National Action Plan
ENERGY EFFICIENCY & CONSERVATION
2023-2030

Ministry of
Science and Technology

National Energy Efficiency
and Conservation Authority

www.neeca.gov.pk

FIRST DRAFT

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Abbreviations

ADB	Asian Development Bank
AEDB	Alternative Energy Development Board
AJK	Azad Jammu & Kashmir
CAGR	Compound Annual Growth Rate
CBAM	Carbon Border Adjustment Mechanism
CCI	Council of Common Interest
CPEC	China-Pakistan Economic Corridor
CPI	Consumer Price Index
CPPA-G	Central Power Purchase Agency-Guarantee
CPPs	Captive Power Plants
CSR	Corporate Social Responsibilities
DC	Direct Current
DISCO	Distribution Company
DFI	Development Finance Institutions
DSM	Demand Side Management
ECF	Energy Conservation Fund
EE	Energy Efficiency
EE&C	Energy Efficiency & Conservation
EIH	Energy Information House
EnMS	Energy Management System
HDIP	Hydrocarbon Development Institute of Pakistan
HRS	Heat Recovery Systems
HSD	High Speed Diesel
ICE	Internal Combustion Engine
ENERCON	Energy Conservation Centre
EPC	Energy Performance Contract
ESCO	Energy Service Company
EUI	Energy Use Index
EV	Electric Vehicles
EVSE	Electric Vehicle Supply Equipment (Charging Infrastructure)
EPA	Energy Purchase Agreement
ESMAP	Energy Sector Management Assistance Program
FY	Financial Year
FF	Foreign Financing
FO	Furnace Oil
GB	Gilgit-Baltistan
GBGs	Green Banking Guidelines
GHG	Greenhouse Gases
GSP+	Generalised Scheme of Preference Plus
G2G	Government to Government
GDP	Gross Domestic Product
GENCO	Generation Company
GIS	Geospatial Information Systems
GWh	Giga Watt Hour
MoCC & EP	Ministry of Climate Change & Environmental Coordination
MoST	Ministry of Science & Technology
MRV	Measuring, Reporting and Verification
MToE	Million Ton of Oil Equivalent

IE2	International Efficiency Class 2
IOT	Internet of Things
ISO	International Organization for Standardization
IA	Implementation Agreement
IEP	Integrated Energy Plan
IFC	International Finance Corporation
IP	Investment Prospectus
IPP	Independent Power Producer
Kgoe	Kilogram of Oil Equivalent
KPIs	Key Performance Indicators
KRIs	Key Risk Indicators
KP	Khyber Pakhtunkhwa
KV	Kilo Volt
KWh	Kilo Watt Hour
LF	Local Financing
LNG	Liquid Natural Gas
LPG	Liquefied Petroleum Gas
LoI	Letter of Intent
LoS	Letter of Support
MEPS	Minimum Energy Performance Standards
MIS	Management Information System
NEECAP	National Energy Efficiency & Conservation Action Plan
NDC	Nationally Determined Contribution
NEECA	National Energy Efficiency and Conservation Authority
NEP	National Electricity Plan
NEPRA	National Electric Power Regulatory Authority
NREL	National Renewable Energy Laboratory
NTDC	National Transmission and Dispatch Company
NTRC	National Transport Research Centre
OGRA	Oil & Gas Regulatory Authority
PAEC	Pakistan Atomic Energy Commission
PEECA	Punjab Energy Efficiency & Conservation Agency
PCSIR	Pakistan Council for Scientific and Industrial Research
PDA	Provincially Designated Agency
PIA	Pakistan International Airline
PNAC	Pakistan National Accreditation Council
PPA	Power Purchase Agreement
PPMC	Power Planning and Monitoring Company
PRS	Product Registry System
PPDB	Punjab Power Development Board
PPIB	Private Power Infrastructure Board
PPP	Purchasing Power Parity

MJ	Megajoule
MoE	Ministry of Energy
MoIP	Ministry of Industries and Production
$MTCO_2$	Million Tons of Carbon Dioxide Equivalent
MVA	Mega Volt Ampere
MW	Mega Watt
RPS	Renewable Portfolio Standards
RRA	Renewables Readiness Assessment
PKR	Pakistan Rupee
SBP	State Bank of Pakistan
SEECA	Sindh Energy Efficiency & Conservation Agency
SHS	Solar Home System
SMEs	Small and Medium Enterprises
SNGPL	Sui Northern Gas Pipelines Limited
SPP	Solar Power Project
PPRA	Public Procurement Regulatory Authority
PSQCA	Pakistan Standard and Quality Control Authority
QASP	Quaid-e-Azam Solar Park
RE	Renewable Energy
RET	Renewable Energy Technology
R&D	Research & Development
SRO	Statutory Regulatory Order
SSGC	Sui Southern Gas Company
TFEC	Total Final Energy Consumption
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USD	United States Dollar
UFG	Unaccounted for Gas
VFD	Variable Frequency Drives
WAPDA	Water & Power Development Authority

Foreword

(MESSAGE FROM FEDERAL MINISTER S&T/SECRETARY MoST – to be added in the final draft)

Preface

(By MD NEECA in the final document)

Research Team

(Research Team will be added in this section)

Executive Summary

Energy efficiency is a key pillar of the Sustainable Development Goals. It is a cross cutting area which complements the national efforts for sustainable energy for all. Subsequent to the approval of the National Energy Efficiency & Conservation (NEEC) Policy 2023, the Cabinet Committee on Energy (CCoE) directed that an action plan shall be prepared which shall provide a clear, concise, and measurable implementation roadmap for the Policy. National Energy Efficiency and Conservation Action Plan (2023-30) is a comprehensive and holistic long-term plan, aligned with Pakistan Vision 2025 and integrated with national energy policies. The plan ensures overall sector-wide coherence and synergy of the collective efforts toward doubling the rate of improvement of energy efficiency to be achieved by 2030. In total, the energy efficiency sector offers an investment potential of $8 billion to achieve the SDG-7 objectives in Pakistan.

The vision, targets, and the sectoral focus of the NEEC Policy 2023 defined the minimum scope of the NEEC Action Plan 2023-2030 during development phase. It is important to reflect here that the Policy envisions to "steer Pakistan towards a culture of conservation and efficient use of energy resources to achieve sustainable development" and sets EE&C goals for 2030 with an aim to develop an entire eco-system of EE&C in the country through multi-sectoral synergy and coordination among federal and provincial governments. The policy sets the energy saving and GHG emission reduction targets of 9 MTOE and 35 MTCo2e respectively. This reflects that the said policy will substantially contribute to Pakistan's climate change mitigation given the share of energy sector in the Nationally Determined Contributions (NDCs).

Hence, in this first draft of NEEC Action Plan, 27 priority actions have been defined across 6 categories namely industry, buildings, transport, agriculture, energy, and cross-cutting areas. The Action Plan is also projected to achieve savings of 9 Mtoe cumulatively by 2023, for which 8 billion USD of investment potential has been mapped. The cumulative financial savings by 2030 will be 6.4 billion USD at 2022 prices, where the effect of certain savings will continue through to 2050 in terms of economic transition towards net-zero emissions, if the government chooses to do so in the next 8 years. The average payback period for the prioritized actions is less than 8 years which is aligned with the targeted timeline of 2030.

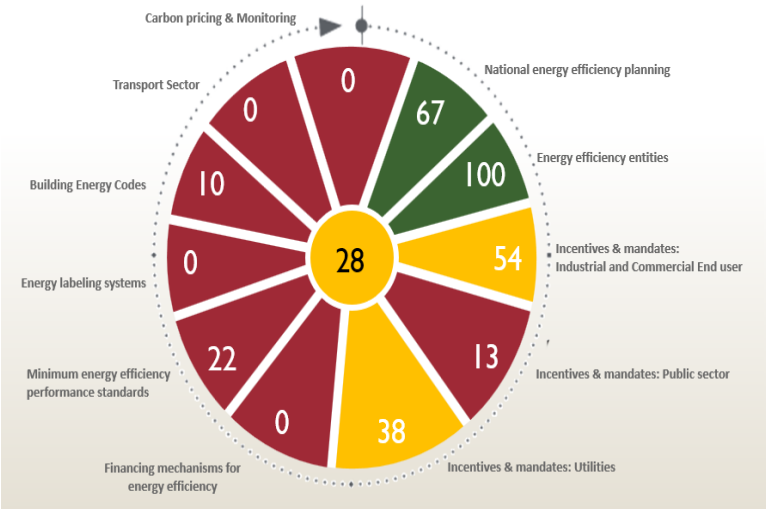
The ground-truthing of energy efficiency and conservation landscape was an important step in the preparation of this NEEC Action Plan 2023-2030 especially with regards to energy sector challenges at hand. While taking stock of energy efficiency and conservation in national and international perspective, it was found that EE&C is one of the key priorities due to surging energy prices and climate change agenda. Increasing energy demand and limited supply of modern energy sources have become a challenge and major policy concern in Pakistan. The demand forecast results by energy resources suggest that the overall primary energy demand of the country (including power generation and feedstock requirements) will increase to 115 Mtoe by 2030 with a major share of natural gas (including LNG) and oil, followed by coal and electricity and LPG. More than a quarter of primary energy supply is utilized in energy transformation which is reflective of poor energy efficiency standards. Further, due to lack of effective supply side energy

efficiency (SSEE) measures and good management practices, Pakistan's energy sector has experienced 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%.[1] 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 $36 billion and, together with conservation efforts, the energy sector's supply response to peak demand will be boasted offering resilience and sustainability to this overstressed sector.

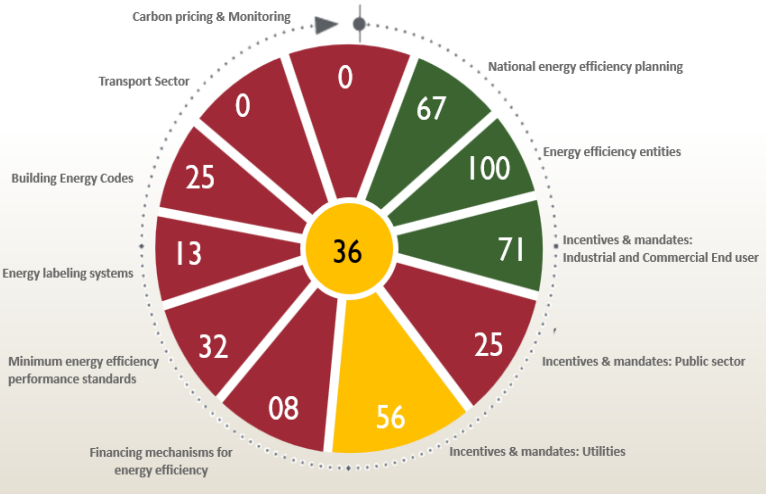
Previously, a NEECA Strategic Plan (2020-2023) was developed in 2019 which directed the initiation of immediate actions for institutionalization and operationalization of energy efficiency and conservation at federal and provincial level. Under Strategic Plan (2020-2023), various actions were successfully undertaken ranging from strengthening of organizations, development of rules & regulations, and capacity building of implementing partners at provincial level. The success of the EE&C institutionalization is also acknowledged internationally where Pakistan has been promoted by 8 scores in year 2021 (36 score) as compared to year 2019 (28 score) on the Regulatory Indicators for Sustainable Energy (RISE) metric developed periodically by the World Bank. This reflects that Pakistan has been successful in institutionalization of EE&C and is all set to implement and integrate the EE&C agenda across the economy with the close support of the provincial governments.

Figure 1. Energy Efficiency Scores and Indicators of Pakistan in 2021 Compared to 2019.

Year 2019



Year 2021



Source: www.rise.esmap.org , The World Bank Group

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

The first draft of Plan is prepared as a living document which is flexible, measurable and revisable to adapt changing conditions and open to innovations in process and methods. The action plan defines short, medium, and long term prioritized actions, draws KPIs/responsibilities, and coordination mechanisms for/between all stakeholders for effective implementation of NEEC policy 2023. Further, the NEEC Action Plan 2023-2030 ensured integration of the provisions/measures of the NEEC Policy 2023 with all the cross sectoral policies and plans, wherever it was required. While prioritizing the action areas, careful consideration has been given towards enhancing the co-benefits of energy efficiency in terms of industrial competitiveness especially at export markets, indigenization, and transition to clean energy specifically to alternate renewable energy. The *'Priority Action Areas'* identified and recommended under this Plan are discussed in detail at Part-2.

Moreover, an Investment Prospectus (IP) for energy efficiency has also been designed to provide an approach for operationalizing the Action Agenda (see Part-3). 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 $ 18 billion is identified for NEEC policy 2023 implementation agenda by combining different investment opportunities in one package at national and provincial levels.

Part-4 outlines the implementation, coordination, and monitoring framework of the NEEC Action Plan 2023-2030. Special attention has been rendered towards provincial implementation through provincial action plans and stakeholder coordination. The roles and responsibilities of each implementing mechanism at federal and provincial level have been defined vertically and horizontally. The use of technology has been promoted while designing the progress monitoring and reporting mechanisms for the NEEC Action Plan 2023-2030.

Given the national mandate to develop an all-inclusive National Energy Efficiency and Conservation Action Plan (2023-2030), NEECA will initiate extensive consultations with all sectoral and cross sectoral stakeholders at federal and provincial levels. As a next step, consultative meetings will be held country-wide with all stakeholders to finalize the proposed scope, timeline, and coordination mechanisms for each of the priority action. The consultative meetings will use a bottom-up approach to gather input from all stakeholders. In this process, stakeholders will identify various on-ground challenges unique to the local setting which require urgent redressal to create a reliable, affordable and sustainable energy market in the country. Further, the proposed federal-provincial coordination mechanism in this Plan will also be reviewed and finalized in consultation with provincial governments.

The Methodology

The methodology devised for NEEC Action Plan is multi-tiered following the international best practices. The mixed method approach i.e. qualitative and quantitative was adopted to conduct thorough sectoral reviews and analyses. 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.

National Action Plan builds-up on the earlier research conducted for NEEC Policy 2023. Ministry of Science and Technology as a focal ministry has overseen the task of preparation of NEEC Action Plan and the Investment Prospectus. After the approval of the first draft, provincial consultations will be initiated 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)
- Balochistan
- Azad Jammu & Kashmir (AJK)
- Gilgit-Baltistan (GB)

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

- Consensus on the proposed action areas till 2030
- Finalization of scope of these Priority Action Areas
- What are the challenges faced by the provincial governments in the implementation of the proposed actions and what could be the possible solutions to address these challenges?
- What shall be the optimal coordination and follow-up mechanism for NEEC Action Plan 2023-2030?
- How to prepare and implement regulatory mechanisms for implementation?

EE&C agenda under the umbrella of Sustainable Development Goals does inherent the components of sustainability. Therefore, while finalizing the document, the sustainability parameters of the plan including environmental, economic, and social impact on the society has

been considered. Moreover, the externalities, and socio-economic cost has been analyzed and viable financing options has been discussed. The priority action areas have been developed through this systematic analysis which factors-in the on-ground situation and challenges expected to these action areas.

INTRODUCTION

Pakistan's primary commercial energy supplies are 87 million tonnes of oil equivalent (Table 1). The existing primary commercial energy supply mix during 2021 has increased by 7.4%. According to Pakistan Energy Year Book 2021, the share of oil and gas is 25.90% and 42.00 % respectively, followed by 9.20% from hydroelectricity and 19% from the coal. The nuclear share is 2.60%, renewable electricity is 1.20% and imported electricity 0.1%. This shows that Pakistan energy mix has diversified over the last five years.

Table 1: Primary Energy Supply by Source

Primary Electricity of 2021		
Source	**Unit TOE**	**% Share**
Oil	22,577,047	25.90
Gas	25,500,568	29.30
LNG Import	9,920,947	11.4
LPG	1,116,597	1.3
Coal	14,711,973	18.20
Hydro Electricity	8,007,673	9.20
Nuclear Electricity	2,230,835	2.60
Renewable Electricity	1,031,857	1.20
Imported Electricity	118,957	0.1
Total	**87,035,009**	100
Source: Pakistan Energy Year Book 2021		

Pakistan's final energy consumption is 60.21 MTOE (Table 2). Oil, gas and electricity, coal and LPG are the major sources in final energy consumption respectively. An analysis shows that around 39 percent of primary energy consumption is lost while conversion to final energy.

Table 2: Final Energy Consumption by Source 2021

Final Energy Consumption 2021		
Source	Unit TOE	%Share
Oil	18,569,102	30.80
Gas	18,346,902	30.50
Coal	12,407,520	20.60
Electricity	9,513,502	15.80
LPG	1,371,416	2.5
Total	60,208,443	100
Source: Pakistan Energy Year Book 2021		

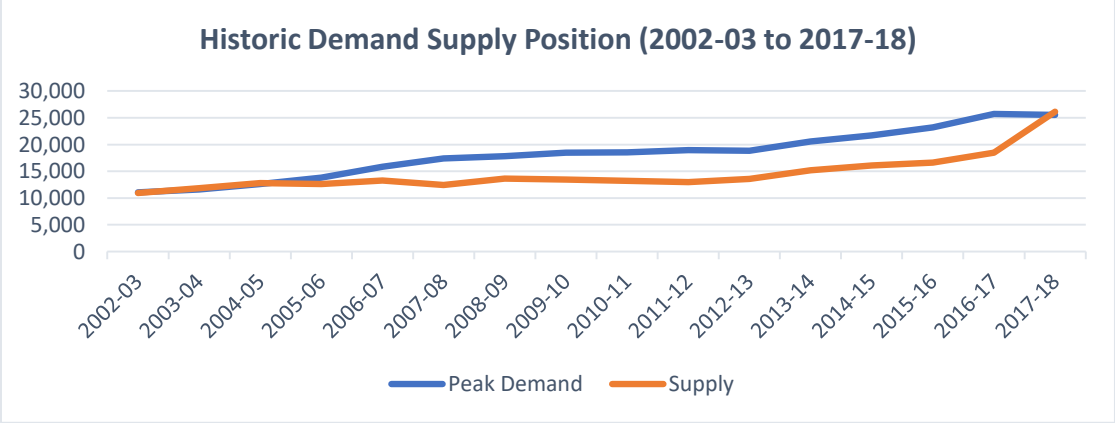
Pakistan's Energy Sector Vision & Reforms

Power sector supply-demand gap has declined from 2013-2023 in Pakistan. The government of Pakistan has an absolute resolve to end energy crisis in the shortest possible time. GOP 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 governance of power utilities and arrest circular debt, as it is a politically charged agenda item.

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. The development of hydel power, natural gas, and coal power projects are the department's top priority. National Electricity Policy of 2021 has been launched to set some clear standards and resolve the electricity problem through tariff rationalization to arrest circular debt, energy efficiency, changing energy mix, and strict punishment for electricity pilferages.

