



NATIONAL TRANSMISSION & DESPATCH CO. LTD

General Manager (Technical)

No. GMT/NTDC/**T-48/ 596 - 602**

Dated: **20** -09-2022

Syed Safeer Hussain

Registrar NEPRA

NEPRA Tower, Attaturk Avenue, G-5/1
Islamabad.

Subject: **INDICATIVE GENERATION CAPACITY EXPANSION PLAN (IGCEP) 2022-31**

Reference: i) BoD (NTDC) notification No. NTDC/CS/1781-83 dated 14.09.2022.
ii) NEPRA letter No. NEPRA/R/DG(Lic)/LAT-01/14741 dated 04.08.2022.

With reference to the above-mentioned letters, NTDC is pleased to submit the hard copy of the IGCEP 2022-31 containing the Base Case along with the following Six Nos. Additional Scenarios, for review and approval by the Authority:

- i) Low Demand.
- ii) High Demand
- iii) Diamer Bhasha HPP in 2029.
- iv) Chashma Nuclear(C-5) for Energy Security.
- v) Local Coal Inclusion in 2027 & 2030.
- vi) Unconstrained VRE.

This is issued with the approval of Dr. Rana Abdul Jabbar Khan, Managing Director NTDC.

DA / As Above


General Manager (Technical) NTDC

CC:

1. Joint Secretary (Transmission), MoE (PD), Islamabad
2. Managing Director, NTDC, WAPDA House, Lahore.
3. Dy. Managing Director (P&E) NTDC, WAPDA House, Lahore.
4. Deputy Managing Director (SO), NTDC, Islamabad.
5. General Manager (Power System Planning), NTDC, PIA Tower, Lahore.
6. Company Secretary (NTDC), WAPDA House, Lahore.

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NATIONAL TRANSMISSION & DESPATCH CO. LTD

Company Secretary

No. NTDC/CS/1781-83

Dated: 14 - 09 - 2022

NOTIFICATION

Approval of IGCEP 2022 and onward submission to NEPRA.

The Board of Directors of National Transmission & Despatch Company Limited (NTDC) in its 231st meeting held on 13.09.2022 against agenda item No.04 has unanimously resolved and approved the following: -

- (a) IGCEP 2022 in accordance with the salient features & provisions of the National Electric Policy 2021 and the Grid Code 2022.
- (b) Authorization for submission of IGCEP 2022 to NEPRA.



Azhar Saleem
Company Secretary

Copy to:

- 1. Managing Director
- 2. Deputy Managing Director (SO)
- 3. Chief Financial Officer

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

September 2022



NTDC

STRIVING FOR RELIABLE GRID
Power System Planning Department
National Transmission and Despatch Company

Indicative Generation Capacity Expansion Plan

IGCEP 2022-31

September 2022

Striving for Reliable Grid

Power System Planning Department
National Transmission and Despatch Company



Acknowledgements

The preparation of a country wide generation plan, such as the IGCEP, rely extensively on the input data provided by a wide range of entities. In case of IGCEP 2022-31, these entities include Pakistan Atomic Energy Commission (PAEC), State Bank of Pakistan, Finance Division–Economic Advisory Wing, Alternative Energy Development Board (AEDB), National Electric Power Regulatory Authority (NEPRA), Private Power Infrastructure Board (PPIB), Pakhtunkhwa Energy Development Organization (PEDO), Punjab Power Development Board (PPDB), Sindh Energy Board, Sindh Transmission & Dispatch Company (STDC), Azad Jammu & Kashmir Private Power Cell (AJKPPC), Azad Jammu & Kashmir Power Development Organization (AJKPDO), Central Power Purchasing Agency-Guarantee (CPPA-G), Power Planning and Monitoring Company (PPMC, former PEPCO), National Energy Efficiency and Conservation Authority (NEECA), Thar Coal and Energy Board (TCEB), K-Electric (KE), Water and Power Development Authority (WAPDA) and all DISCOs; this output could have not been materialized without the contribution by these entities.

The IGCEP has also been benefited from advice, suggestions, and value addition from various entities including Ministry of Energy (Power Division), CPPA-G and various power sector professionals.

The LF&GP Team is, therefore, highly grateful to all those who have contributed for the preparation, revision and finalization of the IGCEP 2022-31.

Disclaimer

- a. This Indicative Generation Capacity Expansion Plan 2022-31 (the “IGCEP”) has been prepared only as an indicative development plan for the period commencing on FY 2022 to FY 2031 (the “Plan”). It does not contain or determine targets or ascertain liabilities pertaining to power purchase or procurement, commissioning of future power projects, regulation or determination of electricity tariff, performance or ascertainment of economic dispatch etc. and is merely a suggested guide subject to finalization as per approval of the competent authority according to applicable law, policy and procedure.
- b. The IGCEP has been prepared as per Planning Code (PC-4) of the prevailing Grid Code, based on proprietary input data as received from various power sector entities. In order to prepare the IGCEP, reliance is also placed on reference data and bench mark practices of international power sector entities for preparing similar plans, tariff determinations by NEPRA etc. Use of the IGCEP and / or any portion or variation thereof shall be at the sole discretion and risk of the user parties. NTDC shall not be held responsible in any manner whatsoever for the integrity, accuracy, inaccuracy, authenticity, correctness or representation of such data or consequences resulting therefrom. NTDC makes no representation or warranty of any kind, either express or implied, statutory or otherwise, including the accuracy or completeness of any data, reports, records, projections, information, or materials made available under the IGCEP and the transactions contemplated as consequence thereof.
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List of Acronyms

Acronym	Description
\$/GJ	US Dollar per Giga joule
\$/kW	US Dollar per kilowatt
\$/MWh	US Dollar per Megawatt hour
ADB	Asian Development Bank
AEDB	Alternative Energy Development Board
AGL	Attock Generation Limited
Agr	Agriculture
AJKPDO	Azad Jammu & Kashmir Power Development Organization
AJKPPC	Azad Jammu and Kashmir Private Power Cell
ARE	Alternative and Renewable Energy
AT&C	Aggregate Technical & Commercial
BCF	Billion Cubic Feet
BESS	Battery Energy Storage System
c/Gcal	Cents per Giga calorie
c/kWh	Cents per kilowatt hour
ckm	Circuit kilometre
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CASA	Central Asia South Asia
CCGT	Combined Cycle Gas Turbine
CCI	Council of Common Interests
CCoE	Cabinet Committee on Energy
CFPP	Coal Fired Power Project
COD	Commercial Operation Date
Com	Commercial
CPEC	China Pakistan Economic Corridor
CPI	Consumer Price Index
CPPA-G	Central Power Purchasing Agency – Guarantee
Cumm.	Cumulative
Cus.	Customer
DISCO	Distribution Company
DOM	Domestic
DSM	Demand Side Management
EIA	US Energy Information Agency
EOI	Expression of Interest
EPA	Energy Purchase Agreement
EV	Electric Vehicle
FC	Financial Closure
FCC	Fixed Cost Component
FESCO	Faisalabad Electric Supply Company
FKPCL	Fauji Kabirwala Power Company Limited

Acronym	Description
FS	Feasibility Studies
G.R.	Growth Rate
G/s	Grid Station
G2G	Government to Government
GDP	Gross Domestic Product
GENCOs	Generation Companies
GEPCO	Gujranwala Electric Power Company
GoP	Government of Pakistan
GoS	Government of Sindh
GT	Gas Turbine
GTPS	Gas Thermal Power Station
GWh	Gigawatt-hour
HCPC	Habibullah Coastal Power Company
HESCO	Hyderabad Electric Supply Company
HFO	Heavy Furnace Oil
HPP	Hydro Power Projects
HR&A	Human Resource and Administration
HSD	High Speed Diesel
IAEA	International Atomic Energy Agency
IDC	Interest During Construction
IEP	Integrated Energy Plan
IESCO	Islamabad Electric Supply Company
IGCEP	Indicative Generation Capacity Expansion Plan
IIEP	International Institute of Electric Power Ltd.
IMF	International Monetary Fund
Imp.	Imported
Ind	Industry
IPP	Independent Power Producer
JICA	Japan International Corporation Agency
K2	Karachi Coastal Nuclear Unit 2
KAPCO	Kot Addu Power Company
kcal/kWh	kilo calorie per kilowatt hour
KE	K-Electric
KKI	KANUPP Karachi Interconnection
KPI	Key Performance Indicator
KPK	Khyber Pakhtunkhwa
kV	kilo volts
LCP	Least Cost Plan
LED	Light Emitting Diode
LESCO	Lahore Electric Supply Company
LF&GP-PSP Team	Load Forecast and Generation Planning of Power System Planning, NTDC
LNG	Liquified Natural Gas

Acronym	Description
LOI	Letter of Intent
LOLE	Loss of Load Expectation
LOLP	Loss of Load Probability
LOS	Letter of Support
LT	Long-term
M/s	Messers
MEPCO	Multan Electric Power Company
MEPS	Minimum Energy Performance Standards
MoPD & R	Ministry of Planning Development & Reforms
MT	Medium Term
MTPA	Million Ton Per Annum
MVA	Mega volt ampere
MW	Megawatt
MW _p	Megawatt Peak
NEECA	National Energy Efficiency and Conservation Authority
NEPRA	National Electric Power Regulatory Authority
NPCC	National Power Control Center
NPHS	Naya Pakistan Housing Scheme
NPP	National Power Plan
NPSEP	National Power System Expansion Plan
NPV	Net Present Value
NTDC	National Transmission and Despatch Company
O&M	Operation and Maintenance
OLS	Ordinary Least Squares
PAEC	Pakistan Atomic Energy Commission
PASA	Projected Assessment System Adequacy
PC	Planning Code
PEDO	Pakhtunkhwa Energy Development Organization
PEPCO	Pakistan Electric Power Company
PESCO	Peshawar Electric Supply Company
PITC	Power Information Technology Company
PKR	Pakistan Rupee
PP	Project Planning
PPA	Power Purchase Agreement
PPDB	Punjab Power Development Board
PPIB	Private Power Infrastructure Board
PPMC	Planning Power and Monitoring Cell
PSP	Power System Planning, NTDC
PV	Photo Voltaic has
QESCO	Quetta Electric Supply Company
RE	Renewable Energy
RFO	Residual Furnace Oil
RLNG	Re-gasified Liquid Natural Gas

Acronym	Description
ROR	Run of the river
RP	Resource Planning
Rs./kWh	Rupees per kilowatt hour
SCADA	Supervisory Control & Data Acquisition
SEPCO	Sukkur Electric Power Company
SS	System Studies
SSRL	Sino Sindh Resources Limited
STs	Steam Turbines
T&D	Transmission and Distribution
TEL	Thar Energy Limited
TESCO	Tribal Electric Supply Company
TP	Transmission Planning
TSEP	Transmission System Expansion Plan
TWh	Terawatt hour
USA	United States of America
USAID	United States Agency for International Development
VRE	Variable Renewable Energy
WAPDA	Water and Power Development Authority
WPP	Wind Power Project

Stakeholder Entities

Stakeholder Entities	Cyber Link
Alternative Energy Development Board (AEDB)	http://www.aedb.org/
Azad Jammu Kashmir Power Development Organization (AJK PDO)	http://ajkpdo.com/
Central Power Purchasing Agency (CPPA)	http://www.cppa.gov.pk/
Energy Department, Government of Punjab	http://www.energy.punjab.gov.pk/
Energy Department, Government of Sindh	http://sindhenergy.gov.pk/
Faisalabad Electric Supply Company (FESCO)	http://www.fesco.com.pk/
Federal Ministry of Energy	http://www.mowp.gov.pk/
Federal Ministry of Finance	http://www.finance.gov.pk/
Federal Ministry of Planning, Development & Reforms	https://www.pc.gov.pk/
Government of Azad Jammu and Kashmir	http://www.ajk.gov.pk/
Government of Baluchistan	http://www.balochistan.gov.pk/
Government of Gilgit Baltistan	http://www.gilgitbaltistan.gov.pk/
Government of Khyber Pakhtunkhwa	http://kp.gov.pk/
Government of Pakistan	http://pakistan.gov.pk/
Government of Punjab	https://www.punjab.gov.pk/
Government of Sindh	http://www.sindh.gov.pk/
Gujranwala Electric Power Company (GEPCO)	http://www.gepco.com.pk/
Hyderabad Electric Supply Company (HESCO)	http://www.hesco.gov.pk/
International Monetary Fund	https://www.imf.org/en
Islamabad Electric Supply Company (IESCO)	http://www.iesco.com.pk/

Stakeholder Entities	Cyber Link
K-Electric (KE)	https://www.ke.com.pk/
Lahore Electric Supply Company (LESCO)	http://www.lesco.gov.pk/
Multan Electric Power Company (MEPCO)	http://www.mepco.com.pk/
National Electric Power Regulatory Authority (NEPRA)	http://www.nepra.org.pk/
National Transmission and Despatch Company (NTDC)	http://www.ntdc.com.pk/
Pakhtunkhwa Energy Development Organization (PEDO)	http://www.pedo.pk/
Pakistan Atomic Energy Commission (PAEC)	http://www.paec.gov.pk/
Pakistan Bureau of Statistics	http://www.pbs.gov.pk/
Peshawar Electric Supply Company (PESCO)	http://www.pesco.gov.pk/
Power Planning and Monitoring Cell	https://www.pepcopakistan.com
Private Power Infrastructure Board (PPIB)	http://www.ppiib.gov.pk/
Quetta Electric Supply Company (QESCO)	http://www.qesco.com.pk/
Sukkur Electric Power Company (SEPCO)	http://www.sepco.com.pk/
Thar Coal and Energy Board	http://www.tceb.gos.pk/
Tribal Areas Electric Supply Company (TESCO)	http://www.tesco.gov.pk/
Water and Power Development Authority (WAPDA)	http://www.wapda.gov.pk/

Foreword

The Report on “Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31” presents the results of the latest generation expansion planning study conducted by the Power System Planning (PSP) Department of National Transmission and Despatch Company (NTDC) for the entire bulk power system, as per the criteria specified in prevailing Grid Code, National Electricity Policy (NEP) 2021 and specified assumptions.

This report provides a comprehensive view of grid-connected electricity demand, forecasted until 2031, and the generators optimized from the stock of existing, committed and candidate power plants to meet that demand in a cost-effective manner while ensuring system adequacy. Annual revision of this plan remains a regulatory obligation on the part of the NTDC.

Ensuring system adequacy, reliability and affordability has been a challenge for the System Operator in 2022. High fuel prices and fuel shortages were compounded by an unusually high demand for electricity in April. While the Base Case is the least cost solution, the Sensitivity Scenarios provide alternatives for increased energy security, which is an important consideration in the context of climate change and the high cost of imported fuels.

I commend the Load Forecasting and Generation Planning for preparing the IGCEP 2022-31, in view of their enthusiastic willingness to learn and contribute in the best interests of NTDC and Pakistan, I envisage this team will continue to develop its expertise, engage with stakeholders and provide outputs at par with international standards.

Deputy Managing Director (System Operation)
National Transmission and Despatch Company

Executive Summary

Pursuant to the provisions of the National Electric Power Regulatory Authority (NEPRA) prevailing Grid Code i.e., Planning Code PC 4 and PC 4.1, NTDC has prepared IGCEP 2022-31 covering 10 years' time frame from 2021-22 to 2030-31 encapsulating power generation additions required to meet the future energy and power demand of the country including NTDC and KE systems.

The report presents the results of the generation capacity expansion planning study which is composed of two key processes: 1) Load forecast; followed by 2) Generation capacity expansion and despatch optimization. Both processes involve complex statistical and computation efforts performed using dedicated software programs.

Three scenarios of long-term forecast, as per prevailing Grid Code, are prepared for the Low, Normal and High GDP growth of 3.40%, 4.30% and 5.42% respectively.

Table E1 shows a summary of the forecast results for the horizon 2022-2031.

Table E1: Summary of Load Forecast (2022-31)

FY	Low		Normal		High	
	Energy	Peak Demand	Energy	Peak Demand	Energy	Peak Demand
	GWh	MW	GWh	MW	GWh	MW
2021-22*	153,866	26,945	153,866	26,945	153,866	26,945
2022-23	155,919	28,351	156,379	28,436	156,904	28,532
2023-24	163,166	28,836	164,394	29,054	165,840	29,310
2024-25	169,733	30,168	172,056	30,583	174,841	31,081
2025-26	176,681	31,440	180,396	32,105	184,897	32,909
2026-27	183,271	32,722	188,651	33,688	195,241	34,865
2027-28	190,366	34,120	197,651	35,430	206,693	37,053
2028-29	197,288	35,489	206,693	37,191	218,524	39,321
2029-30	204,729	36,955	216,444	39,086	231,394	41,786
2030-31	214,233	38,744	228,505	41,338	246,925	44,668
CAGR (2022-2031)	3.75%	4.12%	4.49%	4.87%	5.40%	5.78%

*Actual figures

The least cost, long-term generation expansion plan for the power system of country is developed using state-of-the-art generation planning software - PLEXOS. The IGCEP 2022-31 is developed through a rigorous data modelling and optimization exercise based on the existing and future generation power projects, existing policy framework, existing contractual obligations, natural resource allocations, relevant provisions of prevailing Grid Code, and assumptions laid down in National Electricity Policy 2021 (NEP) along with some additional assumptions.

The base case scenario is developed on normal scenario of long-term forecast, existing contractual obligations and retirements of power projects, during the planning horizon of the IGCEP, as per terms of their respective Power Purchase Agreement (PPA), except KAPCO.

For the study, 8,021 MW of existing power generation capacity is retired during the plan horizon, in every scenario.

For the purpose of sensitivity analysis, five (5) scenarios are developed, in addition to the base case scenario, which include i) Low Demand Scenario; ii) High Demand Scenario iii) Diamer Bhasha HPP in 2029; iv) Chashma Nuclear (C-5) for Energy Security; v) Local coal inclusion in 2027 and 2030 and vi) Unconstrained VRE Scenario.

Hourly demand forecast is developed specially to cater for the intermittency of variable renewable energy resources such as wind and solar PV. This is particularly important in view of the aggressive targets pertaining to renewable energy envisioned by the Government of Pakistan. Hence, the energy and peak demand forecast of 87,600 hours have been estimated from the FY 2022 to FY 2031.

In the base case, the demand and installed capacity of the whole country is 41,338 MW and 69,372 MW, respectively by the year 2031. It is to highlight that in the said installed capacity, the optimized share from variable renewable energy (VRE) resources include 8,350 MW_p of Solar PV (utility solar & feeder based/DG) and 4,928 MW of Wind. Apart from VREs, 3,544 MW and 990 MW of hydro and local coal is optimized by the tool, respectively. It is to add here that the optimized local coal can be installed in any of the three blocks of Thar i.e., Block-I, II & VI, based on the assumption that the price at all three blocks of Thar will be same. It is added that 4,320 MW_p net metering solar is also added in the system i.e., 480 MW_p, every year.

Consequently, salient features of the base case include: i) aggressive inclusion of VREs; ii) Minimal reliance on imported fuels i.e., Coal, RLNG and Residual Furnace Oil (RFO) based technologies, iii) increased share of hydropower as well as local coal, and iv) All optimized generation is based on Indigenous resources. Inclusion of VREs, hydro and local coal will help in lowering the basket price of the overall system thus providing much needed relief to the end consumers, though in the long run.

Table E2: Scenario-wise Installed Capacity (MW) by 2030-31

Category	Base	Low Demand	High Demand	Diamer Bhasha HPP in 2029	Chashma Nuclear (C-5) for Energy Security	Local Coal inclusion in 2027 & 2030	Un-constrained VRE
Imported Coal	4,680	4,680	5,340	4,680	4,680	4,680	4,680
Local Coal	4,590	4,590	5,580	4,590	4,590	7,230	4,590
RLNG	8,710	8,710	8,710	8,710	8,710	8,710	8,710
Gas	1,933	1,933	1,933	1,933	1,933	1,933	1,933
Nuclear	3,620	3,620	3,620	3,620	4,820	3,620	3,620
Bagasse	394	394	394	394	394	394	394
Solar PV*	13,670	10,921	13,840	12,103	12,889	12,367	12,375
HPP	22,560	22,262	22,900	26,731	22,262	22,262	22,560
Cross Border	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Wind	6,868	5,805	8,959	5,890	7,046	5,751	7,512
RFO	1,347	1,347	1,347	1,347	1,347	1,347	1,347
Total (MW)	69,372	65,262	73,623	70,998	69,671	69,294	68,721

*Solar values are in MW_p

The Annexures in the report present the detailed results of all the scenarios and sensitivity studies conducted. The results show a shift in the energy mix (GWh) from imported fuel to indigenous ones, i.e., local coal and dominating share of renewables and hydropower. The base case shows a major contribution from renewables, i.e., 41% of hydropower and 20% of variable renewable energy in the overall energy mix by the year 2031. There is minimal reliance on the imported fuels with RFO having no contribution at all in the energy mix. Imported coal and RLNG is contributing just 8% (due to contractual binding) and 2% in the total energy requirements. The share of indigenous fuels stands 29%, i.e., 13% of local coal, 5% of local gas and 11% of nuclear in the overall energy mix.

