA and promulgation of Energy Efficiency & Conservation Act is a positive step in the right direction. It shows the commitment of Government of Pakistan to reduce the energy wastage and improve energy productivity. Additionally, there is an increasing demand to develop effective regulatory measures which will be complimented with appropriate policy, fiscal and financial instruments to create a meaningful impact.

The primary energy intensities of selected countries including Pakistan are shown in the figure8 below for comparison and analysis. Left axis represents the primary energy intensity for the year 2014 and their percentage improvement (reduction in primary energy intensity) over the last 14 years is on the right axis. The fact that Russia has a very high energy intensity, it is not because the country is energy inefficient, but it is due to Russia's industrial structure, mainly vast geography and extremely cold climate conditions make it a highly energy intensive country. As discussed above that energy intensity of GDP is not the best indicator to assess the energy competitiveness of a country.

Fig 9 **Primary energy intensity and the rate of Improvement of energy efficiency, Comparative Assessment**



Source: World Energy Council and EnerData

1.3.1 Residential/Domestic Sector

In Pakistan, there are over 29 million households in the residential sector that consume about 23.2% of total final energy consumption of the country. However, in contrast to the global trends, domestic sector consumes 49.2%[15] of the total electricity consumption and while only 27.7% of the electricity goes into the industrial sector. While the access to electricity stands at about 73%[16] in the country.

Natural gas has the biggest share in the energy mix and dominates in domestic sector with a contribution of 20.79% in energy consumption. Even though, only 25% of households in the country have access to piped natural gas. This indicates that about 75% of the households use traditional biomass (animal dung, firewood, etc.). Use of traditional biomass using conventional cook stoves and open fires is an inefficient process, and it has a direct impact on deforestation and pollutes the household environment. The improved cook stoves can be very instrumental for energy efficiency measures in Pakistan.

1.3.1.1 . Electricity Saving Potential in Domestic Sector

According to NEECA that over 10 million new fans are sold annually in the domestic market and standard power consumption of these fans is about 80 watt each. There are new more efficient fan entrants in the market which can achieve around 50 watts of power consumption. In addition, 1.3 million new refrigerators are added in the market annually. Similar trends have been witnessed in the case of Air Conditioners as well. Worldwide, the efficiency of these appliances has been improving and their costs have been declining.

The energy (electrical) saving potential for selected appliances in the residential sector is given inTable10 and it shows there is a substantial potential of electrical saving of 16,791 GWh that is about 40% electricity consumption in the domestic sector and 20%[17] of total electricity consumption in Pakistan. For instance, 16,791 GWh translates into 3200 MW of power demand at the average system capacity factor of 60%.[18] Since, Pakistan's current electricity supply-demand gap is around 4000 to 5000 MW and it can be significantly reduced by taking adequate energy efficiency measures in the domestic sector, this potential can be realized by replacing these appliances with more efficient technology (See Fig.8).

1.3.1.2 Natural Gas Saving Potential in Domestic Sector

According to Asian Development Bank, a substantial amount of natural gas saving can be achieved in the Pakistan's Domestic sector (Table 10). The table shows the gas saving potential for domestic geysers, space heater, and cook stoves. Energy efficiency potential for geysers is about 30%. In addition, the use of solar water heaters for water heating can bring down the consumption of natural gas in the residential sector.

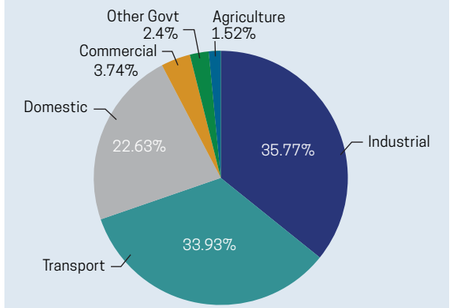
There are 2 million gas geyser consumers in the SNGPL network, if all those consumers were to be converted to the solar water heater, there will be an estimated saving of 15[19] BCF annually or 41 MMCFD which is about 9% of total natural gas consumption in Punjab.

Table 10 Electricity Savings Potential for Selected Appliances in the Domestic Sector

Appliance	Energy Savings Potential	Negawatt-hour Potential (GWh)
Lighting[1]	60%	8456
Refrigerator[1]	23%	667
Fans[1]	50%	6839
Air Conditioners[2]	40%	829

Sources: 1 – RAFTAAR & 2 – Asian Development Bank

Fig 10 Final Energy Consumption by Sector, FY 2017



Source: Pakistan Energy Year Book 2017

The potential for improving energy efficiency in space heating is 36%, which can be achieved by replacing existing low-quality space heaters with more efficient ones. Similarly, the potential for improving energy efficiency for cook stoves is around 40%.

Table 11 Gas savings potential in the residential sector

	Gas Savings Potential
Domestic Geysers	30%
Space Heaters	36%
Cooking Stoves	43%

RAFTAAR & 2 – Asian Development Bank

1.3.2 Industrial Sector

The industrial sector of Pakistan is highly energy intensive sector as its intensity stands at 0.117 kgoe/$GDP(PPP) versus 0.08 kgoe/$GDP in the Europe. Industrial sector accounted for 20.88%[20] of the GDP and 43.5%of employment in 2016. It is the biggest energy consumer with 35% of total final energy consumption in 2016[21] and contributing over 18%[22] of overall GHG emissions in the country.

Energy efficiency in the industrial sector is planned to be achieved by employing a broad range of energy management, efficient technologies, and practices to reduce overall energy consumption. A huge potential for investment exists in the industrial sector. According to a study conducted by IFC, over US$ 4 billion can be absorbed in energy efficiency improvements in the industrial sector of Pakistan with a typical payback of around 5 years.[23]

The technologies and practices for improvements of High Impact Opportunity which offer high energy saving will include:

- Retrofitting;
- Variable Frequency Drives (VFDs);
- Efficient Electric Motors;
- High Pressure and Efficient Boilers;
- Energy-Efficient Lighting;
- Heating Ventilation & Air Conditioning (HVAC);
- Waste Heat Recovery Systems;
- Renovation of Process Equipment;
- Improved Process Performance with Applications of Sensors and Controls Network; and
- Development of Adequate Energy Management Systems.

Most of the industrial units use standby generators as a backup option in case of the power outages from the grid, while many units do not even rely on grid electricity and they have their power generation units for self-generation[24] which is more commonly known as captive generation capacity. According to an estimate, the import of backup generators exceed over 1 billion USD per annum in the country.[25] Diesel and natural gas are two commonly used sources of fuel for local industry. While some units, especially the textile mills are beginning to use the imported Liquefied Natural Gas (LNG) from Qatar. Cement & brick industries meet their fuel demands primarily through local or imported coal.

According to IFC, energy shortages and rising energy prices are driving industries to take significant measures and reduce energy consumption

Table 12 Energy and Cost Saving Potential in the Industrial Sector of Pakistan

Industry	National Sector-Wide Energy Savings %	Energy Saving Estimates per year (MWh)	Associated Cost Saving per year (Million PKR)
Textile Spinning	3.50%	247,990	2,075
Textile Processing	18.40%	2,155,043	4,262
Sugar	3.60%	1,149,901	1,698
Leather	6.90%	9,776	14
Pulp & Paper	6.30%	167,176	142
Total		3,729,886	8,191

Source: IFC-funded Study "Sustainable Growth: Cleaner Production in Pakistan" by National Productivity Organization (NPO) & Cleaner Production Institute (CPI)

on a voluntary basis. Some industrial units have already achieved savings of 287 GWh (15% of current electricity requirement) which translate into a cost saving of PKR 381 million. Most of energy saving measures were achieved in the textile and sugar industry.

The Table 11 shows the estimated energy and cost saving potential in the industrial sector of Pakistan. The investments in textile industry can be attractive as it offers highest energy efficiency gains with a total energy saving potential of 2,150 GWh and cost saving of over 4 billion PKR. Most energy efficiency gains therefore are planned to be achieved by implementing following fundamental measures:

- Improvement in Process Operation. e.g. proper metering in the textile and sugar industry;
- Replacement of low-pressure boilers with higher pressure boilers in the sugar industry;
- Installation of Variable Frequency Drive (VFD) or inverters on pumps and motors;
- Installation of Heat Recovery Systems (HRS) from exhaust flue gases in sugar and paper industry;
- Thermal insulation of steam lines and valves in almost all the industrial units;
- Improvement of Maintenance Operation i.e. reduction of air leakages; and
- Proper maintenance and operation of electrical motors. Electric motor-driven systems (EMDS) in the industry consume almost half of the total electricity. The cost-effective potential to improve the energy efficiency of electric motor systems in the industrial sector is about 20% to 30%.[26]

1.3.2.1 Textile Industry

Pakistan's textile sector is one of the most important contributors to economic growth, Natural gas accounts for about 70%[27] of primary fuel for the textile sector. Since, it is the highest electricity consumer amongst other industries, it is a potentially suitable area for energy efficiency. Most energy savings are planned to be achieved in the textile industry by the installation of meters, controls to reduce leakages of compressed air and improved maintenance of electrical motors.

1.3.2.2 Sugar Industry

Sugar is the second largest industry in Pakistan. As of 2016, there are over 89 sugar mills in the country producing over 5 million tonnes of sugar annually.[28] Energy in the sugar industry is consumed mainly in the form of steam (96%) and electricity (4%).[29] Energy requirements of sugar industry are largely met by combustion of bagasse which is a renewable energy source and a by-product of sugar production. Processing of every 3 tons of sugarcane, produces about 1 tons of bagasse .[30]

> Only three sugars mills have HPC technology in Pakistan where total sugar mills are 89.

Sugar industry offers good potential for energy efficiency by deploying the energy efficient technologies, such as the High-Pressure Cogeneration (HPC). HPC is an efficient power generation technology use high-pressure boilers (66 bar), widely deployed in the sugar industry across the world. It generates electricity based on bagasse consumption. Sugar mills with HPC technology consumes 46% less bagasse to produce the same amount of electricity compared to existing low-pressure technology (23 bar).[31]

Sugar mills in Pakistan can take advantage of this opportunity by using HPC technology and generate revenue by selling of electricity to the national grid. Despite all these competitive advantages of using HPC technology, only three sugars mills have HPC technology in Pakistan where total sugar mills are 89. With a production of 4.4 million tonnes of bagasse annually, Pakistan has the potential to generate about 1000 MW of electricity. According to Cleaner Production Institute, there is also a good potential in the sugar industry to reduce energy consumption and cost by insulation of steam lines and valves in sugar mills that can offer decent energy savings.

1.3.2.3 Cement Sector

Cement production is an energy-intensive process. The primary fuel for cement production is coal, which accounts for more than 90 per cent of energy consumption and thus it is the largest contributor of GHG emissions amongst industrial sector.[32] Energy prices havemajor impact on the cost of production as fuel and energy cost accounts for more than 60% of the total production cost of cement. Consequently, investments in more energy efficiency cement processing technologies can significantly reduce the fuel or energy consumption and as well as cut down the fuel emissions.

Pakistan has a production capacity of over 45 million tons of cement.[33] It is another industry where huge energy savings are planned to be achieved as it an energy-intensive sector. The electricity demand for cement industry is over 700 MW. Each ton of cement production requires about 80 to 100 kWh of electricity. In cement sector, most energy savings could be achieved by improving process related technology and equipment, including the raw material etc.

Currently, most cement units employ single stage dry kilns which can be shifted to the more efficient process of multistage dry kilns to improve overall energy efficiency of cementing process.

1.3.2.4
Leather Industry

The energy efficiency potential in leather industry is quite low as it is water-intensive manufacturing rather than an energy intensive. Leather sector uses steam as a thermal energy, natural gas, diesel and as well as grid electricity to meet its energy requirements. According to IFC, leather industry has annual energy saving potential of over 17,000 MWh. According to CPI, implementation of simple energy-saving techniques such as efficient lighting and installing controls for compressed air could help save $134,000 in energy costs annually.

> Simple energy-saving techniques such as efficient lighting and installing controls for compressed air are estimated to save $134,000 in energy costs annually.

In addition, proper metering and insulation offer best energy efficiency potential and reduce the energy consumption. The NAP as such envisage to tap these potentials in a phased manner.

1.3.2.5
Fertilizer Sector

In Pakistan natural gas is being used as raw material for producing fertilizer. Natural gas supply to Fertilizer was constrained and diverted to power and residential sector because of emerging acute gas shortages across the country. This led to massive production cuts of fertilizer units based on SNGP network. Due to this fact, the fertilizer production was drastically reduced to 256,000 tons against the production capacity of 2 million tons.[34] It has been the lowest production rate ever reported. As a result of this low production, the government had to spend over $1 billion to import urea and provided over PKR 80[35] billion in subsidy on imported urea which may have cost $450 million to the exchequer.

> Fertilizer sector will convert existing processes to a high-efficiency steam reforming and Haber-Bosch synthesis with the potential to reduce gas consumption by 25% by 2030

Therefore, fertilizer sector could be an ideal case to invest in energy efficiency technology and practices that will not only reduce their energy consumption and the fuel requirements, but it will also improve the economics of fertilizer production. The major step towards energy efficiency in fertilizer sector is to convert existing processes to a high-efficiency steam reforming and Haber-Bosch synthesis. It has the potential to reduce gas consumption by 25% by 2030.[36] Significant energy efficiency gains in fertilizer sector will be achieved by investing in co-generation, installation of meters and improvement of power factors etc.

1.3.2.6
Pulp and Paper

Currently, there are about 100 paper and pulp production units in Pakistan with a total production capacity of 434,740 tonnes.[37] The production of paper and pulp is an energy intensive process. The pulp and paper manufacturing mainly rely on natural gas as primary fuel to generate steam and electricity for paper production. According to a study conducted by the University of West Scotland, for each tonne of paper produced, Pakistan's paper sector consumes the additional energy of 1.46 MWh compared to the Canada and United Kingdom. In addition, pulp and paper mills in Pakistan have the potential to reduce their gas demand by 7%[38] and overall energy consumption by 5.6%[39] just by tuning their boiler burners and adjusting air-to-fuel ratios.

> By tuning boiler burners and adjusting air-to-fuel ratios of pulp and paper mills' gas demand can reduced by 7% and overall energy consumption will reduce by 5.6% .

1.3.2.7
Brick Kiln

The brick kiln sector in Pakistan is mostly unregulated and documentation of this sector is also very limited. There are over 18,000-20,000 brick kilns in Pakistan. The coal is the primary fuel for brick manufacturing and consumes more than 3 million tons of coal[40] making it a third largest contributor to GHG emissions in the industrial sector. Most-brick-kilns still use the bull-trench process for brick production, which have been phased out in almost all the developed regions. The NAP as such envisages to promote alternative "Zig Zag" technology considering its potential to save 30-40% energy and 70% reduction in emissions.

> An alternative brick kiln's "Zig Zag" technology will be employed as it saves 30-40% energy and 70% reduction in emission.

1.3.3
Energy Efficiency in Transport Sector

The transport sector accounted for 33.93% of total final energy consumption in 2017. With a contribution of over 13% to Pakistan's GDP, oil (liquid fuels) dominates in the transport energy consumption mix, while the share of natural gas is about 10%.

Much of this gasoline demand is coming from increasing number of motor cars and motorcycles which have been growing at an excessive rate (CAGR) at 10% (See Fig. 10). The NAP as such

envisages to achieve 10% fuel efficiency through sensitization of car users about efficient driving and other fuel consumption measures.[41]

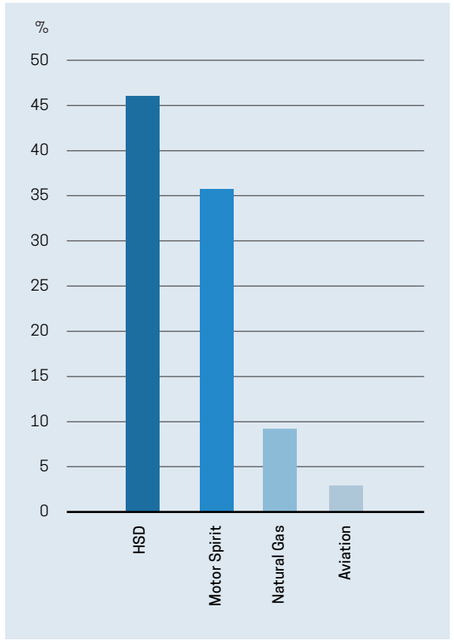
1.3.3.1
Road Transport

Pakistan's vehicle population is over 13 million.[42] Since 2000, it has been annually increasing at the rate of 10%.[43] At the government level, NEECA has been assigned to develop a suitable standardization mechanism to monitor and improve fuel efficiency for vehicles. a sizeable energy saving potential can be realized if proper maintenance, tune-ups, and fuel efficiency standards are applied on all kinds of vehicles.

In this regard, one of the key areas is addressing the trucking business for cargo services. These trucks are highly inefficient as their design is not synchronized with latest scientific practices of aerodynamics. According to one estimate the only change in design of truck can save around 26 % of energy consumption.

The conversion efficiency of conventional CNG vehicles is only 17% to 21%.[44] This implies that this precious natural gas resource is being wasted that could have been utilized much efficiently in processes like power production for which the conversion efficiency is much higher. Therefore, NAP envisages to adopt latest power technologies, like Combine Cycle Natural Gas (CCNG) having potential of achieving a conversion efficiency of over 60%.[45]

Fig 11 **Energy Consumption by Transport Sector**



Note: Consumption of HOBC, furnace oil, kerosene, and E-10 is almost negligible in transport sector

Source: Energy Year Book 2017

Recently, public sector has successfully completed the Mass Transit Projects i.e. Metro Bus Service in Islamabad, Multan and Lahore. Similar projects are also being planned for other cities like Karachi, and Peshawar. The NAP envisages to initiate a Mass transit projects in other cities to achieve the fuel efficiency and conservation on larger in road transportation system.

> The conversion efficiency of conventional CNG vehicles is only 17% to 21% .

1.3.3.2
Fuel Efficient Cars: Hybrid and Electric Vehicles

There is a strong case for Pakistan to develop Electric Vehicles market, because of advantages of lower energy consumption, reduced fuel and health costs and the GHG emissions. The environmental and economic benefits of using electric technology for urban transit and public buses are even higher than passenger cars.

Major barriers to adoption of EVs are costs, limited driving range and the charging infrastructure. In Pakistan, wholesale diffusion of EVs still appears to be far away into the future. Deployment of EVs requires the building of necessary infrastructure which would be enormous, especially power generation and distribution network to charge all those electric vehicles and installation of charging stations across the country. Nonetheless, future of EVs looks promising with increasing share of renewables into the grid and declining costs of battery technology.

The NAP envisages to follow a more energy efficient policy to encourage manufacturing and importing fuel efficient cars and electric vehicles.

1.3.3.3
Railway Transport

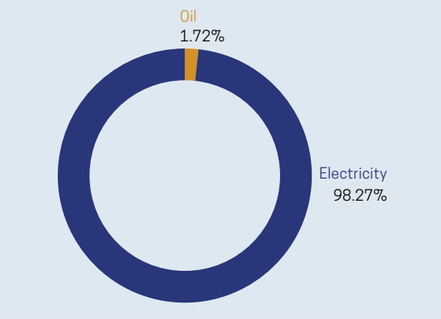
Railway transport is to play an important role in achieving energy efficiency and sustainable mobility. In Pakistan, about 72% of crude oil and petroleum products are transported by road, 19% by pipeline and remaining 9% by railways.[46] In developed regions, this trend is quite opposite.

Railways is the most preferred way to transport oil and petroleum because of the efficient movement and safety reasons. The railroads consistently spill less crude oil per ton-mile transported than any other mode of land transportation.[47] Because of these reasons, Government of Pakistan will prioritize and consider freight transport as a most-preferable mode for oil and petroleum. As per findings of a study conducted through ADB, the cost of transportation of one tonne of freight by railways is 80% less than conventional road transport. However, only 4% of the total freight is carried out by railways. The NAP envisages to increase this percent up to 15% of total freight to be carried by railways.

1.3.4
Energy Efficiency in Agricultural Sector

Pakistan's 62.63 % population lives in rural areas which rely on agriculture[48] to sustain their livelihood. In agriculture sector energy is consumed for operating water pumps for irrigation and tractors for soil preparation (See Fig.11). The use of commercial energy is also steadily increasing with growing number of mechanized practices to improve agricultural productivity. The process of irrigation through diesel and electric powered pumps is extremely inefficient. Effective energy efficiency measures can help farmers save energy, increase yields, and reduce production costs.

Fig 12 **Energy consumption in Agriculture Sector FY-2017**



Source: Pakistan Energy Year Book 2017

> Over 180,000 tube wells are connected to the electric grid consuming more than 10% of the total electricity. Replacing tube-wells with efficient pumps will save 1000 MW.

In Pakistan, over the last five years, over 90% of the energy consumed in the agriculture sector is in the form of subsidized electricity, while 10% is supplied by oil in the form of High-Speed Diesel for irrigation pumps and machinery. Use of solar photovoltaic will be cost effective option to convert existing low-headtube wells to run on solar, thereby improving independence and reducing the overall pumping costs. The low head pumping requirement for these areas, these pumps are particularly suitable for solar conversion with an investment of PKR. 1.5 million and they offer a very low payback period of about three years. If converted to solar, these tube wells can potentially save HSD fuel by about 27%.[50]

Previously, an initiative to improve energy efficiency in the agricultural sector was launched with the assistance of the USAID in 2009. The tube well Efficiency Improvement Program (TWEIP) was introduced to reduce power demand of existing tube wells and replace them with more efficient pumping systems. The program offered 50% subsidy to potential farmers, which helped reduce the power consumption of tube wells by 7 mega-watts.

The NAP therefore envisages initiating a program to replace 30,000 existing diesel-based pumps with solar pumps in a phased manner. In addition, farmers will be given incentives to replace inefficient pumps with more efficient ones.

1.3.5 Supply, Transformation, Transmission & Distribution Efficiency

ransmission and distribution losses of Power and Natural Gas in the country are one of the highest in the region. In 2016, it was between the range of 9.47% and 38.56%[51] compared to 7% in Europe (See Fig. 13).