Figure 1 Historic Demand Supply Situation

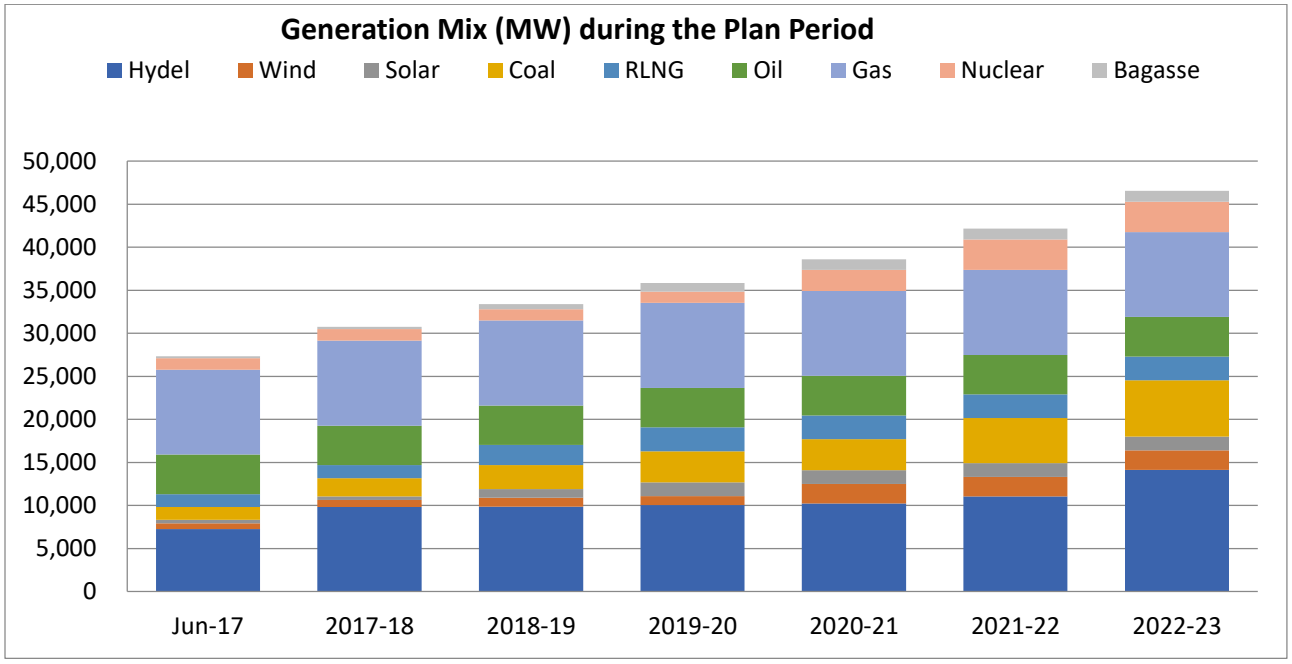


In the medium term, to meet the energy requirements of the country, Ministry of Energy (former-Ministry of Petroleum and Natural Resource) is importing LNG as a medium-term solution. Whereas, coal and gas power plants development are envisioned as long-term strategy. Oil and Gas Regulatory Authority (OGRA) as a regulator, provides level playing field for all

energy sector stakeholders and players in the market with its effective regulations.

The power supply of the country is dominated by thermal power, as it constitutes over 61% of the total installed capacity. On the other hand, renewable energy (including hydroelectricity) constitutes 31% of the entire power generation mix of the country. Without the inclusion of hydroelectricity, the share of renewables (solar, wind, biomass) is 6.5% (as per table 3), 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 energy mix of Pakistan is projected (see Figure 3).

Figure 3: Pakistan's Power Generation Mix 2017-23 - NEPRA



Source: NEPRA State of Industry Report 2016

Financially, Pakistan'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, GOP is planning 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 will be not a practical option.

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 67.90% in primary energy supplies. Similarly, the majority of electricity generation in the country is through thermal sources. Renewable energy (including hydroelectricity) contribution in the electricity generation is 31%. It is expected that by 2030, Pakistan's energy mix will significantly change. Pakistan's recent focus on the generation of electricity through coal will lead to a 75% share of oil, gas, and coal in primary energy supplies. 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 problem of circular debt is one of the biggest contributors to the electricity load-shedding and financial instability in the energy sector. Governance reforms in the energy sector can help overcome circular debt and other pilferages in the system. Policy and legislative framework for energy efficiency and conservation will get special attention.

However, some of the proposed NEPRA regulation on "Net-Metering" has already created 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.

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 notproliferated**

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 wind and renewable has decreased drastically. 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

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.

This plan has documented various plans and reforms to enhance improvement in energy efficiency and conservation, and ensure its coupling with the renewable energy. However, substantive efforts are required to achieve NEEC policy goals. This action plan has listed many of such high-priority initiatives that can help achieve these goals.

Energy Efficiency and Climate Change Mitigation

Globally, Pakistan adopted the international climate agreement at the U.N. Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP21) in Paris in December 2015. Pakistan's Ministry of Climate Change in collaboration with other ministries has outlined post-2020 climate actions intended to take under the Paris agreement.[2] Internationally, three main components outlined in this agreement are a) holding the increase in global average temperature below 2°C b) pursue efforts to limit the increase to 1.5°C c) net zero emission in the second half of the century.

Given the significant impact of energy efficiency measures on the national GHG emission reduction (i.e. 35 $MTCO_2$ emission reduction target of the NEEC Policy 2023), it can be said that the NEEC Policy 2023 is effectively a climate change mitigation framework for the country. Though energy sector is dominant in the mitigation efforts, the NEEC policy does provide an enhanced benefit of decarbonizing the other energy intensive sectors of the economy. Hence, the NEEC Action Plan 2023-2030, also, focuses on extensive monitoring, reporting, and verification mechanisms to register and report national progress on climate change mitigation to tap into the climate finance.

Pakistan's NDC is strategically aligned with "Vision 2025" and is based on sectoral growth in accordance with various lines ministries and entities plans and policies. 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.

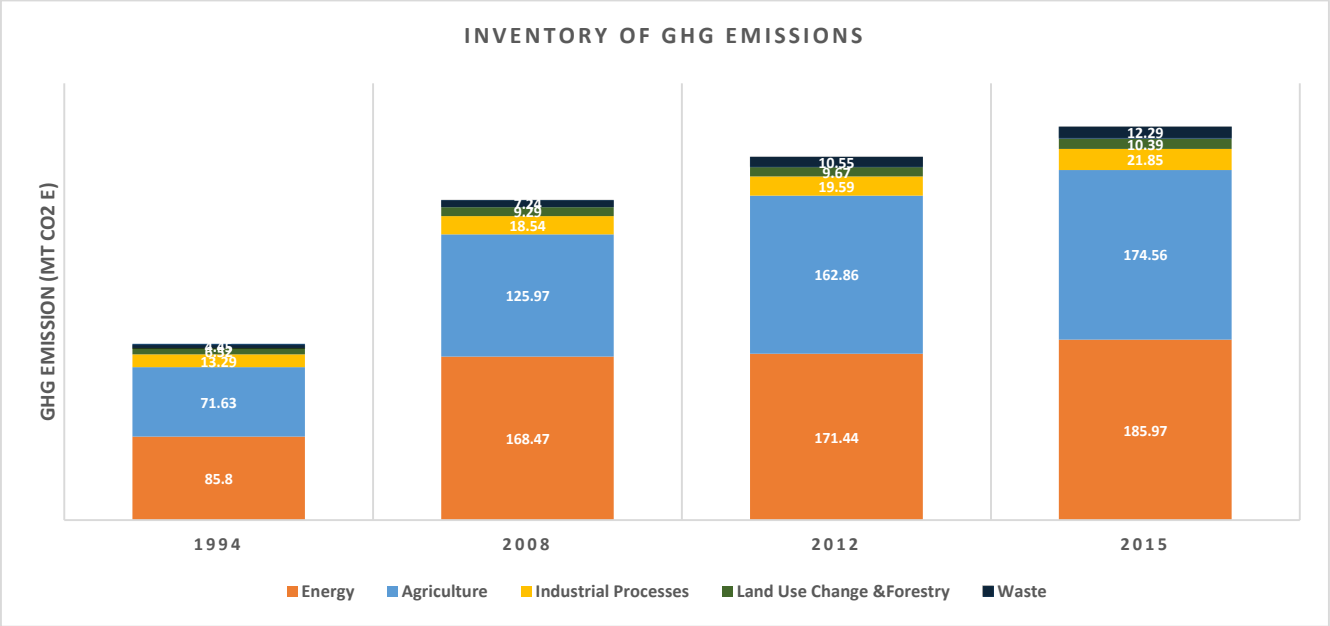
According to Ministry of Climate Change, the total GHG inventory of Pakistan (2014-15) is 405.06 MT CO2-Equivalent. From 1994-2015, the overall increase in emission is approximately 123%with 90% of emissions are solely attributed to energy and agriculture sector (See Fig. 5). The emission profile is 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 electricity and projected population growth rate of 2.4%. Population is expected to increase to 95.5 million by 2025 and 102 million by 2030. In

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

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 exponentially.

Figure 5: Inventory of GHG Emission (MT Co2-Equivalent)



Source: Nationally Determined Contributions of Pakistan

Since Pakistan is going through major economic transformation, it is imperative to systematically establish some credible GDP growth scenarios. These scenarios will reflect the energy demand projections, further translating into GHG emissions. The government of Pakistan 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 by 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[3]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

[3] http://germanwatch.org/en

damaged, and 10.63 million acres of crops destroyed.[4] In addition, federal expenditure related to climate was between 5.8 and 7.6%of total expenditure in 2015.[5]

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.[6]
- 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.

[4] http://www.ndma.gov.pk/
[5] http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Pakistan/1/Pak-INDC.pdf
[6] Calculated at current prices.

PART-1: VISION & TARGETS UNTIL 2030

Vision and Targets Until 2030

The energy efficiency potential of Pakistan is estimated around 15-20%of primary energy use.[7] 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 provincial energy efficiency agencies.

Table 2: Energy Efficiency Targets

EE&C Pakistan's Target	Status 2023	Target 2030	Gap	Remarks
Energy Saving	Baseline 87 Mtoe Primary Energy Supply	9 Mtoe saving in Primary Energy Supply	-	-
Energy Efficiency [8]	1.5 %	18%	16.5%	NEECA Operationalized
GHG Emission Reduction	TBC from MoCC's Inventory, although 185 $MTCO_2$ in 2015	35 $MTCO_2$ Reduction	-	NEEC Policy 2023 approved and covers the mitigation side of the climate change

1.1 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 "**megawatt**" 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. Megawatt-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.

[7] Source: https://www.adb.org/projects/42051-023/main#project-pds Access Date: December 1, 2017
[8] UNDP, SE4ALL "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%.

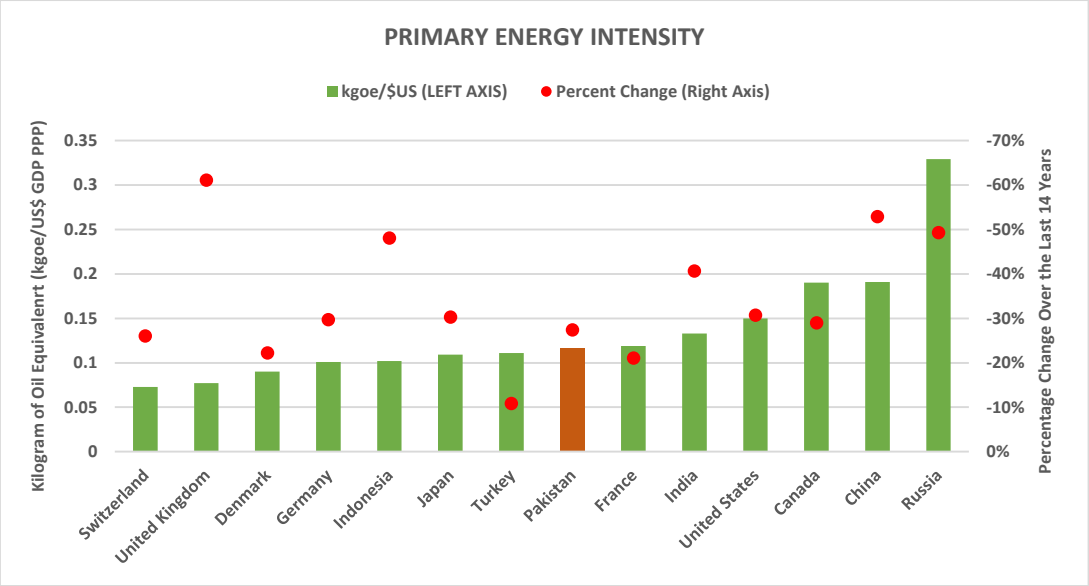
The energy efficiency has been based on indicators of energy intensity in terms of primary energy and uses PPP (Purchasing Power Parity) for GDP. The target for energy efficiency under SDG-7 is to double the rate of improvement of energy efficiency. Therefore, it is important to identify and assess the current rate of improvement of energy efficiency in Pakistan which has to be doubled by 2030.

Currently, the rate of improvement of energy efficiency has been improving at the rate of 1.7% annually since 2000 (i.e., 27% over the last 14 years). In other words, the primary energy intensity of Pakistan has decreased by 1.7% annually since 2000. In order to achieve the SDG-7 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.

Figure 6: Primary Energy Intensity and Rate of Improvement of Energy Efficiency, Comparative Assessment



Source: World Energy Council and EnerData

1.1.1 Residential/Domestic Sector

In Pakistan, there are over 29 million households in the residential sector that consume about 2098% of total final energy consumption of the country. However, in contrast to the global trends, domestic sector consumes 50.27%[9] 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%[10] in the country.

Natural gas has the biggest share in the energy mix and dominates in domestic sector with a contribution of 57.91% 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.

1.1.1.1 Electricity Saving Potential in Domestic Sector

It is reported that over 10 million new fans are sold annually in the Pakistani 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

[9] Pakistan Energy Year Book 2017
[10] Access to electricity and natural gas estimates (Planning Commission)

the case of Air Conditioners as well. Worldwide, the efficiency of these appliances has been improving and their costs have been declining.

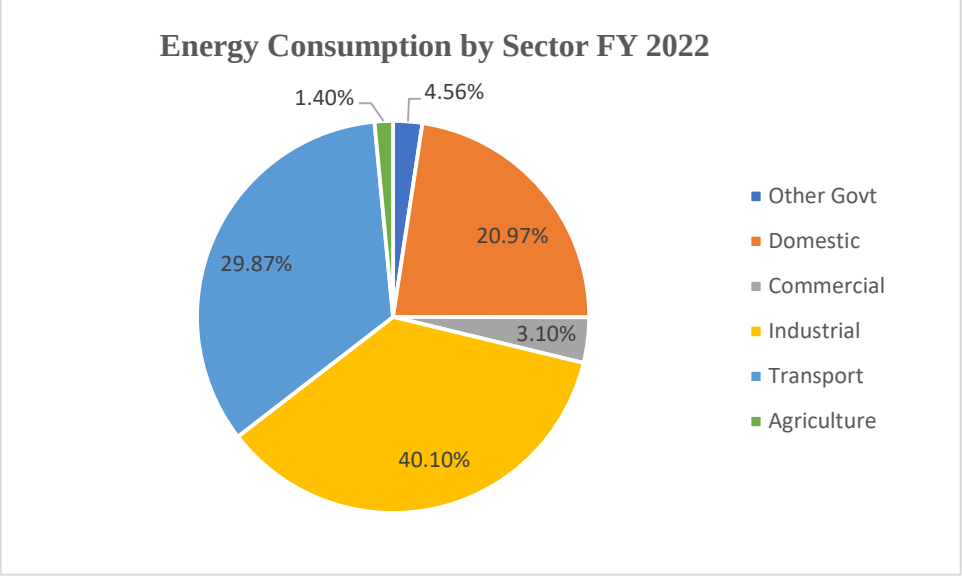
Table 3: Electricity Savings Potential for Selected Appliances in the Domestic Sector

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

The energy (electrical) saving potential for selected appliances in the residential sector is given in Table10 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%[11] 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%[12]. 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.7).

Figure 7 Final Energy Consumption by Sector, FY 2022



Source: Pakistan Energy Year Book 2021

[11] Pakistan Energy Year Book, 2017
[12] NTDC

1.1.1.2 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 (Table4). The table above 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.

Table 4: Gas savings potential in the residential sector

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

RAFTAAR & 2 – Asian Development Bank

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[13] BCF annually or 41 MMCFD which is about 9% of total natural gas consumption in Punjab.

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%.

1.1.2 Energy Efficiency in 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%[14] of the GDP and 43.5%of employment in 2016. It is the biggest energy consumer with 40.10% of total final energy consumption in 2021[15] and contributing over 18%[16] of overall GHG emissions in the country.

Energy efficiency in the industrial sector can be achieved by employing a broad range of energy management, efficient technologies, and practices to reduce overall energy consumption. A huge potential for investment exist 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[17].

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

- Retrofitting;
- Variable Frequency Drives (VFDs);

[13] Energy Saving in Pakistan by RAFTAAR, DFID (2016)
[14] Economic Survey of Pakistan (2016-17)
[15] Pakistan Energy Year Book (2017)
[16] International Institute for Sustainable Development, IISD
[17] International Finance Cooperation, 2014

- 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[18] 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[19]. 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 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.

Table 5: 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)

The Table (5) above 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

[18] Market Study of Sustainable Energy Finance in Pakistan, IFC 2014
[19] Energy Saving in Pakistan, RAFTAAR, DFID 2016

PKR. Most energy efficiency gains can be achieved by implementing the most fundamental measures such as the following:

- Improvement in Process Operation. E.g. Proper metering in the textile and sugar industry can reduce the energy consumption significantly;
- Replacement of low-pressure boilers with higher pressure boilers can increase the energy efficiency 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 can reduce the energy losses in almost all the industrial units;
- Improvement of Maintenance Operation i.e. reduction of air leakages; and
- Proper maintenance and operation of electrical motors.

Besides, 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 roughly about 20% to 30%.[20]

1.1.2.1 Textile Industry

Pakistan's textile sector is one of the most important contributors to economic growth, Natural gas accounts for about 70%[21] 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 could be achieved in the textile industry by the installation of meters, controls to reduce leakages of compressed air and improved maintenance of electrical motors. According to IFC, the textile industry offers highest energy efficiency and cost saving potential.

1.1.2.2 Sugar Industry

Sugar is the second largest industry in Pakistan. There are over 89 sugar mills in the country producing over 5 million tonnes of sugar annually.[22] Energy in the sugar industry is consumed mainly in the form of steam (96%) and electricity (4%)[23]. 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[24].

[20] *Trends in Global Energy Efficiency: An Analysis of Industry and Utilities*, ABB (2011)
[21] Arshad H Abbassi & Maha Kamal, "*Importing LNG: A Policy Analysis"* Sustainable Development Policy Institute (SDPI)
[22] Pakistan Sugar Mills Association (2016)
[23] IFC funded Study "Sustainable Growth: Cleaner Production in Pakistan" by National Productivity Organization (NPO) & Cleaner Production Institute (CPI), 2016.
[24] CKDN "Catalyzing leadership on efficient bagasse processing: Case Study on Pakistan Sugar Industry"

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)[25].

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

Sugar mills in Pakistan can take advantage of this opportunity by using HPC technology and generate revenue by exporting 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.

ESMAP, NUST, and World Bank carried out an extensive biomass potential mapping study[26] 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.

- **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[27]. 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[28]. 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.
- **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

[25] ibid
26 World Bank, Biomass Potential Mapping Of Pakistan 2016. Access at <http://documents.worldbank.org/curated/en/104071469432331115/pdf/107200-ESM-P146140-PUBLIC-PakistanBiomassMappingFinalReportWBESMAPJuly.pdf
27 Pakistan Sugar Mills Association website
28 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.

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.

- **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.