It is pertinent to mention that the tool assures sufficient firm/base capacity in the form of hydel (existing, committed & optimized), RLNG (existing & committed), local coal (existing, committed & optimized), imported coal (existing & committed) and nuclear based (existing) power projects is available 24/7 in the system till the end of study horizon to meet the given hourly system demand whilst catering for REs intermittency and system reserve requirements.

Furthermore, the present volume of solar PV and wind power project considered as candidate is subject to change, based on the outcome of operational/stability studies to be conducted in future, in order to determine the optimum quantum of solar PV and wind sources that can be integrated in National Grid. The same will be considered in the next iteration of IGCEP.

PLEXOS tool also computes Net Present Value (NPV) of the power generation operations and investments of existing and future power projects by 2031 based on the objective function for the optimization exercise. Table E3 shows the total NPV required to manage generation infrastructure construction, operations and maintenance by 2031 separately for all scenarios. The base case scenario indicates 52.93 billion US\$ NPV investment requirements both in terms of CAPEX and OPEX of electric power generation by the year 2031.

Table E3: Total Cost Comparison of all Scenarios in Billion US \$

#	Scenario	Total Cost (Billion US \$)
1.	Base Case	52.93
2.	Low Demand	51.16
3.	High Demand	55.39
4.	Diamer Bhasha HPP in 2029	53.87
5.	Chashma Nuclear (C-5) for Energy Security	53.28
6.	Local Coal inclusion in 2027 & 2030	53.06
7.	Unconstrained VRE Scenario	52.26

The generation planning exercise demands extensive data, i.e., both validated and verified. Strenuous efforts are needed to streamline access to data for future exercises pertaining to forecasting, generation capacity expansion and despatch optimization. In addition to access to the available data, provision of certain key targets is essential for updating of the IGCEP that includes demand side management, net-metering, distributed generation etc.

The IGCEP 2031 also facilitates structural changes in the power sector planning process with enhanced role of distributed generation and reduction in the large projects distant from the load centers. Further, indigenization of RE technologies through local manufacturing is also suggested to lower the basket price, for provision of relief to the end consumer as well as saving precious foreign exchange while maximizing the nature's endowment bestowed upon Pakistan.

In view of the results stated above, the following conditions are set herewith for all the candidate projects being optimized in IGCEP 2022-31:

- a. The tariff given / cost approved by NEPRA for an optimized project shall either be equal or less than the cost used in IGCEP. If in any case the tariff given by NEPRA to any optimized project is more than the one used in IGCEP, then a re-run of the model shall be required to assess the viability / optimization of that very project on new cost. Hence, the final tariff / cost approved of any optimized project shall always be either equal or less than the cost used in IGCEP.
- b. For issuance of LOS to the private sector projects and PC-1 approval of the public sector projects, the relevant agency must ensure that the tariff approved / project cost

determined by NEPRA should be less than or equal to IGCEP cost of the optimized project, otherwise, re-evaluation of the project shall be done on the basis of new cost.

In addition to above, it is re-iterated that the selection of any generation project in IGCEP does not ensure any guarantee to execute that project which shall have to undergo approvals from all the relevant government authorities.

1. SETTING THE PERSPECTIVE

1. Setting the Perspective

1.1. Generation Planning – A Subset of Power System Planning

Power system planning is an important subset of the integrated energy planning. Its objective is, therefore, to determine a minimum cost strategy for long-range expansion of the power generation, transmission and distribution systems adequate to supply the load forecast within a set of prevailing technical, economic and political constraints.

Generation expansion planning concerns decisions for investment pertaining to development of different types of power projects over the long-term horizon – 10 years for IGCEP 2022-31. The goal of this plan is to improve decision-making under different long-term uncertainties while assuring a robust generation expansion plan with least cost and minimum risk.

As depicted in the Figure 1-1, generation planning is at the heart of planning cycle. In an ideal scenario, the Integrated Energy Plan (IEP), a mandate of Ministry of Planning, Development and Special Initiatives is meant to provide the fuel mix targets for all sectors of the economy including the power sector and such targets are adopted under the National Electricity Policy. The IGCEP is prepared to ensure its maximum contribution in energy security, sustainability and affordability while considering policy inputs and broader macroeconomic perspectives. Under Section 32 of NEPRA Act, such integration should be ensured that brings the full dividends of the integrated planning.

However, in absence of the natural resource allocation targets for power generation, the IGCEP minimize the generation costs while ensuring adequate generation capacity is added to meet the hourly forecasted demand.

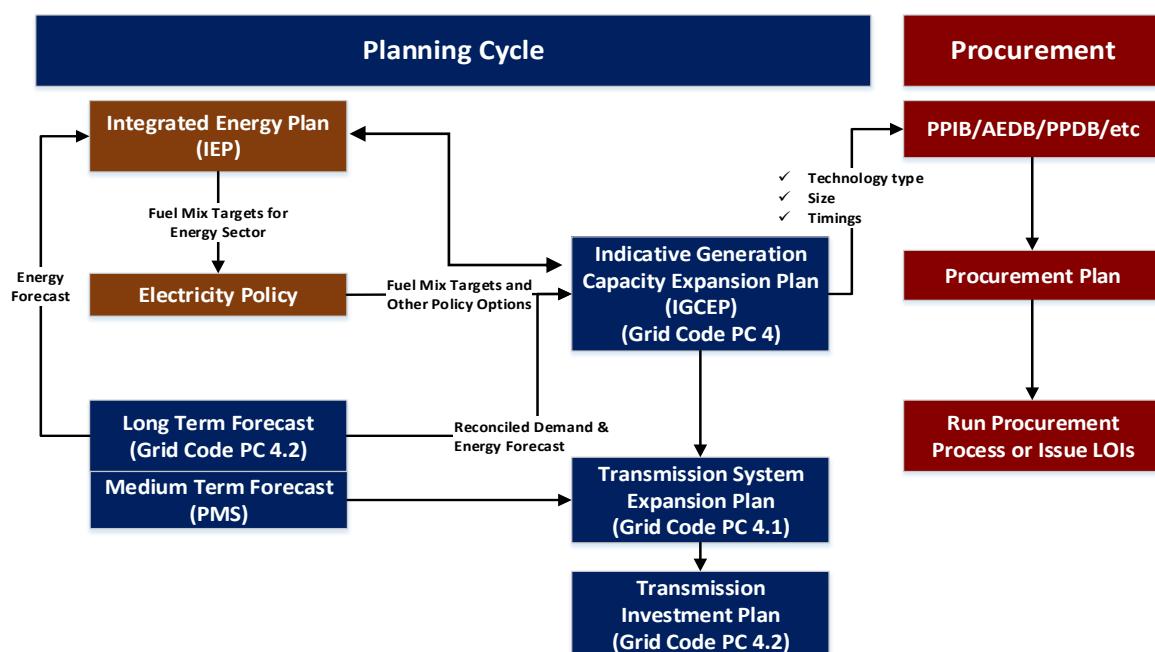


Figure 1-1: Planning Cycle Leading to Procurement

1.2. Preamble

Taking a glimpse at the relevant previous milestones, following six (06) major generation expansion plans have been formulated by the then WAPDA and now NTDC with the assistance of foreign/local consultants coupled with in-house efforts:

- a) National Power Plan (NPP 1994-2018) developed by Canadian Consultant; M/s ACRES International Limited
- b) National Power System Expansion Plan (NPSEP 2011-2030) developed by Canadian Consultant; M/s SNC Lavalin
- c) Least Cost Plan (LCP 2016-2035) developed by Japanese Consultant; M/s International Institute of Electric Power, Ltd. (IIEP)
- d) Indicative Generation Capacity Expansion Plan (IGCEP 2018-40)
- e) Indicative Generation Capacity Expansion Plan (IGCEP 2020-47)
- f) Indicative Generation Capacity Expansion Plan (IGCEP 2021-30)

This latest iteration of IGCEP 2022-31 has been developed based on the relevant provisions of prevailing Grid Code, and assumptions laid down in National Electricity Policy 2021 (NEP) along with some additional assumptions, using generation capacity expansion planning tool i.e., PLEXOS, by considering all the existing, committed and candidate power projects.

It is worth mentioning here that the last three (03) versions of IGCEP were developed for NTDC system only with a fixed quantum (MW) of export to K-Electric, however, pursuant to National Electricity Policy 2021, NTDC is responsible for power system planning of the whole country. In this regard, this iteration of IGCEP comprises of NTDC and K-Electric systems connected with a tie line having a fixed export of 1,100 MW till June 2024 and 2,050 MW till the end of study horizon. Moreover, expansion of candidate power projects has been opened both in NTDC and K-Electric system, thus covering the whole country.

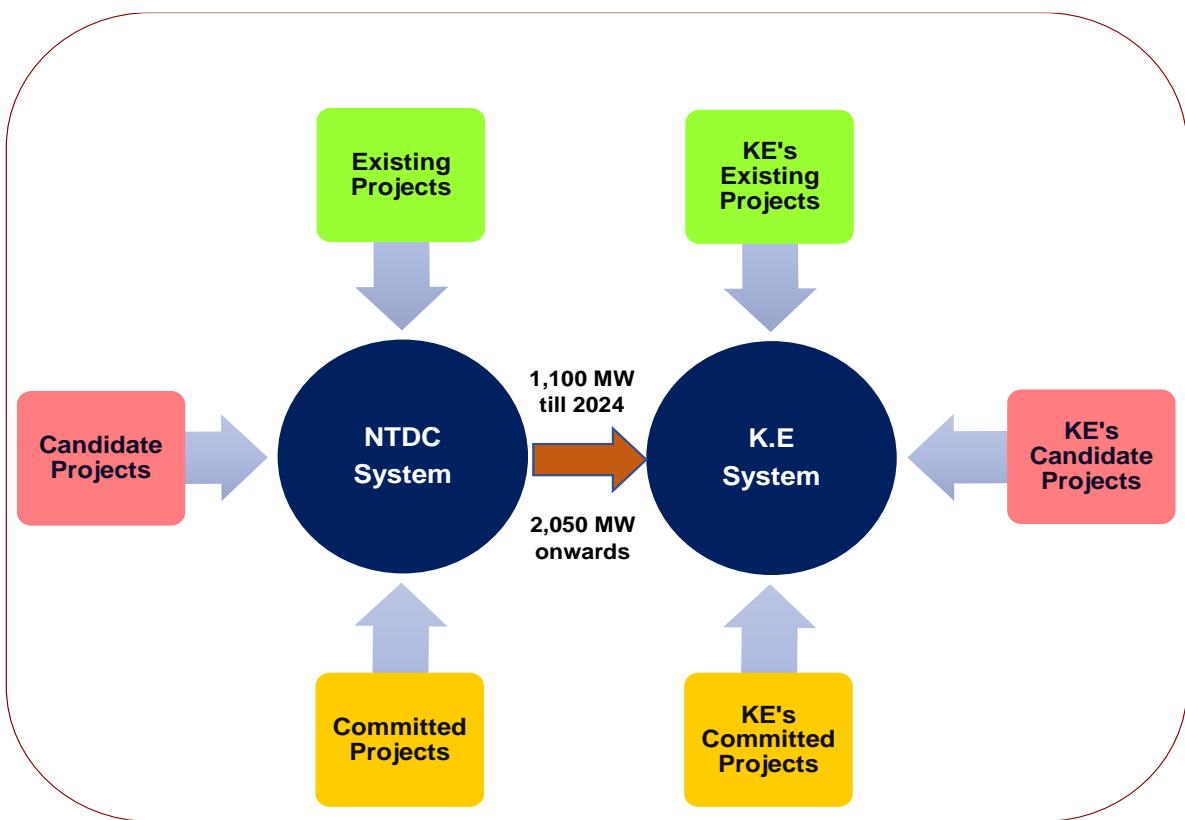


Figure 1-2: IGCEP System (NTDC + K-Electric)

1.3. Introduction

Energy access is an essential requirement of modern society. Therefore, certain electricity indices such as per capita consumption of electricity and access to electricity are used to express the economic strength of a country. Electricity is unique, since it cannot be stored, at least not in large quantities. Power generation and consumption must equate in real time. Additional factors such as seasonal variations make the demand forecast process quite complicated. On the other hand, insufficient or even surplus generation capacity adversely affects the economy. Long-term generation planning is therefore, a complex task, which involves the commitment of large resources, for the power sector and the economy as a whole.

Least cost generation planning is one of the important elements of overall integrated planning of electricity sector. Therefore, and further in compliance to NERPA's approved prevailing Grid Code clause PC-4 (Forecasts and Generation Expansion Plan) and PC-4.1 (Generation Capacity Additions), this long-term least cost generation plan or the IGCEP is prepared for review and approval by NEPRA, the Regulator.

The IGCEP is prepared based on long-term electricity demand forecast, updated generation commitment schedule and other parameters.



Figure 1-3: The IGCEP Objectives

1.4. Objectives of the IGCEP

The IGCEP is envisioned to meet the following objectives, as highlighted in the Figure 1-3:

- a. **Identify** new generation requirements by capacity, fuel, technology and commissioning dates on year-by-year basis;
- b. **Satisfy** the Loss of Load Probability (LOLP) not more than 1% year to year, as initially set under the prevailing Grid Code: PC - 4.1;
- c. **Cater** for the long-term load growth forecast and reserve requirements pursuant to the prevailing Grid Code; and
- d. **Provide** a least cost optimal generation expansion plan for development of hydroelectric, thermal, nuclear and renewable energy resources to meet the expected load demand up to the year 2030-31.

1.5. Scope and Planning Horizon

The IGCEP covers the whole country including K-Electric, a vertically integrated power utility, managing all three key stages – generation, transmission and distribution – of producing and delivering electrical energy to consumers within the geographical jurisdiction of the city of Karachi. However, the IGCEP 2022-31 includes an export of 1,100 MW from NTDC system to K-Electric up to June 2024, which is further increased to 2,050 MW after commissioning of 500 kV KANUPP Karachi Interconnection (KKI) grid station by K-Electric, as detailed in

proposed tri-partite agreement among K-Electric, NTDC & CPPA-G, till the end of study horizon. The planning horizon of the IGCEP is from the year 2021-22 to 2030-31.

1.6. Purpose of the IGCEP

Overall purpose of the IGCEP is the fulfillment of outlines, actions, and strategies as stipulated in the relevant policies and decisions of Government of Pakistan, latest generation technologies, constraints and certain regulatory obligations. The focus of this plan is to identify generation additions, by capacity and fuel type along with commissioning dates, for a certain plan period, through optimal use of all available generation resources.

The system's optimum expansion is determined by the IGCEP considering various limitations and factors such as governmental policies, investment costs, operation costs, contractual obligations, fuels, reserve requirements, maintenance allowance, etc. For this purpose, generation optimization model based on the generation planning tool i.e., PLEXOS¹ includes consideration of hourly projected electric power demand up to the year 2030-31 and various other characteristics such as hydrology of hydro power projects, fuel costs estimations and all technical and financial data pertaining to existing and potential generation options i.e., hydro power, thermal and renewables, and optimization of all options. The IGCEP is the starting point for the Transmission System Expansion Plan which is the next step in the PSP process.

The IGCEP should be considered as an indicative generation expansion plan, since it will be updated on yearly basis to account for any change in generation technologies trends, governmental policies, progress/priorities of different project execution agencies and project sponsors in developing the generation facilities, etc.

1.7. Rationale for Preparation of the IGCEP

Pursuant to the provisions of the prevailing Grid Code i.e., Planning Code (PC) - 4 and PC - 4.1, NTDC is mandated for preparation of the IGCEP on annual basis for review and approval of NEPRA. This plan shall take-into account the objectives/criteria as mentioned under sub-section 1.1 above and shall be used as an input for NTDC's Transmission System Expansion Plan (TSEP) as stated in the PC 4.2.

The IGCEP plays a key role in the expansion of the power system. The Plan ensures that the demand in the system is adequately met by adding generation capacity on least cost basis. The plan takes long term view and therefore is indicative in nature in the long run, however, it provides a perspective to potential investors and other players in the market regarding the future demand and supply situation and the probable generation mix.

Along with serving as guiding document for procurement of power for regulated consumers, the IGCEP will also provide basis for the expansion of the transmission network. The IGCEP identifies the types of generation to be added to the system and also the location in case of

¹ <https://www.energyexemplar.com/plexos>

hydro power projects. The IGCEP is used as one of the main inputs to the TSEP along with spatial demand growth to work out the power evacuation requirements and serving the load in a reliable manner.

1.8. Generation Capacity Expansion Software

For preparation of the IGCEP, PLEXOS package has been utilized. The objective function seeks to minimize the net present value of build costs plus fixed operations and maintenance costs plus production costs. The core formulation for LT Plan by PLEXOS is thus:

Minimize

- $\sum_y \sum_g DF_y (BuildCost_g * GenBuild_{g,y}) + \sum_y DF_y [FOMCharge_g * 1000 * Pmax_g (Units_g + \sum_{i \leq y} GenBuild_{g,i})] + \sum_t DF_{t \in y} L_t [VOLL * USE_t + \sum_g (SRMC_g * GenLoad_{g,t})]$

Subject to constraints:

Equation 1: Energy Balance

$$\sum_g GenLoad_{g,t} + USE_t = Demand_t \forall t$$

Equation 2: Feasible Energy Dispatch

$$\sum_g GenLoad_{g,t} \leq PMAX_g \left(Units_g + \sum_{i \leq y} GenBuild_{g,i} \right)$$

Equation 3: Feasible Builds

$$\sum_{i \leq y} GenBuild_{g,i} \leq MaxUnitsBuilt_{g,y}$$

Element	Description	Unit
GenBuild (g,y)	Number of generating units build in year y for Generator g	integer
GenLoad(g,t)	Dispatch level of generating unit g in period t	continuous
USE _t	Unserved energy in dispatch period t	continuous
CapShort _y	Capacity shortage in year y	continuous
D	Discount rate. We then derive $DF_y = \frac{1}{(1+D)^y}$ which is the discount factor applied to year, and DF _t which is the discount factor applied to dispatch period t	
L _t	Duration of dispatch period t	Hours
BuildCost _g	Overnight build cost of generator g	\$

MaxUnitsBuilt _(g,y)	Maximum number of units of generator g allowed to be built by the end of year y	
PMAX _g	Maximum generating capacity of each unit of generator g	MW
Units _g	Number of installed generating units of generator g	
VoLL	Value of lost load (energy shortage price)	\$/MWh
SRMC _g	Short-run marginal cost of generator g which is composed of Heat Rate × Fuel Price + VO&M Charge	\$/MWh
FOMCharge _g	Fixed operations and maintenance charge of generator g	\$
Load _t	Average power demand in dispatch period t	MW
PeakLoad _y	System peak power demand in year y	MW
ReserveMargin _y	Margin required over maximum power demand in year y	MW
CapShortPrice	Capacity shortage price	\$/MW

2. POWER SYSTEM OF PAKISTAN

2. Power System of Pakistan

2.1. Economics of Pakistan Power Sector

Electricity is a critical input for economic development and correspondingly power sector comprises of an indispensable infrastructure in any economy. The provision of adequate, reliable and affordable electric power is essential for economic development, human welfare and better living standards. The growth of economy along with its global competitiveness hinges on the availability of reliable and affordable power to all consumers throughout the country. Electricity is central to achieving economic, social and environmental objectives of sustainable human development. Development of different sectors of economy is impossible without matching with development of the power sector.