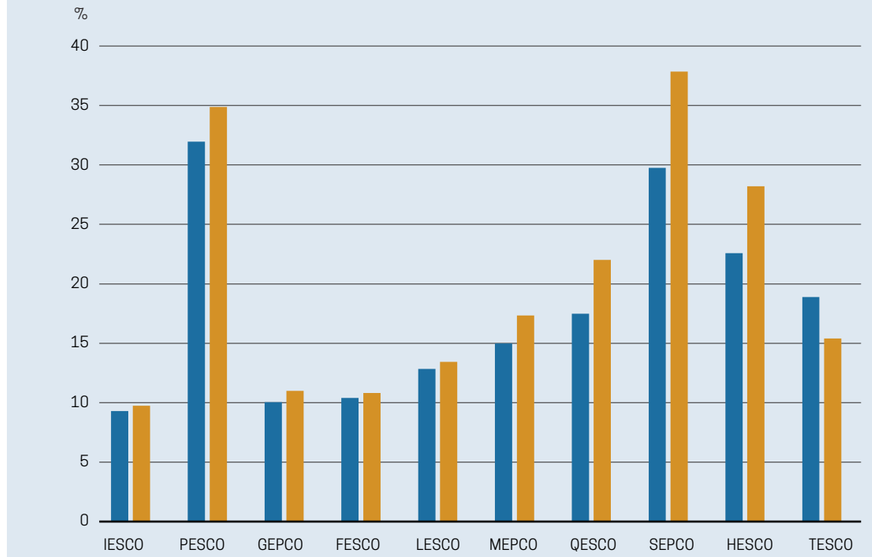
Similarly, a huge volume of natural gas is lost due to theft, leakages, and non-recovery of bills. The UFG (Unaccounted for Gas Losses) losses in southern (SSGC) network are about 15%, but the permissible limit is about 4.5%[52] in 2016. This is reported to be one of highest UFG losses in the region. Whereas, the UFG losses in northern (SNGPL) network stands at about 11.5%. This indicates the potential for improvement in efficiency of the transmission and distribution of gas network, which would not only lead to cost

Table 13 **Possible Interventions and Potential Energy Savings in Agriculture sector**

Intervention	Saving Potential	Potential Sector Investment (M PKR)
Use of mechanical seal pumps instead of gland-packed pumps	1-2 %	
Use of energy efficient electric pumps, motors, and diesel engines	20 %	
Installation of properly sized pumps	5 %	10,000
Proper maintenance of pumping system	5 %	
Installation of Variable Speed Drive (“VSD”)	5 %	

Source: International Finance Cooperation

Fig 13 **Power distribution losses in DISCOs in Pakistan**



Source: National Electric Power Regulatory Authority (NEPRA)

savings but reduce primary energy demands for various natural.

The NAP envisages to introduce smart metering technology for natural gas and power consumers. Along with the upgradation of transmission and distribution system. Smart metering technology has been proven to be very useful and effective in reducing the losses, improving the accuracy of measurements and billings.[53]

1.3.6
Energy Efficiency in Power Sector

1.3.6.1
Energy Efficiency in Buildings

Buildings consume a significant amount of energy. According to IEA, buildings sector consumes more electricity than any other sector. Generally, the space heating, space cooling, refrigeration, cooking, and lighting are one of the major end-use activities in the buildings sector.
Although, Pakistan Engineering Council (PEC) has developed Pakistan Building Codes Regulation 2011 with a provision to employ energy efficiency in the buildings sector of Pakistan, it lacks a clarity as to how these codes can be enforced. Establishment of the Pakistan Green Building Council is a positive step towards improved energy efficiency in the building sector. PGBC operates under the framework of World Green Building Council. PGBC use an international LEED (Leadership in Energy and Environmental Design) certification system of the USA. Besides, PGBC is also establishing the indigenous standards for energy efficiency for local buildings.

1.3.6.2
NTDC's Expansion Plan

To cater for transmission of power from upcoming generation power plants and strengthening of the existing system, NTDC has planned up-gradation of its system. By the end of 2017, 3 new grid stations at 500 kV level will be added which will add 3,750 MVA in transformation capacity in the system, the fourth 500 kV grid station will be completed by the end of 2020 adding additional 1500 MVA to the system. At 220 kV level, 8 new grid stations with a cumulative transformation capacity of 5750 MVA will be added in the system. Similarly, one overloaded 500 kV grid station will be strengthened, while six such grid stations at 220 kV level are being improved by 2019-20 (See Annex XV).

1.4
Projections for Primary Energy Supply and Final Energy Consumption by 2030

While considering the targets envisaged in the preceding sections, it is estimated that the overall Commercial Primary Energy Supply and Final Energy Consumption will be increased by 88% and 76% respectively by 2030.

Oil

In the case of oil, the final primary energy supply of the oil would be 45 MTOE, which would still be insufficient to fulfill the country's demand. This requires development of additional infrastructure such as pipelines, refineries and downstream distribution network and aligned infrastructure.
It is anticipated that domestic exploration and production activities would boost once law and order situation in western provinces (Balochistan and KP) has improved. In addition to setting up new refinery projects, capacity expansion of the existing refineries is required. This offers good opportunities for the foreign companies.

Table 14 Projected Primary Energy Supply Mix by 2030

S. No	Source		2030	% Change (over 2017 to 2030)
A	Commercial Energy	MTOE	% Commercial + Non-Commercial Energy	
	Oil	45	25%	64%
	Gas	50	28%	66%
	LPG	3.5	2%	247%
	LNG	8	4%	80%
	Hydel	25	14%	226%
	Coal	10	6%	54%
	Nuclear Electricity	4.28	2%	156%
	Renewable Electricity	4.8	3%	655%
	Wind	1.8	1%	
	Solar	3	2%	
	Others (Geothermal & bagasse)	0.65	0%	
	Imported Electricity	0.1	0%	-15%
	Subtotal	151.33	84%	90%
B	Non-Commercial Energy			
	Wood / Dung / Others	28	16%	65%
	Subtotal	28	16%	65%
A+B	Grand Total	179.33	100%	71%

Source: Author's Estimate Based on Energy Year Book 2017 and MOE data

Similarly, Pakistan's domestic gas production is expected to decline to 2 billion cft by 2020. Demand, on the other hand, is expected to ascend to 8 billion cft by that time, creating a 6 billion cft shortfall. In order to overcome demand/-supply gap, import of natural gas into Pakistan from gas-rich countries in the region including Iran, Turkmenistan and Qatar are suitable option. Moreover, Pakistan must continue improving the investment climate in the gas exploration and production sector.

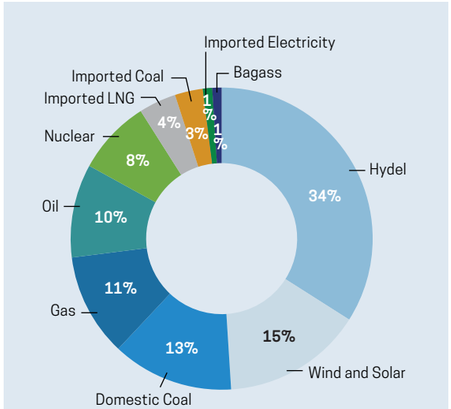
Projected Primary Energy Supply

The total Primary Energy supply has been estimated at 179.33 MTOE out of which 151.33 MTOE would be met from commercial energy source. It is estimated that share of commercial energy in overall primary energy supply will increase by 90 % compared to 2017.

1.4.1 Final Energy Consumption

This Action Plan projects that share of final energy consumption by 2030 will 88 MTOE, whereas the non-commercial energy will be 28 MTOE and total from both will be 116 MTOE. The analysis shows that that overall share of electricity will increase 260% by 2030 as compared to the electricity use of 2017.[54] The share of oil and gas is expected to decrease in overall final energy mix. However, the share of coal will increase 56 percent by 2030 as compared to the electricity use of 2017. Although the share of non-commercial energy will increase in absolute terms approximately 28 MTOE by 2030. But in relative terms the non-commercial energy share will decline.

Fig 14 **Pakistan's Projected Power Generation by 2029-2030**



Source: Author's Own Estimate Based on Energy Year Book 2017 and MOE

In addition to the above due to adaption of comprehensive power generation policies and plans additional electricity of 75,000 MW would also be made available which will result in reduction of non-commercial energy share.

The projected power generation by 2030 is 102425 MW from diverse sources, however, there will shift from thermal power generation which is based on imported oil to indigenous resources. It evident from the table that the share of thermal is already decreasing from 65% due to 31.65% by 2030 The share of Hydel and other renewables (e.g. Solar, Wind, Bagasse) will also increase considerably (See Table 18).

The projected power generation by 2030 comes out to be 102,425 MW which corresponds to NTDC demand under high growth scenario 104210 MW assuming a growth rate of around 10%.

Table 15 **Projected Final Energy Consumption by 2030**

S. No	Source	2030		% Change (over 2017 to 2030)
A	Commercial Energy	MTOE	%	
	Oil	22	0.19	23%
	Gas	25	0.22	47%
	Electricity	28	0.24	260%
	Coal	9.5	0.08	56%
	LPG	3.5	0.03	167%
	Subtotal	88	0.76	76%
B	Non-Commercial Energy			
	Wood/Dung/Others	28	0.24	65%
	Subtotal	28	0.24	65%
A+B	Grand Total	116	100%	88%

Source: Author's Estimate Based on Energy Year Book 2017 and MOE data

Table 16 **Pakistan's Projected Power Generation in MW by 2029-2030**

S.No	Source	Existing (2017-18)	2018-19	2021-22	2024-25	2029-2030
1	Hydel	7122	12089	12089	27196	34500
2	Oil & Gas	16,370	13370	13370	13370	12000
3	Domestic Coal	633	810	4440	8400	13225
4	Imported Coal		2640	3600	3600	3600
5	Imported LNG		3600	3600	3600	3600
6	Nuclear	705	2445	3545	4645	8000
7	Imported Electricity			1000	1000	1500
8	Bagasse	146	850	919	1200	2000
9	Wind and Solar	902	2231	4732	9582	24000
	Total	25,878	38,035	47,295	72,593	102,425

Source: Author's Estimate Based on Energy Year Book 2017 and MOE data

PART-2

PRIORITY ACTION AREAS

2.1 Priority Action Areas

To achieve the targets given in part I of the NAP, Government intends to take concrete steps through a comprehensive action plan to be implemented in collaboration with provinces, private sector, local government and the community. Access to energy is the one of top priorities of the Government of Pakistan and considerable measures have been taken in the recent years. The access to energy is in urban areas has improved to great extent. However, there is still considerable efforts required to ensure universal access in rural areas. There are initiatives taken by the government to ensure universal access to energy. These initiatives are discussed in the following sections.

2.1.1 Energy Access - The Status and Trajectory

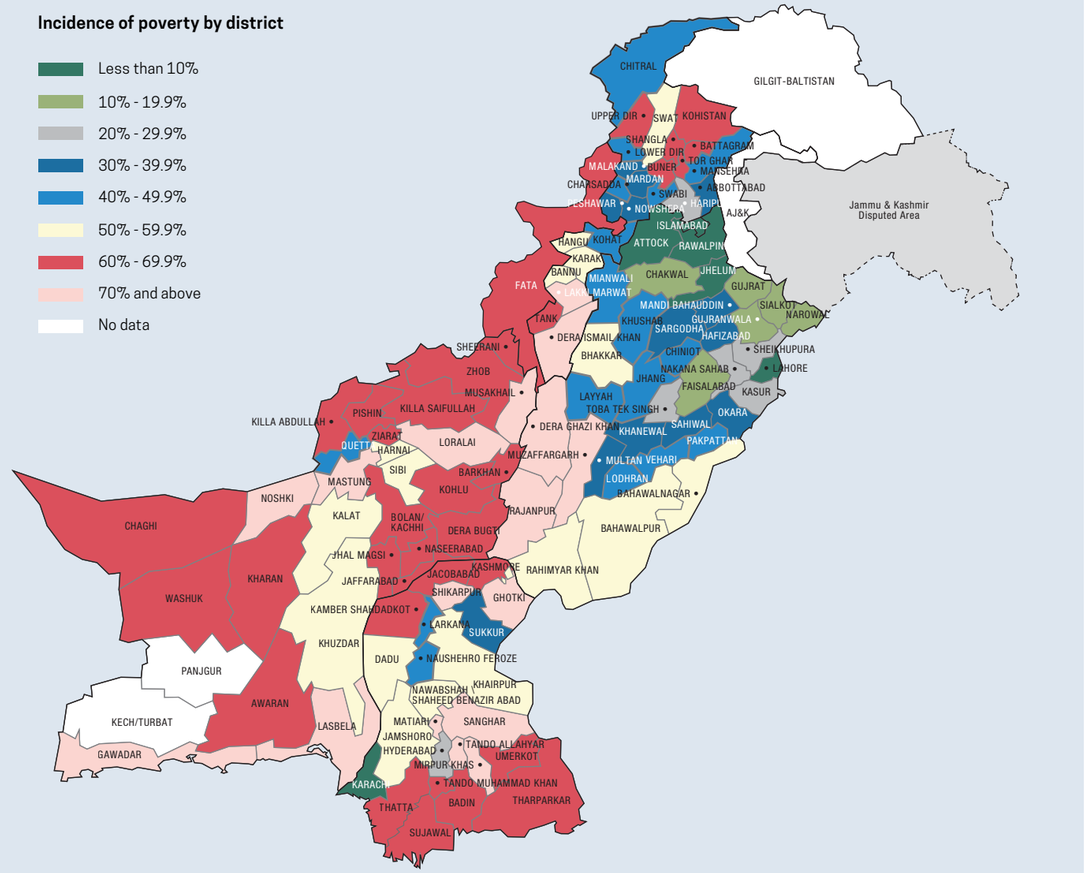
According to Global Tracking Framework, Pakistan's energy access situation has improved exponentially from 1990-2014, where the national electrification rate of urban has increased from 58.74%in 1990 to 97.53% in 2014. The situation of urban electrification is 100% by 2014. Access to clean cooking fuel and technologies has increased from 23.77% to 44.84%during 2000-2014.

UN Multidimensional Poverty Report 2014-15, the incidence of poverty is highest in Balochistan followed by KP, Sindh, and GB. This is consonant with the energy access maps as the districts with low energy access are the ones with the highest incidence of poverty. These districts will be prioritized for installing off-grid RE projects. See (Fig 15) for the districts with a high incidence of poverty.

Based on the level of electricity access and the incidence of poverty, priority districts have been identified in the table below, which the provincial governments will target for off- grid electrification in the next 5 years. Work in some of these districts has already been initiated, details of which are summarized in the following table (Table 18).

Pakistan has a large geographical area with diverse topography and terrain which requires diverse energy solutions. Similarly, all these areas have different set of challenges to ensure universal energy access. Following is the list of the key challenges and proposed interventions (Table 19)

Fig 15 **Incidence of Poverty by District 2014-15**



Source: UNDP Multidimensional Poverty Index Report 2014

2.1.2

Completion of On-Going Plans / Strategies

The following are the existing off-grid plans and programs under the provincial governments to contribute towards electricity services. Upon their completion these programs are envisaging to contribute around 1150 MW electricity through solarization and micro/mini-grids.

Table 17 **Recommended Priority Districts for Off- Grid Lighting Programs**

Region	Priority Districts
Punjab	Bahawalnagar, Rahim Yar Khan, Bahawalpur, Rajanpur, Dera Ghazi Khan, Vehari, Khanawal, Multan, Lodhran and Muzaffargarh
Sindh	Thatta, Badin, Tharparkar, Umerkot, Mirpur Khas, Sanghar, Matiari
KP	Kohistan, Batagram, Upper and Lower Dir, Buner, Shangla, Tor-ghar, Karak, D.I.Khan, Bannu, Lakki-Marwat and Kohat
Balochistan	Awaran, Chaghi, Zhob, Sherani, Killah Saifullah, Barkhan, Kohlu
AJK	Neelam, Haveli Kahuta, Hattain
Gilgit-Baltistan	KharmongHunza, Gilgit,Ghaza
FATA	Parachanar. Kurram, Orakzai

Source: Review of Government Programs and SEforAll Review Meeting

Table 18 **Challenges and Recommended Interventions for Access to Electricity**

Region	Key Challenges	Recommended Interventions
Gilgit-Baltistan	Difficult terrain and lack of connectivity with the national grid. Lack of financing available from International donor agencies to timely execution of planned projects. Lack of capacity of Water and Power Department of GB.	Interconnectivity of all parts of GB by developing the regional grid. This will ensure that surplus electricity in one part of the region can be transmitted to another. Extending technical assistance to GB Water and Power Department for their capacity building Connecting GB to the national grid to attract private sector investment for power projects in the region. Setting up micro/mini hydel stations for unconnected and underserved areas of the region. (See List of Solicited Projects Annex XIV)

Table 18 Challenges and Recommended Interventions for Access to Electricity

Region	Key Challenges	Recommended Interventions
AJK	Dilapidated grid infrastructure and power project issues in the absence of NTDC presence in the region. Lack of capacity of AJK power department to undertake major power generation projects.	Facilitating private sector investment for power projects in AJK by easing regulatory and institutional hurdles. Exploit the hydel potential in the north and solar potential in the south for powering off-grid communities. Channel investment in upgrading the transmission and distribution infrastructure in AJK.
Sindh	Power Evacuation has emerged as one of the main problems from newly established Renewable Energy Power sites. Lack of financial and technical capacity of the concerned DISCOs to extend the grid to off-grid areas.	Increased penetration of solar home systems through micro-financing and/or pay-as-you-go-systems. Facilitating private companies engaged in the distribution of solar home systems for un-served and underserved communities. Setting up hybrid plants (solar+wind, solar+gas)
Balochistan	Lack of grid infrastructure for a scattered population over a large area; Present 132 kV lines are not sufficient to meet the current demand of 1600MW of the province. Inability to evacuate the power from the province if province solar generation potential is optimally utilized. High dependency on electricity to pumps groundwater for irrigation.	Expansion of transmission and distribution network in the province. Distribution of Solar Home Systems to off-grid communities on subsidized rate considering lower per capita income in the province. Replace of conventional power pumps with more efficient solar PV powered pumps. This measure is expected to reduce power demand by at least 400 MW.

Table 18 Challenges and Recommended Interventions for Access to Electricity

Region	Key Challenges	Recommended Interventions
KP	Limited affordability of rural population and low connection efficiency in remote areas constraining viability of rural electrification projects.	Setting up mini/micro hydel stations in the northern KP. Distribution of solar home systems in southern KP
Punjab	Business models for commercially viable operations of renewable energy off-grid projects are not well established yet hindering investment by either public or private sector.	Provision of fiscal and/or financial incentives for the private sector to invest in RE off-grid projects Implementing business models that minimize reliance on subsidies and/or grants from the government and generate adequate tariff-based revenue stream for recovery of at least operation and maintenance costs Technical support for communities to install and operate RE technology

Source: Review of Government Programs and SEforAll Review Meeting

Table 19 Existing Programs on Off-Grid Electrification

Region	Program/ Project Name	Beneficiaries/ Purpose	Implementing Agency	Funding Sources	Execution Period
Punjab	Khadam-e-Punjab Ujala Program(KPUP)	Solarization of 20000off- grid schools and BHUs	Punjab Energy Department	ADB	2016-2020[1]
	Energy solution using indigenous resources in villages (PV and Biogas Hybrid)	Vehari and Faisalabad	Directorate of Power Projects, Punjab Energy Department	Annual Development Program	2017-2018
Sindh	Pakistan Solar and Renewable Energy Program	50,000 households could be electrified	Sindh Energy Department	World Bank	2017-20

Table 19 Existing Programs on Off-Grid Electrification

Region	Program/ Project Name	Beneficiaries/ Purpose	Implementing Agency	Funding Sources	Execution Period
Sindh	Solar Electrification of 284 BHUs	Solar Systems are being handed over to School Management Committees through respective District Education Officer	Sindh Energy Department	otal Cost PKR. 454 million to be funded by ADP	2017-20
	Scheme I Electrification of 40 homes each in 300 villages Scheme 2: Electrification of 5000 Schools on Stand Alone off-Grid technology in 10 Border Districts of the province	12,000 households altogether in 300 villages will be electrified through solar home systems	Sindh Energy Department	Total Cost is PKR. 0.5 billion to be funded through ADP	2016-18
	Construction of 230 Biogas Plants in Rural Areas	Rural Populations	Sindh Energy Department	20 million by ADBz	2017-18
Khyber Pakhtunkhwa	Mini/Micro Hydel Schemes	356 stations to be set up in 12 districts through 6 NGOs (35 MW). 248 completed and 108 under construction. To be scaled up to 1028 stations with cumulative capacity of 100 MW targeting 1.0 Million population	Pakhtunkhwa Electricity Department (PEDO)	PEDO, ADB	2016-2020 2017-2020

Table 19 Existing Programs on Off-Grid Electrification

Region	Program/ Project Name	Beneficiaries/ Purpose	Implementing Agency	Funding Sources	Execution Period
Khyber Pakhtunkhwa	Solar Home Solutions	Chitral – 3750 households Central/Southern Districts – 2,950 households	Pakhtunkhwa Electricity Department (PEDO)	ADB	2016-2020
	Solarization of Schools and BHUs	8000 Schools and 187 BHUs will be solarized with cumulative capacity of 50 MW	Pakhtunkhwa Electricity Department (PEDO)	ADB	2018-2020
	Solarization of Mosques	4440 Mosques will be solarized	Pakhtunkhwa Electricity Department (PEDO)	KPK – ADP	2018-19
Balochistan	Provision of Solar System for Water Access	Tapping shallow groundwater emanating from perennial streams of the river basins of Zhob and Mula, using solar-powered systems in off-grid locations	Balochistan Energy Department	ADB	2018-2022
FATA	Micro Hydel	19 Small Hydropower Projects for Power generation and irrigation	FATA Secretariat	ADP	2017-2020
AJK	Solarization of Schools and Hospitals	400 Schools and 100 BHUs	AJK Electricity Department	ADP	2017-2020

Table 19 Existing Programs on Off-Grid Electrification

Region	Program/ Project Name	Beneficiaries/ Purpose	Implementing Agency	Funding Sources	Execution Period
AJK	Solarization of Remote Areas	10,000 Houses will be electrified	AJK Electricity Department	ADP / Community Participation	2017-2022
	Solarization of office buildings and hospitals	More than 100 buildings and 5 hospitals in GB	GB Water and Power Departments	GB ADP	2018-2025

Source: Review of Government Programs and SEforAll Review Meeting

2.1.3 Actions Needed to Achieve Energy Access: Modern Cooking Appliances and Fuel

Government's plans to provide LPG Air-mix plants/facility to population of far-flung / hilly areas. GOP will be installing 60 LPG Air Mix plants, out of which 28 will be in Balochistan, 2 in Sindh and the remaining 30 will be set up in Punjab, KP, AJK, and Gilgit-Baltistan. According to Petroleum Division of Ministry of Energy the size of these plants is going to be between 0.5 and 1 mmcfd.

Assuming an average size of 0.75 mmcfd,[2] one LPG air mix plant will serve gas to 7,500 households. 60 such plants will serve 450,000 households by 2018. The cost of these plants is estimated to be PKR. 2500/mmbtu. However, the government will be giving subsidy to the consumers charging them PKR. 600/mmbtu, which is about one-third price of an LPG cylinder of 11.8 kg.

2.2. Status of Renewable Energy in Pakistan

2.2.1 Biomass Energy

Pakistan has approximately 50 million[3] animals for agricultural and livestock-related activities. On average, the daily waste produced from a cow, bullock or bull (the most common animals kept in Pakistan) is around 10kg, if 50% of this can be collected for fuel; it amounts to 150 million kg translating into around 12 million cubic meters of biogas. The potential uses of this are for households (cooking/ lighting) and industry, transportation and to generate electricity helping to reduce the dependency on fossil fuel imports in rural areas.