1.1.2.3 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.[29] 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[30]. It is another industry where huge energy savings could 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. Higher efficient processes in the cement industry would also help in reduction of dust, GHG emissions and conserve water.

1.1.2.4 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. In addition, proper metering and insulation offer best energy efficiency potential and reduce the energy consumption.

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

[29]International Institute for Sustainable Development, IISD
[30] All Pakistan Cement Manufacturing Association (APCMA) (2016)

1.1.2.5 Fertilizer Sector

The raw material for fertilizers is natural gas. 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[31]. 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[32] billion in subsidy on imported urea which may have cost $450 million to the exchequer.

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[33]. Significant energy efficiency gains in fertilizer sector can be achieved by investing in co-generation, installation of meters and improvement of power factors etc.

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

1.1.2.6 Pulp and Paper

Currently, there are about 100 paper and pulp production units in Pakistan with a total production capacity of 434,740 tonnes[34]. 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%[35] and overall energy consumption by 5.6%[36] 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%[1] and overall energy consumption will reduce by 5.6%[1].

[31] International Finance Cooperation, 2014
[32] News Pakistan Today: http://www.pakistantoday.com.pk (2013)
[33] International Institute for Sustainable Development, IISD
[34] Pulp & Paper Industry in Pakistan, Embassy of Brazil in Pakistan
[35] International Institute for Sustainable Development, IISD
[36] Cleaner Production Institute (2016)

1.1.2.7 Brick Kiln

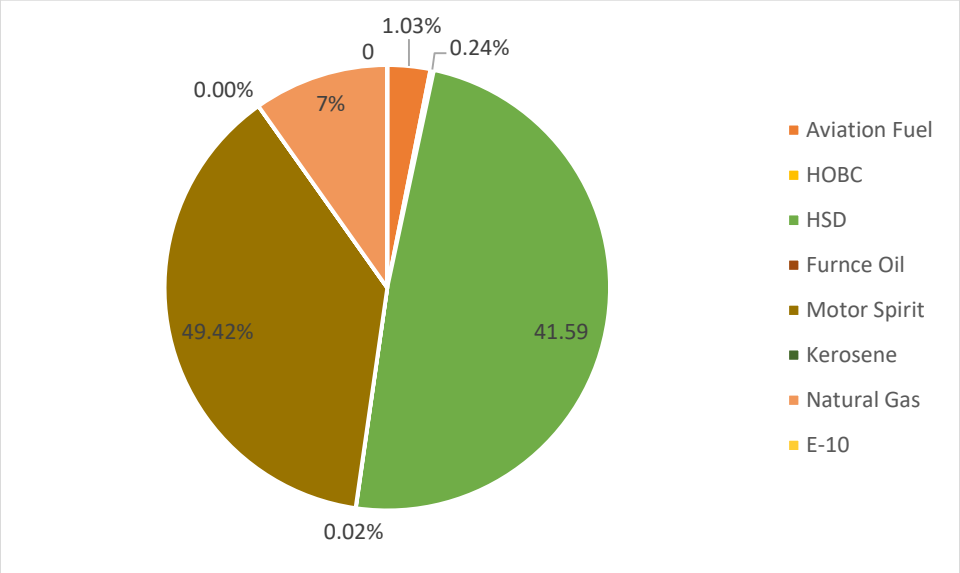
The brick kiln sector in Pakistan is mostly unregulated and documentation on this sector is also very limited. There are over 18,000-20,000 brick kilns in Pakistan Coal is the primary fuel for brick manufacturing and this sector consumes more than 3 million tons of coal.[37] It is important to note that brick manufacturing is a third largest contributor to GHG in the industrial sector in Pakistan. In Pakistan, most kilns still use the bull-trench process for brick production, which have been phased out in almost all the developed regions. An alternative technology "Zig Zag" will be employed as it saves 30-40% energy and 70% reduction in emission.

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

1.1.3 Energy Efficiency in Transport Sector

The transport sector accounted for 29.87% of total final energy consumption in 2021. 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%.

Figure 8 Energy Consumption by Transport Sector



Source: Energy Year Book 2021

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%. According to a study conducted by Canadian researchers, the proper training and driver monitoring can achieve 10%[38] fuel efficiency.

[37] *Brick kiln industry* by Syed Akhtar Ali – Business Recorder
[38] World Energy Council

1.1.3.1 Road Transport

Pakistan's vehicle population is over 13 million.[39] Since 2000, it has been annually increasing at the rate of 10%[40]. 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. Although the exact energy saving potential ought to be worked out.

In this regard, one of the key area 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%[41]. 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.

Latest power technologies, like Combine Cycle Natural Gas (CCNG), has achieved a conversion efficiency of over 60%[42]. Supply of natural gas to more productive sectors, such as industry, power, and services to meet their energy demands would certainly bring higher economic benefit compared to its use as a transport fuel.

Recently, GOP has successfully completed the rapid road transit projects i.e. Metro Bus Service in Islamabad and Lahore. Similar projects are also being planned for other cities like Karachi, Multan, and Peshawar. It is a sustainable mode of transport that use segregated bus lanes. This initiative by the Government will certainly help energy efficiency, support economic growth and ease accessibility.

The conversion efficiency of conventional CNG vehicles is only 17% to 21%[1].

1.1.3.2 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. The table 13 below shows the comparison of emissions and cost for travel by different types of buses and fuels. It clearly shows that electric buses are the least cost option in term of fuel costs savings and they emit the least amount of CO2 if the grid is relatively cleaner. However, if entire power generation is coal based, diesel fueled buses will be cleaner than electric buses, but fuel cost will still be higher than electric vehicles.

[39] Petroleum Institute of Pakistan
[40] Petroleum Institute of Pakistan
[41] https://www.fueleconomy.gov
[42] National Electric Power Regulatory Authority (NEPRA)

Table 6: Energy Intensity of Various Transit Modes

Public Transit Method	Energy Intensity (BTU/Passenger-Mile)
EV Transit Bus	816
Diesel Transit Bus	4030
Rail	2398
National Railroad Passenger	2120
Rail Transit	2398

Source: www.kpcb.com

China is becoming a world leader in the electric vehicles market. The government could benefit from the CPEC initiative to introduce electric buses in major cities of Pakistan[43].

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.

1.1.3.3 Railway Transport

Railway transport can 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.[44] 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[45]. Because of these reasons, Government of Pakistan will prioritize and consider freight transport as a mostpreferable mode for oil and petroleum. Currently, only 4% of the total freight is carried out by railways. According to Asian Development Bank, the cost of transportation of one tonne of freight by railways is 80% less than conventional road transport.

1.1.4 Energy Efficiency in Agricultural Sector

Pakistan's Agriculture sector contributed 22.70 %to the GDP in 2021. While agriculture sector only accounts for 1.40% of total final energy consumption in Pakistan, Water pumps for irrigation and tractors for soil preparation are major energy consumers in the agriculture sector. Besides, use of commercial energy is also steadily increasing with growing number of mechanized practices to improve agricultural productivity.

[43]The Indian Government aims to achieve 100% electric vehicles by 2030. It is certainly an ambitious target, but the sense of urgency for India to go all electric is understandable. India is on a path to become world's third largest auto market by 2020[43], which poses a major challenge. India does not have sufficient fossil reserves to keep fueling this auto growth and air quality issues are already growing in major cities.

[44] Asian Development Bank 2009

[45] U.S. Rail Transportation of Crude Oil: Background and Issues for Congress. US Congressional Research Service

About 62.63 % of Pakistan's population lives in rural areas which rely on agriculture[46] to sustain their livelihood. Pakistan's Agriculture sector contributed 19.5 %to the GDP in 2016. While agriculture sector only accounts for 1.4% of total final energy consumption in Pakistan, Water pumps for irrigation and tractors for soil preparation are major energy consumers in the agriculture sector. Besides, 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 in Pakistan. Effective energy efficiency measures can help farmers save energy, increase yields, and reduce production costs.

The operational efficiency of conventional tube wells is at or below 30% in many cases[47]. In most of cases, energy wastages in pumps are due to their oversized and improper selection. Lack of proper maintenance and use of high friction piping networks are also a cause of inefficiency in tube wells. According to IFC, over 180,000 tube wells are connected to the electric grid and they consume more than 10% of the total electricity in the country. There is a potential to reduce power demand by 1000 MW if all these pumps are replaced with more efficient pumps. Of course, conversion of all these pumps in short term may not be possible but the long-term goal for 2030 calls for complete conversion.

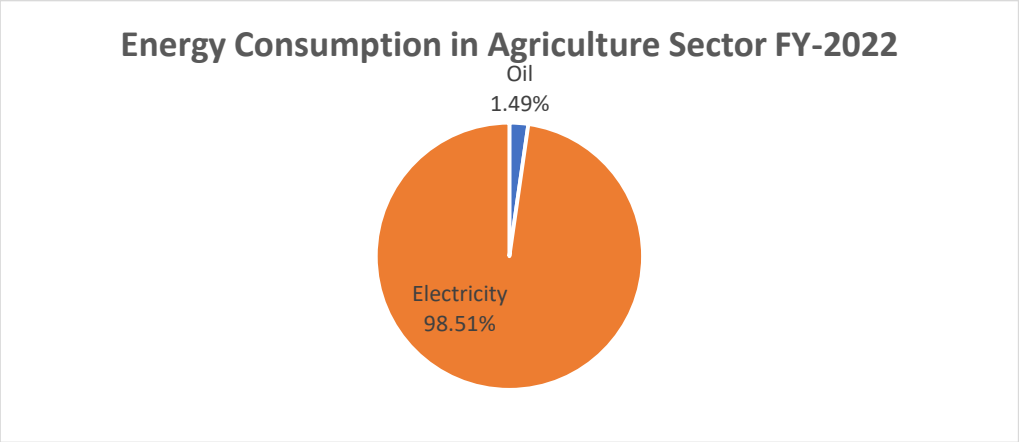
The overall performance of agriculture sector has been sluggish and subdued. During the last year, agriculture sector witnessed the negative growth of 0.19%, while the growth of important crops declined by 6.25%[48]. The negative growth in the agriculture sector can partially be attributed to the lack of reliable energy supply at affordable prices. Energy consumption in agriculture sector showed a declining trend as shown in the figure below. With declining agriculture production,

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.

electricity consumption has decreased by CAGR of 3.5% from 0.79 MTOE in 2010 to 0.65 MTOE in 2015, while oil consumption has decreased by CAGR of 8.5% over the same period.

[46]Pakistan Bureau of Statistics 2018. Date taken January 2018
[47] International Finance Cooperation
[48] Ibid

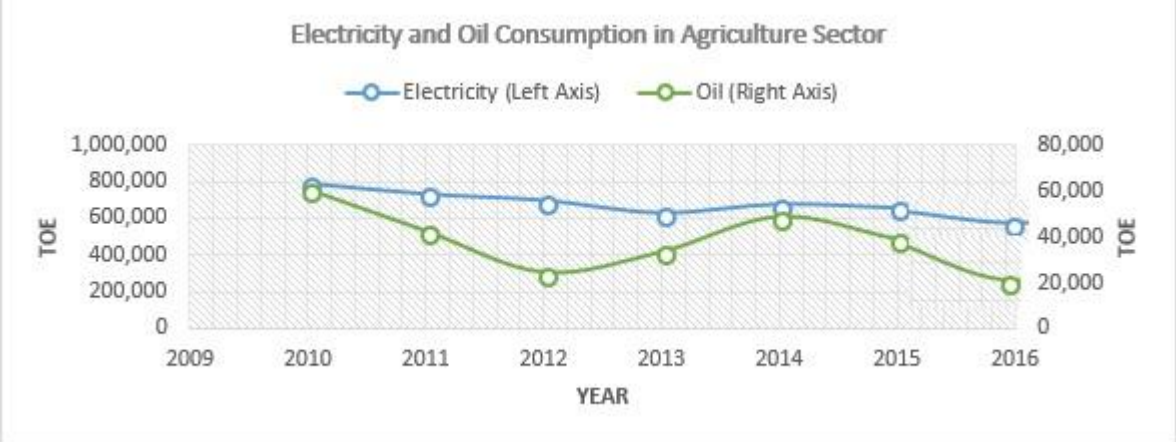
Figure 9 Energy consumption mix in Agriculture Sector



Source: Pakistan Energy Year Book 2021

In Pakistan, over the last five years, energy consumption in the agriculture sector has declined by 4% (See Fig.10). Over 90% of the energy consumed in the agriculture sector is in the form of electricity, while 10% is supplied by oil in the form of High-Speed Diesel for irrigation pumps and machinery.

Figure 10 Electricity and oil consumption trends in Agriculture sector



Source: Pakistan Energy Year Book

On the contrary, the ratio of electricity versus diesel pumps installed in the country is 20:80. Electric tube wells offer high-cost advantages as running cost is much lower than diesel pumps. However, electricity supply in rural areas for irrigation purposes is highly irregular which negatively affects the farmers and reduce yields. Use of solar photovoltaic can be cost effective option to convert existing low-headtube wells to run on solar, thereby improving independence and reducing the overall pumping costs.

Previously, an initiative to improve energy efficiency in the agricultural sector was launched with an 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 megawatts. Therefore, government will design a program to replaced inefficient pumps with more efficient pumps. Government will launch a program to replace 30,000 existing diesel-based pumps with solar pumps in first phase.

Table 7: 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 %	10,000
Use of energy efficient electric pumps, motors, and diesel engines	20 %	
Installation of properly sized pumps	5 %	
Proper maintenance of pumping system	5 %	
Installation of Variable Speed Drive ("VSD")	5 %	

Source: International Finance Cooperation

The low head pumping requirement for these areas, these pumps are particularly suitable for solar conversion with an investment of PKR. 1 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%[49].

1.1.5 Energy Efficiency in Energy Sector

1.1.5.1 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.

1.1.5.2 Power Generation Efficiency

On power generation side, the overall efficiencies have been improving worldwide. Notably, the power generation based on the Combined Cycle has achieved remarkable efficiencies

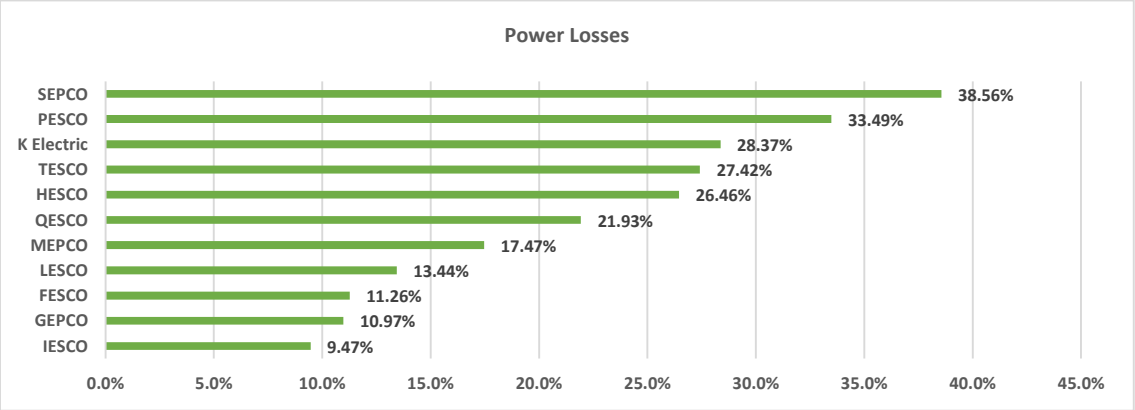
[49] Ibid

of over 60%. Currently, three new RLNG based power plants are under construction phase with a nameplate capacity of 1200 MW each. These power plants would employ one of the most efficient power generation technologies, with a conversion efficiency of 66%[50] and it will improve the overall efficiency power generation. Increasing the efficiency of coal-based power generation using super and ultra-super critical technology can offer a significant reduction in coal demand and as well as CO2 emissions. This measure is particularly important in view of current plans for developing coal power projects under CPEC.

1.1.5.3 Transformation, Transmission & Distribution Efficiency Supply

Transmission and distribution losses of Power and Natural Gas in Pakistan are one of the highest in the region. The average power distribution losses in Pakistan are as high as about 20% of the total generation in 2021 translating into an annual loss of PKR. 90 Billion. But for some DISCOs, these losses can reach over 38%[51] (See Fig. 11. For comparison, the average power distribution losses in Europe are less than 7%.

Figure 11 Power distribution losses in DISCOs in Pakistan



Source: National Electric Power Regulatory Authority (NEPRA)

Similarly, a huge volume of natural gas worth more than PKR. 50 billion is lost due to theft, leakages, and non-recovery of bills. The UFG losses in southern (SSGC) network are about 15%, but the permissible limit is about 4.5%[52]. This is reported to be one of highest UFG losses in the region translating into the monetary loss of PKR. 30 billion. Whereas, the UFG losses in northern (SNGPL) network stands at about 11.5% that amounts to PKR. 23 billion. This indicates the potential for improvement in efficiency of the transmission and distribution of gas network, which would not only lead to cost savings but reduce primary energy demands for various natural. The Government will deploy smart metering technology for natural gas and power consumers. Smart metering technology has been proven to be very useful and effective in reducing the losses,

[50]National Electric Power Regulatory Authority
[51] National Electric Power Regulatory Authority
[52] Sui Southern Gas Company Limited

improving the accuracy of measurements and billings. Reducing these losses would also provide significant environmental benefit in reducing the greenhouse gas emissions[53].

1.1.5.4 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, as shown in the following table. By the end of 2017, 3 new grid stations at 500 kV level were added which added 3,750 MVA in transformation capacity in the system, the fourth 500 kV grid station is nearing completion by the end of 2023 adding additional 1500 MVA to the system. At 220 kV level, 8 new grid stations with a cumulative transformation capacity of 5750 MVA has been added in the system. Similarly, one overloaded 500 kV grid station has been strengthened, while six such grid stations at 220 kV level have been improved.

1.2 Projection for Primary and Final Energy Consumption by 2030

While considering the targets envisaged in the preceding sections, it is estimated that the overall final energy projections by 2030 would be as under (See Table 8).

Table 8: Projected Primary Mix 2030

S. No	Source	2030		% Change (over 2017 to 2030)
		MTOE	% Commercial + Non-Commercial Energy	
A	**Commercial Energy**			
	Oil	45	0.20	80.22
	Gas	50	0.22	66.83
	LPG	1	0.00	122.22
	LNG	2	0.01	325.53
	Hydel	28	0.12	261.29
	Coal	10	0.04	102.02
	Nuclear Electricity	5.52	0.02	300
	Renewable Electricity		0.00	
	Wind	8	0.04	1233.33
	Solar	6	0.03	1900
	Others (Geothermal & bagasse)	0.65	0.00	
	Imported Electricity	0.1	0.00	0
	Subtotal	156.27	0.69	137.01

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

B	**Non-Commercial Energy**			
	Wood / Dung / Others	70	0.31	-28.44
	Subtotal	70	0.31	-28.44
A+B	**Grand Total**	226.27	100	

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

This Action Plan projects that share of final energy consumption by 2030 will 85 MTOE, whereas the non-commercial energy will be 70 MTOE and total from both will be 111 MTOE. The analysis shows that that overall share of electricity will increase 301% 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 105.18 percent by 2030 as compared to the electricity use of 2016. Although the share of non-commercial energy will increase in absolute terms approximately 7 MTOE by 2030 (See Table 9). But in relative terms the non-commercial energy share will decline.