As an emerging economy, country's demand for electricity is enormous and its GDP is positively related with the sale of electricity as shown in Chart 2-1. This is in concurrence with a similar trend in all developing nations where GDP and sale of electricity have a direct relationship and growth in GDP causes increased sale of electricity.

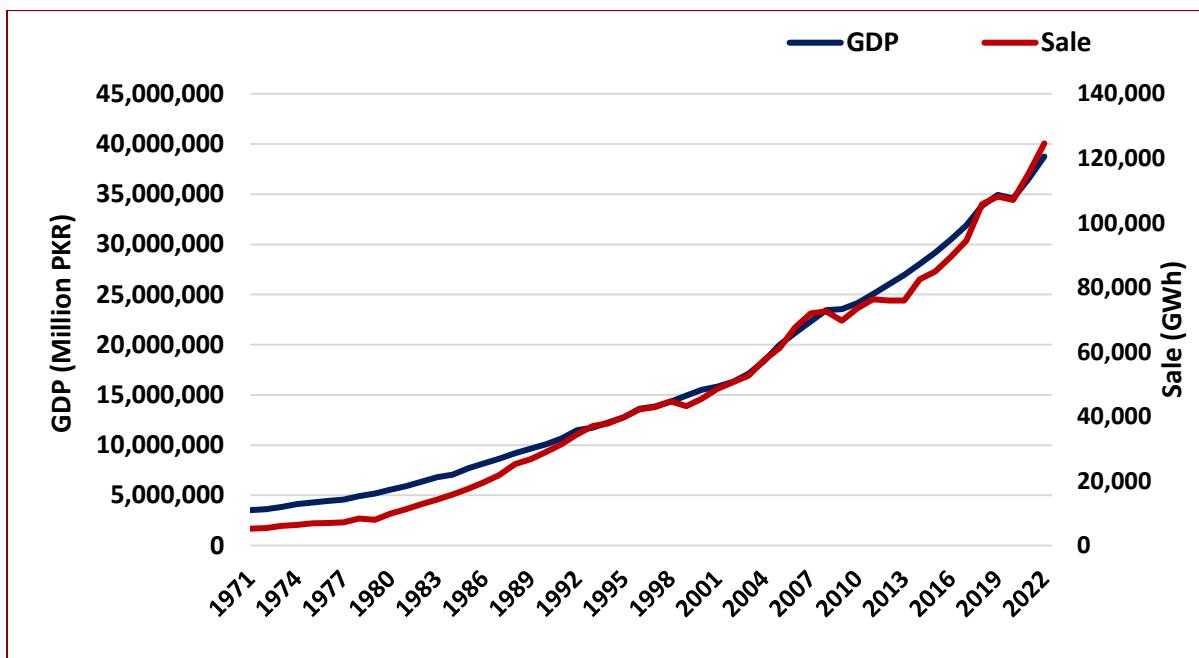


Chart 2-1: GDP (million PKR) vs Sale of Electricity (GWh)

During the fiscal year 2021-22, the country has seen 5.97% growth rate in total GDP (source: Economic Survey of Pakistan, whereas, the growth rates of 4.4%, 7.2% and 6.2% are observed in agriculture, industrial and commercial/services sectors, respectively. During the same period, 7.07% growth rate in generation of electricity has been observed. This increase in GDP as well as in usage of electricity shows strong association between GDP and electricity.

2.2. Power Generation

As of June - 2022 the total installed generation capacity of NTDC system reached to 37,949 MW. Out of which 34% is RE share which comprises of hydro, solar PV, wind and bagasse-based technologies, and 66% share is from thermal projects comprising of local gas, local coal, imported coal, RFO, RLNG and nuclear based technologies, as shown in the Chart 2-2.

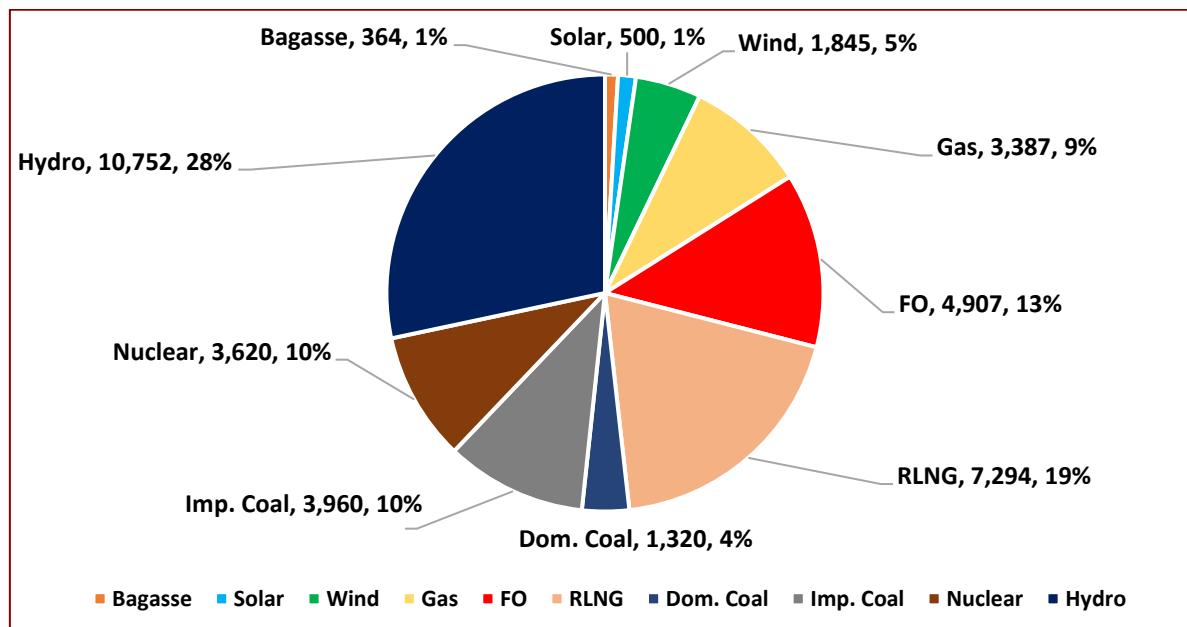


Chart 2-2: NTDC System Installed Capacity (MW)

The energy produced by NTDC system power generation fleet during the fiscal year 2021-22 was 143,017 GWh which was contributed approximately 25% by hydroelectric projects and 58% by thermal projects on local gas, local coal, imported coal, RFO and RLNG based technologies, 13% by nuclear projects, and 4% by renewable energy power projects which covers solar PV, wind and bagasse-based technologies as shown in the Chart 2-3.

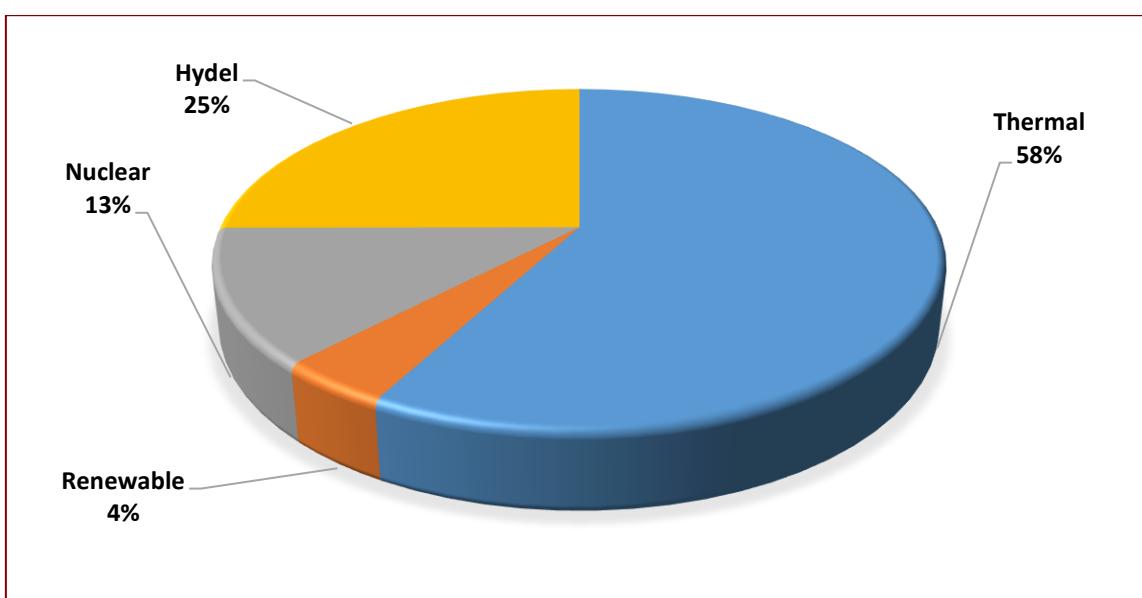


Chart 2-3: NTDC System Annual Energy Generation (GWh) as of 2021-22

Similarly, the total installed generation capacity of KE system reached to 3,319 MW, out of which 97% is thermal projects which comprising of local gas, local coal, imported coal, RFO and RLNG based technologies and 3% RE comprising of solar PV as shown in Chart 2-4.

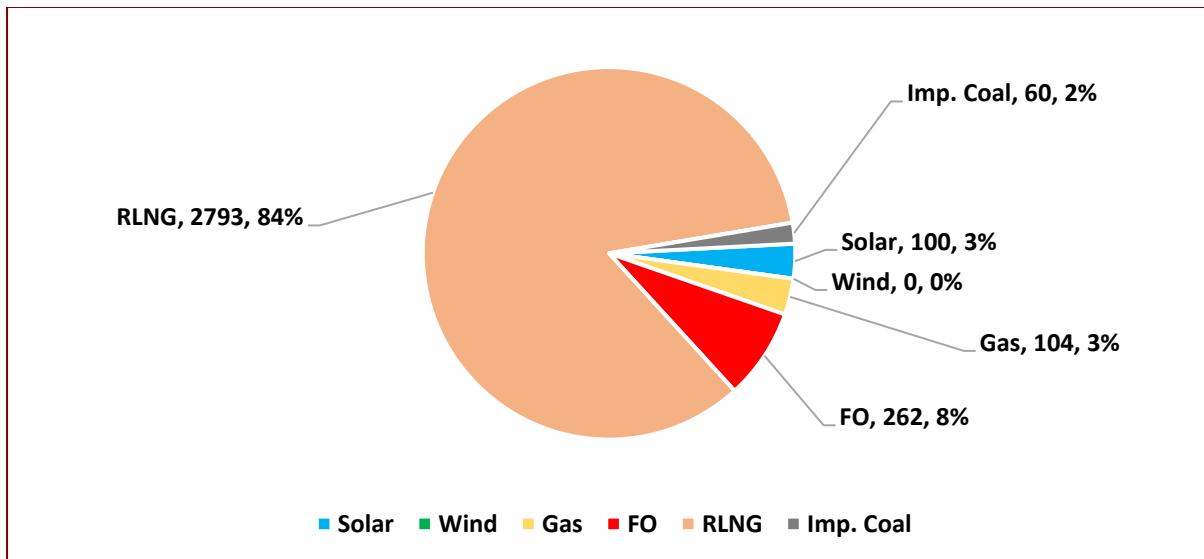


Chart 2-4: K-Electric System Installed Capacity (MW)

The energy produced by K-Electric system power generation fleet during the fiscal year 2021-22 was 10,861 GWh which was contributed primarily 96% by thermal projects on local gas, RFO, HSD, imported coal and RLNG based technologies, 1% by nuclear projects, 2% by solar PV and 1% by wind-based technology as shown in the Chart 2-5.

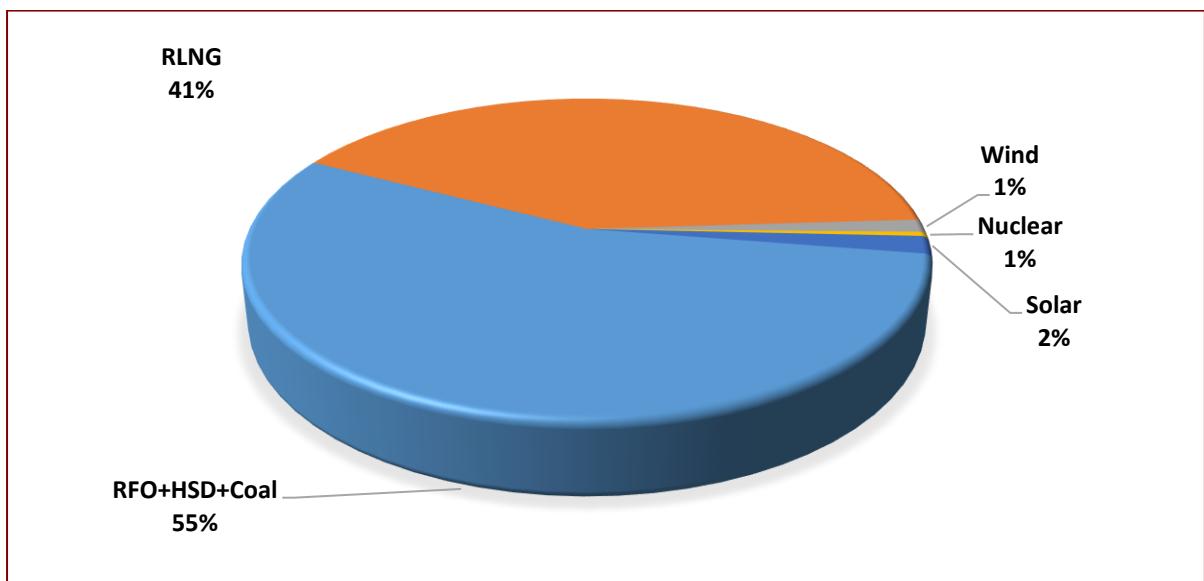


Chart 2-5: K-Electric System Energy Generation (GWh) as of 2021-2022

Furthermore, there has been an increasing trend in the electricity generation (GWh) statistics of the country from 2013-14 to 2018-19, however, a slight decrease is observed in the year 2019-20 due to lesser demand owing to struggling economy coupled with the impacts of COVID-19 pandemic. However, since 2020-21, the trend is again increasing as shown in the Chart 2-6.

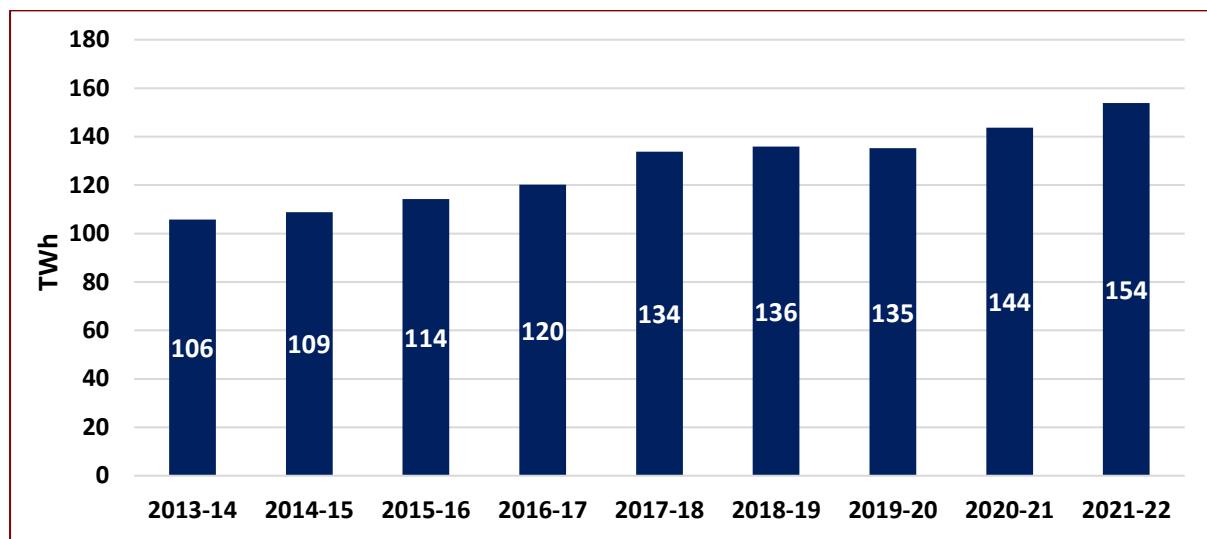


Chart 2-6: Historical Annual Energy Generation (TWh) of country from 2013-14 to 2021-22

Overall, the power demand (MW) has been growing steadily with improved development of electricity supply in the country as it is evident from the electricity peak demand trend as shown in the Chart 2-7.

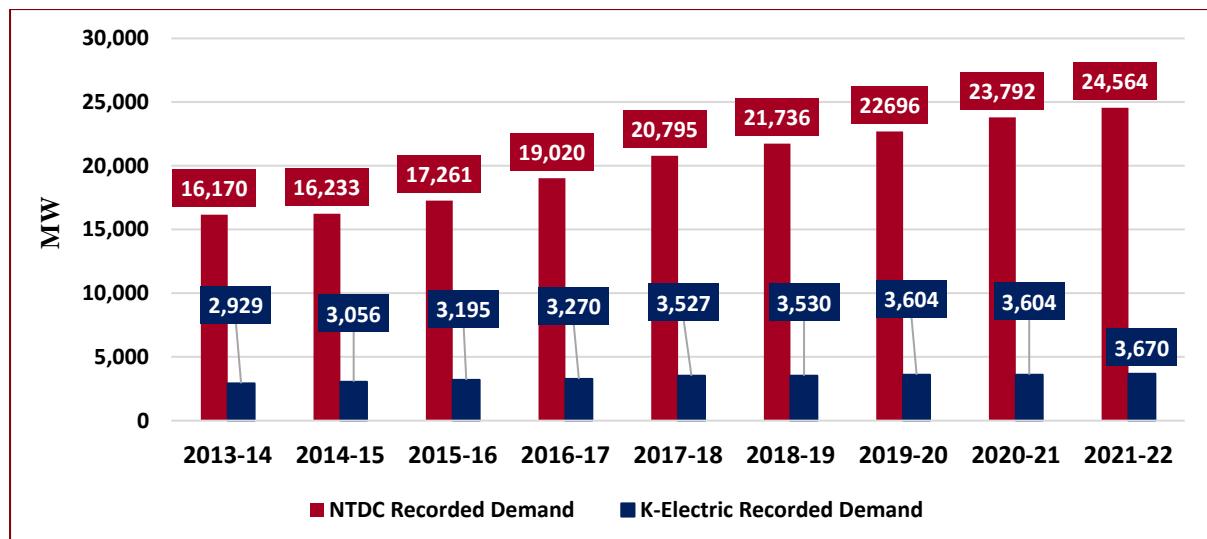


Chart 2-7: Historical Peak Electricity Demand (MW) from 2013-14 to 2021-22

Peak demand of NTDC (including export to K-Electric) and K-Electric during 2021-22 is 24,564 MW and 3,670 MW respectively.

2.3. Power Distribution

By the year 2021-22, total number of electricity consumers in the country have reached to 36,595,128 out of which 31,594,985 belong to domestic category, 3,984,802 belong to commercial category, 391,442 consumers fall under industries, 371,449 are agriculture consumers and other consumers are 252,450 as shown in Chart 2-8.

During the year 2021-22, total electricity consumption in country reached to 124,630 GWh, out of which domestic consumption had a share of 60,410 GWh, commercial consumption

was 9,233 GWh, industrial consumption was 33,958 GWh, agriculture consumption was 11,033 GWh and 9,996 GWh had been consumed by other categories as shown in Chart 2-9.