Biogas is a particularly suitable fuel for rural areas that are not connected to the gas network. In

Table 20 Planned LPG Air Mix Plants

Region	Villages/Towns	Target (2017-2020)	Estimated No. of Household Served
Punjab	Phagwari, Sher Bagla, Rawat, Ghoro Gali, Charhan, Dhanda, Ariari, Karor, Kotli, Santh Anwali, Kahuti, Lehtrar, Narrar and Panjar	15	112,500
Sindh	Umerkot and Mithi	2	15,000
KP	Chitral, Ayun and Malkot	3	22,500
Balochistan	Zhob, Qilla Saifullah, Loralai, Kharan, Musakhail, Qilla Abdullah, Keecha, Khuzdar, Uthal, Winder, Muslim Bagh, Killi Khanzai, Chaman, Sherani, Sanjawai, Sanjawi, Chagi, Panjgor, Harnai, Washuk, Sohbatpur, Wadh, Khuzdar, Barkhan, Bagh, Mitri, Injeera, Gandva, Kohlu and Lehri	28	210,000
AJK	Muzaffarabad, Rawalkot, Kotli, Palandri, Forward Kahuta, Bagh, Hajira, Abbaspur, Dhirkot and Bhimber	10	75,000
GB	Gilgit and Skardu	2	15,000
Total		60	450,000

Source: Petroleum Division, Ministry of Energy

these areas, it provides the residents with an environmentally friendly alternative compared to LPG, coal, diesel or kerosene. In rural areas, materials that can be fed into a biogas digester are mostly readily and locally available: agricultural residues, manure, crops, etc. Furthermore, wastes from landfills or sewer treatment facilities can be used as input materials.

As an agricultural-based economy, biomass is readily available in most areas of Pakistan, particularly in rural areas. Biomass energy offers significant environmental advantages: it saves space in landfills by reusing waste products and is comparatively environmentally friendly.

2.2.2 Bio-Fuel

The bio-energy alternative is an exciting prospect for Pakistan as it provides an easily available fuel that can fit into today's gasoline and diesel engines with minimal or no changes to existing systems. Since we are an agriculture-based economy, production of biodiesel in Pakistan will strengthen our agricultural sector and empower

the farmers.

Pongamia is an example of plant that could be grown to yield biofuel. The plant can grow on marginal, waste or arid land. Pakistan has large areas of such poor-quality land (more than 80 million acres), ideal for the cultivation of energy crops, so growing Pongamia would not divert land away from growing vital food crops.[4]

To produce biodiesel, besides vegetable oil, alcohol (ethanol or methanol) is also required. It only constitutes about 10% of the volume of biodiesel. - Ethanol is abundantly available owing to the large sugar industry.

To promote the bio-fuel energy, following on-going activities in the public sector will be completed[5] during the planned period:

I. AEDB is targeting to gradual introduction of biodiesel fuel blends with petroleum diesel to achieve a minimum share of 10% by volume of the total diesel consumption in the country by 2025. Furthermore, AEDB would also be engaging Pakistan State Oil (PSO) for furthering the National Biodiesel Program.

II. The cultivation of biodiesel was has increased to more than 700 acres in 2010 compared to 2 acres of 2005. Many institutions imported Jatropha seeds for germination from a variety of sources and countries. They have been growing such nurseries at various sites in Sindh, Punjab, and Balochistan. This coverage will be further increased substantially through engagement of private sector.

2.2.2.1 Private Sector

I. Nishat group awarded the electromechanical construction of 6 MW coal and biomass based power project to Descon Engineering Ltd. It will be using solid municipal waste, used tires, rubber chappals, rice husk, wheat straw and corn-cob, as fuel for heating purposes. In addition, a feasibility study for a 25 MW solid municipal waste based power plant has already been completed for the National Industrial Park at Sheikhupura and the work on the project would start soon.

II. K-electric has incorporated a new entity, Karachi Organic Energy Limited (KOEL), to undertake the Biogas project at Cattle Colony, Karachi. KOEL will be utilizing biodegradable waste from the Cattle Colony and organic food waste from the city to produce 22 MW of electricity and 100,000 tonnes per year of organic fertilizer.

III. A 12 MW biomass to energy power plant at Mirwah Gorchani Town, Mirpurkhas, Sindh, will be set by private sector.

2.2.3 Solar Energy

The developments in the solar sector, the demand for new generation and GoP's plans to harness clean sources of energy have led to a surge in interest from several local and foreign investors for developing on-grid solar power projects in Pakistan.

To date, 400 MW of Solar PV plants have achieved Commercial Operation Date (COD). These are part of the 1,000 MW solar park being set up in Cholistan, Punjab. 23 projects of the total capacity of 554.8 MW are at various stages of development within the framework of AEDB policies and procedures.[6] Out of the 23 projects that have been given Letter of Intent (LOI), 7 have been issued Letter of Support (LOS) directly by AEDB and four have been issued tri-partite LOS with Punjab Government. Upfront Tariff has been awarded to 8 of these IPPs by NEPRA; 7 projects of 72.48 MW are in the process of achieving financial close while three projects of 100 MW each have signed a power purchase agreement with CPPA-G and are operational since July 2016.

AEDB is offering Federal Govt. Guarantee to projects initiated under provincial LoIs, provided they obtain a tripartite LoS (AEDB, Prov. Govt. and IPP). Required amendment in the RE Policy 2006 was approved by ECC on May 21, 2015. Standard Templates of LOS, PG, Facilitation Agreement and Coordination Agreement have also been approved by the ECC.

Given the excellent solar irradiance throughout Pakistan, particularly in the south where connectivity to gas and electricity network is the lowest, solarization of homes, schools, hospitals, community buildings, and government offices will substantially reduce the demand to expand the grid to these areas while providing an uninterrupted supply of electricity. During the plan period, following on-going off-grid solar projects will also be completed:

I. Distribution of basic solar products to low-income households at provincial level: These include 200-Watt panels, to power three to four LED lights, a pedestal and a ceiling fan and a couple of mobile charging slots as promotional activity as well as in some areas on subsidized rate.

II. Solarization of un-electrified primary schools and basic health units in rural areas: The project offers the basic utility of electricity to those primary schools in rural areas, which do not have access to grid electricity. The schools will have a standalone solar with a battery backup to power six (6) LED lights and two (2) fans. Stand-alone, emergency equipment in the basic health units will be electrified through solar energy.

III. Distribution of Solar Products by NGOs and Energy Service Companies in off-grid areas under pay-as-you-go schemes.

2.2.3.1 Solarization of Government School and Colleges

Schools, colleges, and universities will be powered using Solar PV technology through either standalone system with a battery backup or through the installation of microgrids of

5kWp-115kW. As per the district educational profiles published by National Education Management Information System Academy — Balochistan and Sindh have the highest percentage of schools without access to electricity. These schools mostly fall in the districts earlier identified as the ones with highest poverty incidence. For example, in Balochistan – Awaran, Barkhan, and Chaghi each have less than 10% schools with access to electricity while in Sindh – Thatta, Tharparkar and Sujawal have the lowest access rates. Schools in such districts will be prioritized for solar system installations in the next couple of years. The recommended priority districts along with the number of institutions without access to electricity in each of these districts is given below. The subsequent investment prospectus will develop the costing for these schools' electrifications (See Annex VII).

The solar system required for these schools financing options may be explored by the Government of Pakistan. The third-party contractor will be hired for the installation, as well as operation and maintenance of these solar systems over the lifetime. Monthly charges for operation and maintenance will be decided at the time of installation with yearly upward revision for the contractor. For a more sustainable solution, the electricity which will be produced after school hours, when it is not used, during the non-working day from these systems will utilize the net-metering mechanism for payment of operation and maintenance changes to the contractor.

2.2.3.2

Promotion of Solar Heating

Solar energy has proven to be a viable resource as solar water heating technology AEDB implemented a Consumer Confidence Building Program to promote a solar water heating system in Pakistan.[7] The main factors contributing to the growth pattern are increasing scarcity of natural gas, the reliability of energy source and increasing affordability.

Solar water heating is particularly feasible for areas, like Gilgit-Baltistan and/or villages in AJK, KP, and Punjab, with no access to the traditional piped gas network. The utilization of solar water heating technology replacing the natural gas or conventional sources will have a significant impact on economic, environmental, and social sustainability.

2.2.3.3

Promotion PV Solar Powered Water Pumps

Water pumping is essential for farmers during the dry season, and therefore a major expense for farmers during this season is electricity (when the grid is available) or diesel oil in off-grid areas. With a fuel consumption of around 3 to 5 liters per hour, the average daily expense per pump is approximately PKR 700 per day ($7/day) in fuel costs every day. [8]

Solar water pumping, levelized cost of energy is at parity with grid energy. The promotion of solar pumping will reduce demand for grid electricity as solar energy is used for powering the pumps for 6-8 hours per day.

2.2.4

Wind Energy

A mapping exercise of wind energy potential undertaken by the government of Pakistan through World Bank assistance establishes the potential of around 130,000 MW. The major wind resource areas in the country include Hyderabad to Gharo region and coastal areas south of Karachi in southeastern Pakistan, hills and ridges in northern Punjab and near Mardan and Islamabad in northern IndusValley, and near Nokkundi and hills and ridges in the Chagai area and Makran in the southwestern part of the country.

Province of Sindh has a Wind Corridor with area coverage of 10,000 sq.kms and it is estimated to generate wind power of over 50,000 MW.[8] The corridor is an exceptionally good resource for generating wind power with an average wind speed ranging from 6.9 to over 9 m/s and power density of 600 to 800 Watt/sq.meter, where a wind power plant can easily achieve the capacity factor of over 35% at a hub height of 50m.[9] [10]

During2016, 1,000 MW of wind power potential was identified in Rajanpur district, development of which is being carried out by the Danish Company Vestas.[11] Four pilot projects, of 250 MW each, would be developed for which Punjab government would provide all the possible facilities.

Currently, in Pakistan, the installed wind capacity is 1326 MW, which are all located in Ghoro-Keti Wind and Jhampir corridors in the southern part of Sindh. Another 450 MW is under construction. NTDC has also approved feasibility study of 1224 MW additional wind plants in Jhampir. Lastly, 625 MW is in the pipeline as the LOIs has been issued by Sindh Government. Thus, a cumulative capacity of 7000 MW wind power projects is estimated to come online by 2029-2030.

2.2.5

Development of Hydel Energy

Pakistan has 60,000 MW of hydropower potential, almost all of which lies in Khyber Pakhtunkhwa (24,736 MW), Gilgit-Baltistan (21,125 MW), Azad Jammu & Kashmir (6,450MW) and Punjab (7,291MW). About 89% of this hydropower potential is still untapped and yet to be exploited.[12] The table below shows the potential available for installation of micro/mini Hydro (below 50 MW) in KP, Punjab, AJK, and the northern mountainous regions of the country. During the plan period efforts will be made to harness these potentials.

2.2.6

Development of Small Hydro

Besides large hydropower, there is significant potential for development of small-hydropower. The country with its natural water flow systems and irrigation canals – especially in Punjab provide immense opportunities for hydropower development. Over 10,000 MW of run-of-river

Table 21 Hydropower Resources in Pakistan

Province	Projects in Operation (MW)	Projects Under Implementation Public Sector	Private Sector		Solicited Sites (Projects with Completed Feasibility Studies) (MW)	Projects with Raw Sites (MW	Total Hydropower Resources (MW)
			Province Level	Federal Level			
Khyber Pakhtunkhwa	3,849	9,482	377	2,370	77	8,930	24,736
Gilgit - Baltistan	133	11,876	40	-	534	8,542	21,125
Punjab	1,699	720	308	720	3,606	238	7,291
FATA	13	19	0	0			
AJK	1,039	1,231	92	3,172	1	915	6,450
Sindh	-	-	-	-	67	126	193
Balochistan	-	-	-	-	1	-	1
Total	6,720	23,309	468	6,262	4,286	18,751	59,796

Source: AEDB

hydropower potential that can be developed in a relatively short timeframe[13] has been identified in Gilgit-Baltistan.

In KP, the hydropower potential is being developed through both public and private sectors. The Pakhtunkhwa Energy Development Organization is developing eight small public-sector projects with a combined capacity of 271.2 MW. In the private sector, 377 projects with cumulative capacity of about 1679 MW are at various stages of development.[14] There are numerous off-grid mini hydropower installations in the provinces of Khyber Pakhtunkhwa and Gilgit-Baltistan. Estimates by the German International Cooperation Agency (Deutsche Gesellschaft für Internationale Zusammenarbeit - GIZ) published in June 2014 shows the combined capacity of mini- and micro-hydropower installations is around 130 MW. Several low-head hydropower projects are being developed on canal falls in Punjab. The Punjab Power Development Board has issued letters of intent for 11 small hydropower projects with a total 80 MW capacity. Additionally, the Punjab government is developing ten projects with a total 80 MW capacity.

2.2.7 Promotion of Geothermal

Table 22 Small Hydropower potential in Pakistan

Serial Number	Area	Number of potential sites	Potential range (MW)	Total potential (MW)	Remarks
1	Khyber Pakhtunkhwa	125	0.2-32 MW	750	Natural falls/flow
2	Punjab	300	0.2-40 MW	560	Canals
3	Gilgit-Baltistan	200	0.1-38 MW	1,300	Natural falls
4	Sindh	15	5-40 MW	120	Canal falls
5	Azad Jammu & Kashmir	40	0.2-40 MW	280	Natural falls
	Total			3,100	

Source: AEDB, 2015 (a)

Geothermal energy in the form of hot water, steam springs, geysers and underground hot aquifers are available in the world including Pakistan. Its promotion is also part of policy for development of Renewable Energy for Power Generation 2006.Geothermal is used for electricity generation, space heating and cooling of buildings, the supply of hot water, green houses, fish farming and setting up of small industries requiring heat. Pakistan is found to have substantially large geothermal energy resources that could generate 100,000MW[15] electricity at the cost of 5-10 cents per unit depending upon different locations of the power plants. Various geothermal indices are present in Northern Area, Chagai Area, Karachi, and Hyderabad. Hot springs with high brine temperature are present in the North-Western Balochistan while South Balochistan hot springs have brines of modest temperature.

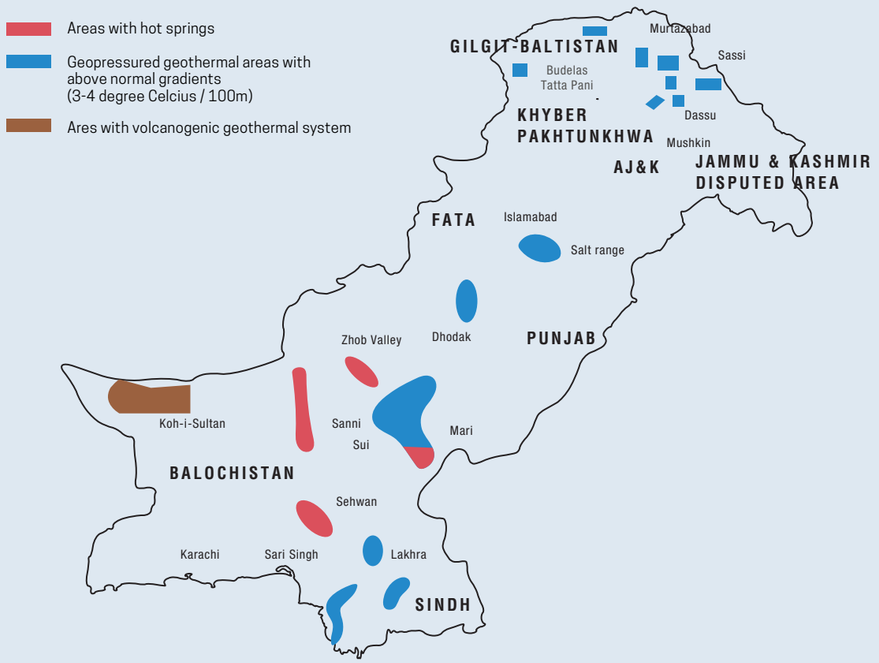
During the plan period government will support private sector to harness the potential in the sector. In this respect detail feasibility report would be undertaken by AEDB, and pilot project will be developed for at least 100 MW.

2.3 Promotion of Energy Efficiency and Conservation

Government has established NEECA through an Act of Parliament. This shows the commitment of government to reduce the energy wastage and improve energy productivity. Additionally, there is an increasing demand to develop effective regulatory measures which will be complimented with appropriate policy, fiscal and financial instruments to create a meaningful impact.

The primary energy intensity of Pakistan has

Fig 16 **Geothermal Resource Potential of Pakistan**



Source: Younas et al. 2016

decreased by 1.7 annually since 2000. To achieve the SEforALL target, the rate of improvement has to be doubled by 2030, which means that there has to be a reduction in the primary energy intensity by 3.4% annually or by about 50% over the next 14 years.

2.3.1

Energy Efficiency Measures in Buildings

Pakistan as a developing country with increasing demands for new construction has a great potential and opportunity to employ energy efficient equipment, material, and practices. There is an energy saving potential to reduce the energy wastage by developing improved building envelope. It can be achieved by retrofitting existing structures or installing roof and wall insulation in existing buildings. This can improve building envelope efficiency, through with electricity demand for air conditioning can be reduced by as much as 20%.[16]

Energy Building codes (EBC) are an important set of regulations and standards with minimum requirements for energy-efficient design and construction for new and as well renovated buildings.

Building energy codes helps to ensure that efficiency measures are employed at the earlier stages of building construction. Thermal insulation is also an important measure that can reduce energy consumption in the buildings by limiting the heat loss/gain through effective building envelope techniques. It is important that energy efficiency measures should be adopted from the very beginning at the building's design phase. Because It is often more expensive and difficult to employ efficiency measures, once a building is constructed.

2.3.2

Energy Efficiency in Transportation Sector

In the past, Government of Pakistan in collaboration with UNDP have taken initiatives to implement fuel saving programs, such as the Fuel Efficiency in Road Transport Sector (FERTS). This initiative mainly focused on corrective maintenance and tune-ups of vehicles. During the plan period these efforts will be scaled-up through private sector. Furthermore, the deficiencies observed in the pilot phase such as development of standards, compliance policy, and enforcement capacity will be addressed.

2.3.3

Energy Efficiency in Domestic Sector

Generally, the market for energy efficient appliances in Pakistan is gradually developing. The adoption of energy efficient appliances (LEDs and DC Inverter Air Conditioners) has been growing at an impressive rate. These are gradually penetrating in the local market due to their cost competitiveness as their upfront costs have come down in the international market. The price point for these appliances and increased awareness for the energy efficiency gains are the two major forces, which have enabled the market for favorable conditions for the energy efficient appliances.

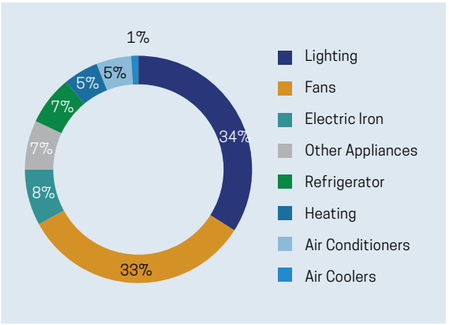
According to a recent study on "Energy Saving in Pakistan" published by RAFTAAR[17] and funded by UK DFID, it has been reported that over 67% of the domestic electricity is consumed by the fans and lighting. Most of these appliances are inefficient and do not comply with modern energy efficiency standards due to lack of standardization and labeling measures in the country. This shows that there is a substantial energy saving potential that exists in the residential sector will be achieved by converting low efficient lighting and fans to more efficient ones. Figure3 below gives the breakdown of domestic energy consumption by appliances.

2.3.4.

Improving Vehicle fuel efficiency standards and emissions

There is pressing requirement to adopt a labeling program and establish a target for vehicle fuel efficiency standards and emissions. The vehicle fuel efficiency standards are essential to phase

Fig 17 **Breakdown of Domestic Electricity Consumption by Appliances**



Source: RAFTAAR - DFID: Energy Saving in Pakistan (2016)

out inefficient and polluting vehicles. Such standards will be introduced to improve fuel economy and limit the GHG emissions under a phased program to bring fuel efficiency by to international standards 2030.

Hybrid and Electric vehicles are revolutionizing the automobile market. Electric vehicles have seen impressive growth in last five years mostly in the developed world. They are challenging the conventional vehicles that use Internal Combustion Engines (ICE). Currently, three different variants of hybrid and electric cars exist in the market, namely Hybrid, Plug-in-Hybrid and all Electric Vehicles.

- Hybrid vehicles use only petrol/gasoline to run power drives, such as electric motor & engine at the same time. They are equipped with regenerative braking technology to generate electricity when brakes are applied. Both the chemical energy from fuel and electricity generated from regenerative braking are used to power dual drives.
- Plug-in-Hybrid uses both fuel and electricity charge to power the vehicle.
- All Electric Vehicles do not use any fuel (petrol) at all and they must be plugged into an electric outlet to get charged.

Hybrid and all Electric Vehicles (EVs) have several advantages compared to conventional ICE powered vehicles. Firstly, th ey are highly energy efficient. For example, EVs conversion efficiency is about 62%, while conventional vehicles efficiency is only 20%. This means that EV requires almost one-third of the energy used by conventional vehicles to cover the same distance. Electric cars offer high-cost savings. According to IEA, electric cars can cost about one- fourth to one-fifth of the cost of using conventional vehicles.[18]

During the plan period, it is envisaged to replace the fuel vehicles by hybrid vehicle by 30% and introduce electric mass transit vehicles.

2.3.5 Upgradation and Improving the Efficiency of NTDC

Pakistan's National Transmission and Dispatch Company (NTDC) system lossesare2.57% of the total transmission and distribution losses in 2015-16. The system consists of over 14,000 kilometers of high-voltage transmission lines and 38,000 MVA of transformer capacity. The system is overloaded, contributing to major blackouts, system trips, and supply constraints. Substantial investment is required to address the reliability and supply quality issues as well as for integration of renewable energy investments. While the transmission sector is expected to remain largely government owned, the regulatory framework allows private sector investment and public–private partnerships.