Table 9 Projected Final Energy Consumption by 2030

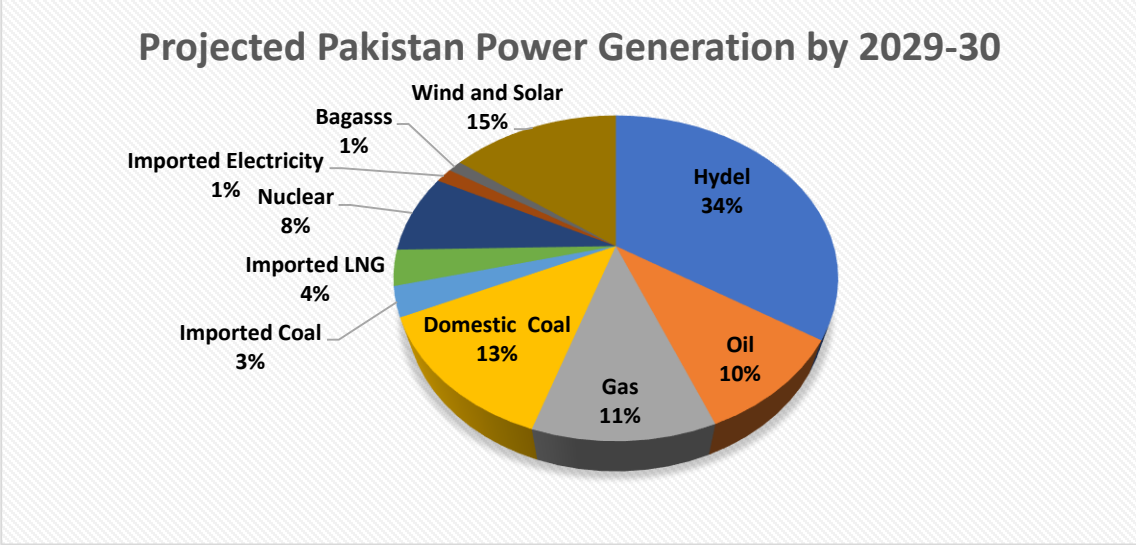
`	Source	2030		% Change (2017 - 2030)
		MTOE	%	
A	**Commercial Energy**			
	Oil	22	19.9	58.84
	Gas	25	22.6	58.73
	Electricity	28	25.3	301.15
	Coal	9.5	8.6	105.18
	LPG	1	0.9	31.58
	Others (Geothermal etc.)	0	0.0	0.00
	Subtotal	85.5	77.4	103.72
B	**Non-Commercial Energy**			
	Wood/Dung/Others	25	22.6	47.06
	Subtotal	25	22.6	47.06
A+B	**Grand Total**	**111**	100.0	87.38

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

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

In addition to the above due to adaption of comprehensive power generation policies and plans additional electricity of 25,000 MW would also be made available which will result in reduction of non-commercial energy share.

Figure 12 Pakistan's Projected Power Generation by 2029-2030



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

The projected power generation by 2030 is 101325 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 due to switching of power plants to LNG and imported coal. The share of Hydel and other renewables (e.g. Solar, Wind, Bagasse) will also increase considerably (See Table 10).

Table 10 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	Thermal	16,370	13370	13370	13370	21300
3	Domestic Coal	633	810	4440	8400	13225
4	Imported Coal		3300	6103	6103	3000
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	919	1200
9	Wind and Solar	902	2231	4732	6582	15000
	Total	25,878	38695	49798	71815	101325

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

PART 2: PRIORITY ACTION AREAS

2. Priority Action Areas

The main objective of the NEEC Action Plan 2023-2030 is to make the highest contribution to national prosperity through efficient and environment friendly utilization of energy and natural resources. Currently, energy efficiency has been improving at the rate of 1.7% annually since 2000 (i.e., 27% over the last 14 years). In other words, the primary energy intensity of Pakistan has decreased by 1.7 annually since 2000. To achieve the SDG-7 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. Hence, this Action Plan pursues the overarching goal of 9 Mtoe reduction in Pakistan's primary energy consumption and GHG emission reduction of 35 MTCO2 cumulative in the period of 2023-2030. The 27 actions have been prioritized across five key sectors of the economy Industry, Buildings, Transport, and Agriculture on the demand side and energy sector on the supply side. Actions have also been prioritized across cross cutting areas.

The measures proposed in the NEEC Policy 2023 have been rigorously evaluated and prioritized on the criteria of 1) supporting the development of an EE&C eco-system, 2) financial & environmental savings, 3) investment requirement, and 4) political economy. Further, the actions have also been prioritized in light of the national commitment towards SDG7 and their possible support to the national sectoral policies listed in the NEEC Policy 2023. Further, the section below also defines the goal of each action, the activities to be undertaken, intended outputs/results, and their key performance indicators.

The prioritized actions involve multiple disciplines; and institutions and organizations which are designated as responsible institutions above are directly responsible for implementing and scaling up the actions. The designated responsible institutions under the Action Plan will pay special attention to the actions when preparing their institutional budgets and annual development plans/ programme work plans. Those designated as relevant institutions will cooperate with the responsible institutions and support the implementation of the actions. The designated responsible institutions will coordinate the activities by the relevant institutions for actions.

The National Energy Efficiency and Conservation Authority is the responsible institution for monitoring and coordinating the Action Plan with provincial governments. Outputs and performance indicators for actions have been identified, which will allow further definition of detailed performance indicators. Activities for monitoring and evaluation of the actions will proceed on quarterly basis.

The detail description of each action under the above mentioned are given below:

2.1. Energy Efficiency in Industry Sector

Being the largest consumer of energy with energy use at 37.1 percent, the industrial sector is highly energy intensive. Pakistan's industrial sector has an intensity of 0.117 kgoe/$GDP(PPP) versus 0.08 kgoe/$GDP in Europe . Internationally, there is an increasing demand of products with higher levels of energy efficiency as a mean to reduce carbon emissions. Pakistan's traditional

export markets are adopting various trade tools i.e. EU's Carbon Border Adjustment Mechanism (CBAM)/Generalized Scheme of Preference Plus (GSP+) etc. to reduce GHG emissions. The energy saving potential of various subsectors of industry is as follows:

- Textile Sector (accounting for 27.6% of the overall electricity consumed by industries & 40 % of the Natural Gas) offers the highest efficiency gains with a total energy saving potential of 2,150 GWh per year by improving the efficiency of compressors, heat transfer & recovery systems, lights, motors, power factor correction panels, process control, steam system optimization and variable frequency drives ("VFDs").
- Cement Sector (accounting for 68.9% of the total coal consumption by industries) has significant energy saving potential.
- Steel sector, which has the worst energy benchmarks in the region, can be tapped for gaining high energy savings through tune-up of inefficient furnaces.
- The sugar mills in Pakistan have a high specific energy consumption of over 1250 MJ/ton which is much higher than the average value of 935 MJ/ton for the regional sugar sector. This high energy consumption value can be attributed to the use of antiquated sugar manufacturing systems and inefficient boilers, though the sugar industry has shifted to alternate renewable energy sources such as bagasse. Sugar industry has a saving potential of 138.35 GWh per year.
- The leather industry has saving potential of 17 GWh per year from heat transfer and recovery systems, motors, general process, and steam system optimization.
- Electric Motor-Driven Systems (EMDS) in the industrial sector consume almost half of the total electricity. The cost effective potential to improve the EE of electric motors is about 20 to 30%.
- Informal energy-intensive industries energy optimization programs would be low hanging fruits to focus on e.g. deployment of EnMS, Installation of APFC units, VFDs, in cottage industries/SMEs.

•

EE&C Potential of Industrial Sector of Pakistan		
Saving Potential in Gas Based CPPs		
CV of Natural Gas	BTU/Ft^3	940
Gas Consumption by Captive Power Plants	Million CFt/Yr	124,000
Potential of Efficiency Improvement	%	20%
Savings Potential in Gas Captive Power Plant	Million CFt/Yr	24,800
	Million BTU/Yr	23,312,000
Total Savings in Gas Based CPPs	**MTOE**	**0.59**
Saving Potential in Industrial Furnaces		
Consumption by Industrial Furnaces	%	25%
	Million CFt/Yr	63,972
Potential of Efficiency Improvement	%	15%
Savings Potential in Furnaces	Million CFt/Yr	9,596
	Million BTU/Yr	90,20,017
Total Savings in Industrial Furnaces	**MTOE**	**0.23**
Saving Potential in Industrial Boilers		
Consumption by General Industry	Million CFt/Yr	255,887
Consumption by Industrial Boilers	%	60%
	Million CFt/Yr	153,532
Potential of Efficiency Improvement	%	15%
Savings Potential in Boilers	Million CFt/Yr	23,030
	Million BTU/Yr	21,648,040
TOTAL Savings Potential in Industrial Boilers	**MTOE**	**0.55**
Saving Potential in HFO CPPs		
GCV of HFO	MJ/Ton	42,859
HFO Consumption by Captive Power Plants	Tons/Yr	1,617,033
Potential of Efficiency Improvement	%	10%
Savings Potential in HFO Captive Power Plant	Tons/Yr	161,703
	MJ/Yr	6,930,441,735
TOTAL Savings Potential in HFO CPPs	**MTOE**	**0.17**
Saving Potential in MEPs for Motors		
Total No. of Motors	Million	14
Projected No. of Motors 2030	Million	25
Energy Consumption of all Motors in 2020	TWh/year	75
Energy Consumption of Motors in 2020	MTOE/Year	6
Projected Energy Consumption of Motors 2030	TWh/year	120
Projected Energy Consumption of Motors 2030	MTOE/Year	10
Saving Potential by 2030 through Adopting World Best Practices	TWh	9
Saving Potential by 2030 through Adopting World Best Practices	MTOE	0.77

TOTAL Savings Potential by Motor MEPs	**MTOE**	**0.77**
Saving Potential in Coal Based Boilers		
GCV of Coal	MJ/Ton	25120
Consumption by General Industry	TOE	9,836,074
Consumption by Industrial Boilers	%	25%
	TOE	2,459,019
Potential of Efficiency Improvement	%	10%
TOTAL Savings Potential in Coal Based Boilers	**MTOE**	**0.25**
Saving Potential in Coal Based Kilns		
Consumption by Kilns	%	50%
	TOE	4,918,037
Potential of Efficiency Improvement	%	5%
TOTAL Savings Potential in Coal Based Kilns	**MTOE**	**0.25**
Total EE&C Potential of Industrial Sector of Pakistan	**MTOE**	**2.81**

Following priority actions (categorized under thematic areas of regulatory, capacity, and advocacy) are proposed to realize the abovementioned energy saving potential:

REGULATORY	
1) Action Code and Title: IS1. Ban on the manufacture, sale, and import of motors having lower than International Efficiency Class 2 (IE2) standard	
Situation Analysis: Motors play a crucial role in the functioning of many industrial processes. They are used to power a wide variety of machines and equipment, ranging from conveyor systems to pumps, fans, compressors, and more. Majority of the motors manufactured and used in the industry are of very poor efficiency (even below IE1) which places enormous stress on the economy, both in terms of direct costs to the motor user, and the indirect costs to the generation and distribution companies to meet the peak demand attributable to motors.	
Goal	To implement the minimum energy performance standards (MEPS) for Motors
Savings (Energy, GHG Emissions, and Financial)	This action will save approx. 0.75 MToE annual energy from electricity. The financial impact of this electricity savings is estimated as 155 Million USD per year. The saving shall reduce approx. 4.4 Million tonnes of CO2 emissions per annum.

Activities to Undertake	The intervention requires investment of approx. 0.5 Million USD for following sub-actions.
	• Development of Final MEPS and Labelling Schemes:
	  o Timeline: 2023
	  o Responsible: NEECA
	  o Co-Responsible: PSQCA
	• Development and operationalization of Product Registration System
	  o Timeline: 2027 (Phase-wise)
	  o Responsible: NEECA
	• Parallel capacity building, awareness & outreach, and engagement of stakeholders on this regulatory action area

Outputs and Indicators	1. Registration of Manufacturers with NEECA Labelling Regime 2. Regulatory directives such as pre-shipment inspection, custom duties on imported motors 3. Increased demand for NEECA Labelled Motors
Lead Responsible Institutions	NEECA/PDAs
Relevant Institutions	PSQCA, EDB, MoPD&SI, Ministry of Commerce, Customs, Industrial Associations

Timeline	Regulatory framework is developed in 2023 and the implementation will be completed till 2027
CAPACITY	
2) Action Code and Title: IS 2 & 3.	**Tune-up & Retrofitting of Gas and Coal based Industrial Boilers, Furnaces, and Kilns**
Situation Analysis: Boilers, furnaces, and kilns are major equipment of the industry that consume natural gas and coal. In order to achieve optimal combustion efficiency, tune-up or appropriate retrofitting of the equipment is to be carried out.	
Goal	To achieve higher efficiency in gas and coal based industrial boilers, furnaces, and kilns
Savings (Energy, GHG Emissions, and Financial)	These actions will enhance efficiency of the combustion process up to 5-10% and save approx. 1 MToE annual energy (gas and coal). The financial impact of these fuel savings is estimated to be 280 Million USD per year. The saving in fossil fuels shall reduce approx. 3.2 $MTCO_2$ emissions per annum.
Activities to Undertake	These actions requires investment of approx. 425 Million USD for following sub-actions. • Establishment of Industrial Boilers, Furnaces, and Kilns efficiency monitoring and optimization centers at provinces o Timeline: 2024 o Responsible: NEECA o Co-Responsible: PDAs • Pilot Projects in different industries esp. Textile, Steel, Cement, Paper & Pulp, Sugar o Timeline: 2028 (Phase-wise) o Responsible: NEECA o Co-Responsible: PDAs • Catalyzing Boilers, Furnaces, and Kilns efficiency improvement through energy audits/tune-ups/retrofitting by engaging Energy Service Companies (ESCOs) o Timeline: 2025 to 2028 (Phase-wise) o Responsible: ESCOs through NEECA • Field surveying for implementation and monitoring of efficiency and activities through web based system o Timeline: 2025 o Responsible: NEECA o Co-Responsible: PDAs • Capacity building, awareness & outreach, and engagement of stakeholders
Outputs and Indicators	1. No. of Boilers and Furnaces audited and tuned/retrofitted 2. Demonstration projects across industry 3. No. of specific concessional financing facilities (RLF, EE credit lines) developed and availed by industries

	4. Regulatory directives for incentives such as relaxed custom duties on boiler and furnace equipment
Lead Responsible Institutions	NEECA/PDAs
Relevant Institutions	Relevant industrial Associations, ESCOs, Ministry of Industries & Production, Ministry of Climate Change & Environmental Coordination, SBP
Timeline	Regulatory framework is developed by 2024 and the implementation will be completed till 2028
3) Action Code and Title: IS 4. Tune-up & Retrofitting of Gas and Furnace Oil based Captive Generator Sets	
Situation Analysis: Captive power plants are usually set up to ensure a reliable and uninterrupted supply of power to the industries. These Generator Sets (Genset) mostly consume Gas (LNG) or Furnace Oil. In order to achieve optimal combustion efficiency, tune-up or appropriate retrofitting of the equipment is to be carried out. **(Recent policy on captives NEP 2023)**	
Goal	To achieve higher efficiency in gas (LNG) and furnace oil based captives
Savings (Energy, GHG Emissions, and Financial)	This action will enhance efficiency of the combustion process up to 5-15% and save 0.52 Mtoe annual energy (gas and furnace oil). The financial impact of these fuel savings is estimated to be 57 Million USD per year. The saving in fossil fuels shall reduce 1.3 $MTCO_2$ emissions per annum.
Activities to Undertake	These actions requires investment of approx. 70 Million USD for following sub-actions. • Establishment of Industrial Captives efficiency monitoring and optimization centers at provinces o Timeline: 2024 o Responsible: NEECA o Co-Responsible: PDAs • Pilot Projects in different industries esp. Textile, Steel, Cement, Paper & Pulp, Sugar, Fertilizer o Timeline: 2028 (Phase-wise) o Responsible: NEECA o Co-Responsible: PDAs • Catalyzing captive efficiency improvement through energy audits and retrofitting by engaging Energy Service Companies (ESCOs) o Timeline: 2025 to 2028 (Phase-wise) o Responsible: ESCOs through NEECA • Field surveying for implementation and monitoring of efficiency and activities through web based system o Timeline: 2025 o Responsible: NEECA

	○ Co-Responsible: PDAs • Launch of national captive energy saving certification regime. ○ Timeline: 2025 ○ Responsible: NEECA PDAs ○ Co-Responsible: Power Division, MoI&P • Parallel capacity building, awareness & outreach, and engagement of stakeholders
Outputs and Indicators	1. No. of Captives audited and tuned/retrofitted 2. Demonstration projects across industry 3. No. of specific concessional financing facilities (RLF, EE credit lines) developed and availed by industries 4. Regulatory directives for incentives such as relaxed custom duties on captive equipment
Lead Responsible Institutions	NEECA/PDAs
Relevant Institutions	Relevant industrial Associations, ESCOs, Ministry of Industries & Production, Ministry of Climate Change & Environmental Coordination, SBP
Timeline	Regulatory framework is developed by 2024 and the implementation will be completed till 2028
REGULATORY AND CAPACITY	
4) Action Code and Title: IS5. Energy audits of designated consumers in the industrial sector and voluntary agreements on five year energy saving plan	
Situation Analysis: There is no mandatory regime for energy audits functional in the country, however, various programmes have been run by the NEECA over the past years where energy audits of Sugar, and Textile industries have been conducted. There is a need for the launch of voluntary energy saving agreement regime with the industry sector designated consumers to nudge the sector towards adoption of energy efficient technologies and processes.	
Goal	To implement the voluntary energy saving agreement regime with designated industrial consumers
Savings (Energy, GHG Emissions, and Financial)	To be calculated based on 2.5% energy saving/annum criteria.
Activities to Undertake	The intervention requires following sub-actions. • The regulatory framework for Designated Consumers and Voluntary Agreements to be developed ○ Timeline: 2024 ○ Responsible: NEECA ○ Co-Responsible: MoI&P • The regulatory framework for Designated Consumers Regime ○ Timeline: 2024

	○ Responsible: NEECA ○ Co-Responsible: PDAs • Signing of VAs with Designated Consumer: ○ Timeline: 2026 ○ Responsible: NEECA ○ Co-Responsible: MoI&P
Outputs and Indicators	Legislative/regulatory framework developed, number of Voluntary Agreements signed every year, energy and financial saving derived from successfully completed Voluntary Agreements.
Lead Responsible Institutions	NEECA/PDAs
Relevant Institutions	Relevant industrial Associations, ESCOs, Ministry of Industries & Production, Ministry of Climate Change & Environmental Coordination, SBP
Timeline	Regulatory framework of VA regime is developed in 2023, energy use index finalized in 2023, designated consumers notified in 2024, and the implementation will be completed till 2026
REGULATORY AND CAPACITY	
5) Action Code and Title: IS6. Deployment of energy management system (EnMS) and energy managers across designated consumers of Industrial Sector	
Situation Analysis: The adoption of EnMS has been limited across the industry due to associated financial costs with certification and required investment with adoption of energy efficient processes and practices. The Industry also faces information asymmetry regarding energy management at their establishments due to lack of HR capacity and understanding.	
Goal	To implement the EnMS with designated industrial consumers and placement of NEECA certified energy managers.
Savings (Energy, GHG Emissions, and Financial)	This action will directly support the implementation of Action IS5 and support the achievement of its goals.
Activities to Undertake	The intervention requires following sub-actions. • The necessary regulatory provisions will be developed to promote certification of energy managers ○ Timeline: 2023 ○ Responsible: NEECA ○ Co-Responsible: PDAs • A custom made EnMS certification regime will be developed for Pakistan in coordination with International Organization for Standardization (ISO) and other relevant internal standard bodies. ○ Timeline: 2024 ○ Responsible: NEECA ○ Co-Responsible: PDAs

	• A dedicated reporting framework shall be developed for energy managers on the industry's performance vis-à-vis its voluntary agreements. o Timeline: 2024 o Responsible: NEECA o Co-Responsible: --- • Certification regime for energy managers will be launched nationwide in collaboration with local universities. o Timeline: 2025 onwards o Responsible: NEECA o Co-Responsible: PDAs and Universities
Outputs and Indicators	1. Number of Voluntary Agreements successfully performed every year 2. Regular reporting on the performance of Voluntary Agreements and initiatives undertaken by designated consumer
Lead Responsible Institutions	NEECA, PDA, Ministry of Industries & Production
Relevant Institutions	ESCOs, ECF, Industrial Associations
Timeline	Regulatory framework for energy managers is developed in 2023, Local version of EnMS launched in 2024, and the implementation will be completed till 2026.