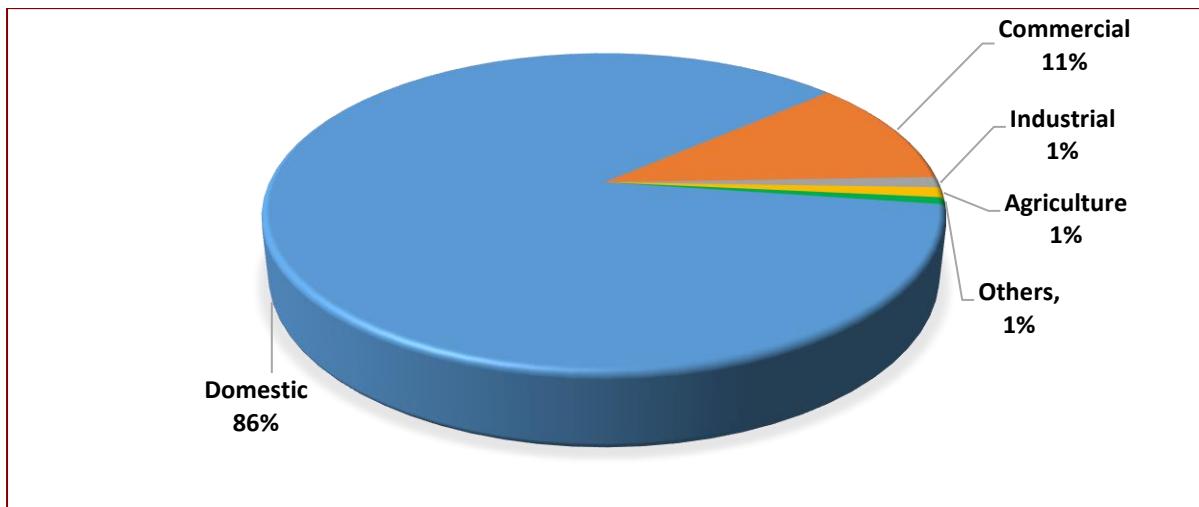


Chart 2-8: Percentage Mix of Number of Electricity Consumers

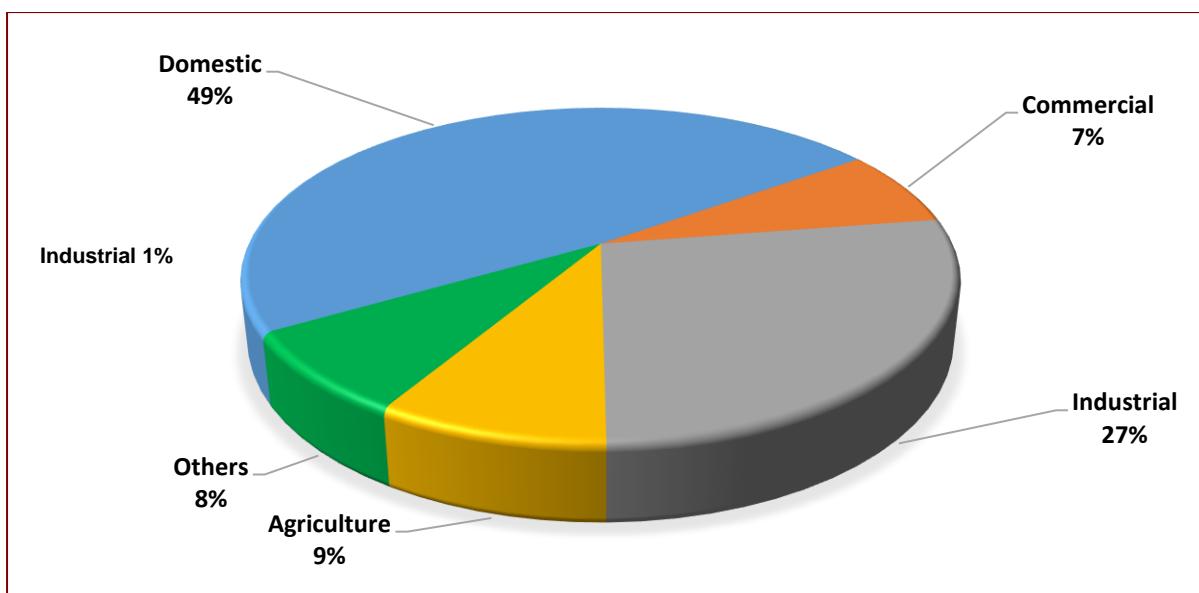


Chart 2-9: Percentage Mix of Category-wise Sale (GWh) of electricity

Electricity consumption in Pakistan is dominated by the domestic sector followed by industrial and agricultural sector as shown in Chart 2-9.

3. THE IGCEP METHODOLOGY

3. The IGCEP Methodology

3.1. Regulatory Compliance

Pursuant to the prevailing Grid Code, the IGCEP covers the future development of hydroelectric, thermal, nuclear and renewable energy resources to meet the anticipated load demand by the year 2030-31. It identifies new generation requirements by capacity, technology, fuel and commissioning dates on year-by-year basis by complying with the various regulatory requirements as set out through the provisions of the prevailing Grid Code including Loss of Load Probability (LOLP), the long-term load growth forecast and system reserve requirements.

3.2. Data Collection Process

The data collection process for the purpose of this study was extremely rigorous; all the concerned project executing entities were approached to provide the requisite data on the prescribed format. For the first time, the data proformas were made available Online on NTDC website through NTDC Forms ([available at the web link https://dplanning.ntdc.com.pk/](https://dplanning.ntdc.com.pk/)) for providing the requisite input data on the prescribed format, the same was shared with all the concerned project executing entities. The following process was followed for the collection of various inputs / data / information pertaining to power projects from the concerned entities:

- a. Specific data input formats were customized, involving suitable conversions, as per requirements of the generation capacity expansion planning tool i.e., PLEXOS.
- b. Concerned entities were approached to share required data on customized data input formats. Multiple reminders were despatched to ensure timely provision of requisite data.
- c. All the data received was precisely analyzed for accuracy and completeness, and gaps were identified and rectified / adjusted accordingly.
- d. The data was developed / formulated as per requirement of the generation planning tool.

3.3. The IGCEP Data Sources and Associated Data Types

Following agencies have contributed for the preparation of input data to be used in IGCEP 2022-31:

- a. Alternative Energy Development Board (AEDB)
 - Existing and future renewable energy projects
- b. Azad Jammu Kashmir Power Development Organization (AJK PDO)
 - Existing and future hydro power projects under the jurisdiction of AJ&K
- c. Azad Jammu Kashmir Private Power Cell (AJK PPC)
 - Existing and future hydro power projects under the jurisdiction of AJ&K
- d. Central Power Purchasing Agency Guarantee Limited (CPPA-G)

- Fuel prices and existing system merit order
- e. Energy Department Sindh / Sindh Transmission and Dispatch Company (STDC)
 - Future hydro, thermal and renewables power projects under the jurisdiction of the Sindh province
- f. Finance Division (Economic Adviser's Wing)
 - Sector wise GDP projections
- g. GENCOs
 - Existing and future thermal power projects in the public sector
- h. K-Electric
 - Hourly energy and demand forecast
 - Existing and future projects data
- i. National Electric Power Regulatory Authority (NEPRA)
 - Different types of input data were collected from NEPRA's publications / website i.e., the latest values from NEPRA quarterly indexation were used to update the costs
- j. National Power Control Centre (NPCC)
 - Monthly energy and MW capacities for the existing wind and solar PV power projects
- k. Pakhtunkhwa Energy Development Organization (PEDO)
 - Existing and future hydro power projects under the jurisdiction of KPK
- l. Pakistan Atomic Energy Commission (PAEC)
 - Existing and future nuclear power projects
- m. Pakistan Bureau of Statistics
 - Input data for long-term forecast such as historic GDP and its components, Consumer Price Index (CPI), etc.
- n. Power Planning and Monitoring Company (PPMC)
 - Category-wise sale, generation, number of consumers, transmission and distribution losses etc.
- o. Private Power Infrastructure Board (PPIB)
 - Existing and future hydro and thermal power projects under IPP mode
- p. Punjab Power Development Board (PPDB)
 - Existing and future hydro, thermal and renewables power projects under the jurisdiction of the Punjab province

- q. Thar Coal and Energy Board (TCEB)
 - Block wise Thar Mine's cost and capacity
- r. Water and Power Development Authority (WAPDA)
 - Existing and future hydro power projects to be developed by WAPDA
- s. World Bank
 - GDP Projections

3.4. Financial Parameters

For existing system, cost data has been obtained from the latest merit order provided by CPPA-G, whereas, for the future power projects, cost data shared by the concerned project executing agencies, after indexation, have been used.

3.5. The IGCEP Preparation Process Map

The IGCEP is prepared after following the process illustrated through Figure 3-1 and is submitted to NEPRA for review and approval, following an extensive internal consultative process.

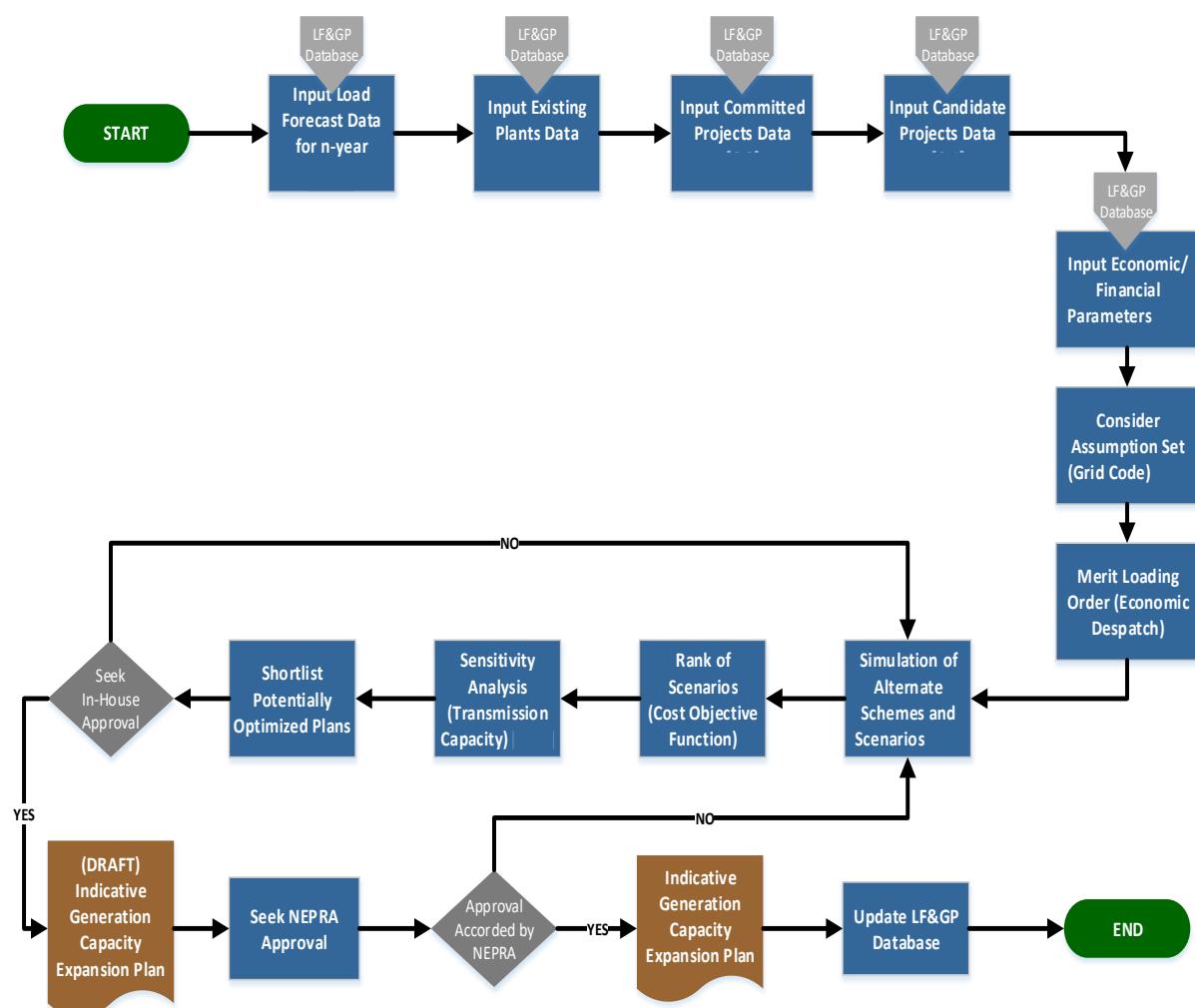


Figure 3-1: The IGCEP Preparation Process

3.6. Criteria and Other Important Considerations for the IGCEP

3.6.1. Planning Timeframe

The planning period taken for this study is 10 years, i.e., from July 1, 2021 to June 30, 2031.

3.6.2. Generation System Reliability

The capability of the generating system to meet the forecasted peak demand remains a major challenge in the generation planning. In this perspective, the IGCEP takes into account the scheduled maintenance and forced outages allowance of all the generating units as well as the seasonal variability in the energy and capacity of the hydroelectric and RE projects.

Loss of Load Expectation (LOLE) in days or equivalently Loss of Load Probability (LOLP) in percentage is considered as generating system reliability criteria. For the purpose of the IGCEP, yearly LOLP criteria of not more than 1%, as stipulated in the prevailing Grid Code, has been adopted.

3.6.3. Hydrological Risk

For the IGCEP, average seasonal values of monthly energy and capacity, as conveyed by the concerned project executing agencies, have been used to capture the seasonality in the output of hydroelectric projects.

3.6.4. Renewable Energy (RE) Generation

As of June 2022, 500 MWp utility scale solar PV and 1,845 MW wind power on-grid projects, have been commissioned in NTDC system whereas 100 MWp utility scale solar PV has been installed in K-Electric system.

Subsequent to Cabinet Committee on Energy (CCoE) decision of April 4, 2019 and June 16, 2020, RE projects, i.e., wind, solar PV, and bagasse (currently under litigation except Shahtaj) defined under Category-I & II, presently at different stages of development are envisaged to be added into the national grid during the next couple of years.

Based on the available data and after multiple rounds of discussions/deliberations with World Bank's engaged consultant i.e., M/s 8.2, AEDB and CPPA-G, capacity factors of 22.1%, 20%, 17%, 42% and 55% have been considered for candidate utility solar PV, feeder based (DG) solar, solar net metering, wind and bagasse-based power projects, respectively.

3.6.5. System Reserve Requirement

Reserve of a generating system is a measure of the system's ability to respond to a rapid increase in load or loss of the generating unit(s). In this study, two types of reserves have been modelled as per provisions of the prevailing Grid Code, i.e., contingency and secondary.

3.6.5.1. Contingency Reserve

The contingency reserve is the level of generation over the forecasted demand which is required from real time plus 24 hours so as to cover the uncertainties. This reserve is provided by the generators which are not required to be synchronized but they can be synchronized

within 30 minutes of the initiation of the Contingency and the corresponding fall in frequency. As per best industry practices, this is equal to the capacity of the largest thermal generator in the system. In this model, the Contingency Reserve is considered equivalent to 1,145 MW (Karachi Nuclear K-2/K-3 being the largest thermal unit). Moreover, to cater for VRE intermittency, some additional reserve on top of 1,145 MW is added i.e., 2.9% and 5.3% of actual generation (MW) of solar PV and Wind, respectively as per best international practices (considered by M/s Lahmeyer Intl. in 'VRE Integration and Planning study for Pakistan').

3.6.5.2. Secondary Reserve

The secondary reserve is a type of spinning reserve and it is the increase in power output of the online generators following the falling frequency and is fully sustainable for 30 minutes after achieving its maximum value in 30 seconds. It is equal to the one third of the largest unit in the system. Hence, in this model 382 MW of the Secondary Reserve along with 2% of actual generation (MW) of solar PV and wind is considered throughout the planning horizon, to mitigate VRE intermittency.

3.6.6. Scheduled Maintenance of the Generation Projects

Scheduled maintenance plays an important role in retaining the desired efficiency and reliability while at the same time preserving the useful life of a generating unit. It is assumed, for the preparation of the IGCEP, that all generating units, except for VRE and hydro, will undergo an annual maintenance program as provided by the concerned project executing agency.

3.6.7. System Load Characteristics

From the planning perspective, the system load to be met by the generating system is represented by the system's hourly load for each year up till 2030-31. Normal scenario of the load forecast has been adopted as a base case in this study.

3.6.8. Fuel Prices Indexation

Pakistan's electricity generation mix relies heavily on fossil fuels including RLNG, imported / domestic coal, local gas and furnace oil, hence, fuel price uncertainty is one of the major determinants for a long-term generation expansion plan. In this regard, the base fuel prices have been taken as per latest Merit Order of June 2022. These fuel prices are then indexed for future years as per the Energy Information Authority (EIA) Annual Energy Outlook 2022 (except for domestic coal & bagasse where Thar Coal & Energy Board tariff was applied to domestic coal and upfront tariff of bagasse in 2017 was applied to bagasse). The variable price index for each of the fuel-based technologies is given in Table 3-1.

Table 3-1: Fuel Price Indexation Factors

Year	Furnace Oil	Local Gas / RLNG	Imported Coal	Uranium	Thar Coal	Bagasse
Variable Price Index for Fuel Based Technologies						
2021-22	1.000	1.000	1.000	1.000	1.000	1.00
2022-23	0.961	0.936	0.992	1.003	1.001	1.00
2023-24	1.029	0.862	0.991	1.004	0.994	1.02
2024-25	1.044	0.820	0.967	1.007	1.009	1.02
2025-26	1.057	0.819	0.951	1.009	0.937	1.04
2026-27	1.089	0.841	0.950	1.012	0.951	1.04
2027-28	1.101	0.878	0.945	1.013	0.949	1.06
2028-29	1.109	0.899	0.949	1.016	0.942	1.06
2029-30	1.116	0.919	0.947	1.019	0.948	1.08
2030-31	1.137	0.931	0.946	1.020	0.935	1.08

4. LONG TERM ENERGY AND DEMAND FORECAST

4. Long Term Energy and Power Demand Forecast

4.1. Energy and Power Demand Forecast

Energy and power demand forecast provides the basis for all planning activities in the power sector. It is one of the decisive inputs for the generation planning. Planning Code (PC4) of the prevailing Grid Code states:

Three levels of load forecasts i.e., high growth, medium growth and low growth projections should be employed for a time horizon of at least next twenty years for the long-term.

Factors that are to be taken into account while preparing the load forecasts include economic activity, population trends, industrialization, weather, distribution companies' forecasts, demand side management and load shedding, etc.

The methodology employed to develop the energy and power demand forecast fulfills the criteria specified in the prevailing Grid Code. The methodology and its results are explained in the following sections.

4.2. Long-Term Demand Forecasting Methodology

The long-term demand forecast is based on multiple regression analysis, which is practiced internationally as an econometric technique to develop robust mathematical relationship between dependent and independent variables. Electricity sale is the variable under study. The electricity consumption pattern varies for different economic sectors of the country namely domestic, industrial, commercial and agriculture. In regard to this, multiple variables most likely to affect the electricity sales were studied, for every sector individually, and tested for significant quantitative relationships. These include electricity prices, GDP, population, number of consumers, lag variables etc. The variables that impacted the sales most significantly were selected for the final equations for electricity sales. Electricity consumption (GWh) is then regressed on these independent variables using historical data for the period 1970-2021. The methodology of long-term load forecast is illustrated in the process flow map in Figure 4-1.