While the sector struggles to tackle technical and financial issues, the electricity demand is expected to grow at 8% annually with a 6% growth in GDP. The high and growing demand make the NTDC's transmission network constantly overloaded, without sufficient margin to prepare for accidents. The overloaded transmission system is unable to provide the quality and reliability of supply required under the national grid code, resulting in major blackouts. Expansion of the network to withstand such pressures from demand and potential accidents is an urgent task for the Pakistan's electricity sector. As per findings of study conducted in 2016, to upgrade and strengthen the transmission and distribution network to ensure efficiency will cost $ 9 billion.[19]

2.4 Conclusion

The following table summarizes the priority action areas of National Action Plan and isa compilation of all the priorities which has been described in the above sections. Additionally, along with the priority action area the responsibility of the concerned ministry, department or agency has been also specified:

Summary of Priority Action Areas for National Action Plan for SEFORALL

Objectives	SDG	No.	Priority Action	Responsibility	Timelines (S=Short Term, M=Medium Term, L=Long Term)
A-Enhance energy access	7.1.1	1	Serving Underserved districts in all provinces for off-gird lightening programs. Punjab (10 districts), Sindh (07 Districts), KP (13 districts), Balochistan (7 District), AJK (3 district), Gilgit Baltistan (4 districts)	Provincial and local Governments	S
	7.1.1	2	Enhancement of generation capacity upto 1,02,425MW by 2030 against the current 25,878 MW as 2017. Hydel 34,500 MW, Thermal 21300 MW, Renewable 16200, and Expansion of Transmission Capacity of Power Sector	Federal and Provincial Governments	S
	7.1.1	3	Solarization of government schools and colleges (the number of institutions without access to electricity in each province has been documented in the report)	Provincial Governments	M
	7.1.2	4	Solarization of basic health units which do not have access to the electricity now	Provincial Governments	M
	7.1.1	5	Schools, colleges and universities will be powered using Solar PV technology through either standalone system with a battery backup or through installation of micro grids of 5kW-115kW.	Provincial Governments, Private Sector &International Agencies	M
	7.1.2	6	Install 60 LPG Air Mix plants in areas un served by piped network, out of which 28 will be in Balochistan, 2 in Sindh and the remaining 30 will be set up in Punjab, KP, AJK and Gilgit-Baltistan. Size of these plants is going to be between 0.5 and 1 mm.	Federal Government	M
	7.1.2	7	Improve access to clean cooking by extending provision of LPG to the regions without access to gas connections. Subsidy for one cylinder per month using BISP mechanism.	Federal Government	M-L
A-Enhance energy access	7.1.1	8	Increase the utilization of renewable energy to alleviate the power shortage problems as renewable (wind and PV energy) costs have lower fluctuations as compared to Oil, Coal and LNG.	Federal and Provincial Governments	M-L
	7.1.1	9	Improved Cooking Stoves for around 40 percent of population by giving alternate source of cooking (biomass)	Provincial and local Governments	L
B-Renewable Energy	7.2.1	1	Exploit potential of Municipal Solid Waste (MSW) to generate around 360 MW of gross power capacity in the anaerobic digester-based power plants by utilizing 16 landfill sites.	Provincial Governments	S
	7.2.1	2	Promotion of Solarization in the country through Distribution of basic solar products to low-income households	NGOs &Provincial Governments	S
	7.2.1	3	Promote Wind energy projects in Hyderabad to Gharo region and coastal areas south of Karachi in southeastern Pakistan, hills and ridges in northern Punjab, near Mardan and Islamabad. In northern Indus valley, and near Nokkundi and hills and ridges in the Chagai area. Makran in the southwestern part of the country.	Federal & Provincial Governments	S
	7.2.1	4	Conduct feasibility for establishing a pilot 100 MW geothermal power generation unit in an area of high potential	Federal &Provincial Governments	S
	7.2.1	5	Promote Solar water-heating for areas, like Gilgit-Baltistan and/or villages in AJK, KP and Punjab, with no access to traditional gas network. Otherwise it would require billions of rupees in capital expenditure to lay down the pipeline network.	Provincial Governments	S-M

Objectives	SDG	No.	Priority Action	Responsibility	Timelines (S=Short Term, M=Medium Term, L=Long Term)
B-Renewable Energy	7.2.1	6	Solar powered water pumps will be provided to reduce the cost of fuel consumption to farmers on subsidized rates. (With a fuel consumption of around 3 to 5 liters per hour, the average daily expense per pump is approximately PKR 700 per day ($7/day) in fuel costs every day)	Federal and Provincial Governments	S-M
	7.2.1	7	Promotion of biomass energy in the rural areas where no gas connections are available. Materials that can be fed into a biogas digester are mostly readily and locally available and it can be used for households (cooking/ lighting) and industry, transportation and to generate electricity helping to reduce the dependency on fossil fuel imports.	Provincial Governments	M
	7.2.1	8	Replace low-pressure steam boilers in 84 Sugar Mills with high-pressure cogeneration plants.	Private Sector and Regulatory Agencies	M
	7.2.1	9	Increase in the share of biomass fuel by generating 162 MW will through Rice mills waste.	Provincial Governments / Private Sector	M
	7.2.1	10	Produce biodiesel in Pakistan on experimental basis to diversify the fuel mix.	Private and Public Sector	M
	7.2.1	11	Convert 2 million gas geyser consumers to solar water heater in the SNGPL network to save 15 BCF annually or 41 MMCFD which is about 9% of total natural gas consumption in Punjab.	Federal Government – SNGPL / SSGCL	M
	7.2.1	12	Provide Clean and Improved Cook stoves with higher conversion efficiencies to help relieve the environmental damage and to save biomass resources.	Provincial Governments and NGOs	M

Objectives	SDG	No.	Priority Action	Responsibility	Timelines (S=Short Term, M=Medium Term, L=Long Term)
B-Renewable Energy	7.2.1	13	Diversification of fuel mix by introducing biogas for cooking and power generation.	Public and private sector	M-L
	7.2.1	14	Development of about 600 Small-Hydel Projects site with cumulative power generation capacity of around 3100 MW	Provincial Hydel Power Development Organizations / Private Sector	M-L
	7.2.1	15	Promote job creation through fostering renewable energy technologies. Developing indigenous capacity for manufacturing renewable energy in SEZs.	Federal and Provincial Governments	L
C-Energy Efficiency and Conservation	7.3.1	1	Promote usage of energy efficient appliances in domestic sector (LEDs and DC Inverter Air Conditioners) to improve energy efficiency.	Federal &Provincial Governments / NEECA	S
	7.3.1	2	Regulate the manufacturing sector to produce energy efficient products.	Federal &Provincial Governments / NEECA	S
	7.3.1	3	Improvement of Maintenance Operation i.e. reduction of air leakages; and Proper maintenance and operation of electrical motors to increase energy efficiency	Private Sector	S
	7.3.1	4	Energy savings in the textile industry by installation of meters, controls to reduce leakages of compressed air and improved maintenance of electrical motors.	Private Sector / Regulator	S
	7.3.1	5	Implementation of simple energy-saving techniques such as efficient lighting and installing controls for compressed air in Leather sector.	Private Sector / Regulator	S
	7.3.1	6	Introduction of Zig-Zag Technology to increase energy efficiency in Brick-Kilns Industry.	Private Sector / Regulator	S

Objectives	SDG	No.	Priority Action	Responsibility	Timelines (S=Short Term, M=Medium Term, L=Long Term)
C-Energy Efficiency and Conservation	7.3.1	7	Replacing smart metering technology for natural gas and power consumers to improve revenue collection.	Federal Government / DISCOs / NEPRA	S
	7.3.1	8	Achieve Energy efficiency in the industrial sector by employing a broad range of energy management, efficient technologies and practices to reduce overall energy consumption.	Federal and Provincial Governments / NEPRA	S-M
	7.3.1	9	Standardizedfuel efficiency mechanism in transport sector i.e. Fuel Efficient - Hybrid and Electric Vehicles.	Private Sector / Regulator	S-M
	7.3.1	10	Up-gradation of NTDC transmission system compatible to evacuate enhanced power generation capacity.	NTDC / Private Sector	S-M
	7.3.1	11	Improvement in Process Operation in Industrial Sector e.g. proper metering in the textile and sugar industry	Private Sector / Regulator	M
	7.3.1	12	Installation of Variable Frequency Drive (VFD) or inverters on pumps and motors reduce energy losses;	Private Sector / Regulator	M
	7.3.1	13	Installation of Heat Recovery Systems (HRS) from exhaust flue gases in sugar and paper industry	Private Sector / Regulator	M
	7.3.1	14	Thermal insulation of steam lines and valves in industrial units	Private Sector / Regulator	M
	7.3.1	15	Sugar industry to deploy energy efficient technologies, such as the High-Pressure Cogeneration (HPC).	Private Sector / Regulator	M

Objectives	SDG	No.	Priority Action	Responsibility	Timelines (S=Short Term, M=Medium Term, L=Long Term)
C-Energy Efficiency and Conservation	7.3.1	16	In Cement Industry, shifting of single stage dry kilnsto multistage dry kilns to improve energy efficiency of cementing process .	Private Sector / Regulator	M
	7.3.1	17	Introducing high efficiency steam reforming and Haber-Bosch synthesis in fertilizer sector.	Private Sector / Regulator	M
	7.3.1	18	Tuning of boiler burners and adjusting air-to-fuel ratios in Pulp and Paper mills to reduce their gas demands.	Private Sector / Regulator	M
	7.3.1	19	Introduction of system to withstand pressures from demand and potential breakdowns in national transmission system. Strengthening the capacity of NTDC to manage the power supply and demand in peak hours.	NTDC / Ministry of Energy (Power Division)	M-L
	7.3.1	20	Replace tube wells pumps i.e. 180,000 with more efficient pumps by 2030	Provincial Governments / Private Sector	M-L
D-Coordination and follow up		1	Facilitation to SEforAll National Steering Committee for providing effective leadership in execution of SEforAll NAP.	UNDP / Development Partners / Ministry of Planning, Development and Reforms	S-M
		2	Establishment of Sustainable Energy for All Secretariat at the Energy Wing, Ministry of Planning, Development and Reforms with the support of UNDP and other development partners. SEforAll Secretariat will liaison with ministries, departments, authorities, research organization, universities, financial institution and private sector at national level for tracking and monitoring.	Ministry of Planning, Development and Reforms	S

Objectives	SDG	No.	Priority Action	Responsibility	Timelines (S=Short Term, M=Medium Term, L=Long Term)
D-Coordination and follow up		3	At provincial level, Planning & Development departments will liaison with provincial stakeholders – ministries, department, authorities, financial institutions, academia, research organization, private sector, NGOs and CSOs. In addition, provincial level Sustainable Development Goals (SDGs) Unit headquartered in provinces could provide input to Planning & Development departments.	Federal and Provincial Governments	S
		4	Establishment of SEforAll Cell in all Energy related Ministries (Power and Petroleum Divisions and Provincial Energy Departments to coordinate with SEforAll Secretariat.	Federal and Provincial Division and Departments.	L

PART-3

ENABLING ACTION AREAS

3.1
Energy Planning and Policy Analysis for SEFORALL

For the developing countries like Pakistan it has been daunting task, to attract private investors for the provision of private infrastructure (power sector projects) in the absence of political stability and high-security risk. The government operated and owned the power sector in the country, with the budgetary allocations as one of its main responsibilities. For Sixth Five-Year Plan (1983-1988) budgetary allocations were 38 % which sky-rocketed to 50% for FY 1989-90[1] for power sector.

However, these allocations weren't able toimprove the operational efficiency to meet the increasing demand for electricity. The adverse situation of the sector, and global wave of market liberalization and deregulations, Government invited private sector (Independent Power Producers) to install additional power generation capacity. These IPP installed thermal power plants with sovereign guarantee offered by the government to overcome the supply shortfall. The induction of thermal plants has not only dominated the energy mix but also made power sector tariff volatile for oil prices shocks.

The following key policies were promulgated for enabling an investment environment in power sector:

I. Power Generation Policy 2015
II. Policy for Development of Renewable Energy for Power Generation 2006
III. National Policy for Power Co-generation by Sugar Industry and Guidelines for Investors 2008.
IV. Petroleum Policy 2012
V. LNG Policy 2015

The analysis of policies delineates that the renewables energy received varied policy response and priority from different government agencies from time to time. Few policy-makers still have doubts of affordability and reliability of renewable energy resources, whereas, some do see a potential as well as further reduction in cost and improvement in technology.

The renewable tariff analysis shows that indicative upfront tariff wind and renewable has decreased drastically since 2013. Although, the cost of power generation from different sources are disputed especially when it comes to infrastructure development of coal and LNG imports – as costs are not properly internalized. Additionally, the development of these projects from public finance will shrink the fiscal space and pose additional challenge to operation and manage-

ment of the system. Further, this may jeopardize the government efforts to achieve energy security of the country.

3.2 Policy Analysis: Power Generation Policy 2015

On April 2015, the Power Generation Policy of 2015 was announced to provide better incentives and efficient processes for the developer of power project companies. The policy addresses the development of large hydropower projects (greater than 50 MW) and new thermal power projects in public and private sector. The policy set the framework for project development and underlies the importance of promoting least-cost power generation. However, with regards to the overall energy mix, it does not specify any binding targets or shares for thermal and large hydropower projects.

3.3 Policy Analysis: Policy for Development of Renewable Energy 2006

The government of Pakistan promulgated the Policy for Development of Renewable Energy for Power Generation in 2006. The policy focused on promoting renewable energy power projects in Pakistan. Initially, the policy mandate was to develop solar, wind and small-scale hydropower projects. Later in March 2013, bagasse, biomass and waste-to-energy were included in the policy through an addendum. Pakistan energy sector has seen some positive advances in the renewable energy arena, especially in solar and wind.

However, the policy for Renewable energy requires a thorough evaluation and revisions due to changes after 18th Amendment in overall governance structure. Similarly, the recent promulgation of reverse auctions and net-metering regimes needs to be embedded in the policy framework.

3.4 Policy Analysis: Regulatory framework and guidelines

In addition to aforementioned policies, various guidelines to develop a comprehensive regulatory regime for the sector has been also issued by the government of Pakistan from time to time. The establishment of NEPRA through NEPRA Act 1997 is the most important achievement. The NEPRA Act of 1997 is complemented through various guidelines and amendments from time to time. However, one of the most important guidelines from the government is in setting tariffs. In November 2005, the guidelines were issued to define and interpret various financial and fiscal incentives, such as a tax on dividend, interest on loans etc., and how they would constitute the applicable tariff. NEPRA has also been issuing various regulations for the smooth functioning of the power sector and promoting new forms of renewable energy. In 2015, it issued "NEPRA (Alternative and Renewable Energy) Distributed Generation and Net Metering Regulations, 2015)".

In parallel, Petroleum division, and Oil and Gas Regulatory Authority (OGRA) is to foster competition, attractive private investment, and ownership in the midstream and downstream petroleum industry. The regulation of activities relating to Liquefied Petroleum Gas (LPG) and Compressed Natural Gas (CNG) sector are assigned to Oil and Gas Regulatory Authority.

3.5 Post 18th Constitutional Amendment Assessment

The 18th Amendment to the Constitution of Pakistan of 2010, transferred the policy-making powers and operations to provinces. Before 2010, the energy policies and planning for the large-scale power projects (more than 50 MW) were under the statute of the federal government. The provinces are allowed to issue a letter of intent for hydropower projects of 50 MW or below, of installed capacity.

After the 18th amendment, the functions were devolved to the provinces, including energy and climate change, empowering the provinces to play a more proactive role in the energy sector. The provinces have been given authority to either develop provincial policies or opt for federal government policies. Furthermore, amendment although has opened avenues for greater provincial participation in development of energy sector, however, in absence of requisite legislation the opportunities are not been capitalized. During the plan period, issues of legislative gaps will be identified and addressed accordingly

3.5.1 Government of Sindh Power policies

The government of Sindh has adopted federal government power policies for the development of renewable energy, offering same incentives as of federal government. Sindh Energy Department is the provincial department issuing letters of intent for solar power projects and wind power projects.

The Government of Sindh has a strong willingness to develop renewable energy. One of the key initiatives in this regard is "Sindh Land Grant Policy for Renewable Energy Projects 2015" to facilitate renewable energy investment. It was introduced with the aim to simplify and fast-track access to land for investors in renewable energy projects by offering lease agreements for up to 30 years at favorable terms. By implementing this policy and earmarking large areas of land for renewable energy projects, provincial government attracted investors. However, the provincial government lacks an effective mechanism coordinating the issuance of letters of intent with the federal government.

3.5.2

Government of Balochistan Power policies

The "Balochistan Power Generation Policy 2007" has been devised for all power projects up to a maximum of 50 MW. After 18th amendment, the policy now applies to projects at any scale. National Power Generation Policy 2002is the basis for the provincial 2007 policy, for implementation of procedures and incentives. Further, the Balochistan Power Development Board was established as a one-window facilitator to encourage private investors. Even though Balochistan is endowed with massive renewable energy potential, particularly for solar and wind, the province has not yet been able to exploit these resources due to under-developed infrastructure, challenging terrain and uncertain security conditions.

3.5.3

Government of Punjab Power policies

To maximize the utilization of indigenous energy sources including coal, biomass, hydropower, wind and solar for power generation the "Punjab Power Generation Policy 2006" was implemented by Punjab Government which was further revised in 2009. Under this, the Punjab Power Development Board is empowered to ease the way for investors setting up power projects in Punjab.

The policy allows the board to assist in liaising with federal agencies such as NEPRA, NTDC, and DISCOs in matters of tariff and grid connectivity etc. The policy is applicable to all renewable and non-renewable power projects. The policy directs the Punjab Power Development Board to co-ordinate with the federal government and NTDC when issuing letters of intent for renewables. Recently, the Punjab Energy Efficiency and Conservation Authority has been also established to effectively implement the energy efficiency and conservation at the provincial level.

3.5.4

Government of Khyber Pakhtunkhwa (KP) Power policies

Federal Government Renewable Energy Policy of 2006 has adopted by Government of KP for their all renewable energy projects, except for hydropower. Due to immense hydropower potential, the provincial government has put in place the "Khyber Pakhtunkhwa Hydropower Policy 2016". Policy goals are to maximize utilization of hydro-potential. Both for public and private sectors, KP government has developed a ten-year action plan for hydropower development. The cornerstone of provincial policy is that it requires the project developer to construct the transmission line. The cost of extending transmission lines from project site to an existing distribution company or NTDC network is embedded in the tariff.

3.5.5

Implementation of Integrated Energy Development Plan / Model

Pakistan energy sector has multiple stakeholders dealing with energy sector which includes Ministry of Energy (power and petroleum division)with the indirect involvement of Ministry of Finance and Ministry of Planning, Development, and Reform. Ministry of Climate Change is also gaining prominence and considered as one of the key stakeholders in the policy arena related to the energy sector, as it has the responsibility to coordinate the efforts for reducing its CO2 emissions to tap into the global financial resources for the energy sector. This will require to project an indicative future energy mix plan commensurate with government commitment under NDC.

Ministry of Finance constituted the Energy Expert Group in 2009 also emphasized to address the energy sector challenges through an integrated energy planning approach.The provinces have also observed that lack of integrated plan raises concern about the power evacuation plan, which requires more comprehensive and integrated approach for optimal functions and planning. The integrated energy plan will serve as a policy analysis tool based on evidence-based management, economic analysis on both demand and supply projection while incorporating input from across ministries, sectors, and provinces.

Although there are efforts going on for the development of Integrated Energy Planning[2] between Planning Commission and USAID. Some of the recent meetings at Government level has involved public sector stakeholders in this process. However, it is proposed that private sectors will be involved in the consultation process for development of Integrated Energy Planning. These private investors are investing in power generation, transmission, distribution, and energy efficiency. This will increase the investors' confidence and bring transparency in the development process as well as better understanding of future policy discourse.

3.5.6

Assigning Priority Based on Integrated Energy Planning

Pakistan energy crisis has severely affected the GDP growth and socio-economic dynamics of society. On the supply side, more power generation is a required and it has been planned effectively. Government plans are in execution phase which will change the future energy mix. However, there is a confusion and uncertainty prevail when it comes to renewable energy resources. Two main issues with renewable energy (mainly with solar, wind) are – tariff and issues of intermittency. The higher tariff for the renewable energy resource has been always raised as a major concern from the policy-makers on comparison with the availability of large hydropower projects.

To address the aforementioned issue, government will implement an Integrated Energy Planning Regime based on evidence-based planning using different computer-based models. The National Steering Committee on Integrated Energy Planning, constituted under the Chairmanship of Federal Minister for Planning, Development & Reform / Deputy Chairman Planning Commission and comprising of representative of all energy sector stakeholders, will ensure its effective implementation. In this respective, development partners including USAID will be insisting the government of Pakistan.

3.5.7

Enabling Action Areas: Measures for Renewable Energy at National Level

The government of Pakistan as per the policy established, Alternative Energy Development Board. AEDB has been specifically mandated to facilitate renewable energy development, both on-grid and off-grid. The efforts of AEDB is also partly complemented by PPIB through implementation of medium to large hydroprojects AEDB in collaboration with international donor agencies – bilateral and multilateral development partners have created an environment to attract private sector investment in Pakistan. Some of the effective policy tools and initiatives by AEDB, related to national and provincial level, interalia include:

a) Allocation of Land (Sub-lease agreement)
b) Upfront tariffs for renewable energy technologies
c) Standardized Agreements
d) Net Metering Provision
e) Renewable Resource Mapping
f) Grid Study to determine the limit of intermittent renewable energy sources
g) Grid codes for solar and wind energy projects

3.6

Enabling Action Areas: On-Grid Distributed Energy - Net-metering Regulation

One of the key regulations put in place by NEPRA in 2015 is the "Alternative & Renewable Energy Distributed Generation and Net Metering Regulations".[3] The regulation permits domestic, commercial and industrial consumers to become a seller of surplus electricity generated through solar system to their respective DISCOs changing the role of DISCOs from power distributor to power management company at utility scale. The regulation has seen major success with more than 200 licenses approved by NEPRA for so far.[4] The regulation will signal the market for on-premises installation for solar power systems replacing the UPS and generators. Further, it will not only create a revenue stream for the household but also reduce the load on the grid.

During the plan, the initiative will be supported through effective regulation, facilitating DISCOs to adopt a bottom-up approach for improvement of dilapidated grid infrastructure through focused investments in an area where net-metering "distributed generators" are expected to penetrate manifold. DISCOs implemented revenue-based load-shedding model, the same revenue-based model will be revamped in this case for grid improvement. To incentivize the consumers in all categories (domestic, commercial and industrial), the government may offer tax rebates and import duties reduction on equipment for grid-connectivity as well invertors and other auxiliary equipment with solar installation.

Table 23 Expected Benefits of Energy Efficiency in Resource Planning

	Electricity	Natural Gas
Energy Related Benefits	Reduced Electricity Purchase Reduced Transmission and Distribution Losses Reduced Emissions	Reduced Natural Gas Purchase Reduced UFG Losses Reduced Emissions
Capacity Related Benefits	Generation capacity/ resource adequacy Availability Operating Reserves Additional Transmission and Distribution Capacity	Production Capacity/ LNG Facilities Additional Pipeline Facilities Less strain on the distribution system
Other Benefits	Cost Reductions Lower Business Risks	

3.7

Enabling Action Areas:Renewable Energy Resource Planning

The endowment of renewable energy in the country is very diverse and they will be developed based on regions' requirements. However, the strategic mapping of these untapped resources will get serious consideration by the government AEDB have initiated the project, under the ESMAP through World Bank support, to assess and map the renewable energy resources including biomass, solar and wind energy. This mapping will signal the investors to realize the market potential to invest in RE resources. [5]

These resource maps will significantly improve the country's capacity for developing effective policies supporting renewable energy development. They will inform decisions on transmission infrastructure planning and facilitate private sector investigation and site selection in new areas.