2.2. Energy Efficiency in Buildings

Pakistan as a developing country with increasing demands for new construction, it 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%.[55]

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 set a baseline for the energy efficiency in the building envelope, equipment, and systems. 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. Due to high population growth and increasing urbanization in the country, the annual rate of construction of new buildings has reached to 5.3%. Despite development of Pakistan Building Codes Regulation 2011 by Pakistan Engineering Council (PEC) buildings sector of Pakistan lacks EE&C measures and its implementation.

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.

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.

Most of the building load consists of the space heating, space cooling, refrigeration, cooking, and lighting. The Building Sector of Pakistan has an enormous potential of energy saving to the tune of 2.63 MTOE by deploying effective EE&C measures in the said areas, as shown in the Table below:-

[55] Sustainable Energy Efficiency Program, ADB (2009)

EE&C Potential of Building Sector of Pakistan		
Saving Potential in Domestic Gas Appliances		
GCV of Natural gas	BTU/Ft^3	940
Gas Savings from Geysers	Million CFt/Yr	52,772
Gas Savings from Cook Stove	Million CFt/Yr	5,496
Savings	Million CFt/Yr	58,268
	Million BTU/Yr	54,771,920
Total Savings in Domestic Gas Appliances	**MTOE**	**1.38**
Saving Potential in Banning the Incandescent Bulbs		
Power Rating of Incandescent Bulb	W	100
Power Rating of Efficient LED Bulb	W	12
Operational hrs / day	Hr/Day	6
Operational days / year	Days/Year	365
Service Operation Factor	%	50%
Total Annual Production of Incandescent Bulbs	No.	4,000,000
Energy Savings on New Production	MWh	385,440
Total Savings by Banning the Incandescent Bulbs	**MTOE**	**0.03**
Saving Potential in MEPS for LEDs		
Power Rating of CFL	W	24
Power Rating of Efficient LED Bulb	W	12
Operational hrs / day	Hr/Day	10
Operational days / year	Days/Year	365
Service Operation Factor	%	70%
Total Annual Import of CFL	No.	86,000,000
Energy Savings on CFL	MWh	2,636,760
	MTOE	**0.23**
Power Rating of Fluorescent Tube Light	W	36
Power Rating of Efficient LED Bulb	W	12
Operational hrs / day	Hr/Day	10
Operational days / year	Days/Year	365
Service Operation Factor	%	70%
Total Annual Import of Fluorescent Tube	No.	96,000,000
Energy Savings on Fluorescent Tube	MWh	5,886,720
	MTOE	**0.51**
TOTAL Savings Potential by LED MEPs	**MTOE**	**0.74**
Saving Potential in MEPs for Fans		
Power Rating of Inefficient Fan	W	120
Power Rating of Efficient Fan	W	60
Operational hrs / day	Hr/Day	24
Operational days / year	Days/Year	180

Service Operation Factor	%	50%
Total Annual Production of Fans	No./Yr	8,000,000
Energy Savings on New Production	MWh	1,036,800
	MTOE	0.09
BISP Consumers	No.	3,000,000
Energy Savings on BISP Fan Replacement	MWh	388,800
	MTOE	0.03
TOTAL Savings Potential by Fan MEPs	**MTOE**	**0.12**
Saving Potential in MEPs for ACs		
Total Annual Production of AC	No./Yr	1,128,000
Annual Production Non-Inverter AC	%	21%
	No./Yr	237,106
Annual Production Inverter AC	No./Yr	890,894
Annual Consumption by Non-Inverter AC	KWh	1,700
Annual Consumption by Inverter AC	KWh	1,129
Energy Savings	MWh	135,388
TOTAL Savings Potential by AC MEPs	**MTOE**	**0.01**
Saving Potential in MEPs for Refrigerators		
Total Annual Production of Refrigerators	No./Yr	1,967,000
Annual Production Inverter Refrigerators	%	9%
	No./Yr	171,129
Annual Production Non-Inverter Refrigerators	No./Yr	1,795,871
Annual Consumption by Inverter Refrigerators	KWh	438
Annual Consumption by Non-Inverter Refrigerators	KWh	1,036
Energy Savings	MWh	1,073,931
TOTAL Savings Potential by Refrigerator MEPs	**MTOE**	**0.09**
Saving Potential in Govt. Buildings Energy Audit		
Total Load of Govt. Buildings	MW	5227
Operating Hours per day	Hrs/Day	8
Operating Days per year	Days/Yr	240
Saving Potential by Energy Audit	%	11%
Saving in Load	MW	575
Energy Savings	MWh	1,103,942
TOTAL Savings Potential by Govt. Buildings Energy Audit	**MTOE**	**0.09**
Saving Potential in Solarization of Govt. Buildings		
Total Load of Govt. Buildings	MW	5227
Operating Hours per day	Hrs/Day	8
Operating Days per year	Days/Yr	240
Saving in Load with Solarization	MW	1,000
Energy Savings	MWh	1,920,000

TOTAL Savings Potential by Solarization of Govt. Buildings	**MTOE**	**0.17**
Total EE&C Potential of Building Sector of Pakistan	**MTOE**	**2.630**

Following priority actions are proposed to realize the abovementioned energy saving potential:

REGULATORY	
1) Action Code and Title: BS1. **Compliance of minimum energy performance standards and labelling regimes for electric appliances, and equipment** **BS2.** **Compliance of minimum energy performance standards and labelling regimes for gas appliances, and equipment**	
Situation Analysis: **BS1:** Fans, Air Conditioners, Refrigerators, and Lights account for the major share of electricity consumption in the domestic sector. Majority of the appliances manufactured and installed in the buildings are inefficient which places enormous stress on the economy, both in terms of direct costs to the consumers, and the indirect costs to the generation and distribution companies to meet the peak demand attributed to electrical appliances. **BS2:** Water Heaters and Cook Stove account for the major share of gas consumption in the domestic sector. Majority of the appliances manufactured and installed in the buildings are inefficient which places enormous stress on the economy, both in terms costs to the consumers, and the cost for importing LNG to meet the gas demand of country.	
Goal	**Improving market penetration of efficient electric and gas appliances in the country via a coordinated demand push.**
Savings (Energy, GHG Emissions, and Financial)	The implementation of BS1 action will save approx. 0.6 MToE annual energy from electricity. The financial impact of this electricity savings is estimated as 340 Million USD per year and this action shall reduce 3.4 $MTCO_2$ GHG emissions per annum. The implementation of BS2 action will 1.4 Mtoe annual energy from gas. The financial impact of this gas savings is estimated to be 93 Million USD per year and a reduction of 3.2 $MTCO_2$ of GHG emissions per annum will be achieved.

Activities to Undertake	The BS1 and BS2 actions require investment of 0.5 Million USD and 400 Million USD respectively for following sub-actions.
	
	• Development of Final MEPS and Labelling Schemes
	  ○ Timeline: 2023 Electric Appliances and 2024 for Gas Appliances
	  ○ Responsible: NEECA
	  ○ Co-Responsible: PSQCA
	• Development of Product Registration System
	  ○ Timeline: 2024
	  ○ Responsible: NEECA
	  ○ Co-Responsible: PDAs
	• On-bill financing mechanisms for use of efficient technology
	  ○ Timeline: 2023

	○ Responsible: NEECA ○ Co-Responsible: PDAs • Incentive Schemes for shifting to Solar Water Heaters ○ Timeline: 2025 ○ Responsible: NEECA ○ Co-Responsible: Finance Division, SBP • Parallel capacity building, awareness & outreach, and engagement of stakeholders
Outputs and Indicators	1. Registration of electric and gas appliance manufacturers with NEECA Labelling Regime 2. Regulatory directives such as pre-shipment inspection, custom duties framework on imported appliances 3. Increased demand for NEECA labelled appliances
Lead Responsible Institutions	NEECA, PDAs
Relevant Institutions	Relevant industrial Associations, PSQCA, Ministry of Science & Technology, PNAC, PCSIR, Ministry of Industries & Production, Ministry of Climate Change & Environmental Coordination
Timeline	The implementation of MEPS and Labelling Regime for Electric Appliances will be completed by 2023. The implementation of MEPS and Labelling Regime for Gas Appliances will be completed by 2024.
2) Action Code and Title: BS3. Mandatory energy audits pre- and post-solarization initiative in the public buildings.	
Situation Analysis: Public buildings consume approx. 5200MW of electricity per annum in the country. This significantly contributes to the seasonal peak demand of electricity. Energy audit is an inspection survey and an analysis of energy flows for energy conservation in a building and the energy audit of public buildings can reduce their energy demand through optimization. Further, this optimized demand may be catered through renewables esp. solar as the majority of public buildings consume electricity during daylight. Through this action, 1000MW of electrical load can be shifted from national grid to solar based electrical power system.	
Goal	To optimize energy demand of public buildings in the country and transition towards renewable power sources esp. solar.
Savings (Energy, GHG Emissions, and Financial)	The implementation of BS1 action will save 0.23 Mtoe annual energy from electricity. The financial impact of this electricity savings is estimated to be at 131 Million USD per year. The saving shall reduce 1.6 $MTCO_2$ emissions per annum
Activities to Undertake	This actions require investment of 850 Million USD for following sub-actions. • Operationalization of ESCO regime in the country through registration and certification ○ Timeline: 2024 ○ Responsible: NEECA

	○ Co-Responsible: PDAs • Development and Operationalization of a super ESCO model utilizing Energy Conservation Fund of NEECA as an initial platform ○ Timeline: 2024 ○ Responsible: ECF ○ Co-Responsible: NEECA • Solarization of public buildings at federal level with net-metering ○ Timeline: 2025 depending on financing guarantees ○ Responsible: AEDB, MoH&W ○ Co-Responsible: NEECA • Demonstration projects at provincial headquarters for replication and scale up ○ Timeline: 2025 depending on financing guarantees from Provincial Governments ○ Responsible: PDAs ○ Co-Responsible: NEECA • Field surveys for energy audits and solarization potential through web based system ○ Timeline: 2023 ○ Responsible: NEECA ○ Co-Responsible: PDA • Parallel capacity building, awareness & outreach, and engagement of stakeholders
Outputs and Indicators	1. No. of public buildings audited and solarized at federal and provincial level 2. The electric load shifted to solar power 3. No. of public buildings successfully executing their ESCO contracts 4. Quarterly energy saving reports submitted to NEECA
Lead Responsible Institutions	NEECA, PDAs, NEECA, Ministry of Energy (Power Division), DISCOs
Relevant Institutions	AEDB, Development Authorities, Provincial Building Departments, Ministry of Housing & Works, Ministry of Climate Change & Environmental Coordination
Timeline	This action will be completed by 2025 depending on the availability of financing guarantees from government of Pakistan.

3) Action Code and Title: BS4. Public procurement guidelines ensuring procurement of Pakistan energy label appliances in the country.	
Situation Analysis: Currently, the mandatory procurement of energy efficient appliances in the public sector is being implemented only in Punjab and that too is limited to Fans. Given the huge size of PSDPs/ ADPs and other development initiatives at the federal and provincial level, there is a significant potential for these platforms to act as a catalyst for penetration of energy efficient appliances in the market. This action will also support the manufacturers to transition towards adoption of efficient technologies through creating initial sustainable demand in the market.	
Goal	To create a demand for the Pakistan energy labelled appliances and products in the market.
Savings (Energy, GHG Emissions, and Financial)	This action will support the implementation of actions BS1 and BS2, however, this is being reported as a standalone intervention given the sheer impact of this action on the manufacturers and consumers of appliances.
Activities to Undertake	The intervention requires no/low investment for following sub-actions: • Mandatory procurement of Pakistan Energy Labeled appliances and products in public procurement and support to PPRA with regard to the review of the PPRA Rules and Regulations o Timeline: 2023 o Responsible: PPRA o Co-Responsible: NEECA • Parallel capacity building, awareness & outreach workshops with the stakeholders involved with project development, appraisals, implementation etc.
Outputs and Indicators	1. Amendments to PPRA rules and regulation for mandatory procurement of Pakistan energy labelled appliances 2. No. of projects under PSDP/ADP passing appraisal on the above mentioned procurement criteria 3. Increased demand for NEECA Labelled appliances
Lead Responsible Institutions	PPRA
Relevant Institutions	NEECA, PDAs, MoPD &SI, provincial P&D departments
Timeline	The implementation will be completed by 2023

4) Action Code and Title: BS5. **Placement of energy managers at designated consumers of the building sector for verifiable energy management system deployment through regular reporting.** **BS6. Mandatory energy audits of designated consumers in old buildings with five-year energy saving plan**	
Situation Analysis: The adoption of EnMS has been limited across the building sector due to associated financial costs with certification and required investment with adoption of energy efficient processes and practices. There is a non-availability of energy teams at the buildings which reflects non-existent HR capacity and understanding vis-à-vis EnMS.	
Goal	To implement the EnMS with designated building sector consumers and placement of NEECA certified energy managers.
Savings (Energy, GHG Emissions, and Financial)	These actions will directly support the implementation of Action BS3 and its replication beyond public buildings.
Activities to Undertake	The intervention requires no/low cost investment on part of government as most of the cost will be borne by the designated consumers. Following activities will be undertaken under this action: • The regulations will be developed to promote certification of energy managers o Timeline: 2023 o Responsible: NEECA o Co-Responsible: ---- • A custom made affordable EnMS certification regime will be developed for Pakistan in coordination with International Organization for Standardization (ISO), Leads, and other relevant internal standard bodies. o Timeline: 2024 o Responsible: NEECA o Co-Responsible: ---- • A dedicated reporting framework shall be developed for energy managers on the designated building's performance vis-à-vis its voluntary agreements. o Timeline: 2024 o Responsible: NEECA o Co-Responsible: Designated Consumers • Certification regime for energy managers will be launched nationwide in collaboration with local universities. o Timeline: 2025 o Responsible: NEECA o Co-Responsible: PDAs and Universities • Voluntary energy saving agreements with the designated consumers of the building sector o Timeline: 2025 o Responsible: NEECA o Co-Responsible: PDAs • Parallel capacity building of existing building maintenance teams of the designated consumer

Outputs and Indicators	1. Deployment of energy teams and energy policy at the designated consumer level 2. Number of Voluntary Agreements successfully performed every year 3. Regular reporting on the performance of Voluntary Agreements and EE&C initiatives undertaken by designated consumer
Lead Responsible Institutions	NEECA, Provincial Designated Agencies (PDAs)
Relevant Institutions	ESCOs, ECF, Ministry of Energy (Power and Petroleum Divisions), DISCOs, SNGPL, SSGC
Timeline	Regulatory framework for energy managers is developed in 2023, Local version of EnMS launched in 2024, and the implementation will be completed till 2025.
5) Action Code and Title: BS7. Mandatory compliance of Energy Conservation Building Codes (ECBC)	
Situation Analysis: The ECBC (energy provisions) have been revised in 2023 to achieve alignment with international best practices on building design, orientation, construction material, equipment, and green & EE practices.	
Goal	To promote and ensure the implementation of ECBC 2023 across the country.
Savings (Energy, GHG Emissions, and Financial)	This action will directly support the country in achieving 15-20% energy saving potential in the building sector esp. new construction
Activities to Undertake	The action requires 3 million USD to implement following activities: • Amendments in local by-laws, rules, and regulation related to building control at provincial level in line with ECBC 2023 and according to the local climatic zones. o Timeline: 2024 o Responsible: City Development Authorities/Building Control Authorities o Co-Responsible: NEECA and PDAs • National awareness and capacity building workshops with provincial and local governments on ECBC 2023 o Timeline: 2024 onwards o Responsible: NEECA o Co-Responsible: PDAs • Establishment of building design appraisal labs at the NEECA and PDAs to support building control authorities with compliance of ECBC 2023 (energy provisions) o Timeline: 2024 o Responsible: NEECA o Co-Responsible: PEC

Outputs and Indicators	1. Number of by-laws amended and adopted by city development authorities/building control authorities of major cities of the country. 2. Number of building design appraisal labs established in the country 3. Percentage of successful design appraisals year on year.
Lead Responsible Institutions	City Development Authorities/Building Control Authorities
Relevant Institutions	PEC, NEECA, PDAs
Timeline	This action will be completed by 2024.

2.3. Energy Efficiency in Transport Sector

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 out inefficient and polluting vehicles. For example, the US introduced fuel economy standards known as Corporate Average Fuel Economy (CAFE) in 1975, after the oil embargo[56]. The CAFE standard for passenger vehicle was 18 Miles Per Gallon (MPG) in 1978 and it has been improved to 30 MPG as of 2011. These standards were mainly introduced to improve fuel economy and limit the GHG emissions.

The Transport Sector of Pakistan is one of the most inefficient in the region having energy intensity of 10.24 TOE/million rupees and its growing at a massive speed. The overall energy consumption of Transport Sector of Pakistan has increased from 13.60 MTOE in 2014-15 to 17 MTOE in 2018-19. Almost all the transportation sector is dependent on fossil fuel and the country is spending almost USD 13 billion on the import of oil every year. If our transport sector continues to grow at the same rate, the bill for oil import is expected to reach USD 30 billion by 2025. The transport sector consumed 30% percent of the total final energy consumption in 2020.