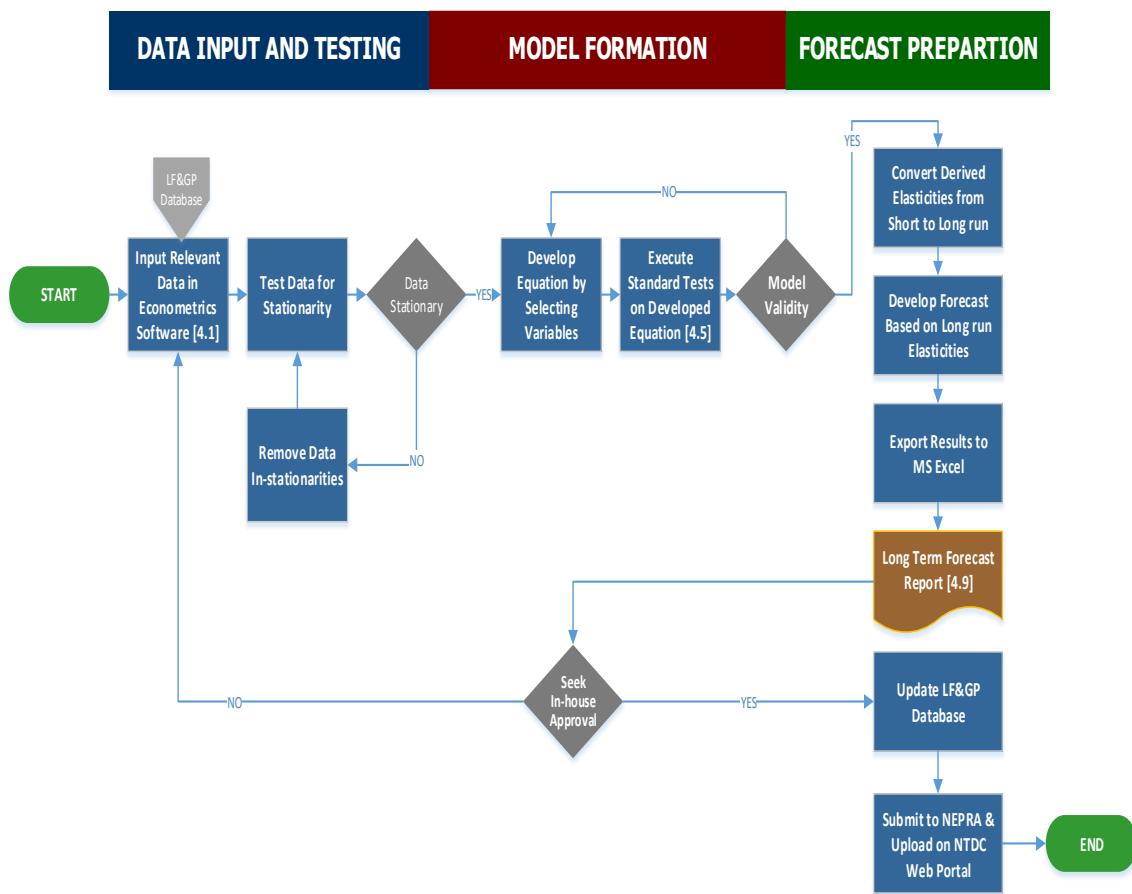


Figure 4-1: Process Flow of Methodology of Long-Term Demand Forecast

4.3 Data Sources

The data sources for the long-term demand forecast are as under:

- Historical GDP and Consumer Price Index (CPI) is obtained from Economic Survey of Pakistan 2020-21 published by Finance Division, Government of Pakistan.
- GDP growth rate projections from FY 2022-23 to 2030-31 have been provided by the World Bank. However, the actual GDP growth rate for FY 2021-22, which is recently revised by the Pakistan Bureau of Statistics, has been considered. The GDP growth rate projections which have been considered in this plan for Normal, Low and High scenario are given in Annexure A-1, A-2, and A-3, respectively.
- Energy Sales, Transmission & Distribution Losses and Energy Purchased data is obtained from DISCOs Performance Statistics by PPMC – June 2021
- Category-wise average tariff is obtained from DISCOs Performance Statistics by PPMC – June 2021.
- Peak Demand (MW) and Load management data is obtained from NPCC, KE, PITC and DISCOs
- The demand side management targets have been provided by NEECA.

4.4 Key Considerations

4.4.1 Demand Side Management

The starting year was 2019-20 for the calculation of reduction in energy consumption due to “Energy Efficiency” targets, provided by NEECA in November, 2020. The revised energy efficiency targets by NEECA have not been received this year and hence the same are being considered. The base year for the load forecast calculation is 2020-21 for which the quantum of target determined by NEECA is 2,190 GWh. The real impact of this target on reduction of electricity utilization is assumed to be achieved and already incorporated in the sales data for FY 2020-21. It is a cumulative impact for future years, therefore, the future years’ targets are rationalized by subtracting 2190 GWh from each future planning year, by Load Forecast team, presented in the Table 4-1 below. These rationalized targets have been used for energy consumption reduction in the formulation of load forecast.

Table 4-1: NEECA Energy Efficiency Targets

Energy Saving through Standardization & Labelling		
Year	GWh (Provided by NEECA)	GWh (Rationalized by NTDC)
2021-22	3,765	1,575
2022-23	5,340	3,150
2023-24	6,916	4,726
2024-25	8,491	6,301
2025-26	10,066	7,876
2026-27	11,642	9,452
2027-28	13,217	11,027
2028-29	14,792	12,602
2029-30	16,368	14,178
2030-31	16,368	14,178

4.4.2. Net Metering

Keeping in view the growing demand of net-metering connections in the country, its impact has been considered in IGCEP for the first time. The Net Metering targets are provided by the Alternative Energy Development Board (AEDB). It is pertinent to mention that in this plan these Net Metering targets are modelled at the supply side, since the generation through Net Metering will also be contributing towards meeting the Renewable Energy targets.

4.4.3. Load Management

For preparation of the Long-Term Demand Forecast, load management, being carried out in the country is incorporated in the forecast. Currently, there are six factors that are contributing towards load management namely generation constraints, emergency situations, Industrial

cut, technical NTDC constraints, DISCOs' constraints and DISCOs' high loss feeders (known as Aggregate Technical and Commercial (AT&C) load management). Primarily, there are only two major types of load Management i.e. AT&C and Non AT&C. AT&C load management is being carried out deliberately on the feeders where the revenue recovery is very low due to electricity theft and other governance issues. Non-AT&C (1,684 GWh) is being carried out due to system constraints, fuel shortage and voltage profile etc. Now AT&C (12,774 GWh) based load management has been gradually factored in the demand forecast starting from year 2023-24 till the end of study horizon with the assumption that governance will improve over the time. Whereas Non-AT&C based load management is added in the base year.

Table 4-2: AT&C Losses Inclusion in Forecast

Year	GWh	Factored-in Percentage (%)
2021-22	0	0
2022-23	0	0
2023-24	639	5
2024-25	1,277	10
2025-26	2,555	20
2026-27	3,832	30
2027-28	5,748	45
2028-29	7,664	60
2029-30	10,219	80
2030-31	12,774	100

4.5. Preparation of Demand Forecast

This year for the purpose of IGCEP country wide demand forecast is developed which includes NTDC system and K Electric System

For NTDC system, the electricity consumption is segregated into the following four major sectors:

- a. Domestic;
- b. Commercial;
- c. Industrial; and
- d. Agriculture

These aforesaid sectors typically show different consumption patterns throughout the year. Hence, they are forecasted separately. The load demand forecast of these sectors is then combined to obtain the forecast of total electrical energy demand. In order to forecast the annual consumption of electricity up to the year 2031, a multiple regression model has been used. Electricity energy sale of the respective category is the dependent variable in the regression model, whereas, the independent variables for each category are as follows:

- a. Annual total GDP and its components, i.e., agriculture sector, industrial sector and services sector;
- b. Tariff - wise electricity prices, i.e., domestic, commercial, agriculture and industrial;
- c. Category – wise Number of consumers;
- d. Lag of dependent and independent variables;
- e. Consumer Price Index; and
- f. Dummy variables

Considering the above-mentioned factors, four equations are selected, one for each category of electricity consumption. For statistical analysis, popular statistical software EViews is used.

Ordinary Least Square technique is selected for the estimation of regression equation. The equations are written in logarithmic form to evaluate elasticity in percentage. Various statistical tests were performed to establish the significance of the relationship between the dependent variable and the independent variables.

After thorough statistical analysis using EViews, the appropriate elasticity coefficients are selected for all the four equations. These elasticities were then converted into long-term elasticities. On the other hand, projection of growth rates for independent variables such as total GDP, electricity price, etc. are taken from various sources. The long-term elasticities and the projected independent variables are subsequently used in the equation to develop the long-term energy forecast of each category using the equation below.

$$Y_T = Y_{T-1} * (1+GR \text{ of } G)^b * (1+GR \text{ of } R)^c * (1+GR \text{ of } L)^d$$

Table 4-4 provides the description of all the variables used in this equation:

Table 4-3: Description of Dependent and Independent Variables

Variable	Description
Y_T	Electricity Demand of current year (Sales GWh)
Y_{T-1}	Electricity Demand of previous year (Sales GWh)
GR	Growth Rate
G, R, L	Independent variable (GDP, Real Price, Lag)
b, c, d	Elasticities of independent variables (GDP, Real Price and Lag respectively)

The demand forecast results of the four categories are combined to calculate the sale forecast at the country level. It is important to mention here that, in order to calculate the elasticities of commercial and industrial sectors the impact of load shedding on their historical data has been considered for the study, provided the fact that load shedding does not hinder or majorly affect the activities in these sectors. This is due to the alternative energy supplies widely used in these sectors which keep their activities going.

In compliance to prevailing Grid Code, three scenarios of load forecast are developed based on the three different projections of GDP categorized as Low scenario, Normal scenario and High scenario. In Low scenario, low projection of GDP as given in Annexure A-2 is considered. Thus, the projected energy and demand is on the lower side as given in Table 4-5. For normal scenario medium projection of GDP as given in Annexure A-1 is considered and the projected energy and demand is at the moderate level as given in Table 4-4 and similarly in high scenario, high projection of GDP is considered as given in Annexure A-3 and as a result the forecasted energy and demand forecast is at the higher side as given in Table 4-6.

Required generation (GWh) for each scenario is calculated after adding projected distribution losses at 11 kV and transmission losses at 132 kV, 220 kV and 500 kV. The calculated base year load factor is projected for the future years which is then used along with projected energy generation to get the peak demand in MW.

The demand forecast of K-Electric is developed and provided by K-Electric from 2021-22 to 2030-31. K-Electric has considered the hourly historic pattern and the projection of net-metering connections primarily for developing its forecast.

The country-wide energy forecast is then developed by adding both NTDC and K-Electric forecast for each respective year. For country-wide peak demand forecast, projected hourly pattern of NTDC and K-Electric are added and then the maximum value is sorted out to obtain country-wide demand forecast.

4.6. Energy and Power Demand Forecast Numbers

Based on the variables and methodology explained above, Table 4-4, 4-5 and 4-6 highlights forecast result for the Normal, Low and High scenarios respectively.

Table 4-4: Long-Term Energy & Power Demand Forecast - Normal Growth Scenario

Years	NTDC		K-Electric		Country	
	Energy (GWh)	Peak Demand (MW)	Energy (GWh)	Peak Demand (MW)	Energy (GWh)	Peak Demand (MW)
2021-22	134,064	23,544	19,802	3,670	153,866	26,945
2022-23	134,453	24,755	21,926	4,321	156,379	28,436
2023-24	142,057	26,202	22,337	4,418	164,394	29,054
2024-25	149,502	27,625	22,554	4,574	172,056	30,583
2025-26	157,615	29,177	22,781	4,726	180,396	32,105
2026-27	165,562	30,703	23,089	4,882	188,651	33,688

Long Term Energy and Power Demand Forecast

2027-28	174,333	32,388	23,318	5,032	197,651	35,430
2028-29	183,155	34,089	23,538	5,213	206,693	37,191
2029-30	192,690	35,928	23,754	5,387	216,444	39,086
2030-31	204,388	38,179	24,117	5,568	228,505	41,338
CAGR	4.80%	5.52%	2.21%	4.74%	4.49%	4.87%

Table 4-5: Long-Term Energy & Power Demand Forecast - Low Growth Scenario

Years	NTDC		K-Electric		Country	
	Energy (GWh)	Peak Demand (MW)	Energy (GWh)	Peak Demand (MW)	Energy (GWh)	Peak Demand (MW)
2021-22	134,064	23,544	19,802	3,670	153,866	26,945
2022-23	134,146	24,698	21,773	4,320	155,919	28,351
2023-24	141,119	26,029	22,047	4,360	163,166	28,836
2024-25	147,634	27,280	22,099	4,482	169,733	30,168
2025-26	154,542	28,608	22,139	4,592	176,681	31,440
2026-27	161,032	29,863	22,239	4,703	183,271	32,722
2027-28	168,113	31,233	22,253	4,802	190,366	34,120
2028-29	175,027	32,576	22,261	4,927	197,288	35,489
2029-30	182,454	34,020	22,275	5,043	204,729	36,955
2030-31	191,843	35,836	22,390	5,166	214,233	38,744
CAGR	4.06%	4.78%	1.37%	3.87%	3.75%	4.12%

Table 4-6: Long-Term Energy & Power Demand Forecast - High Growth Scenario

Years	NTDC		K-Electric		Country	
	Energy (GWh)	Peak Demand (MW)	Energy (GWh)	Peak Demand (MW)	Energy (GWh)	Peak Demand (MW)
2021-22	134,064	23,544	19,802	3,670	153,866	26,945
2022-23	134,826	24,824	22,078	4,351	156,904	28,532
2023-24	143,212	26,415	22,628	4,475	165,840	29,310
2024-25	151,827	28,055	23,014	4,668	174,841	31,081
2025-26	161,463	29,889	23,434	4,861	184,897	32,909
2026-27	171,279	31,763	23,962	5,067	195,241	34,865
2027-28	182,271	33,863	24,422	5,270	206,693	37,053
2028-29	193,635	36,039	24,889	5,512	218,524	39,321
2029-30	206,035	38,417	25,359	5,752	231,394	41,786
2030-31	220,947	41,272	25,978	5,998	246,925	44,668
CAGR	5.71%	6.44%	3.06%	5.61%	5.40%	5.78%

The Chart 4-1 shows peak demand projections of Normal, Low and High growth scenarios:

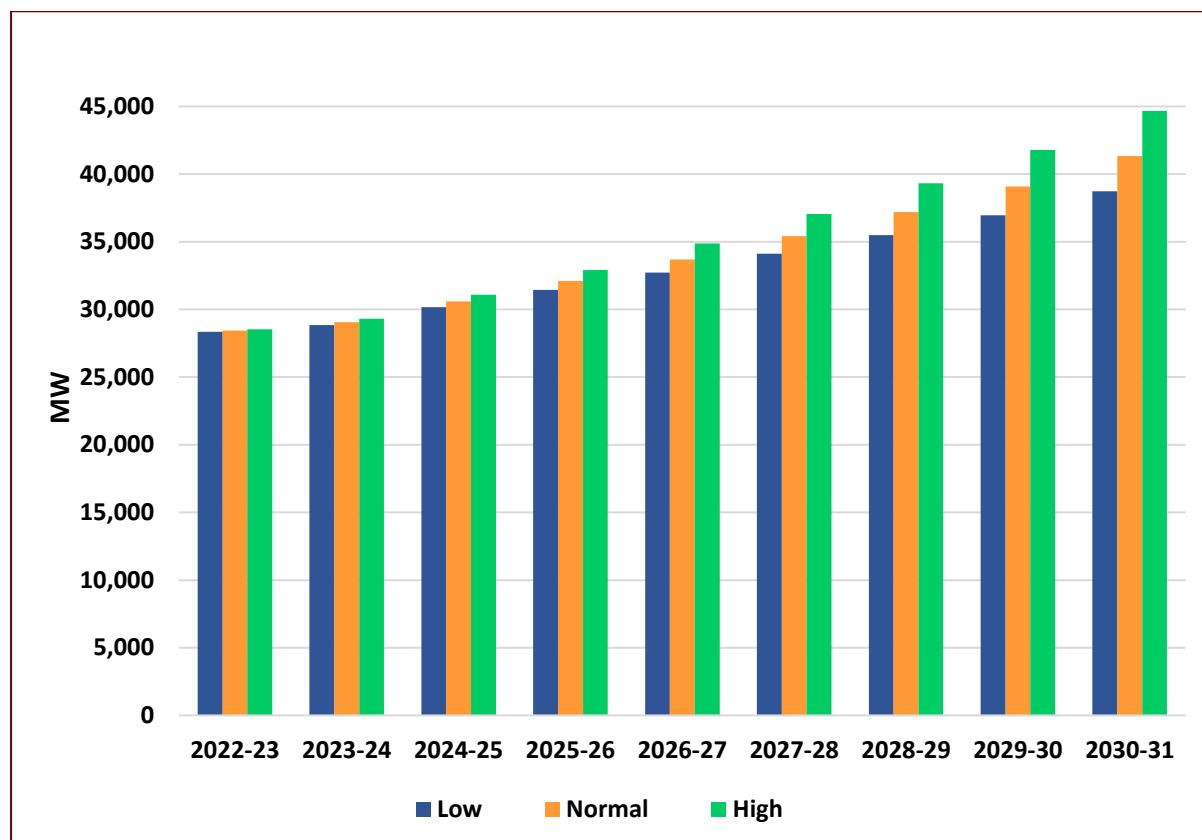


Chart 4-1: Peak Demand (MW) Forecast 2022-2031

4.7. Hourly Demand Forecast

Hourly demand forecast has been developed to cater for the intermittency of variable renewable energy sources. This is particularly important in view of the aggressive targets envisioned by the GoP pertaining to renewable energy. Hence, the demand forecast of 87,600 hours have been estimated for the plan horizon. In this process, the forecasted annual peak demand was converted into hourly demand based on the recent historical hourly demand and generation pattern which is then adjusted to cater for the upcoming net – metering connections in the country. The load duration curve for the year 2026-27 and 2030-31 is given Chart 4-2.

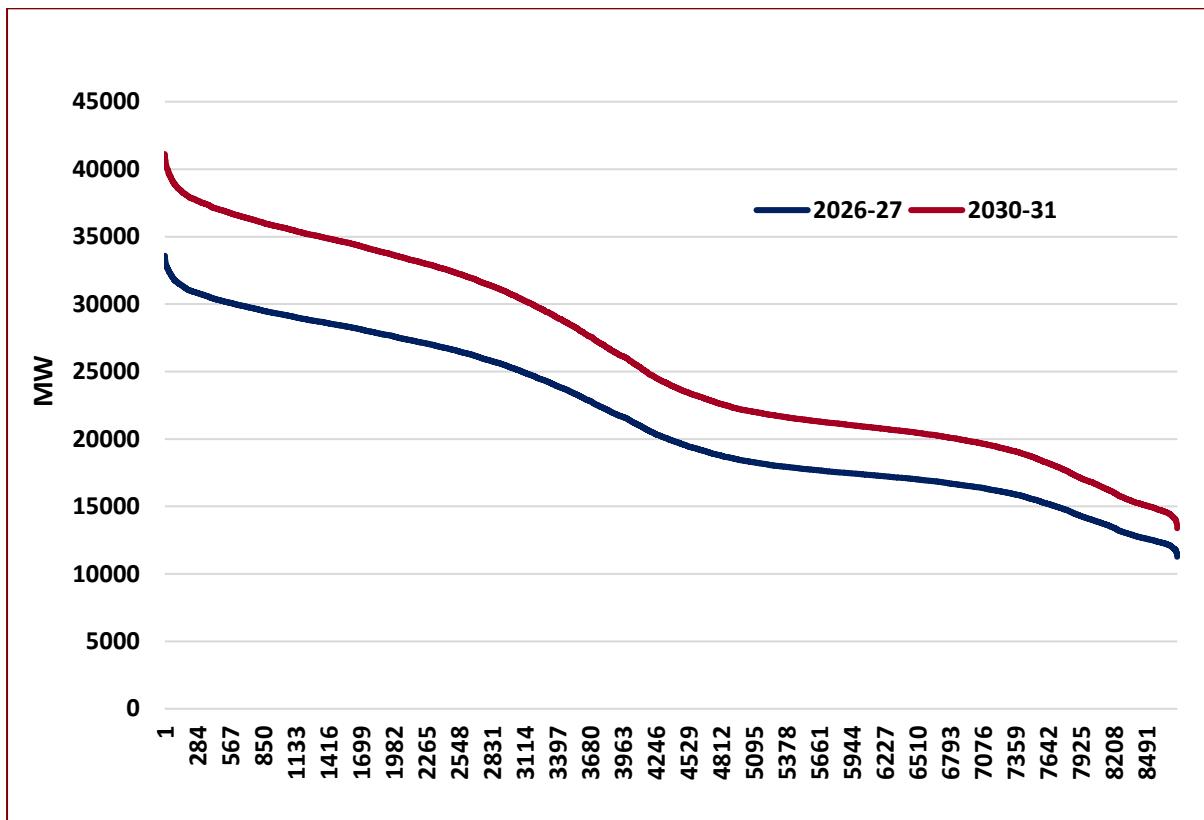


Chart 4-2: Load Duration Curve (2026-27 & 2030-31)

5. INSIDE THE IGCEP

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

5. Inside the IGCEP

5.1. Introduction

The key objective of IGCEP is to develop a least cost, 10-year indicative generation expansion plan for the whole country to meet the load and energy demand in a reliable and sustainable manner while maximizing use of indigenous resources for energy security. NTDC prepares this IGCEP every year to meet its regulatory requirement, as stipulated in the Planning Code 4 of the prevailing Grid Code, which takes into account the assumptions laid down in National Electricity Policy 2021 (NEP) along with some additional assumptions and identified constraints, if any. The plan is to be reviewed and approved by NEPRA – the electricity regulator. The following section describes the key parameters and results of the generation planning study.