3.8

Energy Efficiency Regulatory Reforms

The primary mandate to promote energy efficiency and conservation in the country has long been with National Energy Conservation Center (ENERCON now reconstituted as National Energy Efficiency & Conservation Authority (NEECA)). NEECA Act 2016 is aimed at developing the mechanism and procedures for effective conservation and productive use of energy in the Country. NEECA will be the focal federal agency for development, implementation, and coordination of energy efficiency and conservation in all econom-

ic sectors of Pakistan.

The establishment of NEECA as an autonomous federal agency shows the commitment of Government of Pakistan to reach energy efficiency goals through an effective regulatory framework. This will compliment with existing appropriate policy, fiscal and financial instruments to create a meaningful impact.

NEECA will be mandated with developing necessary policy measures which play an important role in the market to reinforce the role of energy prices and create the appropriate conditions for energy efficient equipment and services. The conditions further drive consumer towards the most cost-effective solutions. Development of energy standards and the introduction of labeling for the various appliance on the market are one of the few instruments that can help improve energy efficiency. NEECA will establish these standards and introduce attractive policy instruments on a high priority bases and use them to strategize the energy efficiency.

NEECA Act also provides a legal framework to set targets and adopt regulations, such as Energy labeling, Standards, and MEPS. NEECA therefore, will organize mandatory energy audits of certain large consumers and implement energy savings obligations for power and gas utility companies. Energy efficiency law provides a legal framework for setting up an energy efficiency fund which will be used to facilitate the effective functioning of Energy Servicing Companies (ESCOs).

In the long-term labels will be complemented with MEPS (Mandatory Energy Performance Standards) to remove inefficient equipment or practices. Energy efficiency labels guide consumers to make informed choices by enabling them to compare various equipment from standpoint of energy efficiency and cost savings, while the MEPS provide minimum performance standards for new appliances and buildings. In view of above, NEECA has to develop MEPS for many appliances, such as air conditioners, refrigerators, fans, and lighting.

Business Model and Technology Innovation

3.9 Mobilizing Private Sector Investment

The reforms process in energy sector has remained in transition from last two decades. This inter alia mainly include privatization of power generation, transmission, and distribution. The development of energy infrastructure (power as well as fuel) is a capital-intensive project which cannot be financed by limited public fiscal space. Therefore, the financing framework has remained based on Build-Own-Operate-Transfer (BOOT) under the Public Private Partnership mode of financing. This framework will be refined and expanded further to help the private sector to mobilize their resources to upgrade existing and development of new infrastructure projects.

During SEforAll consultative meetings, grid infrastructure, and evacuation emerged as one of the crucial problems for power projects investors/developers. According to AEDB, there is a huge volume of wind power projects are about to reach to commercial operations. Meanwhile, new substations and associated transmission lines will be constructed and upgrades. NEPRA has issued upfront tariff for transmission project under the BOOT framework for the private sector.[6] This has set a new precedent for the private sector to invest in the grid infrastructure while mobilizing their resources.[7] To attract the private sector investment in transmission projects a profitable tariff will be offered.

A comprehensive integrated infrastructure development plan will be launched in near future. The provincial and federal government has issued Letters of Intent (LOI) they will be assessed and incorporated into the plan. The recommendation proposed by Ministry of Energy through USAID supported grid study will be the part of this plan. The CPEC projects are also assessed and incorporated in the plan till 2030. To develop a holistic strategy for the country in accordance with the development goals.

In collaboration with the provincial / regional governments efforts will also be made to formulate policy to attract private sector investment for community run small hydel projects, particularly in KP, AJK and GB. The capacity of small hydel projects in the country has been estimated around 3000 MW.

3.10 Enabling Action Area: ESCO Business Model for Promotion of Energy Efficiency

Implementation of energy efficiency retrofits and process improvements that pay for itself through energy saving can be a complex task. Recently, there has been a growing trend and interest to provide energy services to achieve energy efficiency. Some companies provide these specialized energy services to the energy consumers which may include the installations and supply of energy efficient appliances, retrofits and process improvements.

These companies are called the Energy Service Companies (ESCOs). Particularly, ESCOs have experienced and qualified manpower which can effectively deliver or provide the maximum amount of energy resource efficiency. ESCOs have extensive implementation and technical experience in developing energy efficiency measures, this is the reason that organizations often require services of ESCOs while considering energy efficiency and retrofit projects. ESCOs even provide some financial guarantee for energy saving that these savings will pay for the debt servicing. The major difference between an ESCO and any other energy efficiency company is that the ESCO provide guaranteed energy savings which are generally stated in the terms of agreement of the contract between the ESCO and the

client organization. ESCOs can even finance the energy efficiency measures or process improvements, whereby their earnings are directly linked to the energy savings of client organization.

However, in Pakistan, the market for ESCOs is quite underdeveloped and there are hardly any local companies that can provide energy services and simultaneously finance the efficiency improvements or project retrofits. The two biggest barriers to implementation of energy efficiency are access to finance and availability of reliable service providers (e.g. ESCOs) in the market. Thus, ESCOs can play a significant role in achieving energy efficiency in the country. There is an increasing demand to develop and build the capacity of local companies in Pakistan which can provide energy services to end users.

Finance and Risk Management

Pakistan's energy sector is financially haunted by the menace of circular debt .[8] The current energy crisis has evolved as a critical socio-economic issue. It is deep rooted in the country's poor governance. More specifically, the electricity shortages are mainly due to widespread inefficiency and corruption with lack of political will to solve the problem. The multiple dimensional problems are poor supply-demand management and projections, power thefts, costly input and the rising recurring costs. The peak power shortfall reaches almost 5000 megawatts across the country.

3.11

Enabling Action Areas: Addressing Circular Debt

The NAP intends to eradicate the causes of circular debt by formulating policies aiming at to improve the governance and performance of energy sector entities to decrease costs, increase cash flow, and ensure operational/financial integrity of the sector. These will include: -

i. Address the legislative lacunas in the execu tion of public private partnership projects particularly in the coal and hydro sectors.
i. Timely tariff determination by NEPRA & its notification - delay in tariff determination and its notification by government causes accumulation of receivables and disturbs liquidity position of DISCOs.
ii. Improve the liquidity position of DISCOs - settlement of receivables particularly from AJK, FATA and K-Electric (13% of Circular debt in FY 2017-18). It is imperative to recover the cost of electricity sold to these entities.
iii. Clearance of Tariff Differentials Subsidies on monthly basis - delayed or under payments on account of Tariff Differentials Subsidies (TDS) was constituting 9% of circular debt during the financial year 2017-18.
iv. Operationalization of a time-bound payment mechanism of the subsidy to DISCOs besides ensuring that only life-line consumers get this facility is very much crucial.
v. Eliminate tube-wells subsidy in Balochistan by installation of solar PV based tube wells.
vi. Introduce tax reform for energy producers to settle refund claims within a rational time period.
vii. Introduce supply side reforms including: -
    a) Improve Generation Mix through induc tion of cheap RE resources such as wind and solar based power which provides an opportunity to phase out retiring imported oil-based power plants.
    b) Tariff determination - Heat rate testing of GENCOs by NEPRA to monitor the efficiency of these plants. NEPRA to strictly implement its laid down standards. Inefficient plants which are having low heat rates, leading to lower performance of power plants, to be immediately shut down. Inspection of power plants with low heat rate to be carried out regularly.
    c) Audit of actual units purchased by CPPA-G and delivered by IPPs/GENCOs. Automated and software based sale and purchase agreements to be put in place
    d) Thermal power generation to be planned on availability of indigenous fuel. Imported fuel-based power generation to be discontinued.
    e) Renewable energy - Wind/ Solar etc., to be given priority in short term power generation mix over thermal and nuclear.
    f) Abolishing the 'Take or Pay' mechanism in Power Purchase Agreements by eliminating capacity payments for idle/ underutilized IPPS.
    g) Moving away from single buyer power market towards a competitive, open, multi buyer market
    h) Moving away from cost plus tariffs in favor of international competitive bidding
    i) Fuel supply should be the responsibility of the power producer instead of purchaser.
viii. Introduce demand side reforms including;
    a) Optimal determination of consumer tariff by NEPRA
    b) Improvement in recovery and losses by DISCOs
    c) Unbundling of DISCOs into separate wire and retail business
    d) Outsourcing of retail functions of DISCOs especially of areas where recovery rate is comparatively lower
    e) Professional composition of BODs, CEOs of Public Sector entities and DISCOs

3.12

Enabling Action Area: Financing for Renewable Energy and Energy Efficiency

Worldwide, the financial institutions, such as the commercial banks are providing attractive financial packages for renewable energy and energy efficiency technologies to investments in industrial, residential, agriculture and commercial sectors. As, these sectors have capacity to absorb these investments for their profitability.

Currently, in Pakistan there are a limited number of energy financing products offered by the commercial banks. Although, there is a great potential to attract investments to improve renewable energy technologies and energy efficiency in the industrial sector as it is relatively easy for the industries to have access to capital and as well as the capacity to utilize these investments to make profits. New energy financing instruments or products for renewable energy and energy efficiency for industrial users will be offered through regulatory framework under State Bank of Pakistan.

Access to finance in the agriculture sector energy user (tube-well) will be ensured. Government will introduce an agriculture relief package including markup free loan for the farmers to install solar tube wells. These loans will be utilized for small to medium scale farmers and financing will be limited to farmers who own land of 12 acres or more. The federal and provincial government will pick-up themarkupcost of this financing.

3.13

Enabling Action Area: Policy and Financing Mechanism for Off-Grid Rural Electrification

The goal of universal access to energy is not possible without 100% electrification of rural areas. However, the rural electrification programs are considered to be high-risk investment due to low-income clientele. It also argued that rural electrification cannot be sustained on client revenues and requires external financing.[9] This result in governments offering subsidies, grants and concessional loans. Pakistan Poverty Alleviation Fund and GIZ demand assessment study indicated that over 72% rural population are interested to take microloans for solar home systems.[10]

The plan therefore envisages to facilitate rural electrification through off-grid /distributed solar system supported by government policy and regulatory framework. Similarly, mini-grids will be promoted through a clearly defined policy mechanism. Policies for mini-grids will be carefully formulated for universal energy access while ensuring economic viability.[11] Government will facilitate the micro-financing mechanism for rural clients to develop a sustainable market-based model.

Fiscal and Financial Incentives for Energy Efficiency Program

Fiscal and financial incentives are essential to achieving energy efficiency improvements. These incentives are typically provided to encourage investments in energy efficiency by bringing down the equipment and processes costs for improvements. Financial incentives generally include subsidized investments', soft loans, and subsidized energy audits. While fiscal instruments have an indirect impact on investments and include tax credits, exemption fromcustoms duties and taxes on energy efficient equipment and processes. These measures include

3.14

Enabling Action Area: Investment Subsidies for Energy Efficiency

Investment subsidies to retrofit existing buildings, appliances and industrial facilities with a goal to shorten the payback times. Subsidies will be considered to reduce the replacement cost of efficient equipment that are more expensive than the average market price. Investment subsidies can be implemented for LEDs, electric motors, solar water heaters, & boilers etc. and these subsidies are often conditional on replacement of old or inefficient equipment.

3.15

Enabling Action Area: Incentives for Energy Audits

Energy auditing is one of the effective ways to deliver targeted information that enables consumers to undertake investments and cut energy wastages. Energy Auditing is a service where the factories or buildings are evaluated based on their energy usage with the aim to recommend the best means to improve energy efficiency.
Energy audits by consumers will be encouraged through financial incentives provided by the government. These audits will be financially incentivized to encourage consumers by carrying out energy audits at subsidized rates.

3.16

Enabling Action Area: Concession of Customs Duties /Taxes on EE Equipment

Many countries encourage the purchases of energy-efficient products or renewable energy equipment by providing concession on tax and duties on the purchase of such equipments. The government is already offering generous tax relief in the power sector. The government has reduced sales tax and duties to zero for power generation using renewable energy resources (the wind, solar and hydro) and are subject to some conditions.

Similar tax and duty exemption measures will also be implemented for energy efficient equipment, such as inverter air-conditioners, refrigerators, LED lamps, electric motors, cook stoves etc. While income tax credit will be offered to businesses who invest in energy conservation and efficiency or the manufacture of renewable energy equipment.

3.17

Enabling Action Area: Soft Loans

Initial capital cost is a potential barrier which can be intensive in energy efficiency investments. An access to capital for initial investments at attractive financing terms can be a fundamental step to overcome this barrier. Consumers who invest in energy efficiency equipment would be provided soft loans at subsidized interest rates by establishing specific credit lines with the support of guarantee schemes which encourages banks to finance energy efficiency investments.

3.18

Enabling Action Area: On-bill Financing Scheme

On-bill financing can be one of the effective instruments for utility consumers to overcome the barrier presented by the high initial costs of energy measures. On-bill financing enables the customer to pay for energy efficiency equipment, whereby the investments are financed through monthly installment via bill payments. It delivers financial benefits to the consumers by providing them access to low financing costs offered by the power or gas utility company. Such facilities will be extended to replace old appliances with more efficient products, such as LEDs, air-conditioners, refrigerators, and fans. On-bill financing of solar water heaters is being provided through SNGPL, who have sold over 2,000 units to its consumers through easy installments of up to 24 months.

3.19

Enabling Action Area: Renewable Energy &Energy Efficiency Funds

Energy Efficiency funds are dedicated funds for the investment in a project that reduce energy wastage, extract useful energy from waste and avoid excessive energy consumption. These funds are typically invested in public and commercial building retrofits; industrial energy sector; urban infrastructure and utilities to improve the energy efficiency. Large multilateral organizations and governments generate this fund which is routed through Energy Services Companies (ESCOs), where Energy Efficiency Agencies (e.g. NEECA) monitors the fund and client organizations utilize them. These funds, if utilized and invested well can provide extraordinary solutions that deliver energy savings and produce optimal performance and best value for money for consumers.

Pakistan as developing country can take benefit of external finance in the form of special credit lines with soft loans and special grants. The government of Pakistan has signed the Paris Agreement; therefore, it will explore various avenues to set up indigenous funds as well as attract investments from energy efficiency fund with the support of the multilateral organization. The World Bank, Global Environment Facility (GEF), UNFCCC, Asian Development Bank, GIZ, and USAID are fairly active in financing energy efficiency programs in developing countries.

The government of Pakistan can also attract investments through financial mechanism operated under Green Climate Fund (GCF). GCF is a fund set up under the framework of UNFCCC to assist developing countries like Pakistan in adaptation and mitigation practices. The target for climate financing under GCF is to reach US$ 100 billion annually, whereby it primarily redistributes money from the developed world to developing world to counter climate change.

The SEforAll Small Grants Programme will be established to offer grants up to USD 100,000/- for any initiatives that accelerate the adoption of any of the proposed actions within the SEforAll plan. A trust fund of USD 20 million will be set aside, and only the investment income be utilized for grant making. It is suggested that at least 40% of this USD 20 million is contributed from the government's own funds, and the rest can be through donor contributions facilitated by UNDP. The SEforAll Trust Fund should be established as a Section 42 non-profit company with an independent Board.

Capacity Building and Knowledge Sharing

3.20

Rural electrification and off-grid market

There is a provision of off-grid and distributed renewable power generation under the Renewable Energy Policy 2006mandated to AEDB and other concerned provincial agencies. However, the implementation mechanism and procedural modalities will bedeveloped.[12] Initially, the small-scale hydropower projects were implemented under the policy framework. Although policy provides an option for other off-grid technology such as solar, biomass, and wind to be developed for community or isolated grid distribution.[13] However, no detail policy mechanism has been so far developed.[14] Further, in the absence of the policy mechanism, there is no incentive for private sector to invest in this area which can be a critically important area for the economy and social development.

In the absence of the government policies, neither public sector nor private sector has put serious efforts for development of micro/mini-grids for rural electrification. Rural areas lack technical skills and no financial incentive for development and implementation of any such technology. There is a lack of standardization for solar PV which has resulted in the poor performance of

small-scale systems. It also lowered end-user confidence in stand-alone systems.[15]

The Private sector has highlighted the issues with the investment in rural areas such as:

I. Solar PV installation offered in some region for free by Government and donor agencies;
II. Commercial risks and higher investment costs;
III. No information available of market potential;
IV. Lack of financing mechanism for solar installation for small scale solar installation;
V. Lacking Government support.

The government will devise policy framework to facilitate private sector to provide an off-grid solution to rural areas.

3.21

Enabling Action Area: Energy Information Sharing and Delivery

Currently, customers lack access to information on energy saving opportunities that exist in various sectors of the economy. This potentially reduces the investments in the energy efficiency as consumers are not well aware of the fact as for how these energy efficiency programs, such as labeling or Minimum Energy Performance Standards and benchmarking can help consumers save resources, energy, and capital.
An Energy Efficiency Benefits Calculator as such will be developed. This will help educate the energy customers and stakeholders to understand the broad benefits of Energy Efficiency. The objective of development of such a tool would be to provide a simplified framework to show a business case for energy efficiency from the standpoint of consumers, utilities, and government policies.

Worldwide, many countries have established energy information centers to inform and educate households on energy efficiency actions. These information centers have been developed for energy information and dissemination where households and consumers can receive all information relevant to energy efficiency, these are called the "one-stop shops" for energy efficiency. NEECA will establish similar kind of information centers in all the provincial headquarters to facilitate and educate the public and consumers about the potential benefits of energy efficiency in Pakistan.

In gas sector there is no incentive for utilities to improve their efficiency. It is evident from the fact thatbusiness model of SSGC and SNGPLis based on return on assets. This incentivized to build large network, instead of improvement in the efficiency of the system. As such tariff regime will reviewed and reformed to improve the performance and efficiency of the system.

In addition, there is a barrier of split-incentive, which usually discourages home builders and commercial developers to improve energy efficiency in the new building because often it is the tenants who pay the energy bills not home builders.The capacity of the builders and commercial developers will be enhanced to address the issue of split-incentives through improvement in the building codes.

3.22

Enabling Action Area: Appliance Testing Laboratories

Successful implementation of energy appliance labeling measures requires adequate facilities of energy standards and certification laboratories in the country. Pakistan Standards and Quality Control Authority (PSQCA) is the designated agency of the Government of Pakistan which develops the national standards. PSQCA is responsible for the development of national standards, quality testing and conformity assessment of various products. Conformity Assessment includes a range of activities such as the testing, calibration, inspection, system and product certification.

At present, there is a paucity of testing and inspection labs for certification of energy appliances and products. NEECA and PSQCA are working to establish liaison with each other to develop these energy standards, testing and certification laboratories for various products and appliances. These laboratories have to be run and managed by qualified professionals which will be trained according to international best practices, thus capacity will build in setting up these labs.

In addition to the development of local testing procedures, NEECA will develop harmonization schemes for equipments' testing and standards so that the locally made equipment could be exported and as well as encourage the import of efficient appliances and equipment. This would also enhance the international and regional cooperation and strengthen trade of energy efficient equipment within the region. International energy organizations will be used as an exchange platform to learn from the experiences of other countries to develop policies and identify best practices.

3.23

Enabling Action Area: Mandatory Regulatory Measures for Consumers

Mandatory regulatory measures often produce positive results because compliance to these measures become obligatory. Mandatory regulations have been quite successful in several jurisdictions. Many countries have adopted mandatory regulatory measures for the consumer that meet a certain threshold. For example, in Singapore, companies with energy consumption exceeding over 54 Tera Joules are required by law to appoint an energy manager, conduct energy audit periodically and submit these audit reports and plans to improve energy efficiency.

Similar measures have been implemented by the UK government, whereby certain large consumer

(organizations with more than 250 employees or an annual turnover of more than €50 million) are required by law to submit serious targets and plans to reduce energy use. These organizations are also required to monitor their performance against those targets. Similarly, India has established mandatory minimum energy standards for buildings with a connected load of over 100 kW or contracted demand of over 120 kVA. Likewise, there is a great potential to reduce energy use in large organizations in Pakistan. NEECA will initiate similar measures in Pakistan.

3.24
Enabling Action Area: Mandatory Energy Audits and Reporting

Energy auditing is one of the effective ways to deliver targeted information that enables consumers to undertake investments and cut energy wastages. Energy Auditing is a service where the factories or buildings are evaluated based on their energy usage with the aim to recommend the best means to improve energy efficiency. Without getting a building or factory audited, consumers would generally be not aware of the potential savings or improvements that they could make by implementing relatively simpler measures. Consumers and organizations often do not realize the true potential and financial attractiveness of implementing energy efficiency measures.

NEECA will devise a mechanism by which certain consumers will get their facilities audited by certified energy auditors. These auditors will recommend cost-effective strategies that will save them money and energy. Energy savings achieved through energy efficiency improvements will increase their business competitiveness and operations.

The mandating of energy audits will be an important step which will allow the consumers to know the actual opportunities that exist within their business operations. Consumers will get their facilities audited, and based on the outcomes of these audit reports, NEECA will issue Energy Performance Certificates. These certificates will indicate as to how these facilities perform and how much energy they consume relative to other facilities. The major goal of developing any such mechanism is to encourage the market towards an increased demand for energy efficient practices, operations, and facilities.

3.25
Enabling Action Area: Mandatory Energy Saving Plans

Transmission and distribution losses of Power and Natural Gas utilities in Pakistan are one of the highest in the region. The average power distribution losses in Pakistan are as high as about 20% and for some DISCOs, these losses can reach over 38%.[16] For comparison, the average power distribution losses in Europe are less than 7%. While the UFG losses in the gas network for SSGC and SNGPL stands at about 15% and 11.5% respectively. NEECA will enforce a mechanism whereby these power and gas utility companies will be required to set targets and timelines to cut their energy losses and improve energy efficiency. The Mandatory Energy Saving Plans can also be implemented in the private businesses and government organizations as well. NEECA will impose a penalty in case of non-compliance to these measures.

3.26
Enabling Action Area: Capacity Building of Government Departments

Government departments are the owner and implementers of the Sustainable Energy for All initiatives. The departments at national and provincial levels are dealing with day to day energy planning, financing, management and legal issues. The energy markets are becoming more and more sophisticated whereas, the personnel in these departments and ministries are using the conventional techniques and knowledge. Therefore, the capacity building/ training of officers and staff at national and provincial energy departments will be organized in phased manner.

Furthermore, Planning Commission's Energy Wing will spearhead the Integrated Energy Planning in collaboration with international donor agencies. In-house capacity buildings through trainings, courses and international collaborations will be developed for sustainable energy planning and management.

3.27
Private Sector Role and Incentives in the Energy Sector of Pakistan

Energy Sector will be opened for more private sector investment. Pakistan has a proven track record of encouraging private sector participation and investment in both developing its oil & gas resources and building, owning, and operating power generation facilities to supply energy to the economy. To encourage and incentivize this investment, the government has issued a number of energy development policies such as the Private Power Development Policy, the Petroleum Development Policy, the LNG Import Policy, and the Renewable Energy Development Policy.