The Transport Sector of Pakistan has a huge potential of energy saving to the tune of 7.15 MTOE by deploying effective EE&C measures as shown below:

EE&C Potential of Transport Sector of Pakistan		
Saving Potential in Vehicle Tune UP Centres		
GCV of Petrol (Motor Spirit)	MJ/Ltr	37.5
GCV of HSD	MJ/Ltr	37.5
Motor Spirit Consumption in Road Sector (OCAC)	Tons/year	8,976,577
HSD consumption in Road Sector (OCAC)	Tons/year	8,011,694
Saving Potential by Vehicle Tune Up	%	10%
Saving in Motor Spirit Consumption	Tons/year	897,658
	Ltrs/year	763,009,045
	MJ/Ltr	28,612,839,188
	MTOE	0.68
Saving in HSD Consumption	Tons/year	801,169
	Ltrs/year	680,993,990
	MJ/Ltr	25,537,274,625
	MTOE	0.61
Total Savings by Vehicle Tune Up Centres	**MTOE**	**1.29**
Saving Potential in Fuel Economy Standards		
GCV of HSD	MJ/Ltr	37.5

No. of Cars sold per year	No./year	151,182
Daily Trips per Car	KM /Day	50
Annual travelling per car	KM/Year	18,250
Specific fuel consumption by car before implementation of Standards	KM/Ltr	10
Specific fuel consumption by car after implementation of Standards	KM/Ltr	15
Savings Potential	KM/Ltr	5
Annual savings in fuel per car	Ltrs	3,650
Saving in petrol Consumption	Ltrs/year	551,814,300
	MJ/year	20,693,036,250
Potential for Saving by Fuel Economy Standards	**MTOE**	**0.49**
Saving Potential in EV Adoption		
GCV of Petrol (Motor Spirit)	MJ/Ltr	37.5
GCV of HSD	MJ/Ltr	37.5
Motor Spirit Consumption in Road Sector (OCAC)	Tons/year	8,976,577
HSD consumption in Road Sector (OCAC)	Tons/year	8,011,694
Fuel Avoided by Conversion to EV	%	30%
Saving in Motor Spirit Consumption	Tons/year	2,692,973
	Ltrs/year	3,168,203,647
	MJ/Ltr	118,807,636,765
	MTOE	2.84
Saving in HSD Consumption	Tons/year	2,403,508
	Ltrs/year	2,827,656,706
	MJ/Ltr	106,037,126,471
	MTOE	2.53
Total Savings Potential by EV Adoption	**MTOE**	**5.37**
Total EE&C Potential of Transport Sector of Pakistan	**MTOE**	**7.15**

Following specific EE&C measures can be implemented to realize the abovementioned energy saving potential:

REGULATORY	
1) Action Code and Title: TS1.	**Implementation and development of codes and standards associated with Electric Vehicle Supply Equipment (EVSE), Electric Vehicles (EVs) and the related charging infrastructure.**
Situation Analysis: The transport sector is the largest consumer of petroleum-based fuels, accounting for 30% of final energy consumption of Pakistan, and the road transport sector has the major share. Globally, Electric Vehicles (EVs) are gaining substantial momentum due to their higher energy efficiency, lower running and operations costs, and zero tailpipe emissions. **Realizing the energy efficiency and saving potential in transport sector through introduction of EVs, Pakistan has introduced Electric Vehicle Policy in 2019 with objectives of EV penetration and standardization of EV charging infrastructure.**	
Goal	To promote and accelerate the EV penetration in the local automobile market esp. two/three wheelers and support the goals of EV Policy 2019.
Savings (Energy, GHG Emissions, and Financial)	This action will save 0.9 Mtoe energy per annum from fuel. The financial impact of these fuel savings is estimated at 605 Million USD per year. The saving in fuel shall reduce approx. 2.75 $MTCO_2$ emissions per annum.

Activities to Undertake	The intervention for standardization of EVs to achieve the switching of 5% Internal Combustion Engine (ICE) vehicles to EVs requires investment of approx. 1 Million USD. Following activities will be undertaken:
	• Development of regulations for implementation of EVSE Standards
	  o Timeline: 2025
	  o Responsible: NEECA
	  o Co-Responsible: EDB
	• Establishment of EV charging stations for demonstration and research purposes at federal and provincial levels
	  o Timeline: 2025
	  o Responsible: NEECA
	  o Co-Responsible: PDAs, City Development Authorities
	• Parallel capacity building of the stakeholders as and when required

Outputs and Indicators	1. Regulation for standardization of EVSE and charging equipment developed 2. Number of demonstration stations established in the country
Lead Responsible Institutions	NEECA, Provincial Designated Agencies (PDAs), Ministry of Climate Change & Environmental Coordination, Ministry of Energy (Power Division), Ministry of Industries & Production, Engineering Development Board

Relevant Institutions	Pakistan Automotive Manufacturers Association, Pakistan Association of Automotive Parts and Accessories Manufacturers, Alternate Energy Development Board (AEDB), City Development Authorities, OGRA, Pakistan Petroleum Dealers Association (PPDA)
Timeline	This action will be completed by 2025.
REGULATORY AND CAPACITY	
2) Action Code and Title: TS2. Mandatory annual tune-up certification for Internal Combustion Engine (ICE) vehicles, on road for 5 years or more, across the country.	
Situation Analysis: The existing mechanism of vehicle tune-up certification is outdated and marred with irregularities. There is significant portion of more than 5 year old cars in Pakistan because, interestingly, the value of old cars almost never depreciate as compared to global market trend. Further, the consumers are attracted towards local workshops for car maintenance due to premium service charges of the OEM service centres and lack of auto insurance esp. after 5 years' service life.	
Goal	To improve the mileage and efficiency of old ICE vehicles and reduce the tailpipe emissions.
Savings (Energy, GHG Emissions, and Financial)	This action can enhance efficiency of the combustion process on average by 10% and save 1.34 Mtoe annual energy from fuel (petrol, diesel, CNG). The financial impact of these fuel savings is estimated as 906 Million USD per year. The saving in fuel shall reduce approx. 4.15 $MTCO_2$ emissions per annum.
Activities to Undertake	The intervention requires investment of 15 Million USD for following sub-actions. • Regulations for inspection and tune-up of ICE vehicles. o Timeline: 2025 o Responsible: NEECA o Co-Responsible: PDAs • Develop a market for computerized tune-up centers through certification regime. o Timeline: 2025 o Responsible: NEECA o Co-Responsible: PDAs and Provincial Transport Departments • Develop financial & technical support mechanisms to catalyze establishment and mushrooming of tune-up centers. o Timeline: 2025 o Responsible: NEECA and PDAs o Co-Responsible: Provincial transport departments, SBP, EPA • Development and up-gradation of Inspection and Tune-up Manuals & Procedures for auto mechanics. o Timeline: 2025

	○ Responsible: NEECA ○ Co-Responsible: PDAs • Field surveys for implementation, and monitoring through web based system ○ Timeline: 2025 onwards ○ Responsible: NEECA ○ Co-Responsible: PDAs
Outputs and Indicators	1. Number of Tune-up centres established in the country 2. Number of tune-up certifications awarded to vehicles
Lead Responsible Institutions	NEECA, Provincial Designated Agencies (PDAs)
Relevant Institutions	Provincial Transport Departments, Pakistan Automotive Manufacturers Association, Pakistan Association of Automotive Parts and Accessories Manufacturers, Ministry of Climate Change & Environmental Coordination, EPA, SBP
Timeline	This action will be completed by 2026.
REGULATORY	
3) Action Code and Title: TS3. Enforcement and development of National Fuel Economy Standards and vehicle/fleet retirement age for transport sector of Pakistan	
Situation Analysis: There are no fuel economy standards for automobiles in the country. Many countries around the world have placed fuel economy standards with a vision to reduce energy intensity and environmental footprint of automotive industry. The lack of any fuel economy standards is one of the major reason behind challenges of smog, air pollution, and temperature fluctuations being faced by our metropolitans.	
Goal	To improve the mileage and fuel efficiency of ICE vehicles and reduce the tailpipe emissions.
Savings (Energy, GHG Emissions, and Financial)	This action can improve mileage of vehicles up to 25% and save 0.25 Mtoe annual energy from fuel (petrol and diesel). The financial impact of these fuel savings is estimated as 165 Million USD per year. The saving in fuel shall reduce 0.78 $MTCO_2$ emissions per annum.
Activities to Undertake	The intervention requires investment of 15 Million USD for following sub-actions. • Development of fuel economy standards and labelling schemes ○ Timeline: 2026 ○ Responsible: NEECA ○ Co-Responsible: MoI&P • Regulations for vehicle fleet retirement age ○ Timeline: 2026 ○ Responsible: NEECA and PDAs

	○ Co-Responsible: all relevant government departments
Outputs and Indicators	1. Number of tune-up centres established 2. Number of tune-up certifications awarded to vehicles per year
Lead Responsible Institutions	NEECA, Provincial Designated Agencies (PDAs)
Relevant Institutions	Provincial Transport Departments, Pakistan Automotive Manufacturers Association, Pakistan Association of Automotive Parts and Accessories Manufacturers, Ministry of Climate Change & Environmental Coordination, EPA, SBP
Timeline	This action will be completed by 2026.

2.4. Energy Efficiency in Agriculture Sector

Agriculture Sector of Pakistan is backbone of country's economy as majority of population of Pakistan (almost 61%) resides in rural areas which rely on agriculture to sustain their livelihood. According to Economic Survey of Pakistan, the Agriculture Sector contributed 22.7% to the GDP in 2021-22. The Agriculture Sector only accounts for 2% of total final energy consumption in Pakistan which translates to 1.8 MTOE out of 90 MTOE for 2020. With the adoption of mechanized practices in the country to improve agricultural productivity, the use of commercial energy is also increasing gradually.

Tractors and Water Pumps used for irrigation and soil preparation are major sources of energy consumption in the Agriculture Sector. The diesel and electric powered pumps used for irrigation in Pakistan are extremely inefficient. The operational efficiency of conventional tube wells is below 30% in many cases. Oversizing and improper selection is the major cause of most of the energy wastage in water pumps. Another reason of low efficiency of water pumps is the lack of proper maintenance and use of high friction piping networks.

More than 90% of the energy consumption of the Agriculture Sector is in the form of electricity, while 10% is supplied by oil in the form of High-Speed Diesel for irrigation pumps and machinery. In Pakistan, 366,966 Tube-wells are connected to the electric grid and they consume more than 15% of the total electricity in the country. There is a potential to reduce power demand by 1500 MW if all these pumps are replaced with more efficient pumps.

Furthermore, most of the Tractors used for soil preparation are also very old and highly inefficient. By deploying effective EE&C measures for Tube-wells, Tractors and other farm machinery the Agriculture Sector of Pakistan can save up to 0.66 MTOE of energy, as shown in the Table below:-

EE&C Potential of Agriculture Sector of Pakistan		
Saving Potential of Inefficient Tractors		
GCV of HSD	MJ/Ltr	37.5
Total No. of Tractors in Pakistan	No.	612,000
Inefficient Tractors (Kisan Board)	%	60%
	No.	367,200
Total Area of Land Cultivated in Pakistan	Acres	54,610,205
Area Cultivated by Tractors (NARC)	%	60%
	Acres	32,766,123
Average consumption of inefficient Tractor (Kisan Board)	Ltr/Acre	24
Average consumption of efficient Tractor (Kisan Board)	Ltr/Acre	20
Saving in Diesel by Tune-up	Ltr/Acre	4
	Ltrs/year	131,064,492
	MJ/Year	4,914,918,450

Total Savings by Tune-up of Inefficient Tractors	**MTOE**	**0.12**
Saving Potential in Diesel Tubewells		
GCV of HSD	MJ/Ltr	37.5
Total No. of Tubewells	No.	1,425,225
Total Diesel Operated Tubewells	No.	962,502
Percentage of inefficient Diesel Tubewells	%	0.5
Total No. of inefficient Diesel Tubewells	No.	481,251
Consumption of inefficient Diesel Engine	Ltr/Hr	2.5
Consumption of efficient Diesel Engine	Ltr/Hr	2
Average Daily usage of Diesel Operated Tubewell	Hrs	6
No. of days in Operation Per Year	No.	180
Annual Fuel Consumption of inefficient Diesel Tubewell	Ltr/Yr	2,700
Annual Fuel Consumption of efficient Diesel Tubewell	Ltr/Yr	2,160
Annual Fuel Savings Per Tubewell	Ltrs	540
Country Level Fuel Savings	Ltrs	259,875,540
Energy Savings	MJ/Yr	9,745,332,750
Total Savings in Diesel Tubewells	**MTOE**	**0.23**
Saving Potential in Electric Tubewells		
Total No. of Electric Tubewells	Million	0.37
Average Consumption of Electric Tubewell	KW	7
Daily Average Usage	Hrs/Day	6
Average Daily Consumption of Tubewell	Hrs/Day	45
Total Daily Consumption in Pakistan	MWh/Day	16,561
No. of Days in Operation	Days/Year	180
Annual Consumption (Inefficient Scenario)	MWh/Year	2,981,016
Saving Potential through EE Measures	Percent	15%
Annual Consumption (Efficient Scenario)	MWh/Year	2,533,864
Annual Energy Savings	MWh/Year	447,152
Energy Savings	MWh	3,577,219
TOTAL Savings Potential in Electric Tubewells	**MTOE**	**0.31**
Total EE&C Potential of Agriculture Sector of Pakistan	**MTOE**	**0.66**

Following priority EE&C actions can be implemented to realize the abovementioned energy saving potential:

REGULATORY AND CAPACITY	
1) Action Code and Title: AS1. Implementation of energy efficiency standards for electric water pumps and tube-wells. **AS2. Implementation of energy efficiency improvement in diesel engine tube-wells**	
Situation Analysis: **AS1. Pakistan is an agriculture based economy and tubewells (electric & diesel) are the most dominant irrigation mean. The electric pump-set systems are not designed and installed considering optimum efficiency. Inefficient /oversized motors, older pump-sets, and their drive alignment issues are the major reasons for the loss of energy. This increases electricity cost for the farmers which results in loss of competitive edge in the market.** **AS2. Further, the diesel engine driven tube-wells are inefficient due to expired service life and poor maintenance and repair. Efficiency of the diesel engine of the tube-well can be enhanced by proper tune-up top achieve optimal combustion efficiency and retrofitting / replacement, where required.**	
Goal	To improve the energy efficiency of electric and diesel based water pumps and tube-wells
Savings (Energy, GHG Emissions, and Financial)	AS1. This action can enhance efficiency of the electric pump-set on average by 15% and save 0.3 MToE annual energy from electricity. The financial impact of this electricity saving is estimated at 310 Million USD per year. The saving in electricity shall reduce approx. 1.8 $MTCO_2$ emissions per annum. AS2. This action can enhance efficiency of the combustion process of the diesel engine driven tube-wells up to 20% and save 0.23 Mtoe annual energy from diesel. The financial impact of this saving is estimated at 160 Million USD per year. The saving in fuel shall reduce approx. 0.7 $MTCO_2$ emissions per annum.

Activities to Undertake	The intervention requires investment of 1465 Million USD for following sub-actions of AS1 and AS2.
	
	• Regulations for installation of electric tube-wells based on optimum efficiency of the pump-set
	  o Timeline: 2024
	  o Responsible: NEECA
	  o Co-Responsible: PSQCA
	• Develop a mechanism for computerized tune-up agents for diesel pumps through certification.
	  o Timeline: 2025
	  o Responsible: NEECA
	  o Co-Responsible: PDAs and TEVTA
	• Develop financial & technical support mechanisms including credit products, RLF etc. to catalyze replacement of inefficient electric pump-sets & diesel tube-wells and their shift towards renewable energy.

	○ Timeline: 2025 ○ Responsible: SBP and Commercial Banks ○ Co-Responsible: NEECA and PDAs • Development and up-gradation of design and inspection manuals & procedures for electric and diesel based water pumps ○ Timeline: 2025 ○ Responsible: NEECA ○ Co-Responsible: PDAs
Outputs and Indicators	1. Number of tune-up centres/technicians for diesel tube-wells designated/established 2. Number of electric tube-wells transferred to renewable power. 3. Increased demand for electric tube-wells
Lead Responsible Institutions	NEECA, Provincial Designated Agencies (PDAs)
Relevant Institutions	Relevant Manufacturers/Importer Association, Provincial Agricultural Departments, Kissan Board, Ministry of Climate Change & Environmental Coordination, EPA, ZTBL, SBP, TEVTA
Timeline	This action will be completed by 2025.
CAPACITY	
2) Action Code and Title: AS3. Establishment of Tractor Tune-up Centres	
Situation Analysis: Pakistan has more than 0.6 million tractors of different horsepower used for agricultural purpose and is an energy intensive component of this sector. Regular tune-up of tractors improves its efficiency by complete burning of the fuel in the engine. Range of inspections, adjustments, and replacements to various parts and components of the tractor will be carried out through computerized tune-up centers.	
Goal	To improve energy efficiency of tractors in the agriculture sector.
Savings (Energy, GHG Emissions, and Financial)	AS1. This action can enhance efficiency of the combustion process in tractor engines on average by 15% and save 0.1 Mtoe annual energy from diesel fuel. The financial impact of this electricity saving is estimated at 80 Million USD per year. The saving in electricity shall reduce approx. 0.31 $MTCO_2$ emissions per annum
Activities to Undertake	The intervention requires investment of 23 Million USD for following sub-actions: • Regulations for periodic inspection and tune-up of tractors. ○ Timeline: 2024 ○ Responsible: NEECA ○ Co-Responsible: PDAs • Develop a market for computerized tune-up centers through certification regime. ○ Timeline: 2025 ○ Responsible: NEECA

	○ Co-Responsible: PDAs • Develop financial & technical support mechanisms to catalyze establishment of tune-up centers. ○ Timeline: 2025 ○ Responsible: ECF, SBP (concessional financing facilities) ○ Co-Responsible: NEECA • Development and up-gradation of inspection and tune-up manuals & procedures for Tractors ○ Timeline: 2025 ○ Responsible: NEECA ○ Co-Responsible: PDAs • Capacity building of local motor mechanics/technicians, awareness & outreach, and engagement of stakeholders including farmers ○ Timeline: 2025 ○ Responsible: NEECA ○ Co-Responsible: PDAs
Outputs and Indicators	1. Number of tractor tune-up centres/technicians designated/established 2. Number of electric tube-wells transferred to renewable power. 3. Increased demand for electric tube-wells
Lead Responsible Institutions	NEECA, Provincial Designated Agencies (PDAs)
Relevant Institutions	Provincial Agricultural Departments, Pakistan Association of Automotive Parts and Accessories Manufacturers, Ministry of Climate Change & Environmental Coordination, EPA, SBP, Kissan Board, Ministry of Climate Change & Environmental Coordination, EPA, ZTBL, TEVTA, ECF
Timeline	This action will be completed by 2025.

2.5. Energy Efficiency in Energy Sector

The sustainable and affordable electricity is a key prerequisite for socio-economic development of any country. In fact, the economic growth of any country is directly linked with the availability of safe, secure, reliable and cheaper supply of electricity. The Power Sector of Pakistan is one of the most inefficient among the regional countries with average Transmission & Distribution (T&D) losses of 20% along with inefficient Generation Plants and under capacity Transmission & Distribution System.

The installed electricity generation capacity reached 41,557 MW in 2022. The maximum total demand coming from residential and industrial estates stands at nearly 30,000 MW, whereas the Transmission Capacity is stalled at approximately 22,000 MW. This leads to transmission constraints which results in the operation of inefficient plants, underutilization of efficient power plants and operation of efficient power plants on partial loading causing the efficiency loss of the efficient power plants.

There is enormous potential to save energy to the tune of 2.5 MTOE/year by deploying effective EE&C measures as shown below.