5.2. Assumptions of IGCEP

The IGCEP 2022-31 has been developed in the light of the criteria laid down in National Electricity Policy (NEP) along with some additional assumptions related to certain specific projects have also been considered based on the ground realities and updated data / status of these projects as per discussion held in the NTDC Board Technical Committee meetings held in March / April 2022. The same are reproduced below:

1. Out of the three load forecast scenarios (Low, Normal, High), ‘normal’ served demand forecast scenario for base case, has been used based on the following inputs:
 - i. Historical GDP and Consumer Price Index (CPI) is obtained from Economic Survey of Pakistan 2020-21 published by Finance Division, Government of Pakistan.
 - ii. GDP growth rate projections from FY 2022-23 to 2030-31 have been provided by the World Bank. However, the actual GDP growth rate for FY 2021-22, which is recently revised by the Pakistan Bureau of Statistics, has been considered. The GDP growth rate projections which have been considered in this plan for Normal, Low and High scenario are given in Annexure A-1, A-2, and A-3, respectively.
 - iii. Energy Sales, Transmission & Distribution Losses and Energy Purchased data is obtained from DISCOs Performance Statistics by PPMC – June 2021
 - iv. Category-wise average tariff is obtained from DISCOs Performance Statistics by PPMC – June 2021.
2. Planning horizon of the study is 2022 to 2031 with annual updating.
3. Reserve and reliability requirements (LOLP = 1%) have been considered as per prevailing Grid Code.
4. Retirement of existing thermal power Project including GENCOs has been considered as per expiry of contractual term of corresponding PPA and relevant CCoE decisions.
5. Till the expiry of contractual term of corresponding PPA and GSA, existing RLNG and imported coal-based projects have been given a minimum dispatch as per contractual obligations.
6. Fuel costs as per Merit order of June 2022, have been considered.

7. Fixed O&M and variable O&M as per NEPRA's quarterly indexation of March 2022, as available on NEPRA's website, has been considered.
8. Fixed O&M costs of power Project built under 1994 Power Policy are not available on NEPRA's website, so these costs have been obtained from previous data available with Power System Planning, NTDC and CPPA (G).
9. A project has been considered as '**committed**' and its capital cost or CAPEX is not entered in the model, provided the project fulfills at least one of the following pre-requisites:
 - i. Has obtained LOS as of December 2020 for private sector projects. For Federal and Provincial public sector projects, the PC-I has been approved and funding secured (As of March 2021). However, M/s Jamshoro Unit-2 & M/s Chashma-5 Nuclear Project shall be modelled as candidate projects to be evaluated under "Least Cost Principle".
 - ii. G2G project: Power Generation projects which are listed under Federal Government's international (bilateral or multilateral) commitments, if project / financing agreements signed.
 - iii. RE Project (Wind, Solar, Bagasse) enlisted in Category I & II of CCoE's decision dated 4th April 2019.
 - iv. CODs for '**committed power projects**' will be taken as per project security documents (PPA/IA) or as conveyed by the competent forum / concerned organization / entity.
10. Cost data of committed projects has taken as per data/information provided by the concerned project executing agency and NEPRA determined tariff.
11. For nuclear power Project, Capital Cost, Variable O&M cost and Fixed O&M cost and operational data as conveyed by Pakistan Atomic Energy Commission (PAEC) has been considered.
12. Local and imported coal power Project: Capital Cost, Variable O&M cost, Fixed FCC and Fixed O&M cost has been taken from the latest NEPRA determined tariff for respective technology.
13. RLNG based OCGT power Project: Fuel cost, Fixed O&M cost and Variable O&M cost of latest available OCGT Project is considered while Capital cost for OCGT has been considered as conveyed by the concerned project executing agency or as per best international practice.
14. The CAPEX of wind and solar has been determined based on the annualized cost of 4 cents/kWh as conveyed by AEDB, subject to approval by NEPRA.
15. Bagasse based power Project: Capital cost, Variable O&M cost, Fixed O&M cost and Fuel cost have been taken from the latest available NEPRA's tariff determination.
16. Hydro power Project: Capital cost and Fixed O&M cost have been considered as shared by the concerned project executing entities.
17. All years correspond to fiscal years e.g., 2025 is the fiscal year from July 1, 2024 to June 30, 2025.

18. Only Shahtaj is taken as a committed project from Category-I and II bagasse-based projects since it has been awarded revised tariff by NEPRA. Further, yearly candidate block of 100 MW bagasse has been considered from the year 2024-25 onwards.
19. 480 MW_p of net metering is considered each year till the end of study horizon.
20. Candidate as well as committed power projects under 20 MW and connected below 132 kV (and hence, not in central dispatch) have not been considered.
21. No candidate thermal or RE projects have been considered by name.
22. Siddiqsons CFPP has been removed from the list of committed projects, due to LOS expiry and presently under litigation as per PPIB.
23. Gwadar CFPP has been considered on Local Coal as conveyed by relevant project executing agency, i.e., PPIB
24. The COD of CASA has been assumed as August 2024.
25. Diamer Bhasha HPP has been delayed beyond the study horizon of the current version of IGCEP owing to the progress made so far by the project, as decided in a meeting held at MoE (PD), among representatives from NTDC, PPIB, MoE (PD), WAPDA and MoW&R.
26. Existing Engro Powergen CCPP has been modelled as per data provided by M/s Engro CCPP representative in view of its Gas Depletion Mitigation Plan (GDMP). It is to highlight that minimum take or pay dispatch of 50% on the available yearly Permeate gas has been considered.
27. Pursuant to approved NE Policy 2021, K-Electric system has also been included in the current version of IGCEP.
28. For candidate local coal-based projects, the fixed fuel cost component (FFCC) of 11.2 \$/Ton (71.821 \$/kW-year) and fuel price of 9.97 \$/Ton (0.88 \$/GJ) have been considered as per TCEB determination of 2020 pertaining to Thar Block-II at 30.8 MTPA.
29. In order to cater for network requirements/constraints, some existing projects located near load center have been considered as “Must Run”, for summer months, i.e., May to September until year 2025.
30. Minimum Despatch of 500 MW from Existing KAPCO CCPP (Block-I and Block-II) in the months of May to September until year 2025 has been considered, beyond its PPA expiry i.e., Oct. 2022, owing to network requirements/constraints, whereas, the remaining capacity (Block-III) has been retired as per PPA expiry. It is pertinent to mention that the requirement of KAPCO beyond its PPA expiry will be assessed in ongoing Transmission System Expansion Plan (TSEP), accordingly competent forum will be approached, after consensus among concerned stakeholders i.e., NTDC, CPPA-G and KAPCO, for PPA extension or otherwise and the same will be considered in next iteration of IGCEP.
31. 140 MW Habibullaah Costal (HCPC) and 31 MW Altern Energy Limited (AEL) have not been considered in the existing installed capacity owing to termination of Gas Supply Agreement (GSA) and de-licensing by NEPRA, respectively.
32. The COD of a committed project i.e., 84 MW Gorkin Matiltan HPP, has been assumed as of July 2024 instead of July 2023 in view of its latest progress.
33. Following lead time criterion for the candidate power projects has been assumed:

- a. 4 years for coal power projects; earliest year of availability, July 2026
- b. 2 years for Utility Solar PV, and Wind power projects; earliest year of availability, July 2024
- c. For certain Hydro power projects, the earliest year of availability is July 2028 and onwards (details given in Anexure-B6)
 - Either Due to their remote locations
 - Or non-availability of feasibility studies for power evacuation

34. All the costs have been indexed as of March 2022.

For Hydro power projects, the cost data shared by concerned project execution agencies has been indexed and are given in Annexure B-3. The values for indexation were obtained from NEPRA's website.

5.3. Conditions for Optimized / Selected Power Projects

The following conditions are set herewith for all the candidate projects being optimized in IGCEP 2022-31:

- a. The tariff given / cost approved by NEPRA for an optimized project shall either be equal or less than the cost used in IGCEP, if in any case the tariff given by NEPRA to any optimized project is more than the one used in IGCEP, then a re-run shall be required to assess the viability / optimization of that very project on new cost. Hence, the final tariff / cost approved of any optimized project shall always be either equal or less than the cost used in IGCEP.
- b. For issuance of LOS to the private sector projects and PC-1 approval of the public sector projects, the relevant agency must ensure that the tariff approved / project cost determined by NEPRA should be less than or equal to IGCEP cost of the optimized project, otherwise, re-evaluation of the project shall be done on the basis of new cost.

In addition to above, it is re-iterated that selection of any generation project in IGCEP does not ensure any guarantee to execute that project which shall have to undergo approvals from all the relevant government authorities.

5.4. Adherence to Contractual Obligations

In order to develop an effective least cost generation capacity expansion plan that will meet the future power needs of the country, the IGCEP adheres to the existing constraints such as take or pay contractual obligations of at least minimum annual despatch of 50% for existing imported coal-based power projects (Sahiwal, China HUBCO & Port Qasim), and three low btu gas-based projects (Uch-II, Engro and Foundation).

5.5. Approach and Methodology

The development of the least cost generation capacity expansion plan is the process of optimizing i) existing and committed generation facilities and ii) addition of generation from available supply technologies/options, which would balance the projected demand while

satisfying the specified reliability criteria. For the purpose of the IGCEP, following methodology has been adopted as illustrated in Figure 5-1:

- a. First Step: Review the existing generation facilities, committed power projects and explore the range of generation addition options available to meet the future demand.
- b. Second Step: Determine the economically attractive / viable generation option (s).
- c. Third Step: Define the Base Case subsequent to identification of the economically attractive options.
- d. Fourth Step: Develop the least cost plan whilst considering the reliability criteria and reserve requirements under the already defined Base Case using the PLEXOS tool.

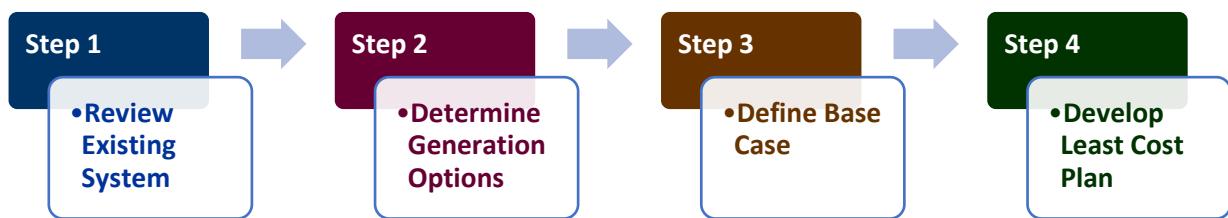


Figure 5-1: The IGCEP Data Modelling Approach

5.6. Planning Basis

The generation planning criteria tabulated in the Table 5-1 is adopted for this study.

Table 5-1: Generation Planning Criteria

Parameter	Value
Discount Rate	10%
Reliability Criteria (LOLP)	1%
Dollar Rate	Rs. 177.95 (March 2022)
CPI (US)	277.948
CPI (Local)	269.27

5.7. Existing Power Generation of Country

Total installed capacity of existing NTDC system is 37,949 MW as of June 2022, whereas the de-rated capacity is equivalent to 35,765 MW. Similarly, for the K-Electric system, the installed and de-rated capacities stand 3,319 MW and 2,941 MW, respectively.

5.8. Retirement of Existing Power Projects

A significant quantum i.e., 7,339 MW of the existing thermal power projects are scheduled to be retired from NTDC system during the planning horizon of the IGCEP 2022-31. It is highlighted that 144 MW GTPS Block 4 U (5-9) has been retired during FY 2021-22, hence the same has been excluded from existing installed capacity. The retirement schedule for the

IGCEP 2022-31 is provided in the Table 5-2. For the purpose of the IGCEP, a power project stands retired either as per its PPA/EPA term or relevant CCoE decision. Major retirement of generation capacity for the IGCEP 2022-31 corresponds to RFO based power projects, followed by Local Gas and then RLNG based power projects.

Table 5-2: Retirement Schedule of Power Projects in the Existing NTDC System

Sr. #	Name of the Power Station	Installed Capacity (MW)	Fuel Type	Retirement Year (FY)						Rationale	
				23	26	27	29	30	31		
1	Guddu-II U (5-10)	620	Gas	✓						CCoE decision	
2	Jamshoro-I U1	250	RFO	✓							
3	Jamshoro-II U4	200	RFO	✓							
4	Muzaffargarh-I U1	210	RFO	✓							
5	Muzaffargarh-I U2	210	RFO	✓							
6	Muzaffargarh-I U3	210	RFO	✓							
7	Muzaffargarh-II U4	320	RFO	✓							
8	KAPCO 1	400	RLNG		✓					PPA extended owing to network constraints*	
9	KAPCO 2	900	RLNG		✓						
10	KAPCO 3	300	RLNG	✓							
11	Liberty	225	Gas			✓					
12	HUBCO	1,292	RFO			✓					
13	Kohinoor	131	RFO			✓					
14	AES Lalpir	362	RFO				✓				
15	AES Pakgen	365	RFO				✓				
16	FKPCL	172	RLNG					✓			
17	Saba	136	RFO					✓			
18	Uch	586	Gas						✓		
19	Rousch	450	RLNG						✓		
Total (MW)				7,339							

Note: *A sensitivity analysis to assess the requirement of existing KAPCO CCPP beyond its PPA expiry, in years to come will be conducted in the on-going Transmission System Expansion Plan (TSEP). However, considering the historical dispatch of KAPCO owing to network constraints in the region, two blocks of KAPCO have been assumed to stay in system until the year 2026.

The retirement plan of K-Electric system is shown in Table 5-3. A total of 682 MW capacity is going to be retired from K-E system in the upcoming years.

Table 5-3: Retirement Schedule of Power Projects in the Existing K-Electric System

Sr. #	Name of the Power Station	Installed Capacity (MW)	Fuel Type	Retirement Year (FY)		Rationale
				23	24	
1	GAEL	136	RFO	✓		PPA expiry
2	TPL	126	RFO	✓		
3	BQPS1-U1	210	RLNG		✓	
4	BQPS1-U2	210	RLNG		✓	
Total (MW)		682				

5.9. Committed Projects

Power projects considered as committed projects based on the criteria stipulated in Assumption Set approved by CCI is shown in the Figure 5-2.

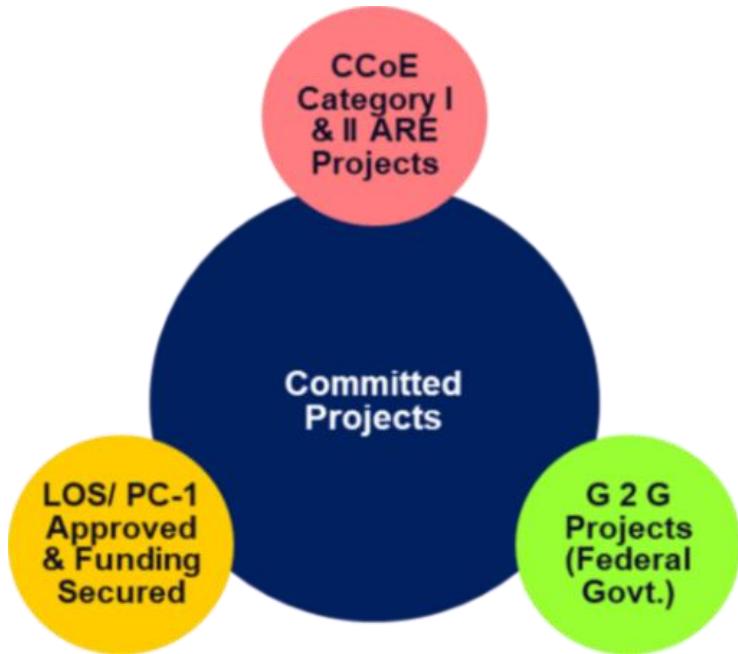


Figure 5-2: Committed Projects Criteria

5.9.1. List of Committed Projects

The committed projects considered in the IGCEP are listed in the Table 5-4.

Table 5-4: List of Committed Projects

#	Name of Committed Project	Fuel Type	Agency	Installed Capacity (MW)	Status	Expected Schedule of Commissioning
1	Thar TEL	Local Coal	PPIB	330	LOS (Issued)	Commissioned
2	Trimmu	CCGT_RLNG	PPIB	1263	LOS (Issued)	Dec-22
3	Mangla (U #5-6)	Hydro	WAPDA	70	Mangla Refurbishment	Dec-22
4	Koto	Hydro	GoKPK	40.8	PC-1 Approved	Dec-22
5	Thal Nova	Local Coal	PPIB	330	LOS (Issued)	Dec-22
6	Jamshoro Coal (U #1)	Imported Coal	GENCO	660	PC-1 Approved	Dec-22
7	Thar-I (SSRL)	Local Coal	PPIB	1320	LOS (Issued)	Dec-22
8	Helios	PV	AEDB	50	Category-II Project	Apr-23
9	HNDS	PV	AEDB	50	Category-II Project	Apr-23
10	Meridian	PV	AEDB	50	Category-II Project	Apr-23
11	Jagran-II (U #1)	Hydro	AJK-HEB	12	PC-1 Approved	Apr-23
12	Mangla (U #3-4)	Hydro	WAPDA	70	Mangla Refurbishment	May-23
13	Jagran-II (U #2)	Hydro	AJK-HEB	12	PC-1 Approved	May-23
14	Jagran-II (U #3)	Hydro	AJK-HEB	12	PC-1 Approved	Jul-23
15	Jagran-II (U #4)	Hydro	AJK-HEB	12	PC-1 Approved	Jul-23
16	Manjhand	PV	GoS	50	PC-1 Approved	Sep-23
17	Siachen	PV	GoS	100	Category-II Project	Sep-23
18	Zorlu	PV	PPDB	100	Category-II Project	Dec-23
19	Lawi	Hydro	GoKPK	69	PC-1 Approved	Apr-24
20	Suki Kinari (U #1)	Hydro	PPIB	221	LOS (Issued)	May-24

#	Name of Committed Project	Fuel Type	Agency	Installed Capacity (MW)	Status	Expected Schedule of Commissioning
21	Trans_Atlantic	Wind	AEDB	50	Category-II Project	Jun-24
22	Western	Wind	AEDB	50	Category-II Project	Jun-24
23	Gorkin Matiltan	Hydro	GoKPK	84	PC-1 Approved	Jul-24
24	Mangla (U #1-2)	Hydro	WAPDA	70	Mangla Refurbishment	Jul-24
25	Tarbela Ext5 (U #1)	Hydro	WAPDA	510	PC-1 Approved	Jul-24
26	Suki Kinari (U #2)	Hydro	PPIB	221	LOS (Issued)	Jul-24
27	CASA	Cross Border Interconnection	NTDC	1000	G2G	Aug-24
28	Tarbela Ext5 (U #2)	Hydro	WAPDA	510	PC-1 Approved	Aug-24
29	Shahtaj	Bagasse	AEDB	32	Category-I Project	Aug-24
30	Tarbela Ext5 (U #3)	Hydro	WAPDA	510	PC-1 Approved	Sep-24
31	Suki Kinari (U #3)	Hydro	PPIB	221	LOS (Issued)	Sep-24
32	Suki Kinari (U #4)	Hydro	PPIB	221	LOS (Issued)	Nov-24
33	Gwadar	Local Coal	PPIB	300	LOS (Issued)	Aug-25
34	Mangla (U #9-10)	Hydro	WAPDA	70	Mangla Refurbishment	Sep-25
35	Dasu (U #1)	Hydro	WAPDA	360	PC-1 Approved	May-26
36	Mohmand Dam (U #1)	Hydro	WAPDA	200	PC-1 Approved	May-26
37	Dasu (U #2)	Hydro	WAPDA	360	PC-1 Approved	Jul-26
38	Mohmand Dam (U #2)	Hydro	WAPDA	200	PC-1 Approved	Jul-26
39	Dasu (U #3)	Hydro	WAPDA	360	PC-1 Approved	Aug-26
40	Mohmand Dam (U #3)	Hydro	WAPDA	200	PC-1 Approved	Sep-26
41	Dasu (U #4)	Hydro	WAPDA	360	PC-1 Approved	Nov-26
42	Mangla (U #7-8)	Hydro	WAPDA	30	Mangla Refurbishment	Nov-26
43	Mohmand Dam (U #4)	Hydro	WAPDA	200	PC-1 Approved	Nov-26