These policies provided a variety of guarantees, risk insurance, and tax breaks to private sector investors. The government's energy planning process has addressed from different

dimension in this National Action Plan. A more rigorous all energy subsectors (oil, gas, power renewables, etc.) mechanism will revised. The sufficient analytical rigor to focus the policy and incentive process for more private sector participation is one of the desired goals to be achieved. Investment prospectus will identify the gaps where private sector can be driving force for implementation of energy projects.

3.28

Linkages to Investment Prospectus

The implementation of this National Action Plan by and large depends on the resource availability which will be developed and linked to the Investment Prospectus (IP). Adaption of viable financial mechanism on business models to execute the planned follow-up projects will depend on selection of projects having potential to repay the capital investment through its own cash generation. In addition, the prioritization of projects is required to make the Action Agenda financially viable.

The Investment Prospectus will present three scenarios for operationalization of SEforAll in the country. First and foremost, the low-hanging short-term projects, then medium-terms projects and lastly long-terms projects aligned with public sector annual and five years plans. The aim is to categorize the projects in such a way that foreign direct investment in the energy sector will be attracted. Similarly, the international donors' agencies will be provided the list of the projects to execute projects as per their resource availability and field of expertise. The Public Private Partnership will be promoted for the development of medium and long-term power projects as well. In this regard, China-Pakistan Economic Corridors (CPEC) serves as example for investments in the energy sector of Pakistan.

PART-4

COORDINATION AND FOLLOW-UP

4.1
Mechanism for Coordination and Follow-up

Sustainable Energy for All initiative at national, provincial, and district level requires a comprehensive and all-inclusive coordination, monitoring and tracking framework to achieve a tangible result. The coordination and tracking framework developed at this level will be part of global tracking framework. The flow diagram (see figure Coordination and Follow-Up) delineates the organizational structure and mechanism.

Sustainable Energy for All Secretariat established at the Energy Wing, Ministry of Planning, Development, and Reforms will be strengthened with the support of UNDP and other development partners (See Fig. 19). The Energy Wing at national level plays a vital role for review of projects to be funded under PSDP. UNDP will assume as the Financial Management Partner (FMP) to operationalize the SEforAll project in Pakistan. The credibility of SEforAll initiative rely to a great extent on UNDP / SEforAll's ability to mobilize the required resources for the implementation of NAP and IP. It is therefore necessary that UNDP should follow-up with donor agencies. The same kind of model has been adopted in other countries for the operationalization of SEforAll NAP and IP.[1]

The SEforAll Secretariat while leading the SEforAll initiative will have management responsibilities for coordination and tracking of initiatives under SEforAll. The relevant section of the Energy Wing notified as Secretariat of SEforAll National Steering Committee will serve as the lead manager of the Action Plan. In addition to National Coordinator, the other proposed team members include:

1. National Project Manager
2. Specialist Energy Access
3. Specialist Renewable Energy
4. Specialist Energy Efficiency and Conservation
5. Specialist Communications and Media / Social Media
6. Business Development Specialist
7. Specialist Policy and Program Analysis
8. Specialist Trainings and Capacity Building
9. Specialist Public Private Partnership
10. Specialist NDC Partnerships.

External loans

Subsidies

Grant Aid

Credit Guarantees

SEforAll Finance Facility Project
Administrative Unit

UNDP As FMP

Donors/Intl. Energy Alliance
Resource Base

PUNJAB

SINDH

BALOCHISTAN

KHYBER PAKHTUNKHWA

GILGIT BALTISTAN

AZAD JAMMU & KASHMIR

Partners responsible for delivery	Partners responsible for delivery	Partners responsible for delivery	Partners responsible for delivery	Partners responsible for delivery	Partners responsible for delivery
- Finance - Technology - Service	- Finance - Technology - Service	- Finance - Technology - Service	- Finance - Technology - Service	- Finance - Technology - Service	- Finance - Technology - Service

Local projects

4.2
Monitoring and Tracking Framework

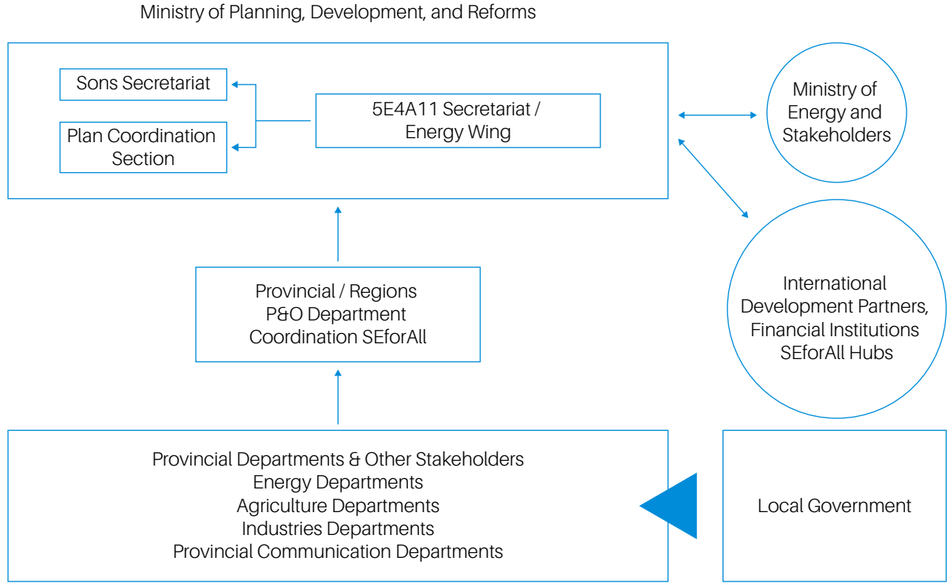
The involvement of diverse stakeholders' vis-a-vis success of the initiative demands a Secretariat with an ability to properly support provincial and regional governments. The secretariat will communicate the best practices in completing the relevant processes and liaison with right partners globally. The effective communication as well as networking between the SEforAll stakeholders and partners is a key for successful implementation. SEforAll Secretariat will liaison with the ministries, departments, authorities, research organizations, universities, financial institutions, donor agencies, CSO and private sector at the national level for tracking and monitoring of SEforAll initiatives. Moreover, the Secretariat will coordinate with SEforAll hubs for information sharing and capacity building. The Integrated Energy Planning Regime being established by the government will also support to coordinate the activities of SEforAll Action Plan.

Post 18th constitutional amendment, the power has devolved to the provincial which substantially increased the function and responsibilities of the provincial government. The SDGs (Goal #7 – SEforAll) mandate right from planning, resource allocation, and implementation perspective has been transferred to provinces. The role of provincial governments as a policymaker and implementor is to effectively coordinate with federal and local governments, and other stakeholders.

For effective SEforAll implementation the provincial government will work with local governments for the development of comprehensive implementation strategy along with clearly defined roles and responsibilities. The local governments will implement the SEforAll at grass-root level and increase the provincial governments' outreach. The local governments will be vital to achieve the targets of SEforAll from multiple perspective i.e. identification, planning, implementation, monitoring and oversight. The involvement of people at grass-root level will capture the local needs which will be reflected into the planning, execution and monitoring of the projects. A successful implementation of SEforAll will benefit the local communities and ensure universal access to energy.

Government of Pakistan has already established the SDGs Secretariat and the Ministry of Planning, Development and Reform convened a "Local Government Summit on SDGs" with the theme of "Development for All". This has initiated the coordination and support mechanism framework for SEforAll among all three tiers of government. At district level, proper accountability mechanisms will be designed to monitor and control the progress on the SDGs (SEforAll) related schemes and projects.

Figure 18 Coordination and Monitoring Mechanism



To develop a comprehensive collaboration mechanism at the national level will require the following key stakeholders to be on board:

- Ministry of Planning, Development, and Reforms
  - Energy Wing
- Ministry of Energy
  - Power Division
    - National Transmission and Dispatch Company
    - Alternative Energy Development Board
    - National Energy Efficiency and Conser vation Authority
    - National Electric Power Regulatory Authority
    - Distribution Companies
    - Water and Power Development Authority
    - Central Power Purchasing Agency
  - Petroleum and Natural Resources Division
    - Sui Northern Gas Pipelines Limited
    - Sui Southern Gas Pipelines Limited
    - Oil and Gas Regulatory Authority
- Ministry of Housing and Works
- Ministry of Communication / National Transportation Research Center
- Capital Development Authority / Planning and Design Wing

Similarly, at the provincial level, Planning & Development departments will liaison with provincial stakeholders – ministries, department, authorities, financial institutions, academia, research organi-

zation, the private sector, NGOs, and CSOs. In addition, provincial level Sustainable Development Goals (SDGs) Unit headquartered in provinces could provide input to Planning & Development departments. To develop a comprehensive collaboration mechanism at provincial level will require the involvement of the following provincial departments:

- Provincial Planning and Development Departments
- Provincial Energy Departments
- Provincial Agriculture Departments
- Provincial Transportation Departments
- Provincial Environment Protection Departments
- Provincial Industries, Commerce and Investment Departments
- Provincial Higher Education Departments

Along with the Governmental ministries and departments at the national and provincial level, International development organizations such as USAID, GIZ, and JICA etc., and international financial institutions such as ADB, AIIB, WB etc., will be engaged as observer and partners at the national level with SEforAll secretariat. Along with the financing, these development organizations and financial institutions can provide assistance to introduce latest trends/technologies/best practices around the World to implement in Pakistan under the SEforAll.

Some of the proposed key responsibilities of SEforAll Secretariat are:

- Provide an overall leadership and coordination mechanism for SEforAll in Pakistan
- Manage awareness campaign and advocacy for SEforAll for better coordination in the line ministries.
- Collaborate with local and international research organization, think-tanks, research centers and universities to bring best practices and research to meet the SEforAll goals.
- Develop and improve the mechanism proposed for SEforAll Coordination, Tracking and Monitoring Framework.
- Implementation of SEforAll Coordination, Tracking and Monitoring Framework: Acquire information for SEforAll targets in short, medium and long-term.
- Negotiate and establish SEforAll Tracking Framework with Provincial Planning and Development Departments.
- Liaison with International Development Partners and International Financial Institutions.
- Introduce new technologies in Pakistan together with international partner organizations.
- Organize Workshops for the end users for awareness related to advantages related to adoption of new technologies.
- Develop and manage a website for ready information for the end users and the stakeholders.
- Provide assistance/support to the donor agencies to implement relevant projects smoothly.
- SEforAll secretariat will act as one window solution for all the stakeholders including end-users and donor agencies.

- Engage UNDP District Accelerator programs to monitor the SEforAll targets.
- Development of medium to long-term action plans to support investments in energy access, renewable resources, and energy efficiency
- Implementing a technical assistance program to utilize indigenous renewable energy resources to supply electricity and improve living standards of poor, and remote communities that are not covered by power grids;
- Prepare Investment Prospectus identifying specific projects and programs to initiate public private partnerships
- Develop capacities of partner organizations and government departments related to energy access, energy efficiency and renewable energy
- Provide resources that support policy and institutional reforms and regulatory frameworks that encourage development of sustainable energy production
- Conduct stakeholder workshops to identify the capacity barriers of the country, including sub-regional or thematic workshops;
- Promote existing regional, sub-regional and national initiatives that align with the objectives of SEforAll; as well as initiatives that arise from individual and joint efforts taken at the country level on sustainable energy;
- Pilot innovative business models for energy service delivery, especially those that strengthen income-generating and entrepreneurial opportunities by promoting productive uses of energy;
- Integrate decentralized energy systems with productive uses of energy and entrepreneurial activities using the energy plus approach; and,
- Develop platforms of key stakeholders to promote knowledge and information exchange and new partnerships to advance sustainable energy solutions;
- Actively promote and carry out advocacy, outreach and communication activities to increase the knowledge and information about sustainable energy business models and available financial resources among energy practitioners
- Development of SEforAll Database / Mobile application, the Secretariat will be responsible for update of the database and mobile application. Secretariat will also track the information in this system. Data feeding responsibility will be of the stakeholders – agencies, line ministries, and departments at provincial and federal level.

NOTES

Executive Summary

1 Source: http://www.nepra.org.pk/industryreports.htm

2 Source: http://www.pbs.gov.pk/content/pakistan-social-and-living-standards-measurement

3 Source: http://rise.esmap.org/country/pakistan - RISE Report reviewed the regulatory performance SEforAll three goals of SEforAll. Pakistan has a very high score on Renewable Energy. Brick kiln industry by Syed Akhtar Ali – Business Recorder

4 For comparison, the average power distribution losses in Europe are less than 7%.

5 A full-time management and technical staff is required for NEECA to operationalize the activities and plans which are mandated through the National Energy Efficiency and Conservation Act.

INTRODUCTION

1 A multi-dimensional definition as "the ability to avail energy that is adequate, available when needed, reliable, of good quality, convenient, affordable, legal, healthy and safe for all required energy services. Source: https://www.esmap.org/node/55526

2 Pakistan Bureau of Statistics, Government of Pakistan. National Census, 2017.

3 Economic Survey of Pakistan 2016.17
List of CPEC Projects is annexed at the end

4 http://pc.gov.pk/uploads//plans//Ch19-Energy1.pdf Page: 208

5 http://pc.gov.pk/uploads//plans//Ch19-Energy1.pdf Page: 209

6 source: http://pc.gov.pk/web/vision

7 Consult Report on the following link: http://www.worldbank.org/en/topic/energy/publication/rise---regulatory-indicators-for-sustainable-energy

8 After submission of intended nationally determined contribution the word "intended" has been dropped to Nationally Determined Contribution.

9 These post-2020 climate action intended to take under the Paris agreement are known as Intended Nationally Determined Contributions (INDCs).

10 http://germanwatch.org/en

11 http://www.ndma.gov.pk/

12 http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Pakistan/1/Pak-INDC.pdf

13 Calculated at current prices.

PART-1: VISION & TARGETS UNTIL 2030

1 Source:https://www.adb.org/projects/42051-023/main#project-pds Access Date: December 1, 2017

2 UNDP, SEforAll "Pakistan: Rapid Assessment Gap Analysis, 2014", "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)". Another indicator for energy efficiency thorough rate of decrease in energy intensity from 2000 onward which is 1.7% and it will be doubled 3.4%.

3 Alternative Energy Development Board, "The Government of Pakistan has tasked the AEDB to ensure 5% of total national power generation capacity to be generated through renewable energy technologies by the year 2030. In addition, under the remote village electrification program, AEDB has been directed to electrify 7,874 remote villages in Sindh and Baluchistan provinces through ARE technologies". http://www.aedb.org/index.php/ae-technologies/bio-mass-waste-to-energy/53-about-aedb

4 Provisional Results of 2017 Census & Household Integrated Economic Survey 2014-15 Date Accessed: December 1, 2017 http://www.pbscensus.gov.pk/

5 In Punjab, a new housing scheme will be given gas connection if the cost of providing the connection is less than PKR. 54,000 per customer. On the other hand, in KPK and Sindh, the cost threshold is PKR. 108,000 while in Balochistan it is PKR. 200,000 per customer. Even with these differences in cost, it will not be financially or economically viable to extend pped gas network to several remote locations.

6 Oil and Gas Regulatory Authority Source: http://www.ogra.org.pk/ufg Data Taken Jan 21, 2018

7 NEPRA State of Industry Report 2016 based on TESCO Data – Date Taken Jan 29, 2018

8 Number of households without a gas connection for baseline year (2016-17) was calculated as (population of each region divided by household size of 6.5). The assumption here is that all the households without access to piped gas are using inefficient cooking stoves. Given the almost insignificant penetration of ICS in Pakistan, this is a rational assumption. This figure was projected to the year 2030 by the annual growth rate of 1.8% (average annual population growth rate for last 10 years). The target is determined by computing the number of households that will not have a gas connection by 2030, as these are the households that will continue to use biomass for cooking purposes

9 Medium Term Development Framework goal is 9700MW
Source:

10 http://www.aedb.org/index.php/ae-technologies/biomass-waste-to-energy/53-about-aedb

11 Energy Year Book, 2017

12 ESMAP, NUST, and World Bank carried out an extensive biomass potential mapping study for Pakistan. Analysis of agro-industrial sites was conducted to evaluate the potential of each site for implementing a biomass-based power or cogeneration plant.

NOTES

19 Findings of USAID GOPA 2016 Study.

PART-3: ENABLING ACTION AREAS

1 Source:https://www.sdpi.org/publications/files/A106-A.pdf

2 Source: http://www.dawn.com/news/1295092

3 http://www.nepra.org.pk/Legislation/Regulations/NOTIFICATION%20SRO%20892%20-2015.PDF

4 Source:https://propakistani.pk/2016/08/12/rawalpindi-resident-becomes-first-pakistani-to-sell-electricity-to-grid-save-thousands/

5 http://documents.worldbank.org/curated/en/104071469432331115/Biomass-resource-mapping-in-Pakistan-final-report-on-biomass-atlas

6 This 660 kV, 878 km transmission line will have transmission capability amounting to 4,000 MW. For detailed information about the project and its financial and technical features, please see NEPRA's tariff determination document (NEPRA, 2016 (e)).

7 DAWN News, 2016.

8 Circular debt is the amount of cash shortfall within the Central Power Purchase Agency (CPPA) that it cannot pay to power supply companies.
Source: www.pdip.pk/circular-debt-report/

9 Ibid.

10 MicroEnergy International, 2014.

11 IRENA, 2016 (f).

12 Government of Pakistan, 2006.

13 Government of Pakistan, 2006.

14 AEDB, 2015 (b).

15 Ali S. , 2015.

16 National Electric Power Regulatory Authority

PART-4: COORDINATION AND FOLLOW-UP

1 Bangladesh and African Countries has successfully operationalized the SEforAll National Action Plan and Investment Prospectus through similar model.

ANNEXTURES

1 Engelmeier et al., 2014.

2 Market Study of Sustainable Energy Finance in Pakistan, IFC 2014

NOTES

13 Pakistan Sugar Mills Association website

14 Use of new extraction condensing steam turbine allows the high-pressure cogeneration system to run during the off-milling season by utilizing all the bagasse generated at the sugar mill as well as additional biomass feedstock sourced from the vicinity of the sugar mill.

15 Pakistan Energy Year Book 2017

16 Energy Access Outlook - International Energy Agency, 2017

17 Pakistan Energy Year Book, 2017

18 NTDC

19 Energy Saving in Pakistan by RAFTAAR, DFID (2016)

20 Economic Survey of Pakistan (2016-17)

21 Pakistan Energy Year Book (2017)

22 International Institute for Sustainable Development, IISD

23 International Finance Cooperation, 2014

24 Market Study of Sustainable Energy Finance in Pakistan, IFC 2014
Energy Saving in Pakistan, RAFTAAR, DFID 2016

25 Trends in Global Energy Efficiency: An Analysis of Industry and Utilities, ABB (2011)

26 Arshad H Abbassi & Maha Kamal, "Importing LNG: A Policy Analysis" Sustainable Development Policy Institute (SDPI)

27 Pakistan Sugar Mills Association (2016)

28 IFC funded Study "Sustainable Growth: Cleaner Production in Pakistan" by National Productivity Organization (NPO) & Cleaner Production Institute (CPI), 2016.

29 CKDN "Catalyzing leadership on efficient bagasse processing: Case Study on Pakistan Sugar Industry"

30 ibid

31 International Institute for Sustainable Development, IISD

32 All Pakistan Cement Manufacturing Association (APCMA) (2016)

33 International Finance Cooperation, 2014

34 Brick kiln industry by Syed Akhtar Ali – Business Recorder

35 World Energy Council

36 Petroleum Institute of Pakistan

37 Petroleum Institute of Pakistan
https://www.fueleconomy.gov

38 National Electric Power Regulatory Authority (NEPRA)

39 Asian Development Bank 2009

40 Ibid

41 National Electric Power Regulatory Authority

42 Sui Southern Gas Company Limited

43 According to the Environmental Protection Agency (EPA), Natural gas emission through leakages into the atmosphere is approximately 21 times more harmful than carbon dioxide.

44 The rational for this increase is extensive growth in power sector with exponential growth in installed power projects.

PART-2: PRIORITY ACTION AREAS

1 Source: http://cm.punjab.gov.pk/node/3971

2 0.75 mmcf = 750 mmbtu Therefore 0.1

3 NRSP, Renewable Energy: Evaluation of Biogas Initiative in Punjab.

4 Usmani, Jafar. "Presentation on Biodiesel in Pakistan"

5 IFC-Market Study of Sustainable Energy Finance in Pakistan

6 http://www.aedb.org/index.php/ae-technologies/solar-power/solar-current-status

7 Raheem, A., Abbasi, S.A., Memon, A. et al. Energ Sustain Soc (2016) 6: 16. doi:10.1186/s13705-016-0082-z

8 These high fuel costs are not fully transferred to the end consumer, due to commodity market prices, but instead absorbed by the farmers, reducing their profit margin substantially.

9 Alternative Energy Development Board (AEDB)

10 This study has also shown that about 3% of Pakistan's total land has Class 4 wind resource and about 9% of the land has Class 3 or even better wind resource

11 Wind Resource Assessment and Mapping for Afghanistan and Pakistan, NREL access at:http://www.nrel.gov/international/pdfs/afg_pak_wind_june07.pdf

12 http://www.pcq.com.pk/denmark-company-vestas-to-bring-wind-energy-to-punjab-region-of-pakistan/

13 Alternative Energy Development Board (AEDB

14 GIZ, 2013.

15 Khyber Pakhtunkhwa Energy & Power Department, 2016 (a).

16 https://www.thenews.com.pk/print/107384-Pak-geothermal-energy-resources-have-potential-to-generate-100000MW-power-Research Sustainable Energy Efficiency Program, ADB (2009)

17 RAFTAAR: Research and Advocacy for the Advancement of Allied Reforms

18 Global EV Outlook 2016

Annex I: Constitution of SEforAll Steering Committee

Annex-II

No.44 (11) Energy/Pc/2014
Government of Pakistan
Ministry of Planning Development and Reform

***

Islamabad the 3rd September, 2015

NOTIFICATION

Constitution of National Steering committee for SEforAll

Ministry of Planning, Development and Reform has constituted National Steering Committee (NSC) for Sustainable Energy for All (SEforAll) Programme, with following mandates/ TORs:

i. Preparation of National Action Plan for SEforAll in line with the vision 2025 and in harmony with global goals and targets set forth upto 2030 under sustainable Development Goals (SDGs) through a consultative process involving relevant Federal/Provincial/Private International stakeholders and civil society organizations.
ii. Monitor Execution of national action plan and develop annual reports. Coordinate with national and international teams of UNDP.
iii. Provide guidance to stake holders for achievement of goals of SEforAll
iv. Energy wing (Energy Finance & Economic Section) of the Planning Commission will act as secretariat to the NSC.