EE&C Potential of Power Sector of Pakistan		
Saving Potential in T&D Losses of Distribution System		
Current T&D Losses of Distribution System of Pakistan	%	20.00
Ideal T&D Losses for Distribution System as International Best Practices	%	6.00
Total Electricity Supply of Pakistan for FY 21-22	Gwh	152,801
Losses at 23.30%	Gwh	30560.2
Losses at 6%	Gwh	9,168
EE&C Potential	Gwh	21,392
1 Gwh	MTOE	0.0000859845
EE&C Potential of Distribution System of Pakistan	**MTOE**	**1.84**
Saving Potential in Generation System		
Total Electricity Generated by Pakistan for FY 21-22	Gwh	152,801
Potential for Efficiency Improvement	%	5
Potential for Efficiency Improvement	Gwh	7,640
Potential for Efficiency Improvement in Generation System	**MTOE**	**0.66**
Total EE&C Potential of Power Sector of Pakistan	**MTOE**	**2.50**

Following specific EE&C measures can be implemented to realize the abovementioned energy saving potential:

<table>
<tr><th colspan="2">CAPACITY</th></tr>
<tr><td colspan="2">1) Action Code and Title: ES1. Establishment of Energy Efficiency & Conservation Cells at all the DISCOs and gas utilities for the capacity development of power & petroleum sector entities to implement the EE&C measures for system improvement.

ES2. Developm and implement medium- and long-term summer and winter load management programs at power & gas sector utilities.

ES3. Basic and bi-annual load profile assessment of domestic, commercial, industrial electricity and gas consumers along with profiling of electricity and gas-based appliances across commercial, household, industrial, agriculture sectors.</td></tr>
<tr><td colspan="2">Situation Analysis:
Transmission & Distribution (T&D) network of Power Transmission & Distribution Companies is the major and one of the most inefficient segment of the Power Sector of Pakistan. Average T&D losses of the T&D network of all the Distribution Companies of the Power Sector of Pakistan is 20%, which is very high as compared to 6% of the efficient T&D networks worldwide. Main causes of the high T&D losses are overloading of distribution Transformers, overloading of Feeders, lengthy distribution lines, low Power Factor, and Voltage Drop. This intervention aims to reduce T&D losses by appropriate monitoring of dispatched power and losses, load flow plans, Geographical Information System (GIS) mapping, power factor improvement, and condition monitoring of electrical equipment.

Further, UFG losses of SNGPL and SSGC are 11.5% and 15% respectively, which are very high as compared to 3% of the efficient T&D networks worldwide. Main cause of the high UFG losses is the leakages due to aging of the network infrastructure. This intervention aims to reduce UFG losses by appropriate monitoring of gas supply & distribution, Geographical Information System (GIS) mapping, metering system, and rehabilitation / upgradation of infrastructure.</td></tr>
<tr><td>Goal</td><td>To improve the energy efficiency, resilience, and sustainability of power and petroleum sector of Pakistan.</td></tr>
<tr><td>Savings (Energy, GHG Emissions, and Financial)</td><td>ES1. This action will reduce T&D losses from 20% to 14% and save 0.8 Mtoe annual energy in terms of electricity. The financial impact of this saving is estimated as 1,830 Million USD per year. The saving in electricity shall reduce approx. 4.6 $MTCO_2$ emissions per annum.

ES2. This action will reduce UFG losses up to 2% and save 0.4 Mtoe annual energy. The financial impact of this saving is estimated at 750 Million USD per year. The saving in the fossil fuel (LNG) shall reduce approx. 0.94 $MTCO_2$ emissions per annum.

ES3. This action will support the demand side adoption of efficient technologies and in turn extend resilience to the power and gas utilities through more informed planning and execution of specific demand side projects such as on bill financing regimes, up-gradation of distribution networks etc.</td></tr>
</table>

Activities to Undertake	The intervention requires investment of 3138 and 500 Million USD for following sub-actions of ES1 and ES2.
	
	• Establishment and operationalization of Energy Efficiency Cells at all the Transmission & Distribution Companies of power sector as well as at the gas utilities of petroleum sector
	  o Timeline: 2024
	  o Responsible: NEECA
	  o Co-Responsible: PDAs
	• Development and implement medium- and long-term summer and winter load management programs at power & gas sector utilities
	  o Timeline: 2025
	  o Responsible: MoE (Power & Petroleum Divisions)
	  o Co-Responsible: NEECA and PDAs
	• Bifurcation of abnormally long and high loss electricity feeders and pipelines and launch of peak load management programmes
	  o Timeline: 2024
	  o Responsible: DISCOs
	  o Co-Responsible: NEECA and PDAs
	• Installation of smart meters and Installation of state of the art Cathode Ray Protection equipment on gas pipelines
	  o Timeline: 2025
	  o Responsible: Petroleum Division
	  o Co-Responsible: NEECA
	• Replacement of overloaded transformers and augmentation of overloaded feeders
	  o Timeline: 2025
	  o Responsible: DISCOs
	  o Co-Responsible: NEECA and PDAs
	• Installation of power factors improvement equipment on grids/lines with low power factors
	  o Timeline: 2025
	  o Responsible: DISCOs
	  o Co-Responsible: NEECA and PDAs
	• Launch of specific on-bill financing schemes for consumers to adopt energy efficient technologies, equipment, etc.
	  o Timeline: 2025
	  o Responsible: DISCOs and gas utilities
	  o Co-Responsible: NEECA
	• Parallel capacity building programmes for the existing manpower of the relevant Power and Petroleum sector entities.
	  o Timeline: Continuous
	  o Responsible: NEECA
	  o Co-Responsible: Power and Petroleum Entities

Outputs and Indicators	1. Number of EE cells designated/established at NTDC, DISCOs and Gas utilities

	2. Number of EE programmes launched on the supply and demand side of the energy 3. Reduction in T&D losses of the petroleum and power sectors.
Lead Responsible Institutions	Ministry of Energy (Power & Petroleum Divisions), PPMC (MIRAD), NTDC, DISCOs, Gas Utility Companies.
Relevant Institutions	NEECA, NEPRA, OGRA, Ministry of Climate Change & Environmental Coordination, PDAs
Timeline	These actions will be launched by 2024 and completed by 2028
2) Action Code and Title: ES4. Bi-annual Heat Rate Assessment of GENCOs and IPPs to ensure performance as per designed efficiency.	
Situation Analysis: Fossil fuel based Thermal Power Plants consists of 61% of the total installed capacity of the Power Sector of Pakistan. Majority of these Thermal Power Plants are very old and their Efficiency has degraded due to inadequate maintenance practices. Through rehabilitation and retrofitting of these power plants, the Heat Rate/Efficiency can be improved significantly up to the level of designed Heat Rate/Efficiency, which can result in fuel cost savings and improved reliability of power supply.	
Goal	To improve the generation efficiency of IPPs/GENCOs.
Savings (Energy, GHG Emissions, and Financial)	ES4. This action will enhance efficiency of the thermal power plants by an average of 2% and save 0.26 Mtoe annual energy from fossil fuel. The financial impact of these fuel savings is estimated at 610 Million USD per year. The saving in fossil fuels shall reduce 1.5 $MTCO_2$ emissions per annum.
Activities to Undertake	The intervention requires investment of 750 Million USD for following sub-actions: • Regulations for efficiency tests of IPPs/GENCOs. o Timeline: 2025 o Responsible: NEECA o Co-Responsible: NEPRA • Development and up-gradation of Operation & Maintenance, and Inspection Manuals & Procedures for power plants o Timeline: 2025 o Responsible: Ministry of Energy (Power Division), GENCOs, IPPs o Co-Responsible: NEECA • Implementation of periodic efficiency testing regime for IPPs/GENCOs. o Timeline: 2026 o Responsible: Ministry of Energy (Power Division), GENCOs, IPPs, NEPRA o Co-Responsible: NEECA, ESCOs, PDAs • Development of Efficiency Testing Market through certification of energy service companies

	○ Timeline: 2024 ○ Responsible: NEECA ○ Co-Responsible: PDAs • Development of financing mechanism for rehabilitation and retrofitting of the power plants ○ Timeline: 2025 ○ Responsible: Ministry of Energy (Power Division), Finance Division ○ Co-Responsible: NEECA • Parallel capacity building programs for technical human resource.
Outputs and Indicators	1. Compliance and maintenance of designed efficiency of IPPs/GENCOs
Lead Responsible Institutions	Ministry of Energy (Power Division), GENCOs, IPPs
Relevant Institutions	CPPA-G, NEPRA, NEECA, ESCOs, MoCC&EC
Timeline	This action will be completed by 2026.
ADVOCACY	
3) Action Code and Title: ES5. Deployment of renewable hydrogen pilot projects in Pakistan	
Situation Analysis: **ES5. 1. Hydrogen holds a prominent position among renewable energy vectors due to its high-energy content, environmental compatibility and ease of storage and distribution. The issue of intermittency and seasonality of renewable power resources calls for high-capacity seasonal energy storage, which hydrogen can enable. Hydrogen will play a central role in securing the Paris Agreement mid-century target of 'net-zero' carbon dioxide emissions to which many nations aspire. Availability of renewable resources in Pakistan to build an economically sustainable domestic hydrogen industry can help meet Nationally Determined Contributions (NDCs) and address concerns around energy security.** **Pakistan is blessed with high solar radiation and steady wind energy, which can produce renewable hydrogen from renewable power using electrolysis. Furthermore, use of the existing infrastructure, such as electrical power grid or gas pipeline network is also available to ensure a cost-effective implementation of hydrogen as an energy vector. Pakistan has widespread natural gas and liquefied natural gas (LNG) infrastructure like pipelines, LNG terminals and regasification facilities and compressed natural gas (CNG) stations in transport sector across the country. Hence, hydrogen has potential to be integrated with existing infrastructure effectively.**	
Goal	To diversify and efficiently expand the ARE within the energy mix of Pakistan and clear a pathway towards clean energy transition.
Savings (Energy, GHG Emissions, and Financial)	The energy savings and GHG emission reduction depends on the selection of pilot projects with in the hydrogen value chain and will vary on a case to case basis. However, NEECA carried out a pre-feasibility for renewable hydrogen where 13 value chains for the production, storage, distribution, and utilization of renewable hydrogen have been carefully

	studied. This study shall form the basis of prioritizing pilot projects during implementation
Activities to Undertake	The motivation for a pilot demonstration project goes beyond immediate financial viability of the scheme and includes objectives such as institutional capacity building, learning and public demonstration to show the potential of hydrogen as a clean energy vector for the future. These 'intangible greater goals' are impossible to quantify in a simple financial analysis but can be justified to support the vision of a clean energy transition, even if they come at a moderate but affordable cost today. Following two pilot projects may be implemented as a first step: • Hydrogen Electrolysis at the Ghazi Barotha Dam with Hydrogen Injection to the Local Natural Gas Grid o Timeline: 2026 o Responsible: Ministry of Energy (Power & Petroleum Division), AEDB o Co-Responsible: NEECA • Hydrogen Electrolysis at the Quaid e Azam Solar Park with Hydrogen Injection to the Local Natural Gas Grid o Timeline: 2028 o Responsible: Ministry of Energy (Power & Petroleum Division), AEDB o Co-Responsible: NEECA
Outputs and Indicators	1. Number of renewable hydrogen pilot projects implemented 2. Inclusion of Renewable Hydrogen in the energy planning especially IGCEP
Lead Responsible Institutions	Ministry of Energy (Power & Petroleum Division), AEDB
Relevant Institutions	WAPDA, NEECA, NEPRA, SNGPL, SSGC, Ministry of Science and Technology, OGRA
Timeline	This action will be completed by 2030.

2.6. Cross-sectoral EE&C Actions

2.6.1. Climate Change Mitigation and Energy Efficiency

Pakistan is among the top ten vulnerable countries due to climate change impact. Pakistan is also signatory of Paris Agreement. In terms of Paris Agreement to address global climate change impact, Pakistan's Nationally Determined Contributions (NDC's) also categorically point out climate change mitigation through energy-efficient appliances and improvement in the process as one of the highest priority areas to achieve CO2 emissions reduction.

Based on the National GHG Inventory for 2014-15, the total GHG emissions of Pakistan from energy sector were projected around 331 MT CO2-equivalentxiv. It is more than 50% of the total GHG emissions. NEEC Policy has set the goal of achieving 9 MTOE energy saving target in next five years that will reduce GHG emissions by 35 MTCO2. This reflects that the current NEEC Policy 2023 is effectively a climate mitigation policy of the country, which requires extensive coordination between Ministry of Climate Change & Environmental Coordination and NEECA for implementation of NEEC Action Plan 2023-2030. This coordination shall be aimed at tapping into climate financing and reporting of mitigation targets vs. achievement within the broader Pak NDCs obligations.

2.6.2. Awareness, Advocacy, and Capacity Building for EE&C Behavior Change

The informational barriers identified during the analytical studies and national consultations for NEEC Policy infer that:

- Stakeholders have low awareness and knowledge about energy conservation, nonetheless they are willing to adopt conservation due to soaring energy prices and depleting energy resource of Pakistan.
- Consumers would be motivated for energy efficient measures if the benefits of energy efficiency were monetized, and fiscal and economic savings from energy conservation behavior and energy efficient technologies were demonstrated and communicated
- Household are not aware of the government's efforts in promoting energy efficiency, including the standards and labels for helping them identify energy efficient products in the market
- There is an information asymmetry for energy efficient products, major stakeholders take advice from traditional mechanisms such as technicians, electricians, masons, TV advertisements, etc.

Given these findings, it is necessary that a sustained awareness and advocacy strategy (5-7 years) shall be implemented to achieve desired behavior change for energy conservation at

national level. This awareness and advocacy across priority sectors must address the following focus areas for effectiveness:

- Emphasize the tangible benefits in Rupees Saving from energy conservation measures while communicating specific actions and attitudes that consumers need to take/adopt towards EE&C.
- Nudge the energy efficiency behavior and its impact on our own economic well-being, and on communities, workplaces and the nation as a whole.
- Harness social influence to motivate individuals and communities to save energy.
- Promote and strengthen the efficacy of government institutional apparatus to remove the "asymmetric information" on energy conservation and energy efficient technologies through standards and labelling.
- Engage opinion leaders like media, celebrities, religious and political figures, product manufacturers, and retailers/distributors to promote impartial information on energy conservation behavior as well as energy and water efficient technologies
- Inculcate energy conservation and efficient practices amongst a wide variety of stakeholders both public and private esp. industry and familiarize them with their individual roles in achieving goals and targets for energy conservation at national level.

In view of the above, any communication campaign/activity shall, in particular, drive messages about the need for, and benefits of, energy conservation for individual consumers of all categories. However, for certain groups, messages regarding the benefits to communities and the nation will also be important to build a rational choice. Similarly, campaigns shall be designed for the industrial partners on the supply side to adopt EE product manufacturing, technologies and processes.

Moreover, appropriate institutional development and capacity building measures shall be taken for effective implementation of the provisions of the NEEC Act 2016 and NEEC Policy 2023. Academia-industry linkages shall be developed to boost research and information dissemination regarding new technologies and techniques for EE&C gains.

2.6.3. Financing for Energy Efficiency

The fiscal and financial incentives are essential to achieve energy efficiency improvements and remove financial barriers involved in adoption of EE technologies by sectoral players. These incentives are crucial to encourage investments in energy efficiency by bringing down the equipment and process costs. The NEEC Policy 2023 has recommended the development of appropriate fiscal and financial measures in close consultation and coordination with relevant Federal and Provincial Governments and regions, public and private financial market stakeholders. The NEEC Action Plan also proposes short, medium, and long term financial initiatives to adhere to the policy recommendations. These include incentive schemes such as grants, rebates, tax

credits, exemptions and concessions on custom duties or any other fiscal measures to promote localization, production, usage, and compliance of energy efficient products, equipment, services and practices in the country.

The aim of activating the above mentioned incentives is to support the indigenization plans of various sectors of the Government and accelerated adoption of EE technologies and practices by sectoral stakeholders especially in the industrial and building sectors.

2.6.4. Coordination with Provincial Governments and other Stakeholders

The NEEC Policy 2023 affords NEECA a mandate to improve energy efficiency nationwide. However, the 18th Constitutional amendment has devolved the authority and powers for legislation to provinces as well. The legal status of provincial energy efficiency agencies/departments and their functions need to be considered for the smooth implementation of energy efficiency. Effective representation of provincial governments in EE governance has been attained through provincial designated agencies such as PEECA, SEECA, etc. These agencies, being the implementing arms of NEECA, require a well-developed support and coordination mechanism with all the stakeholders. In light of the foregoing, it is pertinent that provincial EE&C action plans shall be developed in alignment with the NEEC Action Plan 2023-2030. NEECA shall act as interlocutor between its PDAs and other stakeholders to support delivery of provincial EE&C targets and KPIs.

Further, the role of international partners remained significant in supporting EE&C programs in Pakistan. NEECA has been supported with financial and technical assistance by different donor agencies over the past decade with various key interventions in EE&C sector. This partnership will further be strengthened for EE&C programs in Pakistan especially provinces. Under the North-South-South Cooperation, collaboration with developing/developed countries will be strengthened for knowledge, technology, and resources mobilization. It will help to align the donor funded projects with national level EE&C targets. This will support Pakistan in reaping the low hanging fruits of EE&C in priority sectors of the economy and to achieve the Pak-NDCs targets.