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#	Name of Committed Project	Fuel Type	Agency	Installed Capacity (MW)	Status	Expected Schedule of Commissioning
44	Dasu (U #5)	Hydro	WAPDA	360	PC-1 Approved	Feb-27
45	Keyal Khwar (U #1)	Hydro	WAPDA	64	PC-1 Approved	Feb-27
46	Dasu (U #6)	Hydro	WAPDA	360	PC-1 Approved	May-27
47	Keyal Khwar (U #2)	Hydro	WAPDA	64	PC-1 Approved	May-27
48	Gabral Kalam	Hydro	GoKPK	88	PC-1 Approved	Nov-27
49	Madyan	Hydro	GoKPK	157	PC-1 Approved	Nov-27
50	Balakot	Hydro	GoKPK	300	PC-1 Approved	Dec-27
51	Azad Pattan (U #1)	Hydro	PPIB	175.18	LOS (Issued)	Dec-28
52	Azad Pattan (U #2)	Hydro	PPIB	175.18	LOS (Issued)	Mar-29
53	Azad Pattan (U #3)	Hydro	PPIB	175.18	LOS (Issued)	Jun-29
54	Azad Pattan (U #4)	Hydro	PPIB	175.18	LOS (Issued)	Sep-29
55	Kohala (U #1)	Hydro	PPIB	275.00	LOS (Issued)	Jun-30
56	Kohala (U #2)	Hydro	PPIB	275.00	LOS (Issued)	Aug-30
57	Kohala (U #3)	Hydro	PPIB	275.00	LOS (Issued)	Oct-30
58	Kohala (U #4)	Hydro	PPIB	275.00	LOS (Issued)	Dec-30
59	Kohala (U #5)	Hydro	PPIB	12.00	LOS (Issued)	Feb-31
60	Kohala (U #6)	Hydro	PPIB	12.00	LOS (Issued)	Mar-31
Total Committed (MW)				14,159		
61	Net Meter	PV	AEDB	480	Committed	Jul-22
62	Net Meter	PV	AEDB	480	Committed	Jul-23
63	Net Meter	PV	AEDB	480	Committed	Jul-24
64	Net Meter	PV	AEDB	480	Committed	Jul-25
65	Net Meter	PV	AEDB	480	Committed	Jul-26

#	Name of Committed Project	Fuel Type	Agency	Installed Capacity (MW)	Status	Expected Schedule of Commissioning
66	Net Meter	PV	AEDB	480	Committed	Jul-27
67	Net Meter	PV	AEDB	480	Committed	Jul-28
68	Net Meter	PV	AEDB	480	Committed	Jul-29
69	Net Meter	PV	AEDB	480	Committed	Jul-30
Total Net Meter (MW_p)				4,320		

5.10. New Generation Options

The candidate generation technologies, selected to be fed into the model, are as follows:

For NTDC system:

- a. Steam PP on Thar Coal (660 MW); reference – Engro Thar CFPP / TCEB and CAPEX from upfront local coal tariff 2017
- b. Gas Turbine on RLNG (400 MW); reference – Trimmu Open Cycle (operational data) and CAPEX as per data available with international resource (JICA)
- c. Nuclear Steam PP on Uranium (1,200 MW); reference - PAEC candidate
- d. Wind Turbine
 - i. 500 MW each in July 2024 & July 2025, no limit from July 2027 onwards;
 - ii. Reference cost and parameters – as provided by AEDB, subject to approval by NEPRA
- e. Solar PV
 - i. Utility scale: 3,120 MW_p in July 2024, 1,300 MW_p yearly from July 2025 onwards
 - ii. Feeder Based (DG): 500 MW_p in July 2023, 750 MW_p each in July 2024 & July 2025
 - iii. Net Metering: 480 MW_p yearly from July 2022 onwards
 - iv. Reference cost and parameters – as provided by AEDB, subject to approval by NEPRA
- f. Bagasse (Block of ≤ 100 MW); reference – operational parameters -Upfront Tariff 2017 and CAPEX from Shahtaj
- g. Jamshoro Imported Coal Unit-2 (660 MW) – GENCOs candidate
- h. C-5 Nuclear Power Project (1,200 MW) – PAEC candidate
- i. Steam PP on Thar Coal (330 MW); reference – Siddiqsons CFPP and TCEB

For K-Electric system:

- a. Steam PP on Thar Coal (330 MW); reference – Siddiqsons CFPP and TCEB
- b. Wind Turbine (Block of ≤ 50 MW); reference cost and parameters – as provided by AEDB, subject to approval by NEPRA
- c. Solar PV (Block of ≤ 150 MW_p); reference cost and parameters – as provided by AEDB, subject to approval by NEPRA

5.11. Hydro Projects and Screening

Data for hydro power projects was obtained from the relevant project executing agencies. A total of 46 Hydro Candidates are given to the model for optimization. The candidate hydel projects considered for optimization with their Indexed Capital Cost and Annualized Cost as per latest NEPRA available indexation are presented in Annexure B-3 & Annexure B-5 respectively.

5.12. Performance Characteristics of Generic Thermal Candidates

Generic Candidate thermal options include Gas Turbines (GTs) using RLNG and Steam Turbines (STs) using Local Coal and Nuclear Fuel. In order to develop a least cost generation expansion plan, it is necessary to examine the economic viability of each thermal option and select the least cost supply options taking into account technical characteristics, economic and financial parameters and operational requirements. Table 5-5 shows the performance characteristics of the thermal candidate projects.

Table 5-5: Performance Characteristics of Generic Thermal Power Projects

Performance Characteristics		Jamshoro Coal Fired Steam Unit-II	Coal Fired Steam at Thar	Coal Fired Steam at Thar-K-Electric	Coal Fired Steam-II at Thar	Combustion Turbine on RLNG	Generic Nuclear PP	Bagasse
A	Installed Capacity (MW)	660	660	330	330	400	1,200	100
B	Net Capacity (MW)	627	607	304	304	396	1,111	100
Technical Parameters								
C	Heat Rate (GJ/MWh)	9.11	9.23	9.73	9.23	9.46	9.57	12.68
D	Scheduled Outage (d/year)	36	36	36	36	30	35	-
E	Forced Outage (Hours %)	6.78	6.8	6.8	6.8	4.8	1.2	-

Performance Characteristics		Jamshoro Coal Fired Steam Unit-II	Coal Fired Steam at Thar	Coal Fired Steam at Thar-K-Electric	Coal Fired Steam-II at Thar	Combustion Turbine on RLNG	Generic Nuclear PP	Bagasse
F	Economic Life (years)	30	30	30	30	30	60	30
O&M								
G	Fixed FCC (\$/Ton)	-	11.2	11.2	11.2	-	-	-
H	Fixed (\$/kW-year)	5.06	26.6 + 71.81*	26.6 + 71.81*	25.17 + 71.81*	13.29	73.89	19.23
I	Variable (\$/MWh)	2.85	6.21	6.17	5.93	3.14	-	3.29
J	CAPEX (\$/kW)	669	1,419	1,419	1,419	476	4,319	809
K	Earliest availability (year)	2028	2027	2027	2027	2025	2030	2025

*Fixed Fuel Cost Component (FCC)

All candidate thermal technologies are assessed and ranked in terms of annualized unit cost by using screening curve analysis. Screening curves are used to determine the best possible technology to be inducted at a particular time frame from the available supply options. Two types of screening curves are given below:

- Annualized Cost (\$/kW/year) - Screening Curve (Annexure B-4.1)
- Unit Generation Cost (cents/kWh) - Screening Curve (Annexure B-4.2)

Although the mechanism of project selection by the tool is done through complex computations and optimization techniques, however, these curves give the generic idea / trend about the selection / viability of different candidate thermal power projects at various project factors.

These curves are the plots of unit generation cost on the y-axis and the project capacity factors on the x-axis. The total cost includes the annual capital recovery factor, fuel cost and annual O&M cost. The projects are ranked for each range of operating factors i.e., base load, intermediate and peak load operation. The project ranked lowest is introduced / selected first and remaining projects follow based on increasing order of merit / rank as per the system requirement.

5.13. Parameters of the Candidate REs

RE generation options including Solar PV, Wind, Battery Energy Storage System (BESS), hybrid and bagasse-based projects are other viable generation options. In this perspective,

hybrid technologies are also to be modelled as candidate along with solar PV and wind, subject to data provision by the relevant agencies. In this regard, in response to NTDC's request to relevant agencies, AEDB has launched a technical & financial feasibility study for this purpose. Based on the output of the study, hybrid RE technologies will be considered for the next iteration of the IGCEP.

Consequently, due to non-availability of data (cost, hourly profile, etc.), hybrid technologies are not modelled in the current iteration of the IGCEP. Table 5-6 shows the parameters of the candidate wind and solar PV projects.

Table 5-6: Parameters of Candidate Wind and Solar PV Projects

#	Technology	Installed Capacity	Earliest Availability	FO&M	Installed Cost	Annual Energy	Project Factor	Annualized Cost of Energy	
		(MW)	(Year)	(\$/kW-Yr)	(\$/kW)	(GWh)	(%)	(c/kWh)	(\$/kW-Yr)
1	Solar PV Utility*	100	2025	7.19	638	193.39	22.1%	4.0	77.44
2	Solar Feeder (DG)*	100	2024	7.19	571	175.20	20%	4.0	70.08
3	Wind	100	2025	17.53	1,177	367.92	42%	4.0	147.17

*Solar values are in MW_p

6. THE IGCEP STUDY OUTPUT

6. The IGCEP Study Output

6.1. Introduction

The key objective of IGCEP is to develop a least cost, 10-year indicative generation expansion plan for the whole country to meet the load and energy demand in a reliable and sustainable manner while maximizing use of indigenous resources. NTDC prepares this IGCEP every year to meet its regulatory requirement, as stipulated in the Planning Code 4 of the prevailing Grid Code, which takes into account the Assumption Sets as mentioned in section 5.2 and assumptions laid down in NEP. The plan is to be reviewed and approved by NEPRA – the electricity regulator. The following section describes the key parameters and results of the generation planning study.

6.2. Defining Base Case

Major features of the Base Case are as follows:

- a. Assumption Sets as mentioned in section 5.2 and assumptions laid down in NEP
- b. GDP projections by World Bank (average GDP growth rate 4.30%)
- c. Normal scenario of long-term load forecast
- d. Existing contractual obligations - maintained till the end of contract

6.3. Other Scenarios

In addition to the base case, following scenarios have also been simulated through this study:

a. Scenario - I: Low Demand Scenario

All other parameters are same as those of the base case except for the demand numbers i.e., the average GDP growth rate of 3.40% has been used to devise load demand forecast till 2031. The results are attached as Annexure – C.

b. Scenario - II: High Demand Scenario

All other parameters are same as those of base case except for the demand numbers i.e., the average GDP growth rate of 5.42% has been used to devise load demand forecast till 2031. The results are attached as Annexure – D.

c. Scenario - III: Diamer Bhasha HPP in 2029

Although Diamer Bhasha HPP is not considered in the Base case, owing to its COD beyond study horizon, however a sensitivity analysis has been carried out by considering Diamer Bhasha HPP as a committed power project with CAPEX in the year 2029. The results are attached as Annexure – E.

d. Scenario - IV: Chashma Nuclear (C-5) for Energy Security

Although Chashma Nuclear (C-5) is considered as a candidate project in the Base case but this sensitivity analysis has been carried out by considering Chashma Nuclear (C-5) as a

committed power project with CAPEX in the year 2029. The results are attached as Annexure – F.

e. Scenario – V: Local Coal inclusion in 2027 and 2030

Although generic local coal-based project is considered as a candidate project in the Base case but this sensitivity analysis has been carried out by considering 1,320 MW of domestic coal-based projects as a committed power project with CAPEX in the year 2027 & 2030. The results are attached as Annexure – G.

f. Scenario – VI: Unconstrained VRE Scenario

All other parameters are same as those of the base case except candidate utility solar PV and Wind power projects are unconstrained i.e., no annual limit. However, only 2,000 MW_p solar feeder-based/DG is considered as candidate throughout the study horizon (starting from July 2023). The results are attached as Annexure – H.

6.4. Future Demand and Capacity Additions

Chart 6-1 depicts the relationship between the projected peak demand of the system and the future installed capacity of the system, in terms of different types of energy sources for the period 2022 – 2031. It is evident that the trend of the demand is similar to the capacity additions as both are increasing in the positive direction and there is gradual increment during the horizon of this plan. In the year 2022-23, the installed capacity of the whole country from all generation sources will be around 43,259 MW and the demand will be equal to 28,425 MW whereas in 2030-31, and installed capacity will be 69,372 MW and demand will be equal to 41,338 MW. Chart 6-1 shows that sufficient generation shall be added to satisfy the specified reliability criteria and reserve requirements of the system.

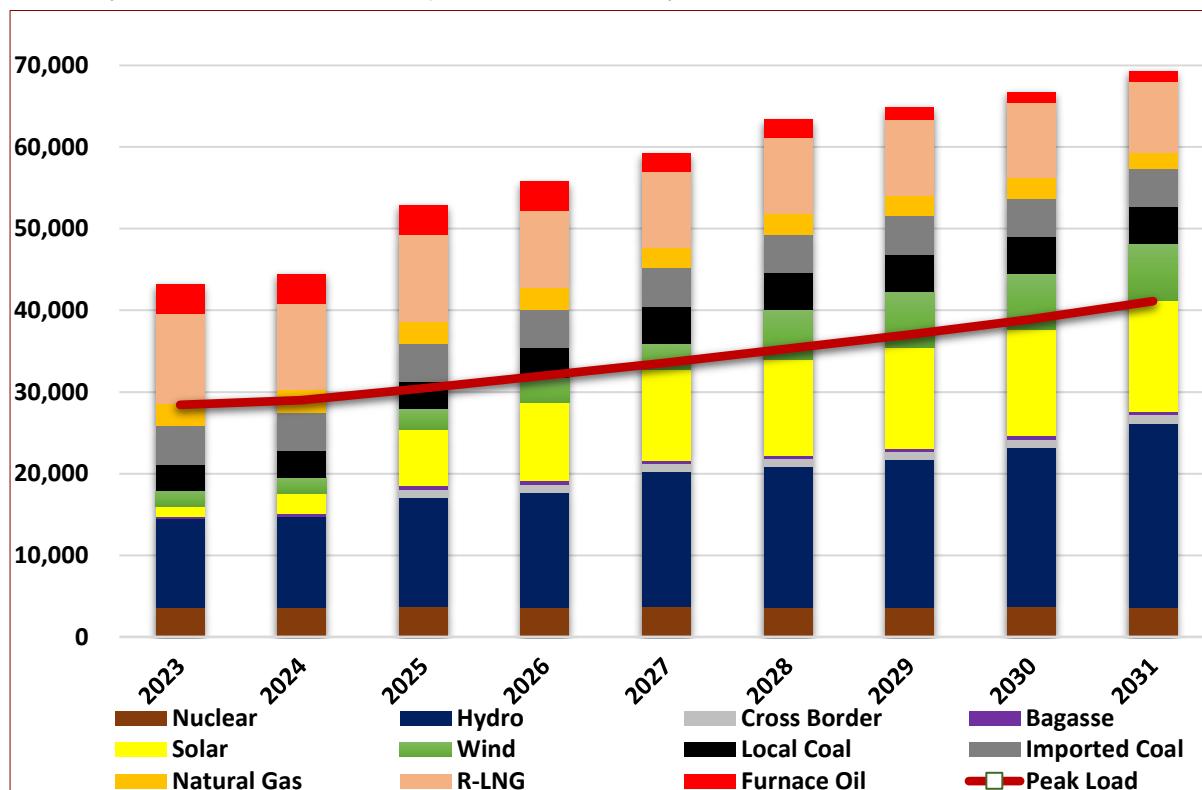


Chart 6-1: Installed Capacity vs Peak Demand (MW) 2022-23 to 2030-2031

On the other hand, energy generation by the power projects in the country has been optimized with the energy forecast by the year 2030-31 as shown in Chart 6-2. By the year 2030-31, 228,505 GWh of the energy demand is met, in which 61% of energy generation is contributed by RE sources comprising of 41%, by hydro and 10% each by wind and solar PV, respectively and remaining 39% is provided by conventional thermal sources.

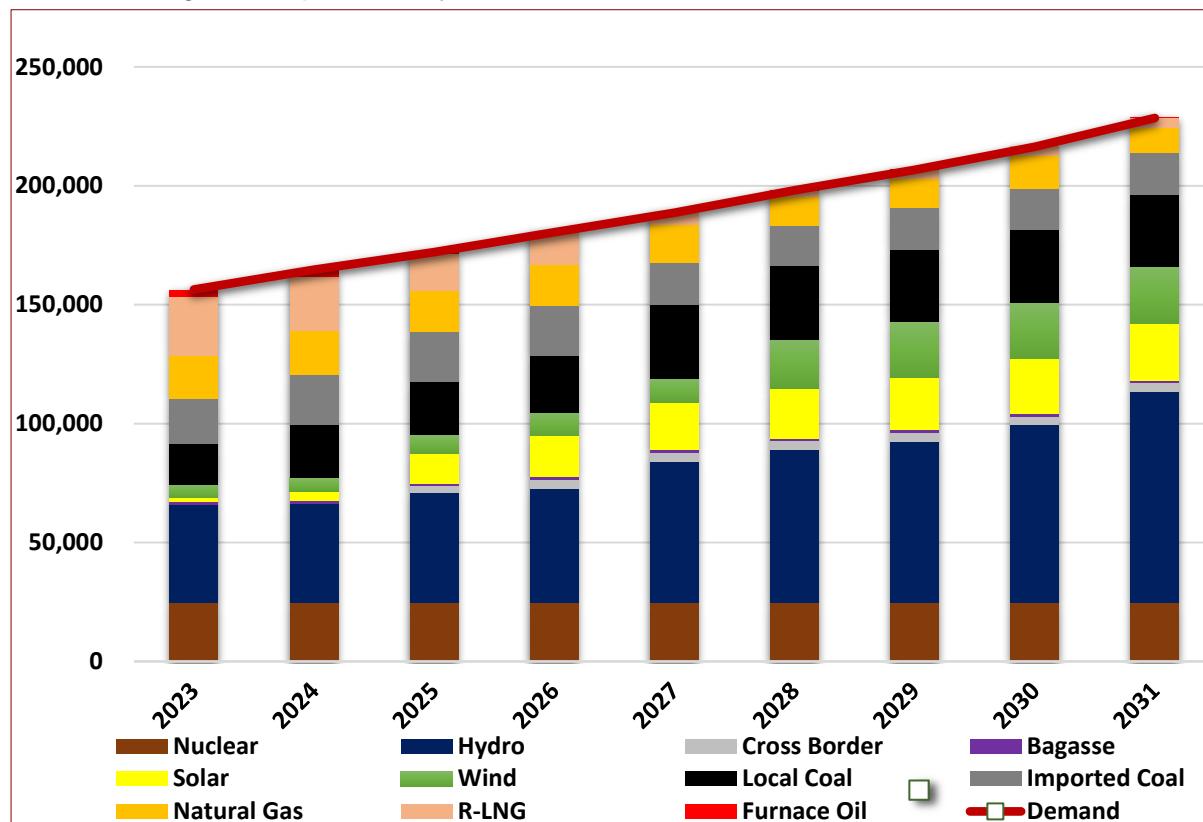


Chart 6-2: Annual Energy Generation vs Demand (GWh) 2022-23 to 2030-31

Chart 6-3 shows the total share of the existing, committed and optimized power projects in the installed capacity for the next nine years, starting from 2022-23 to the year 2030-31.