2-The Composition of the Steering Committee shall be as follow:

i.	Minister for Planning, Development & Reform	Chairman
ii.	Secretary Ministry of Planning Development & Reform	Vice Chairman
iii.	Secretary Ministry of Water and Power	
iv.	Secretary Ministry of Petroleum & Natural Resources	
v.	Secretary Economic Affairs Division	
vi.	Secretary Ministry of Climate Change	
vii.	Secretary Ministry of Communication	
viii.	Secretary Ministry of Industries & Production	
ix.	Secretary Ministry of Textile Industry	
x.	Secretary Ministry of National Food Security and Research	
xi.	Governor/ Representative of State Bank of Pakistan	
xii.	Director General (UN), Ministry of Foreign Affairs	
xiii.	Director General Economic Reforms Unit, Ministry of Finance	
xiv.	Assistant Country Director, (Energy and Environment) UNDP Resident Mission Islamabad	
xv.	Representative of World Bank	
xvi.	Representative of Asian Development Bank	
xvii.	Secretary Department of Energy, Government of Punjab	
xviii.	Secretary Department of Energy, Government of Sindh	
xix.	Secretary Department of Energy, Government of KPK	
xx.	Secretary Department of Energy, Government of Balochistan	
xxi.	Secretary Department of Power, Government of Gilgit-Baltistan	
xxii.	Secretary Energy/Power FATA Secretariat	
xxiii.	Secretary Department of Energy, Government of AJ&K	
xxiv.	Chief Executive Officer. Alternative Energy Development Board,	
xxv.	Managing Director, ENERCON, Government of Pakistan	
xxvi.	Chairman, National Electric Power Regulatory Authority (NEPRA)	
xxvii.	Chairman, Oil and Gas Regulatory Authority	
xxviii.	Three (03) Technical Experts (to be nominated by the Chairman)	
xxix.	Member (Energy) Planning commission Secretary	

3- A brief on SEforAll is also attached for the facilitation of the Members.

Distribution

(Abdul Hamid Balghari)
Chief (EF&E)
Ph: 9245068

All Members.

Copy for information to:-

i. Chief Secretary Governments of Punjab, Sindh, KPK, Baluchistan, AJ&K, Gilgit Baltistan, Lahore, Karachi, Peshawar, Quetta, Muzafarabad
ii. Additional Chief Secretary (Development), Governments of Punjab. Sindh, KPK, Balochistan, AJ&K, Gilgit Baltistan, Lahore, Karachi, Peshawar, Quetta, Muzafarabad
iii. Chief Economist, Planning Commission
iv. Chief (Macro) Ministry of Planning Development & Reform
v. Chief (Plan Coordination), Planning Commission
vi. All Chiefs Energy Wing.
vii. Staff Officer to Minister for Planning Development and Reform
viii. SPS to Secretary, Ministry of Planning Development & Reform
ix. SPS to Member (Energy)

Annex IV JICA's Scenario Base Electric Energy Demand Forecast by 2050

Sector Wise Electric Energy Demand Forecast (High case)

	Unit	2014	2015	2020	2025	2030	2035	2040
Total	GYM	152.282	162.311	238,979	343,495	485.669	656,920	890.168
Aorlcultsre.Fishery	GM	15,200	16,200	22,000	26.800	31,200	35,600	40,500
Industry	GM	44.403	49000	88.400	142.500	216.700	311.500	445.300
Commercial & SanAces	GM	10,100	11,100	18,100	28,303	42,400	62,200	90,100
Public Goverrirnent	GM	73	76	97	124	158	202	258
Pubic Street NM	GM	509	534	682	871	1.111	1,418	1,810
Anklet&	GM	56,400	58.900	76,700	102.000	133,400	163.900	203.900
T/D loss	MAN	25,600	26.500	33.000	42.900	60.700	82.100	111.300
Total	596	100.0	100.0	103.0	103.0	100.0	1000	100.0
AcylcuttusiSbnery	5%	100	10A	9.2	7.8	6.4	5.4	4.5
Industry		29.2	30.2	37.0	41.5	44.6	47.4	50.0
Commerdal & Senas	596	6.6	6.8	7.6	8.2	87	9.5	10.1
Public Government		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Public Street gm	S%	0.3	0.3	0.3	0.3	0.2	0.2	0.2
ResldentUls	5%	37.0	36.3	32.1	29.7	27.5	24.9	22.6
110 loss	5%	16.8	16.3	13.8	12.5	12.5	12.5	12.5

Annex IV JICA's Scenario Base Electric Energy Demand Forecast by 2050

Sector Wise Electric Energy Demand Growth Rate (High case)

	2015/10	2020/15	2025/20	2030/25	2035/30	204W35	2040/15
Total	5.0	8.0	7.5	7.2	6.2	6.3	7.0
noriculture.F 'show	4.13	6.3	4.0	3.1	2.7	2.6	3.7
Industry	7.6	12.5	10.0	8.7	7.5	7.4	9.2
Commercial & Services	5.0	10.3	9.4	8.4	8.0	7.7	8.7
Public Government	-2.6	5.0	5.0	5.0	5.0	5.0	5.0
Public Street light	3.1	5.0	5.0	5.0	5.0		5.0
Residentials	5.8	5.4	5.9	5.5	4.2	4.2	5.0
T/D loss	0.0	4.5	5.4	7.2	6.2	6.3	5.9

Annex-V Private Power Infrastructure Board - Power Project List by 2025

2017	Project	Sponsor/ Company Name	Power Policy	Location	Fuel	Capacity (MW)	Expected COD/ Remarks
1	Patrind Hydropower Project	Star Hydropower Limited	2002	Kunhar River, KP/AJ&K	Hydel	147	Oct-17 Under testing & commissioning
2*	1320 MW Imported coal based Power Project at Qadarabad Dist Sahiwal	Huaneng Shandong Ruyi (Pakistan) Energy (Pvt) Limited	2015	Qadarabad, District Sahiwal	Coal	First Unit 660 Second Unit 660	Inaugurated on 25.05.17 Inaugurated on 03.07.17
3(i)*	1320 MW Imported coal based Power Project	Port Qasim Electric Power Co. (Pvt) Ltd	2015	Port Qasim, Karachi	Coal	First Unit 660 MW	Dec-17 Under construction
4	1180 MW RLNG based Project at Bhikki	QATPL	2015	Bhikki, Punajb	RLNG	1180	Open Cycle (717 MW) commissioned Combined Cycle by Dec-17
5(i)	1223 MW RLNG based Project at Balloki, Punjab	NPPMCL	2015	Balloki, Punjab	RLNG	GT1 & GT2 800	Open Cycle by Sep-17
6(i)	1230 MW RLNG based Project at Haveli Bahadur Shah, Punjab	NPPMCL	2015	Haveli Bahadur Shah, Punjab	RLNG	GT1 & GT2 800	Open Cycle (760 MW) inaugurated on 07.07.17
7	Fatima Energy Cogeneration Project	Fatima Energy Limited	Co-gen Policy 2008	Muzaffargarh	Bagasse/ Imported Coal	118	ec-17 LOS issued FC in progress (Under Construction)
					Sub Total (2017)	5025	

2018	Project	Sponsor/ Company Name	Power Policy	Location	Fuel	Capacity (MW)	Expected COD/ Remarks
5(ii)	1223 ME RLNG based Project at Balloki, Punjab	NPPMCL	2015	Balloki, Punjab	RLNG	ST 423	Combined Cycle by Jan-18
6(ii)	1230 MW RLNG based Project at Haveli Bahadur Shah, Punjab	NPPMCL	2015	Haveli Bahadur Shah, Punjab	RLNG	ST 430	Combined Cycle by Jan-18

2018	Project	Sponsor/ Company Name	Power Policy	Location	Fuel	Capacity (MW)	Expected COD/ Remarks
8(i)*	1320 MW Imported coal based Power Project at HUB Balochistan	China Power HUB Generation Co. Ltd.	2015	Balloki, Punjab	RLNG	ST 423	Combined Cycle by Jan-18
9(i)*	660 MW Thar Coal based Power Project	Engro Powergen Thar Limited	2015	Haveli Bahadur Shah, Punjab	RLNG	ST 430	Combined Cycle by Jan-18
3(ii)*	1320 MW Imported coal based Power Project	Port Qasim Electric Power Co. (Pvt) Ltd	2015	HUB, Balochistan	Coal	First Unit	Dec-18 LOS issued FC in progress (under construction)
					Sub Total (2018)	2503	

2019	Project	Sponsor/ Company Name	Power Policy	Location	Fuel	Capacity (MW)	Expected COD/ Remarks
8(ii)*	1320 MW Imported coal based Power Project at HUB Balochistan	China Power HUB Generation Co. Ltd.	2015	HUB, Balochistan	Coal	Second Unit 660 MW	Aug-19
9(ii)*	660 MW Thar Coal based Power Project	Engro Powergen Thar Limited	2015	Tharb lock-II, Sindh	Coal	Second Unit 330 MW	Jun-19
10	163MW imported coal based Power Project at Arifwala Punjab	Grange Power Limited	2002	Arifwala, Punjab	Coal	163	Sep-19 LOS issued FC in progress
11	Gulpur Hydropower project	Mira Power Ltd	2002	Poonch River/Gulpur, AJ&K	Hydel	102	Oct-19 FC achieved Under Construction
12	1250 MW RLNG based Project near Trimmu Barrage, Jhang, Punjab	Punjab Thermal Power (Pvt) Ltd (PTPL)	2015	Near Trimmu Barrage, Jhang, Punjab	RLNG	1250	Oct-19 LOI issued. LOS in progress
					Sub Total (2019)	2505	

2020	Project	Sponsor/ Company Name	Power Policy	Location	Fuel	Capacity (MW)	Expected COD/ Remarks
13*	1320 MW Thar Coal based Power Project	Thar Energy Limited	2015	Thar Block-I, Sindh	Coal	1320	Dec-20 LOS issued FC in progress
14*	330 MW Thar Coal based Power Project	Thar Energy Limited	2015	Thar Block-II, Sindh	Coal	330	Dec-20 LOS issued FC in Progress
15*	330 MW Thar Coal based Power Project	Thal Nova Power Thar (Pvt) Ltd	2015	Thar Block-II, Sindh	Coal	1180	Dec-20 LOS issued FC in Progress
					Sub Total (2020)	1980	

2021	Project	Sponsor/ Company Name	Power Policy	Location	Fuel	Capacity (MW)	Expected COD/ Remarks
16	660 MW Thar Coal based Power Project	Lucky Electric Power Company Ltd.	2015	Port Qasim, Karachi	Coal	660	Jun-21 LOS issued FC in progress
17	330 MW Thar Coal based Power Project	Siddiqsons Energy Limited	2015	Thar Block-II	Coal	330	Sep-21 LOS issued FC in progress
18*	1320MW Thar coal based Power Project	Oracle Coal Fields PLC England	2015	Thar Block VI, Sindh	Coal	1320	Dec-21 Project proposal yet to be submitted
19*	300 MW Imported coal based Power Project at Gawadar	China Communication Construction Co. Ltd. (CCCC)	2015	Gawadar	Coal	300	Dec-21 LOI issued Tariff determination in progress
20*	Karot Hydropower Project	Karot Power Company Pvt Ltd	2002	Jehlum River, Distt. Rawalpindi Punjab	Hydel	720	Dec-21 FC achieved Under construction
					Sub Total (2021)	3330	

2022	Project	Sponsor/ Company Name	Power Policy	Location	Fuel	Capacity (MW)	Expected COD/ Remarks
21*	Suki Kinari Hydropower Project	S.K Hydro Pvt Ltd	2002	Kunhar River/Mansehra, KP	Hydel	870	Dec-22 FC achieved Under construction
					Sub Total (2022)	870	

2024	Project	Sponsor/ Company Name	Power Policy	Location	Fuel	Capacity (MW)	Expected COD/ Remarks
22*	Kohala Hydropower Project	China International Water & Electric Company	2002	Jehlum River/Kohala, AJ&K	Hydel	1124	Jun-24 LOS issued FC in progress
23	Chakothi-Hattian Hydropower Project	Suhail Jute Mills Ltd	2002	Muzaffarabad, AJ&K	Hydel	500	Jun-24 Feasibility Study level tariff determined by NEPRA. PPIB has requested the Sponsors for submission of Performance Guarantee for issuance of LOS.
24	Azad Pattan Hydropower Project	Alamgir Power Pvt Ltd	2002	Jehlum River/Sudhnoti, AJ&K	Hydel	640	Dec-24 LOS issued FC in progress
25	Kaigah Hydropower Project	Telecom Valley Pvt Ltd	2002	Kaigah/Indus River, KP	Hydel	548	Dec-24 Feasibility Study completed. Sponsors submitted feasibility study level tariff to NEPRA
					Sub Total (2024)	2812	

2025	Project	Sponsor/ Company Name	Power Policy	Location	Fuel	Capacity (MW)	Expected COD/ Remarks
26	Mahl Hydropower Project Turtonas-Uzghor	CWE Investment Corporation/ China Three Gorges & Trans Tech Pakistan	2002	Jehlum River, AJ&K/Punjab	Hydel	590	Dec-25 LOI issued. FS completed and approved by POE. Tariff Application has been filed with CPPAG for negotiation
27	Hydropower Project	Sinohydro-Sachal Consortium	2015	Golen Gol River, Chitral Valley KP	Hydel	58	Dec-25 LOI issued. Feasibility Study in progress
28	Athmuqam Hydropower Project	Korea Hydro and Nuclear Company	2015	Neelum River, AJ&K	Hydel	350	Dec-25 LOI issued. Feasibility Study in progress
					Sub Total (2025)	998	

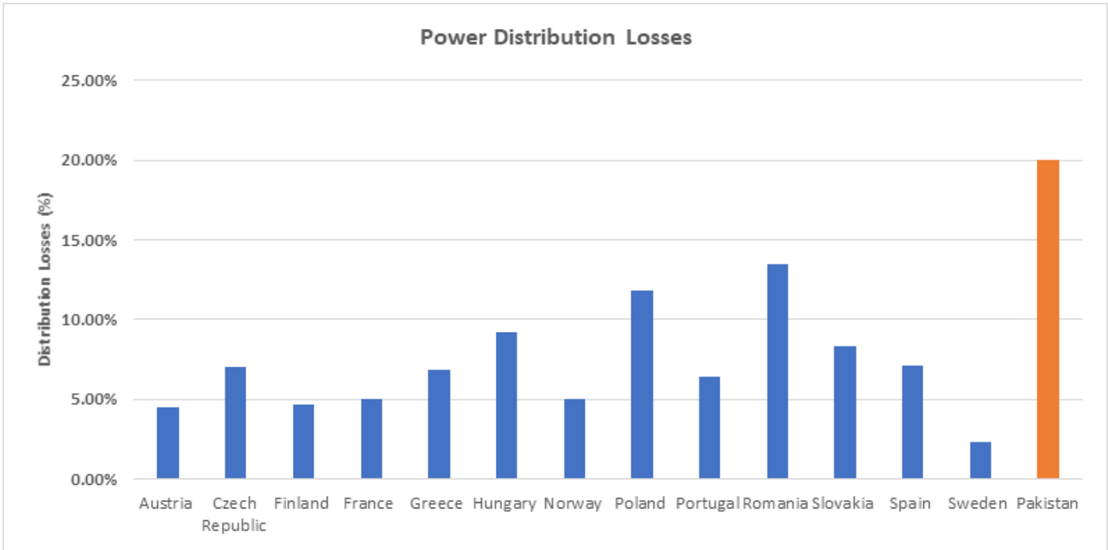
2021	Project	Sponsor/ Company Name	Power Policy	Location	Fuel	Capacity (MW)	Expected COD/ Remarks
16	Rajdhani Hydropower Project		2002	Poonch River AJ&K	Hydel	132	** to be advertised shortly
17	Neckeherdim-Paur Hydropower Project		2015	Yarkun River, Chitral Valley KP	Hydel	80	
18*	Madian Hydropower Project		2015	Swat River, KP	Hydel	157	
19*	Asrit-Kedam Hydropower Project		2015	Near Kalam/Swat River, KP	Hydel	215	
20*	Kalam-Asrit Hydropower Project		2002	Swat River, KP	Hydel	197	
					Sub Total	781	
					Grand Total	20804	

Transmission Line Project

Sr.#	Project	Sponsor/ Company Name	Transmission Line Policy	Location	Technology	Expected COD/ Remarks
1	Matiari-Lahore HVDC Transmission Line Project	China Electric Power Equipment & Technology Co. Ltd. (CET)/ State Grid Corporation of China (SGCC)	TLP 2015	Matiari to Lahore (Approx 880 Km)	+ 660 kV HVDC Transmission Line	2020 LOS issued. Tariff Approved by NEPRA FC in progress

* CPEC Projects
** COD will be assessed after issuance of LOI
GT = Gas Turbine
ST = Steam Turbine

Annex-VI Power distribution losses Europe versus Pakistan



Source: Eurostat and NEPRA

Annex VII Recommended Districts for Solarization for Government Institution

Region	District	Number of institutions with access to electricity	Number of institutions without access to electricity
Punjab	DG Khan	48	923
	Rajanpur	63	431
	Rahim Yar Khan	70	979
Sindh	Thatta	4	1,459
	Tharparkar	4	3,834
	Sujawal	8	1,507
	Kashmore	12	742
	Ghotki	21	1,539
	Umerkot	22	1,741
	Tando Mohammad Khan	23	779
KP	Torghar	2	231
	Kohistan	5	1,012
	Batagram	15	693
	Shangla	27	525
	Upper Dir	30	669
Balochistan	Awaran	1	263
	Chaghi	11	234
	Barkhan	9	541
	Dera Bugti	7	332
	Kachhi	13	392
	Khuzdar	17	600
	Musa khel	12	268
	Ziarat	9	241
GB	Astore	34	77
	Skardu	49	218
AJK	Hattian	11	337
	Haveli	8	233
	Neelam	10	252
	Poonch	15	699
	Sudhnoti	15	419
	Muzaffarabad	18	728
		Total	22,898

Source: Author's own analysis and calculation based on Consultative Meetings

Annex VIII Woman and Children Effected by Indoor Pollution

Number of People Affected by Hazardous Air Pollution (HAP)	111,079,269
Number of People Households Affected by HAP	16,335,187
Number of deaths per year by HAP	114,806
Number of child deaths per year by HAP	33,673

Source: Global Alliance for Clean Cook-stoves, Pakistan Profile

Young children are often carried by mothers or kept in the kitchen area during cooking exposing them to high levels of smoke. Because women do most of the cooking and spend more time indoors, they are exposed more to pollutants and are believed to have greater adverse health impacts. In general, rural women and children are malnourished and the impact of indoor air pollution on them is likely to be much stronger. The table below shows the health effects of air pollution caused by use of traditional fuel

Annex IX Province wise Progression & Targets for On-Grid Electricity Access by 2030

Region	Year	Total Consumption	Added Connections	Total Household	Access to Grid Network
Punjab	2015	11,496,063		15,748,031	73%
	2020	13,699,427	2,203,364	16,912,873	81%
	2025	16,826,650	3,127,223	18,490,825	91%
	2030	20,215,997	3,389,347	20,215,997	100%
Sindh	2015	4,467,692		6,769,231	66%
	2020	5,379,751	912,058	7,269,933	74%
	2025	6,676,496	1,296,746	7,948,210	84%
	2030	8,168,382	1,491,886	8,689,769	94%
KP	2015	3,030,551		4,456,693	68%
	2020	3,589,757	559,206	4,786,343	75%
	2025	4,447,968	858,211	5,232,903	85%
	2030	5,435,071	987,103	5,721,127	95%
Balochistan	2015	437,202		1,461,538	30%
	2020	532,326	95,124	1,569,645	34%
	2025	667,796	135,470	1,716,091	39%
	2030	823,911	156,115	1,876,200	44%
AJK	2015	676,598		735,433	92%
	2020	780,135	103,537	796,056	98%
	2025	878,911	98,775	878,911	100%
	2030	970,388	91,478	970,388	100%
GB	2015	184,394		204,882	90%
	2020	224,234	39,841	228,811	98%
	2025	262,689	38,454	262,689	100%
	2030	301,583	38,894	301,583	100%

Annex X Province Wise Breakup of Fuel Used for Cooking

Province	Firewood	Gas	Kerosene Oil	Dung Cake	Electricity	Crop Residue	Charcoal	Others
KP	79%	16%	0.09%	0.70%	0.05%	4%	0.05%	0.15%
Punjab	46%	24%	0.09%	9%	0.03%	20%	0.06%	1%
Sindh	64%	25%	0.10%	10%	0.04%	1.38%	0.07%	0.07%
Balochistan	18%	25%	0.10%	1.33%	0.02%	3%	0.25%	0.74%
Total	61%	22%	0.11%	7%	0.03%	11%	0.09%	0.63%

Source: PSLM Data 2015

Annex XI Pakistan's Solar Sector Jobs by Market Segment and Value Chain

	Residential	Commercial	Utility-scale	All
Installed capacity 2014/2015 (MW)	300	200	100	600
Value chain activities		Jobs (thousands)*		
Manufacturing**	0.4	0.2	0.1	0.6
Supply chain	1.0	0.5	0.1	1.6
Installations	4.0	1.6	0.3	5.9
Design	0.0	0.4	0.0	0.4
Business development	4.0			4.0
Project development		1.2	0.0	1.2
O&M	1.0	0.6	0.2	1.7
Total employment	10.4	4.5	0.6	15.5

** Assuming 20% local manufacturing primarily in structures and electrical equipment.

* Based on employment factors defined in Engelmeier et al., 2014. [1]

Annex XII Industrial Sector Energy Saving Potential [2]

Industry	Potential Savings per year (MWh)	Annual Potential Savings per (million PKR)	Potential Investment (million PKR)	Main Equipment for investment
Textile	1,965,500	20,638	173,000	Compressors, heat recovery, heat transfer equip., lights, meters, motors, power factor correction equip., main process, process control, steam system, variable frequency drives ("VFDs")
Sugar	138,350	1,453	105,000	Co-generation, heat recovery, transfer equip., motors, general process, process control, steam system, VFDs
Leather	17,000	179	1,150	Compressors, heat recovery, heat transfer, motors, power factor, main process control, steam systems
Paper	92,400	970	7,800	Compressors, heat recovery, motors, power factor, main process, process control, VFD
Cement	660,000	6,930	30,600	Co-generation, meters, motors, power factor, main process, process control, VFDs
Fertilizer	88,200	926	5,800	Heat recovery, heat transfer, main process
Other sectors	486,750	5,111	80,800	Diverse process and ancillary equipment
Total	3,448,200	36,207	404,150	

Source: International Finance Cooperation (2014)