Following are the recommended priority actions across the above mentioned cross cutting and cross sectoral areas:

1) Action Code and Title: CS1.	**Awareness, Advocacy, and Capacity Building to Steer National Behavior Change for Energy Conservation and Adoption of EE technologies**
Situation Analysis: The findings of various studies and analyses reflect that national stakeholders have low awareness and knowledge about energy conservation, nonetheless they are willing to adopt conservation due to soaring energy prices. There is an information asymmetry for energy efficient products, major stakeholders take advice from traditional mechanisms such as technicians, electricians, masons, TV advertisements, etc. There is no integrated strategy for awareness and communication on energy efficiency and conservation at national level.	
Goal	To inculcate a behaviour of conservation among national stakeholders and build their capacity to adopt EE technologies and conserve energy and natural resources
Savings (Energy, GHG Emissions, and Financial)	CS1. This action and its associated outputs and activities shall support the intended outcomes of the above mentioned sectoral actions through employment of print, social, electronic means of communication as well as direct means such as outdoor and event based awareness and capacity building.
Activities to Undertake	The intervention requires investment of 1 billion PKR/annum for following sub-actions: • Implementation of a multi-year 360^{o} awareness and behaviour change strategy on EE&C: o Weekly/Monthly/ quarterly background briefings/OP-EDs/articles, columns, TVCs, Live Bugs, radio beats on various aspects of energy conservation o Continuous geo-fenced awareness campaign through social media marketing o Continuous Branding of Shopping Malls, Parking Plazas, shops, toll plazas, airports, transport hubs, etc. o Frequent city branding through city development authorities, municipalities, housing societies through CSR components across ICT, Provincial Capital Headquarters, Metropolitans nationwide o Bi-annual inter-school and inter-madrassah art competition involving theater, paintings, cartoon series, writing etc. competitions • Integration of EE&C in national curriculum (formal and informal) starting from primary onwards • Launch of energy efficiency performance awards for industry and other sectoral stakeholders • Annual provincial farmer convention on EE&C • Annual Provincial Technician (Electrician, Mechanics, Masons, architects) Convention on Energy Efficiency

	• Promotion of car-pooling and usage of mass transit systems • Earth Week – Celebrate a day for Energy Efficiency and Conservation Day • Promotion of Internet of Things (IoT) based technologies for energy efficiency and conservation. • Development and operationalization of EE&C repositories and energy information house • Adoption of day light saving across Pakistan and suitable schedule for market operating timing • Development and implementation of integrated capacity building programme (2023-2028) on sectoral areas of EE&C
Outputs and Indicators	1. Increased demand for EE technologies & conservation practices and adoption by sectoral stakeholders and wider public 2. Adoption of energy conservation practices and measures at national level to be measured though base and end line assessments
Lead Responsible Institutions	NEECA, PDAs
Relevant Institutions	MoIB, PID, Ministry of Education and Professional Training, Provincial government departments, Industrial Associations, Awareness Raising Partners, Print and electronic Media of Pakistan
Timeline	This action will be launched in 2023 and shall be treated as continuous.
2) Action Code and Title: CS2. Incentives and Financing for EE&C across the five priority sectors of the economy	
Situation Analysis: The lack of adequate and performance based incentives and financing opportunities is one of the major barrier in the uptake of the EE&C agenda in the country. It is assumed that EE&C projects have high upfront costs and long paybacks. There are no specific financial/credit products that have been developed for EE&C by financial institutions. The investments for EE&C projects remain low, despite a potential of 18 billion USD, due to: **• No performance guarantees for the solution providers.** **• No risk coverage for investors or tax rebates/credits for investing in EE&C projects.** **The guidelines for EE&C need to be incorporated in GBG for implementation with concessional re-financing facilities. Financially, project-based financing is usually limited to organizations with long credit history. Most of the industrial enterprises in Pakistan are SMEs having low credit worthiness. In absence of risk coverage for SMEs, financial institutions have minimal exposure/lending. As a result, financial institutions offer a higher markup as a risk premium for SME finance, resulting in reluctance to take on loans for any EE improvement project.**	
Goal	To develop economic and financial mechanism as investment enablers for the adoption of energy efficient technologies, practices, and management in key sectors of economy.
Savings (Energy, GHG Emissions, and Financial)	CS2. This action and its associated outputs and activities shall support the intended outcomes of the above mentioned sectoral actions. Provision of such incentives and financial concessions shall support achievement of the

	energy saving and GHG mitigation potential/target of individual sectoral action proposed above.
Activities to Undertake	Following sub-actions will be undertaken: • Activation of EE component with in GBGs of the SBP • Performance based energy saving certificates and EE bonds • Concessional financing facilities will be developed which include RLF, RGF, Credit Lines, etc.to shorten the payback period on the EE projects • Evaluation of HS Codes and revisions of import duties to penalize import of inefficient equipment/components • Promotion of equity financing through public private partnerships • Development of various fiscal incentives schemes such as exemption/relaxation of/in custom/regulatory duties and tax rebates • On-bill financing schemes for adoption of EE technologies, appliances, and equipment across industry and building sectors • Fixation of 3 to 5 paisa EE levy on the retail price of one unit of electricity sold in the country • Fixation of 80 paisa EE levy on the retail price of one unit of petrol and diesel sold in the country • Fixation of PKR 2 EE levy on the retail price of one unit of gas sold in the country • Establishment of ECF as a Super-ESCO
Outputs and Indicators	1. Annual turnover of the credit by established RLF/RGF 2. Number of concessional credit products/lines activated across commercial banking 3. ECF established as a Super-ESCO
Lead Responsible Institutions	Finance & Revenue Divisions, SBP
Relevant Institutions	NEECA, PDAs, Commercial banking sector
Timeline	This action will be launched in 2024 and shall be treated as continuous.
3) Action Code and Title: CS3. Establishment of National Energy Efficiency Registry System and Energy Information House	
Situation Analysis: As discussed in the CS1, the information asymmetry exists, not only, between the supply and demand side of the EE&C, but, across the energy sector planning and implementation. Pakistan has been unable to portray achievements and impact of its mitigation efforts over the years which has resulted in failure to rally climate financing. This action will enable the public and private stakeholders to tap into climate finance and, also, the federal and provincial governments to strengthen/sustain their EE&C efforts.	

Goal	To improve sustainability of NEEC policy implementation via evidence based knowledge and understanding of the demand side energy management in the country.
Savings (Energy, GHG Emissions, and Financial)	CS3. This action and its associated outputs and activities shall support the intended outcomes of the above mentioned sectoral actions. Hence, it shall be treated as enabler of the energy savings and GHG emission reduction.
Activities to Undertake	Following sub-actions will be undertaken: • Development of Energy Information House (EIH), at NEECA and PDAs in close coordination with its provincial governments and other relevant sectoral entities. • Artificial intelligence, deep machine learning, data mining and internet of things (IOT) shall be implemented on appliances for standards compliance, data collection and other EE&C measures. • Establishment of a National EE registry system to act as a public registry for all sectoral stakeholders such as ESCOs, manufacturers, designated consumers, testing labs, energy auditors and managers etc.
Outputs and Indicators	1. Energy information house established 2. National EE registries established and operationalized
Lead Responsible Institutions	NEECA, PDAs
Relevant Institutions	All relevant public and private stakeholders at national level
Timeline	This action will be launched in 2023 and shall be treated as continuous.
4) Action Code and Title: CS4. Institutional capacity building of provincial governments and setting up the coordination mechanism	
Situation Analysis: Over the years, the provincial government especially Punjab has been strengthening the EE&C governance structure. The other provincial governments were unable to institutionalize and implement the EE&C measures due to lack of synergy and replication. Recently, the Sindh province established its Sindh Energy Efficiency and Conservation Authority (SEECA), while the provinces of Balochistan and Khyber Pakhtunkhwa have nominated their respective energy departments as designated EE&C agencies. There is a need for capacity building of provincial designated agencies across areas such as organizational developing, governance, program development, implementation, & management, monitoring & evaluation, etc. This support shall be extended from federal level under a well aligned and robust coordination mechanism.	
Goal	To improve national response towards implementation of the actions listed in this NEEC action plan 2023-2030.
Savings (Energy, GHG Emissions, and Financial)	This action directly supports the implementation of above mentioned actions and help achieve their savings.

Activities to Undertake	Following activities shall be undertaken: • Constitution of provincial implementation committees comprising of provincial public departments along with private sector representing key sectors of the economy and NEECA (as observer). • Sector specific implementation taskforce at provincial shall be constituted under the provincial EE&C implementation committees • Provincial action plans shall be formulated in consultation with all the provincial stakeholders and should be in line with the NEEC Policy 2023 and the NEEC Action Plan 2023-2030. • Organizational development studies for provincial designated EE&C agencies will be executed and recommendations on type of organizational set-up and the required HR & financial capacity shall be mapped. • Regular training needs assessment studies should be commissioned to design and implement need based capacity enhancement of PDAs.
Outputs and Indicators	1. PDA operationalized and implementation Committees established 2. Number of capacity building programmes launched 3. Allocation of budget from provincial governments
Lead Responsible Institutions	Provincial Governments
Relevant Institutions	NEECA and energy, P&D and finance departments at provinces
Timeline	This action shall be completed by 2023

3.ENABLING ACTION AREAS

3.1. 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.

This barrier to information can significantly limit investments as in the case of lack of adequate knowledge about the most effective and cost-effective energy efficiency schemes. These programs can especially be designed for overcoming common marketplace barriers to energy efficiency. An Energy Efficiency Benefits Calculator 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 addition, it has been observed that policy options in Pakistan generally discourage natural gas and power utilities, transmission and distribution companies to make investments and improve energy efficiency. Historically, energy utilities have been rewarded for expanding their existing infrastructure and increasing energy sales rather than encouraging the consumers to use energy efficiently and wisely. For example, in the case of SSGC and SNGPL, the two gas utility companies, their business model is based on return on assets. This means that SSGC and SNGPL are incentivized to build large network systems and there is less emphasis on the development of efficient network system or bringing efficiency in 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.

3.2. 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.

3.3. 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, and NEECA can establish these regulatory measures for these organization similar to those developed in UK, Singapore, and India.

3.4. 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 can get their facilities audited, and based on the outcomes of these audit reports, NEECA may 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.

3.5. 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%[57]. 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 can 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 may impose a penalty in case of non-compliance to these measures.

3.6. Enabling Action Area: 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.

3.7. Enabling Action Area: Investment Subsidies for Energy Efficiency

Investment subsidies are provided to retrofit existing buildings, appliances and industrial facilities with a goal to shorten the payback times. Subsidies are generally given 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.

[57] National Electric Power Regulatory Authority

Worldwide, subsidies have been effective tools to improve energy efficiency. Looking at global success stories, Denmark has provided subsidies to replace old oil-fired boilers with heat pumps and solar heating in combination with more efficient oil and natural gas fired boilers. While in South Africa, Eskom, the electricity utility company has subsidized the replacement of old motors with highly efficient motors. Eskom directly paid the subsidy to registered suppliers of efficient motors, resulting in an immediate discount for the consumer.

3.8. 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 may be encouraged through financial incentives provided by the government. These audits will be financially incentivized to encourage consumers by carrying out these energy audits at subsidized rates. These kinds of incentives make energy audits more attractive to consumers. The subsidy could be a fixed amount or a percentage of the audit cost (e.g. 20%). In the developed world, these subsidies are more common in the industrial sector and public or commercial sector rather than in residential sectors.

3.9. Enabling Action Area: Exemption of Customs Duties /Taxes on EE Equipment

Many countries encourage the purchases of energy-efficient products or renewable energy equipment. This is usually done by providing exemption on tax and duties on the purchase of such equipments. In the United States, sales of equipment such as the wind turbines, solar cells, biomass energy, tidal or wave energy etc. are not taxed at all. The government of Pakistan 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.

3.10. 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. Typically, consumers who invest in energy efficiency equipment are provided soft loans at subsidized interest rates by banking institutions. Donors as well as government can establish specific credit lines with the support of some guarantee scheme which encourages banks to finance energy efficiency investments.

In Taiwan, small businesses are provided with low-interest loans for the purchase of energy efficiency products and equipment, such as the high-efficiency motors and compressed air systems. France has been providing loans ranging from about 10,000 to 50,000 Euros at a very low-interest rate of 2% to SMEs to finance energy intensive equipment such as electric motors.

3.11. 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. An example of on-bill financing is the BESCOM Efficient Lighting Program, India, which provides upfront funding in return for a monthly charge. It is aimed at removal of the barrier of high initial cost of CFLs. This kind of financing scheme can be replicated in Pakistan 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.

3.12. 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 EE4All 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

NEEC Action Plan. A 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 EAD. The EE4ALL Fund should be established at ECF – a Section 42 non-profit company.

3.13. 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.

3.14. Enabling Action Area: Capacity Building of Government Departments

The NEEC Policy 2023 affords NEECA a mandate to improve energy efficiency nationwide. However, the 18th Constitutional amendment has devolved the authority and powers for legislation to provinces as well. The legal status of provincial energy efficiency agencies/departments and their functions need to be considered for the smooth implementation of energy efficiency. Effective representation of provincial governments in EE governance has been attained through provincial designated agencies such as PEECA, SEECA, etc. These agencies, being the implementing arms of NEECA, require a well-developed support and coordination mechanism with all the stakeholders. In light of the foregoing, it is pertinent that provincial EE&C action plans

shall be developed in alignment with the NEEC Action Plan 2023-2030. NEECA shall act as interlocutor between its PDAs and other stakeholders to support delivery of provincial EE&C targets and KPIs.

Further, the role of international partners remained significant in supporting EE&C programs in Pakistan. NEECA has been supported with financial and technical assistance by different donor agencies over the past decade with various key interventions in EE&C sector. This partnership will further be strengthened for EE&C programs in Pakistan especially provinces. Under the North-South-South Cooperation, collaboration with developing/developed countries will be strengthened for knowledge, technology, and resources mobilization. It will help to align the donor funded projects with national level EE&C targets. This will support Pakistan in reaping the low hanging fruits of EE&C in priority sectors of the economy and to achieve the Pak-NDCs targets.

3.15. 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) as well obligations made to developing countries under NDCs commitments. Overall the potential for investment in EE&C is approximately USD ($) 18 Billion for comprehensive measures based on accelerated saving improvements. However, the Action Plan 2023-30 has been prepared with 27 interventions with overall budget needed of USD ($) 8 billion till 2030.

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 EE&C 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 EE 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. Following are some EE projects and their investment potential:

Investment Potential in Energy Efficiency Projects				
1	Provide Improved Cook stoves	US$ 657.54 Million	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

2	Energy Management in Industrial Sector	US$ 3 billion	Achieve Energy efficiency in the industrial sector by employing a broad range of energy management, efficient technologies and practices to reduce overall energy consumption. Following technologies and practices for improvements of High Impact Opportunity which can offer high energy saving: • 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	Federal and Provincial Governments / NEPRA
3	Energy Efficient Appliances	$ 50 Million	Need to set the rules and regulations for the appliances manufacturers to manufacture the energy efficient products (product wise consumption detail is mentioned in the report)	Federal and Provincial Governments / NEECA
4	Improvement in Process Operation	$ 50 Million	Improvement in Process Operation. e.g. proper metering in the textile and sugar industry.	Federal and Provincial Governments / NEECA
5	Installation of Heat Recovery Systems (HRS)	$ 30 Million	Installation of Heat Recovery Systems (HRS) from exhaust flue gases in sugar and paper industry can increase energy efficiency	Provincial Governments
6	Thermal Insulation of Steam Lines and Valves	$ 300 Million	Thermal insulation of steam lines and valves in almost all industrial units	Provincial Governments
7	Installation of Variable Frequency Drive (VFD)	$ 70 Million	Installation of Variable Frequency Drive (VFD) or inverters on pumps and motors reduce energy losses;	Federal and Provincial Governments / NEECA

8	Improvement of Maintenance Operation	$ 100 Million	Improvement of Maintenance Operation i.e. reduction of air leakages; and Proper maintenance and operation of electrical motors will increase energy efficiency	Federal and Provincial Governments / NEECA
9	Energy Savings in the Textile Industry	$ 1.1billion	Energy savings in the textile industry by installation of meters controls to reduce leakages of compressed air and improved maintenance of electrical motors	Federal and Provincial Governments / NEECA
10	Energy Efficient Technologies for Sugar Industry	$ 230 Million	Sugar industry to deploy energy efficient technologies, such as the High-Pressure Cogeneration (HPC). Sugar mills with HPC technology, consumes 46% less bagasse to produce same amount of electricity compared to existing low-pressure technology (23 bar)	Federal and Provincial Governments / NEECA
11	Single Stage Dry Kilns for Cement Units	$ 500 Million	Cement units to employ single stage dry kilns which can be shifted to more efficient process of multistage dry kilns to improve overall energy efficiency of cementing process. Higher efficient processes in the cement industry would also help in reduction of dust, GHG emissions and conserve water.	Provincial Governments / NEECA
12	Implementation of Simple Energy-Saving Techniques in Leather Sector	$ 134 Million	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 in leather sector. In addition, proper metering and insulation offer best energy efficiency potential and reduce the energy consumption.	Provincial Governments
13	Energy Efficiency in Fertilizer Sector	$ 600 Million	Energy efficiency in fertilizer sector 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. Significant energy efficiency gains in fertilizer sector can be achieved by investing in co-generation, installation of meters and improvement of power factors etc.	Federal and Provincial Governments
14	Boiler and Burner Tuning of Pulp and Paper Mills	$ 70 Million	Pulp and Paper mills to reduce their gas demand by 7% and overall energy consumption by 5.6% percent just by tuning their boiler burners and adjusting air-to-fuel ratios.	Provincial Governments
15	Introduction of Zig-Zag Technology	$ 600 Million	Introduction of Zig-Zag Technology for 12000-18000 Brick Kilns. .	Federal and Provincial Governments / / NEECA

16	Smart Metering Technology	$ 1.0 billion	Need to deploy smart metering technology for natural gas and power consumers to avoid transmission losses	Federal Government / DISCOs / NEPRA
17	Upgradation of the Electricity Grid	$ 9 billion	Upgradation and Expansion of the Grid to withstand demand pressures from potential breakdowns is an urgent task for the Pakistan's electricity sector as a whole	Federal Government / International Donor Agencies.
18	Replace Maximum Possible Tube Wells Pumps	$ 700 Million	Replace maximum possible tube wells pumps (out of 180,000) with more efficient pumps by 2030	Provincial / Federal Government
	Sub-Total	**$ 18 billion**		

PART 4: IMPLEMENTATION, COORDINATION, AND MONITORING

4.1. Implementation, Coordination, and Monitoring

In order to improve energy efficiency across the country; the effective implementation of the prioritized actions, coordination with provincial stakeholders, monitoring and evaluation of associated results are as important as the identification of correct and consistent actions. The actions under the National Energy Efficiency and Conservation (NEEC) Action Plan 2023-2030 will be implemented, coordinated, and monitored through following mechanism:

4.2. National EE&C Implementation Committee:

The implementation of the NEEC Action Plan 2023-2030 requires a strategic plat form to guide, inform, and steer the implementation of prioritized actions listed above. Given the strategic level of this platform, a balance between stakeholder representation and responsible public institutions must be maintained. This platform shall represent federal and provincial public departments as permanent members while the private sector representation from each sector shall be on 3 years term. Following is the composition of National EE&C Implementation Committee:

1. Prime Minister of Pakistan- Chairman
2. Chairman NEECA Board- Member
3. Secretary of the NEECA Board/MD NEECA- Member
4. Secretary, Finance Division- Member
5. Secretary, MoPD&SI- Member
6. Secretary Power
7. Secretary Petroleum
8. Secretary Industries
9. Chief Secretaries/Respective heads of the Provincial Designated Agencies- Member
10. Special Assistant to Prime Minister /Advisor to Prime Minister
11. Any other nomination on need basis as desired by the Chair

For effective monitoring and evaluation, the progress will be reported, potential deviations be identified and measures be taken timely. The committee shall convene twice in a year to oversee the performance on each action and issue an annual progress report. Annual progress report of the NEEC Action Plan will be disclosed in June every year to the public following the approval by the said Committee and NEECA Board. The committee shall have the powers to amend the timelines of the action plan 2023-2030.

4.3. Pakistan Energy Efficiency and Conservation Board (NEECA Board)

The NEECA Board which is mandated, authorized and charged with preparing national energy efficiency strategies, policies, and programmes, assessing the impact and revising as necessary thereof, and coordinating the introduction and implementation of new measures will also serve as the Monitoring, Evaluation and Steering Board for the NEEC Action Plan 2023-2030. The board may also make general assessments of the actualization levels of the actions under the Action Plan as well as the achievement levels of the targets defined in the Action plan. The Board

is authorized to update the actions under the Action Plan, and re-designate responsible and relevant institutions.

4.4. Provincial Action Plans Implementation an Monitoring:

Provincial Designated Agencies have been established after nomination by NEECA Board, they may in-collaboration with provincial public departments along with private sector representing key sectors of the economy will prepare their own action plans. The provinces will ensure implementation of provincial EE&C Action Plans which will be dove-tailed into National Action Plan.

Further, sector specific implementation plan at provincial may be developed, under the provincial EE&C implementation committees, on the basis of categories under the National Action Plan. The PDAs may have at least one expert from institutions designated as responsible and relevant under the respective actions. Starting from July 2023, they will start consultation in July and January of every year, assess the actualization levels of actions, and identify additional measures needed. The progress reports will be prepared and submitted to the PDA Boards. The Boards may request detailed presentation, additional explanation on actions from the responsible institutions.

The PDAs will undertake necessary activities and provide bases for the monitoring of actions, and for task force(s) to effectively function. Relevant institutions will be responsible, within their remits, for providing all possible support to the responsible institutions, participating in the meetings during the implementation and engaging in necessary correspondence.

The information on the progress levels of the actions under the NEEC Action Plan 2023-2030 will be prepared in a common reporting format. The said information will also be entered and monitored in the NEECA EE&C Portal.

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