Annex XIII PPDB's facilitated Renewable Energy &Hydropower Power Projects

A. Solar Power Projects in IPPs mode by Private Sector –Current Projects

Sr. No.	Sponsor name	Capacity MW	Location	Remarks
1.	Quaid-e-Azam Solar Company Ltd.	100	Quaid-e-Azam Solar Park, Lal Sohanra, Bahawalpur	Project completed in March 2015 and electricity is being fed into the National Grid.
2.	Zonergy Company Ltd (CPEC Project)	900	Quaid-e-Azam Solar Park, Lal Sohanra, Bahawalpur	3x100 MW out of 9x100 MW started Commercial Operations since July 31, 2016.Remaining 600 MW is under development
3.	Zorlu Enerji Elektrik Uretim A.S	100	Quaid-e-Azam Solar Park (extension), Lal Sohanra, Bahawalpur	Tariff application @ US cents 6/kWh filed before NEPRA
4.	Zorlu Enerji Elektrik Uretim A.S	200	Quaid-e-Azam Solar Park (extension), Lal Sohanra, Bahawalpur	Feasibility study is in process
5.	Zhenfa Pakistan New	100	Rakh Chaubara, Layya	Power Acquisition consent is pending at CPPA-G end
6.	Energy Co. Ltd.	100	Chishtian, Bahawalnagar (Extension of QA Solar Park)	Grid Interconnection Study was pending at NTDC end. After approval, sponsor is in process to approach NEPRA for completion of regulatory processes
7.	Storm Harbour Solution De Energy	100	Chishtian, Bahawalnagar (Extension of QA Solar Park)	Grid Interconnection Study was pending at NTDC end. After approval, sponsor is in process to approach NEPRA for completion of regulatory processes
8.	CWE & Welt Konnect (Joint Venture)	50	QA Solar Park, Lal Sohanra, Bahawalpur	Grid Interconnection Study was pending at NTDC end. After approval, sponsor is in process to approach NEPRA for completion of regulatory processes
9.	Kinetics Renewable Energy Services Company	49	Hasilpur, Punjab	Matter is pending at NTDC end
10.	TBEA Xingiang Sunoasis Co. Ltd.	100	Punjab	Matter is pending at NTDC end
11.	Roshan Power (Pvt.) Ltd.	10	Lahore	Grid Interconnection Study was pending at LESCO end. After approval, sponsor is in process to approach NEPRA for completion of regulatory processes
12.	China Gezhouba Group Co. Ltd.	4	Village Rakh Mari, Attock	FS is in process
	Total capacity			**Solar – 1,813 MW**

1A. Solar Power Projects in IPPs mode by Private Sector – Projects approved

1A. Solar Power Projects in IPPs mode by Private Sector – Projects approved

Sr. No.	Sponsor name	Capacity	Location
1.	MASDAR Mubadla, UAE	300 MW	Punjab
2.	Zhenfa Energy Group Co. Ltd.	100 MW	Punjab
3.	Shandong Linuo	100 MW	Punjab
	Total capacity	**500 MW**	

1B. 50 Solar Dispersed Sites in Punjab – Development of small scale solar power projects by IPPs – Distributed Power Generation

Sr. No.	Sponsor name	Capacity	Location
1.	50 solar small sites – most sites ranging 5 MW	215 MW	Dispersed locations in Punjab
	Total capacity	**215 MW**	

B. Wind Power Projects in Punjab

Sr. No.	Sponsor name	Capacity	Location	Status	Remarks
1.	Vestas Asia Pacific Wind Technology (Pvt) Ltd	1000 MW (4x250 MW)	Rojhan, Rajanpur	FS completed for 250 MW	Power Acquisition consent is pending at CPPA-G end
	Total capacity			**Wind - 1000 MW**	

C. Waste Power Project in Punjab

Sr. No.	Sponsor name	Capacity	Location	Status	Remarks
1.	Lahore Xingzhong Renewable Energy Co. (Pvt.) Ltd.	40 MW (based on 2,000 tons/day MSW)	Lahore	FS Completed	NEPRA is in process of determination of upfront tariff

Municipal Solid Waste – 40 MW
New initiative at Lahore based on 3,000 tons/day MSW – 60 MW
Faisalabad, Multan, Gujranwala –WtE projects would also be started

D. Hydropower Projects in Punjab

Sr. No.	Sponsor name	Capacity MW	Location	Remarks
1.	Olympus Energy (Pvt.) Limited	20	Marala (Lucky HPP) (Chenab), District Sialkot	Cost Plus Tariff is approved by NEPRA. Gazette Notification by MoWP is awaited.
2.	Trident Power JB (Pvt.) Ltd.	4.6	Lower Bari Doab Canal RD. 260+000, District Sahiwal	Upfront Tariff is approved by NEPRA. Gazette Notification by MoWP is awaited. Sponsor has submitted performance guarantee LOS signing pending at PPIB
3.	Alka Power (Pvt.) Limited	1.8	Jhang Branch Canal (RD. 0+000 to 69+000) District Hafizabad	Upfront Tariff is approved by NEPRA. Gazette Notification by MoWP is awaited.
4.	Gugera Power Company	2.57	Upper Gugera Branch Canal, RD. 214 + 000 to RD. 220 + 750, District Nankana	FS is approved. GL is awarded by NEPRA. Power Acquisition Request from CPPA-G is awaited.
5.	Mehar Hydropower (Pvt.) Limited	10.49	B.S. Link-I Canal HPP, RD. 106+250, District Kasur	FS is approved. Application of GL is with NEPRA. Power Acquisition Request from CPPA-G is awaited.
6.	M/s Trident Power GR (Pvt.) Limited	7.55	Lower Chenab Canal (LCC) HPP, RD. 0 + 000, District Gujranwala	FS is approved. Application of GL is with NEPRA. Power Acquisition Request from CPPA-G is awaited.
7.	Mandi Baha-ud-Din Energy Limited	3.3	Lower Jhelum Feeder Canal HPP, RD. 8+626, District Mandi Baha-Ud-Din	FS is approved. GL is issued by NEPRA on 23.08.2017. Power Acquisition Request from CPPA-G is awaited.
8.	Blue Star Energy (Pvt.) Limited	2.8	Khokhra HPP, Gujrat Branch Canal, RD 0+000 to 2+000, District Gujrat	FS is approved. Application of GL is with NEPRA. Power Acquisition Request from CPPA-G is awaited.
9.	C.J. Hydro (Haseeb Khan & Co.)	25	C.J. Link Tail Canal Fall, (RD. 316+622) District Khushab	Updation of FS is in progress.
10.	S2 Hydro Ltd (Suraj Cotton Mills Limited)	18	Rasul HPP, Rasul Barrage, District Mandi Baha-Ud-Din	FS is in progress.
11.	Saigols (Pvt.) Limited & Associates	1.6	LBDC HPP, RD. 489 + 000, District Sahiwal	FS is in progress.
12.	Packages Power (Pvt.) Limited	2.54	BRBD Link Canal HPP, RD. 509+712, District Kasur	FS is in progress.
13.	Murree Hydropower (Pvt.) Limited	10	Jhalum Tributary Project	FS is in progress.

Sr. No.	Sponsor name	Capacity MW	Location	Remarks
14.	Soan Hydropower (Pvt.) Limited	50	River Soan Tributary	FS is in progress.
15.	Khanewal Hydropower (Pvt.) Limited	1.80	LBDC HPP, RD. 602+000, District Khanewal	FS is in progress.
16.	Paidar Energy (Pvt.) Limited	4.50	BRBD Link Canal HPP, RD. 0+000, District Sialkot	FS is in progress.
17.	Engro Powergen Limited	7.10	D.G. Khan Link – III Canal HPP, RD. 0+000 to RD. 14+000, District DG Khan	FS is in progress.
18.	Mefa Industries (Pvt.) Limited	1.80	Pakpattan Canal HPP RD. 306+000, District Pakpattan	FS is in progress.
19.	Under Process	135.00	Taunsa HPP on Taunsa Barrage, Muzaffargarh	Evaluation of Bids is in progress.
	Total capacity			**Small Hydro - 310.45 MW**

Annex XIV Solicited Hydro Power Projects in the Gilgit-Baltistan Region

Sr. No.	Name of project	Distance	Capacity (MW)	Completion year
1	Hydro power project Phander	85 km from Gilgit	80	2022
2	Hydro power project Shagharthang skardu	36km from Skardu	26	2021
3	Hydro power project Ghowari	55 km from Skardu	30	2021
4	Hydro power project Turmic	67 Km from Skardu	10	2021
5	Hydro power project Hassan abad Hunza	100 km from Gilgit	5	2020
6	Hydro Power Project near KIU Gilgit.	Gilgit city	100	2025
7	Hydro power Project Attabad Hunza.	20 km from Aliabad Hunza	32	2020
8	Hydro power project Passu Gojal	52 km from Hunza	30	2020
9	Hydro Power Project Sai Nallah	67 km from Gilgit	6	2021
10	Hydro power project Golodass	10 Km from Gahkuch Ghazir	15	2020
11	Hydro power project Thak	17 km from Chilas	4	2020
12	Hydro Power project Astak	90 km from Skardu	24	2022
13	Hydro power project Basho	36 km from Skardu	40	2025
14	Hydro power project Baasha	Shigar Valley	10	2021
15	Hydro Power project Ghursay	14 Km from Khaplu	10	2021
16	Hydro power project chorbat	56 km from khaplu	20	2025
	Total		442.0	
17	Establishment of Regional grid and high voltage lines in GB (phase-1)	Connection of District Gilgit, Skardu aqnd Hunza.	Evacuation of electric power from one region to another.	2021
18	Establishment of regional grids and high voltage lines inGB(phase-2)	Linking of all Districts in GB	Evacuation of electric power from one region to another	2025
19	Establishment of regional grids and inter connection of high voltage lines	Inter connection of high voltage lines	Evacuation of surplus power to National Grid	2030
	Other renewable projects.			
1	Solarization of office buildings, schools, hospitals in GB.	Across GB	---	2030
2	Installation of arial bunch conductor(ABC) and smart meters	Across GB	Conservation plan	2030

Annex XV — Expansion Plan for NTDC System (2017-18 to 2021-22)

Planning Power (NTDC)

Sr. No.	Description	500 kV			220 kV		
		No. of Grid Stations	Capacity (MVA)	Lines (km)	No. of Grid Stations	Capacity (MVA)	Lines (km)
1-	Existing (upto September 2017)	17*	21,324	5,122	42**	27,513	9,796
2-	Addition upto 2017-18	01	3,300	1,981	08	6,360	761
3-	Addition from 2018-19 to	07	11,250	1,599	14	17,806	1,765
	2021-22	25	35,874	8,702	64	51,679	12,322

* Out of 17, 15 No. 500 kV Grids Operated by NTDC (19650 MVA)
** Out of 42, 39 No. 220 kV Grids Operated by NTDC (26450 MVA)

Sr. No.	Name of the Project	MVA Capacity	Addition in T/L (km)	PC-I Approval Date	Financing	PC-I Cost (MRs. MUS$)	Expected Completion
1-	220 kV Dera Murad Jamali	2x160	5	07.04.2011	NTDC Own Resources	880 11	Dec, 2017
2-	500kV Lahore New G/S	2x750	130 (500kV) 104 (220kV)	09.12.2010	JICA	12664 147	Commissioned in Dec, 2017
3-	220kV Mansehra	2x250	1	07.04.2011	ADB Tranche-III	905 11	Dec, 2017
4-	220 kV GIS Ghazi Road Lahore	2x250	30	25.02.2005	KfW	2592 43	Mar, 2018
5-	3rd 500 kV Circuit from Jamshoro to Rahim Yar Khan	-	590	26.08.2013	ADB Tranche-III	36857 351	Dec, 2017
6-	220 kV Nowshera	3x250	10	06.02.2008	ADB Tranche-IV	1876 31	Jun, 2018
7-	220kV Lalian	3x250	8	11.11.2011	ADB Tranche-IV	1581 18	Jun, 2018
8-	Augmentation of Existing Grid Stations			21.01.2010		3900 46	
	500kV Sheikh Muhammadi	1x160 to 1x250	-	-	Iranian Loan	-	June 2018
	220kV Burhan	1x160 to 1x250	-	-	Iranian Loan	-	June 2018
	220kV Quetta Industrial	2x160 to 2x250	-	-	ADB	-	June 2018
	500kV Rewat		-	-	ADB	-	June 2018
9-	220kV D.I. Khan	2x250	100	09.12.2010	ADB- Tr-IV	3779 44	Mar 2018
10-	220kV Chakdara	2x250	85	03.10.2014	ADB- Tr-IV	4397 45	Mar 2018
11-	Improvement & Upgradation of Protection System to Avoid the Frequent Trippings in South Areas	-	-	08.06.2016	ADB MFF-II	887 8.5	December 2017
12-	500kV Rahim Yar Khan G/S	2x600 + 2x250	60	22.10.2007	JICA	4936 81	Dec 2017
13-	Extension/Augmentation of 220/132kV Rewat substation (2x160 to 2x250 + 1x250)	430	-	23.09.2014	ADB MFF-II	844 8	June 2018

Ongoing Power Evacuation Projects

Sr. No.	Name of the Project	MVA Capacity	Addition in T/L (km)	PC-I Approval Date	Financing	PC-I Cost (MRs. MUS$)	Expected Completion
1-	969 MW Neelum Jhelum HPP	-	Phase-I (145km) Phase-II (130km)	02.03.2015	Own Resources	21697 218	Phase-I (Nov 2017) Phase-II (Dec. 2018)
2-	1000 MW Quaid-e-Azam Solar Park at Lal-Suhanra	3x250	40	12.02.2014	Own Resources	4065 39	Completed in May 2017
3-	147 MW Patrind HPP	-	70 (132kV)	27.01.2015	USAID	966 10	Phase-I: April 2017 Phase-II: Dec. 2017
4-	500kV D/C T/L from Guddu-Muzzafargarh (747 MW Guddu)	-	276	29.07.2011	ADB	7856 91	June 2018
5-	220 k V Jhimpir G/S alongwith allied T/Ls	3x250	70 (220kV) 172 (132kV)	03.07.2014	Own Resources/ USAID	5833 59	Grid Completed on August 2017
6-	220kV Gharo G/S alongwith allied T/Lines and Extension at 500kV Jamshoro G/S	2x250 (Gharo) + 1x450 (Jamshoro)	85 (220kV) 20 (132kV)	03.07.2014	KfW & ADB	5445 55	June 2018
7-	Reinforcement in Islamabad and Burhan area for Tarbela 4th Extension			09.01.2016			
	i) Replacement of existing 220 kV Tarbela-Burhan D/C T/L (35km)		35		NTDC Own	1293 12.5	March 2018
	ii) Replacement of existing 220 kV Tarbela-Burhan-ISPR D/C T/L (62.5km)		62.5		Resources JICA	2326 22.5	June 2018
8-	1200 MW Thar Coal Power Plant (500 kV Thar – Matiari T/L)		250	16.08.2012	Local Bank Borrowing	22306 237	June 2018
9-	1320 MW Bin Qasim Plant		Phase-I: 50 Phase-II: 130	13.05.2015	Local Bank Borrowing	12977 129	Phase-I: Commissioned Phase-II: June 2018
10-	1320 MW Hubco	-	220	07.11.2016	Local Bank Borrowing	16415 157	June 2018
11-	1320 MW Imported Coal based PP at Sahiwal	1x600	4	31.08.2015	Own Resources/ ADB	1115 11	T/L energized on 27.01.2017 T/F by June 2018
12-	1200 MW LNG Based Power Plant at Balloki	750	40	09.07.2015	NTDC Own Resources /ADB	3433 34	T/L energized

Planned Projects

Summary of Additions from 2018-19 to 2021-22

Sr. No.	Voltage Level	Addition in Transformation Capacity (MVA)				Addition in T/Line (km)	Estimated Cost (MUS$)	Expected Completion
		New	Aug.	Ext.	Total			
1-	500kV	9900	300	1050	11250	1599	4306	2021-22
2-	220kV	1171	4206	1890	17806	1765		

Planned Projects
(For Which Financing Has Been Arranged)

Sr. No.	Name of the Project	MVA Capacity	Addition in T/L (km)	Date of Approval	Financing	Estimated Cost (MRs. MUS$)	Expected Completion
1-	500 kV Faisalabad West G/S	3x250 + 2x750	125 (220 kV) 32 (500 kV)	12.01.2015	JICA & ADB	9380 93	2018-19
2-	500 kV Islamabad West	3x250 + 2x750	35 (220 kV) 27(500 kV)	20.07.2016	WB	8288 79	2018-19
3-	220 kV Zhob	2x160	220	07.11.2016	ADB	6878 66	2018-19
4-	220kV Mirpur Khas	2x250	70	07.11.2016	ADB	3857 37	2018-19
5-	500kV Chakwal	2x450 + 4x160	33	12.04.2017	KFW	6710 64	2018-19
6-	Enhancement in Transmission capacity of NTDC System by Extension and Augmentation of Existing Gridstations	1050 (500kV) 6096 (220kV)	-	12.04.2017	WB	16526 158	2018-19
7-	Conversion of Four 220kV Grids from AIS to GIS	-	-	07.03.2017	WB	5684 54	2018-19
8-	Evacuation of Power from 1224MW Wind Power Plants at Jhimpir Clusters	1250	35 (220kV) 220 (132kV)	Approved on 24-11-2017	USAID	10,753 102	2018-19
9-	Evacuation Of Power from 1230MW RLNG Power Plant At Trimmu	250	100(220kV) 15(132kV)	Recommended by CDWP on 04.12.2017	NTDC Own Resources	4339 41	2018-19
10-	220kV Zero Point Grid Station	3 x 250	24	Approved on 19.09.2017	WB	2541 24	2019-20
11-	Cosntruction of New 220kV Guddu-Uch-Sibbi S/C T/ Line	-	360	Approved on 24-11-2017	ADB	8624 80	2019-20
12-	220kV Kohat G/S	2 x 250	50	Under Preparation	WB	3675 35	2019-20
13-	220kV Mastung G/S	2x250	120	Submitted to MoPD&R on 15.08.2017	WB	6405 61	2019-20
14-	220kV Punjab University Grid Station	3x250	4	Approved on 19-09-2017	WB	2948 28	2019-20
15-	500 kV Lahore North	2x750	110 (500 kV) 15 (220 kV)	Approved on 24-11-2017	ADB	20034 191	2019-20
16-	Evacuation of Power from Karot and Azad Pattan HPPs	-	10	Approved on 02.03.2015	Own Resources	525 5	2020-21
17-	Evacuation of Power from Tarbela 5th Extension	-	53	Approved on 24-11-2017	World Bank	4718 45	2020-21
18-	220kV Jamrud G/S	2 x 250	20	Approved on 19-10-2017	ADB	2398 23	2020-21
19-	Interconnection Scheme for CASA-1000 (HVDC Part)	-	100km (HVDC)	07.05.2015	World Bank	16659 169	2020-21
	500 kV Peshawar Nowshera) alongwith allied HVAC /Ls (HVAC Part of CASA-1000)	2x750	15 (500 kV) 24 (220 kV)			12634 130	2020-21
20-	Evacuation of Power from 2160 MW Dasu Hydro Power Project (Phase-I)	-	250(765kV)	-do-	WB	75680 722	2021-22 2
21-	Upgradation/Extension of NTDC's Telecom & SCADA System	-	-	Recommended By CDWP on 19.09.2017	ADB	11410 108	021-22

Planned Projects
(For Which Financing Is Required)

Sr. No.	Name of the Project	MVA Capacity	Addition in T/L (km)	PC-I Status	Estimated Cost (MRs. MUS$)	Expected Completion
1-	500 kV HVAC T/Lines for Interconnection of HVDC Converter Station at Lahore & Matiari with existing HVAC System	-	60	Approved on 07.11.2016	4806 46	2018-19
2-	Evacuation of Power from K2/K3 Nuclear Power Plants near Karachi	-	116	Approved on 12.04.2017	7501 72	2019-20
3-	Evacuation of Power from 2x660 MW Thar Coal Based SSRL/SECL Power Plant at Thar	-	275	Approved on 12.04.2017	21783 208	2019-20
4-	Evacuation of Power from 350 MW Siddiqsons Ltd	-	40	Approved on 17.01.2017	2520 24	2020-21
5-	Installation of Series Compensation for Enhancement in Transmission Capacity	-	-	Hiring of consultant in progress	21000 200	2019-20
6-	Evacuation of Power from 660 MW Lucky Electric Power Company	-	13	Studies in progress	1260 12	2020-21
7-	Evacuation of Power from Suki Kinari,Kohala and Mahal Hydro Power Projects in Northern Areas	-	697	Submitted to MoPD&R on 24-10-17	73287 696	2021-22
8-	Implementation Of Integrated Solution To Improve Productivity and Control in NTDC by Enterprise Resource Planning (ERP) System.	-	-	Submitted to MoE on 27-09-2017	2690 25	2021-22
9-	Procurement of 5 No 220kV Mobile Grid Stations	-	-	Concept Paper submitted to MoE on 12-10-2017	6300 60	2019-20
10-	220kV Kamra G/S	2 x 250	5	Studies in progress	1595 15	2021-22
11-	220kV Jauhrabad G/S	2 x 250	10	Submitted to MoE on 27-12-2017	3147 30	2021-22
12-	220kV Head Faqirian G/S	2 x 250	58	Studies in progress	3473 33	2021-22
13-	500kV Moro Grid Station	2x750 (500/220kV) 3x250 (220/132kV)	-	Studies in progress	4725 45	2021-22
14-	220kV Nawab Shah Grid Station	3x250	65	Studies in progress	5040 48	2021-22
15-	220kV Larkana Grid Station	3x250	65	Studies in progress	5040 48	2021-22
16-	500kV Quetta Grid Station alongwith Quetta-D.G Khan T/L	2x750	350	Concept Paper submitted to Planning Commission on 12.12.2017	24939 237	2021-22
17-	220kV D/C T/L from Khuzdar to Gawadar	2x250	670	Concept Paper submitted to MoE on 15.11.2017	30000 286	2021-22

Annex XX List of CPEC Project

Summary of Additions from 2018-19 to 2021-22

Sr. No.	Name of the Project	MW
1	2×660MW Coal-fired Power Plants at Port Qasim Karachi	1320
2	Suki Kinari Hydropower Station, Naran,Khyber Pukhtunkhwa	870
3	Sahiwal 2x660MW Coal-fired Power Plant, Punjab	1320
4	Engro Thar Block II 2×330MW Coal fired Power Plant TEL 1×330MW Mine Mouth Lignite Fired Power Project at Thar Block-II, Sindh, Pakistan ThalNova 1×330MW Mine Mouth Lignite Fired Power Project at Thar Block-II, Sindh, Pakistan Surface mine in block II of Thar Coal field, 3.8 million tons/year	660 330 330
5	Hydro China Dawood 50MW Wind Farm(Gharo, Thatta)	50
6	300MW Imported Coal Based Power Project at Gwadar, Pakistan	300
7	Quaid-e-Azam 1000MW Solar Park (Bahawalpur) Quaid-e-Azam	300 600 100
8	UEP 100MW Wind Farm (Jhimpir, Thatta)	100
9	Sachal 50MW Wind Farm (Jhimpir, Thatta)	50
10	SSRL Thar Coal Block-I 6.8 mtpa &SEC Mine Mouth Power Plant(2×660MW)	1320
11	Karot Hydropower Station	720
12	Three Gorges Second Wind Power Project Three Gorges Third Wind Power Project	50 50
13	CPHGC 1,320MW Coal-fired Power Plant, Hub,Balochistan	1320
14	Matiari to Lahore ±660kV HVDC Transmission Line Project Matiari (Port Qasim) —Faisalabad Transmission Line Project	
15	Thar Mine Mouth Oracle Power Plant (1320MW) & surface mine	1320