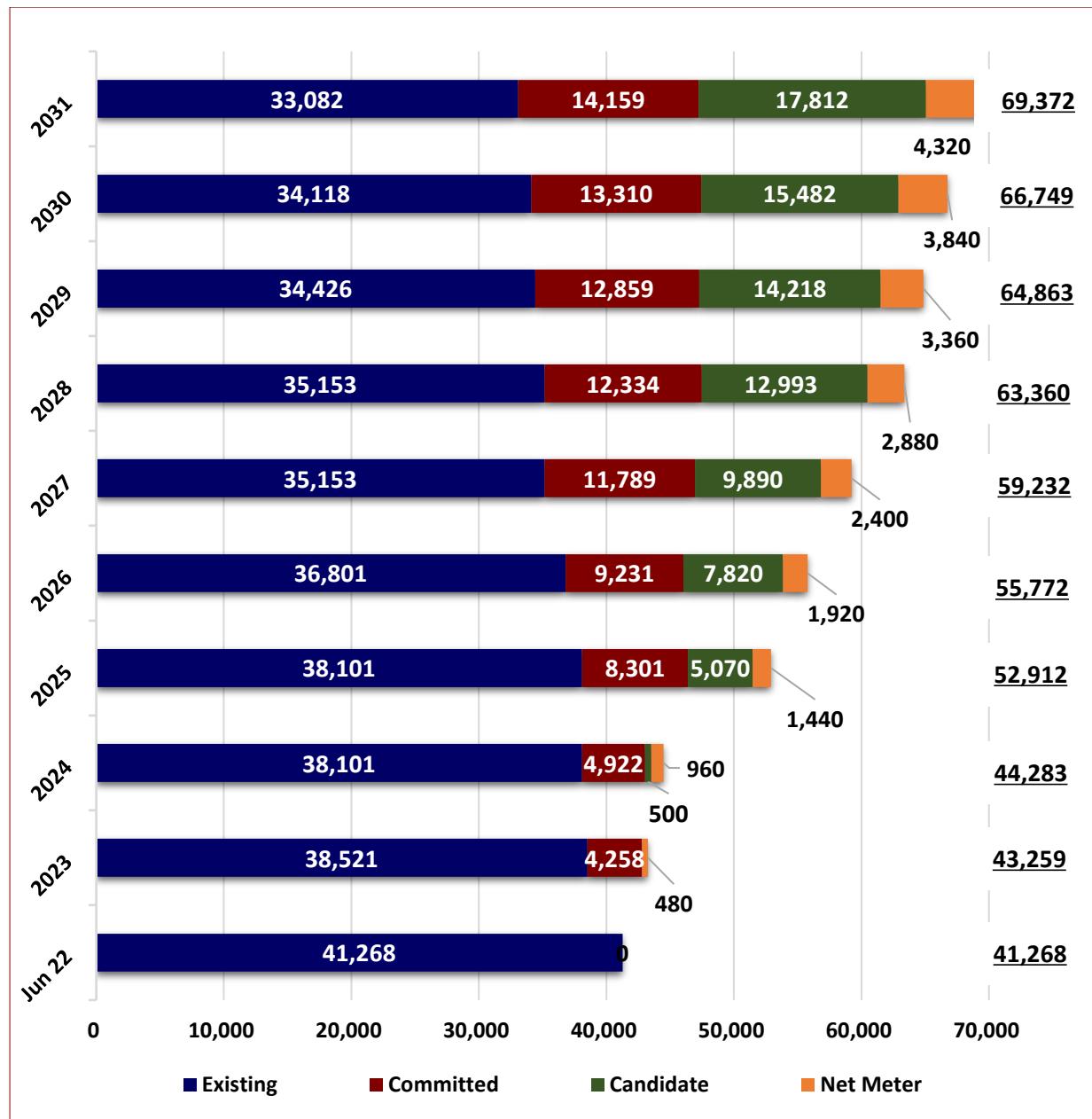


Chart 6-3: Share of Total Installed capacity (MW) 2022-31

Table 6-1: Optimized Generation Capacity Additions (2024-31)

Fiscal Year	Coal Fired Steam Local Coal	Coal Fired Steam Local Coal KE	HPP	HPP KE	Solar Utility MW _p	Solar Feeder/DG MW _p	Solar KE MW _p	Wind NTDC	Wind KE	Bagasse	Per Year Capacity Addition	Cumulative Capacity Addition
2024	-	-	-	-	-	500	-	-	-	-	500	500
2025	-	-	-	-	3,120	750	150	500	50	-	4,570	5,070
2026	-	-	-	-	1,300	750	150	500	50	-	2,750	7,820
2027	-	990	-	-	880	-	150	-	50	-	2,070	9,890
2028	-	-	-	-	-	-	150	2,903	50	-	3,103	12,993
2029	-	-	350	-	-	-	150	675	50	-	1,225	14,218
2030	-	-	981	82	-	-	150	-	50	-	1,263	15,482
2031	-	-	2,130	-	-	-	150	-	50	-	2,330	17,812
Total	-	990	3,461	82	5,300	2,000	1,050	4,578	350	-	17,812	

	Solar DG 500		KE Wind 50			KE Wind 50				
	Net Meter 480	KE Wind 50	Wind 500	KE Local Coal 990		Wind 676				
	Net Meter 480	Trans Atlantic 50	Wind 500	KE Solar 150	KE Wind 50		KE Solar 150			
Thar-I 1320	Western 50	KE Solar 150	Solar Utility 1300	KE Solar 150	KE Wind 50	Chowkel Khwar 60	KE Wind 50			
Thal Nova 330	Zorlu 100	Solar Utility 3120	Solar DG 750	Solar Utility 880	Wind 2903	Bata Kundi 99	KE Solar 150	KE Wind 50		
Thar TEL 330	Siachen 100	Solar DG 750	Net Meter 480	Net Meter 480	KE Solar 150	CJ 25	Turtonas Uzghor 82	KE Solar 150		
Jam-U-I 660	Manjhand 50	Net Meter 480	Gwadar 300	Keyal Khwar U1-2 128	Net Meter 480	31.3	Hydro-III 981	Mahl 640		
Trimmu 1263	Jagran II U3- 4 24	Shahtaj 32	Dasu U1 360	Mangla (U #7-8) 30	Gabral Kalam 88	Taunsa 135	Net Meter 480	Thakot-III 1490		
Solar-I 150	Lawi 69	CASA 1,000	Mangla U9-10 70	Mohmand U2-4 600	Madyan 157	Net Meter 480	Kohala U1 275	Net Meter 480		
Hydro-I 205	Suki Kinari I 221	Hydro-II 2,347	Mohmand U1 200	Dasu U2-6 1,800	Balakot 300	Azad Pattan U1-3 526	Azad Pattan U4 175	Kohala U2-6 849		
Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	
Committed	4,258	664	3,379	930	2,558	545	526	450	849	14,159
Candidate	0	500	4,570	2,750	2,070	3,103	1,226	1,263	2,330	17,812
Net Meter	480	480	480	480	480	480	480	480	480	4,320
Total	4,738	1,644	8,429	4,160	5,108	4,128	2,232	2,193	3,659	36,292

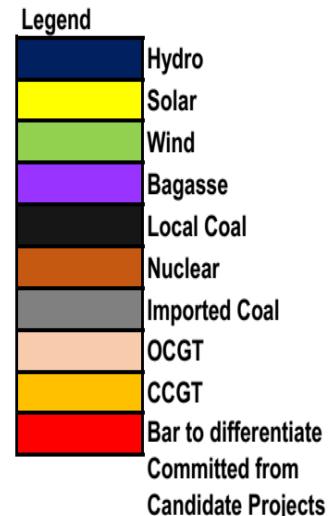


Figure 6-1: IGCEP 2022-31 Generation Sequence

Due to limited space, in Figure 6-1, several projects (Solar PV and Hydro) being commissioned in the same year are combined together in the form of blocks for the purpose of reporting. The detail of these blocks, is provided in Table 6-2.

Table-6-2: Break-up of Blocks

Sr.No.	Year	Block	Name of Project	Installed Capacity
				MW
1	2023	Hydro-I	Mangla (U #5-6)	70
2			Koto	41
3			Jagran-II (U #1-2)	24
4			Mangla (U #3-4)	70
		Sub Total		205
5		Solar-I	Helios	50
6			HNDS	50
7			Meridian	50
		Sub Total		150
Total (2023)				355
1	2025	Hydro-II	Mangla (U #1-2)	70
2			Gorkin Matiltan	84
3			Tarbela Ext5 (U #1-3)	1,530
4			Suki Kinari (U #2-4)	663
Total (2025)				2,347
1	2030	Hydro-III	Arkari Gol	99
2			Asrit Kedam	215
3			Dowarian	40
4			Jagran-IV	22
5			Kalam Asrit	238
6			Nagdar	35
7			Rajdhani	132
8			Sharmai	152.12
9			Shounter	48
Total (2030)				981

The final output of PLEXOS simulation, comprising year-wise addition of all committed and candidate power projects is given below in Table 6-3.

Table 6-3: PLEXOS Annual Addition of Power Projects 2023-2031

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2022-23							
1	Thar TEL	Local Coal	330	300	PPIB	LOS (Issued)	Commissioned
2	Net Meter	Solar	480	480	AEDB	Committed	Dec-22
3	Trimmu	CCGT_RLNG	1,263	1,243	PPIB	LOS (Issued)	Dec-22
4	Mangla (U #5-6)	Hydro	70	70	WAPDA	Mangla Refurbishment	Dec-22
5	Koto	Hydro	40.8	40.8	GoKPK	PC-1 Approved	Dec-22
6	Jamshoro Coal (U #1)	Imported Coal	660	627	GENCO	PC-1 Approved	Dec-22
7	Thal Nova	Local Coal	330	300	PPIB	LOS (Issued)	Dec-22
8	Thar-I (SSRL)	Local Coal	1,320	1,214	PPIB	LOS (Issued)	Dec-22
9	Jagran-II (U #1)	Hydro	12	12	AJK-HEB	PC-1 Approved	Apr-23
10	Helios	Solar	50	50	AEDB	Category-II Project	Apr-23
11	HNDS	Solar	50	50	AEDB	Category-II Project	Apr-23
12	Meridian	Solar	50	50	AEDB	Category-II Project	Apr-23
13	Mangla (U #3-4)	Hydro	70	70	WAPDA	Mangla Refurbishment	May-23
14	Jagran-II (U #2)	Hydro	12	12	AJK-HEB	PC-1 Approved	May-23
Generation Additions in 2022-23 (MW)			4,738	4,519			
Cumulative Addition up till 2023 (MW)			4,738	4,519			
2023-24							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-23
2	New_Solar_DG	Solar	500	500	Yet to be determined	Optimized	Jul-23
3	Jagran-II (U #3-4)	Hydro	24	24	AJK-HEB	PC-1 Approved	Jul-23
4	Siachen	Solar	100	100	GoS	Category-II Project	Sep-23
5	Manjhand	Solar	50	50	GoS	PC-1 Approved	Sep-23
6	Zorlu	Solar	100	100	PPDB	Category-II Project	Dec-23

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
7	Lawi	Hydro	69	69	GoKPK	PC-1 Approved	Apr-24
8	Suki Kinari (U #1)	Hydro	221	221	PPIB	LOS (Issued)	May-24
9	Trans_Atlantic	Wind	50	50	AEDB	Category-II Project	Jun-24
10	Western	Wind	50	50	AEDB	Category-II Project	Jun-24
Generation Additions in 2023-24 (MW)			1,644	1,644			
Cumulative Addition up till 2024 (MW)			6,382	6,163			
2024-25							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-24
2	Mangla (U #1-2)	Hydro	70	70	WAPDA	Mangla Refurbishment	Jul-24
3	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-24
4	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-24
5	New_Solar_DG	Solar	750	750	Yet to be determined	Optimized	Jul-24
6	New_Solar_Utility	Solar	3,120	3,120	Yet to be determined	Optimized	Jul-24
7	New_Wind	Wind	500	500	Yet to be determined	Optimized	Jul-24
8	Gorkin Matiltan	Hydro	84	84	GoKPK	PC-1 Approved	Jul-24
9	Tarbela Ext5 (U #1)	Hydro	510	510	WAPDA	PC-1 Approved	Jul-24
10	Suki Kinari (U #2)	Hydro	221	221	PPIB	LOS (Issued)	Jul-24
11	CASA	Cross Border Interconnection	1,000	1,000	NTDC	G2G	Aug-24
12	Tarbela Ext5 (U #2)	Hydro	510	510	WAPDA	PC-1 Approved	Aug-24
13	Shahtaj	Bagasse	32	32	AEDB	Category-I Project	Aug-24
14	Tarbela Ext5 (U #3)	Hydro	510	510	WAPDA	PC-1 Approved	Sep-24
15	Suki Kinari (U #3)	Hydro	221	221	PPIB	LOS (Issued)	Sep-24
16	Suki Kinari (U #4)	Hydro	221	221	PPIB	LOS (Issued)	Nov-24
Generation Additions in 2024-25 (MW)			8,429	8,429			
Cumulative Addition up till 2025 (MW)			14,811	14,592			

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2025-26							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-25
2	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-25
3	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-25
4	New_Solar_DG	Solar	750	750	Yet to be determined	Optimized	Jul-25
5	New_Solar_Utility	Solar	1,300	1,300	Yet to be determined	Optimized	Jul-25
6	New_Wind	Wind	500	500	Yet to be determined	Optimized	Jul-25
7	Gwadar	Local Coal	300	273	PPIB	LOS (Issued)	Aug-25
8	Mangla (U #9-10)	Hydro	70	70	WAPDA	Mangla Refurbishment	Sep-25
9	Dasu (U #1)	Hydro	360	360	WAPDA	PC-1 Approved	May-26
10	Mohmand Dam (U #1)	Hydro	200	200	WAPDA	PC-1 Approved	May-26
Generation Additions in 2025-26 (MW)			4,160	4,133			
Cumulative Addition up till 2026 (MW)			18,971	18,725			
2026-27							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-26
2	KE_New_Local Coal	Local Coal	990	912	Yet to be determined	Optimized	Jul-26
3	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-26
4	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-26
5	New_Solar_Utility	Solar	880	880	Yet to be determined	Optimized	Jul-26
6	Dasu (U #2)	Hydro	360	360	WAPDA	PC-1 Approved	Jul-26
7	Mohmand Dam (U #2)	Hydro	200	200	WAPDA	PC-1 Approved	Jul-26
8	Dasu (U #3)	Hydro	360	360	WAPDA	PC-1 Approved	Aug-26
9	Mohmand Dam (U #3)	Hydro	200	200	WAPDA	PC-1 Approved	Sep-26
10	Mangla (U #7-8)	Hydro	30	30	WAPDA	Mangla Refurbishment	Nov-26
11	Dasu (U #4)	Hydro	360	360	WAPDA	PC-1 Approved	Nov-26

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
12	Mohmand Dam (U #4)	Hydro	200	200	WAPDA	PC-1 Approved	Nov-26
13	Dasu (U #5)	Hydro	360	360	WAPDA	PC-1 Approved	Feb-27
14	Keyal Khwar (U #1)	Hydro	64	64	WAPDA	PC-1 Approved	Feb-27
15	Dasu (U #6)	Hydro	360	360	WAPDA	PC-1 Approved	May-27
16	Keyal Khwar (U #2)	Hydro	64	64	WAPDA	PC-1 Approved	May-27
Generation Additions in 2026-27 (MW)		5,108	5,030				
Cumulative Addition up till 2027 (MW)		24,079	23,755				
2027-28							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-27
2	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-27
3	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-27
4	New_Wind	Wind	2,903	2,903	Yet to be determined	Optimized	Jul-27
5	Gabral Kalam	Hydro	88	88	GoKPK	PC-1 Approved	Nov-27
6	Madyan	Hydro	157	157	GoKPK	PC-1 Approved	Nov-27
7	Balakot	Hydro	300	300	GoKPK	PC-1 Approved	Dec-27
Generation Additions in 2027-28 (MW)		4,128	4,128				
Cumulative Addition up till 2028 (MW)		28,207	27,883				
2028-29							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-28
2	Bata Kundti	Hydro	99	99	GoKPK	Optimized	Jul-28
3	Chowkel Khwar	Hydro	60	60	PEDO	Optimized	Jul-28
4	CJ	Hydro	25	25	PPDB	Optimized	Jul-28
5	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-28
6	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-28
7	New_Wind	Wind	676	676	Yet to be determined	Optimized	Jul-28

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#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
8	Nila Da Katha	Hydro	31.3	31.3	PEDO	Optimized	Jul-28
9	Taunsa	Hydro	135	135	PPDB	Optimized	Jul-28
10	Azad Pattan (U #1)	Hydro	175	175	PPIB	LOS (Issued)	Dec-28
11	Azad Pattan (U #2)	Hydro	175	175	PPIB	LOS (Issued)	Mar-29
12	Azad Pattan (U #3)	Hydro	175	175	PPIB	LOS (Issued)	Jun-29
Generation Additions in 2028-29 (MW)		2,232	2,232				
Cumulative Addition up till 2029 (MW)		30,439	30,115				
2029-30							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-29
2	Arkari Gol	Hydro	99	99	PEDO	Optimized	Jul-29
3	Asrit Kedam	Hydro	215	215	PEDO	Optimized	Jul-29
4	Dowarian	Hydro	40	40	AJK-HEB	Optimized	Jul-29
5	Jagran-IV	Hydro	22	22	AJK-HEB	Optimized	Jul-29
6	Kalam Asrit	Hydro	238	238	PEDO	Optimized	Jul-29
7	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-29
8	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-29
9	Nagdar	Hydro	35	35	AJK-HEB	Optimized	Jul-29
10	Rajdhani	Hydro	132	132	PPIB	Optimized	Jul-29
11	Sharmai	Hydro	152.12	152.12	PEDO	Optimized	Jul-29
12	Shounter	Hydro	48	48	AJK-HEB	Optimized	Jul-29
13	Turtonas Uzghor	Hydro	82.25	82.25	KE	Optimized	Jul-29
14	Azad Pattan (U #4)	Hydro	175	175	PPIB	LOS (Issued)	Sep-29
15	Kohala (U #1)	Hydro	275	275	PPIB	LOS (Issued)	Jun-30
Generation Additions in 2029-30 (MW)		2,194	2,194				
Cumulative Addition up till 2030 (MW)		32,632	32,308				

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2030-31							
1	Mahl	Hydro	640	640	PPIB	Optimized	Jul-30
2	Thakot-III	Hydro	1,490	1,490	WAPDA	Optimized	Jul-30
3	Net Meter	Solar	480	480	AEDB	Committed	Jul-30
4	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-30
5	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-30
6	Kohala (U #2)	Hydro	275	275	PPIB	LOS (Issued)	Aug-30
7	Kohala (U #3)	Hydro	275	275	PPIB	LOS (Issued)	Oct-30
8	Kohala (U #4)	Hydro	275	275	PPIB	LOS (Issued)	Dec-30
9	Kohala (U #5)	Hydro	12	12	PPIB	LOS (Issued)	Feb-31
10	Kohala (U #6)	Hydro	12	12	PPIB	LOS (Issued)	Mar-31
Generation Additions in 2030-31 (MW)			3,659	3,659			
Cumulative Addition up till 2031 (MW)			36,291	35,967			

*Solar values are in MW_p

6.5. Annual Capacity Factors

The annual capacity factors information based on the Installed Capacity for the corresponding year, as shows in the Table 6-4.

Table 6-4: Annual Capacity Factors (%)age)

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
1	Almoiz	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
2	Chanar	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
3	Chiniot	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
4	Fatima	Bagasse	6.53	6.55	6.53	6.48	6.26	6.25	6.23	5.95	5.90
5	Hamza	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
6	JDW-II	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
7	JDW-III	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
8	Ryk_Mills	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
9	Shahtaj	Bagasse	0.00	0.00	45.77	45.62	45.62	45.77	45.62	45.62	45.62
10	Thal_Layyah	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
11	Appolo	PV	18.96	18.91	18.96	18.96	18.96	18.91	18.96	18.96	18.96
12	Best	PV	18.94	18.89	18.94	18.94	18.94	18.89	18.94	18.94	18.94
13	Crest	PV	19.19	19.13	19.19	19.19	19.19	19.13	19.19	19.19	19.19
14	Helios	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
15	HNDS	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
16	Manjhand	PV	0.00	23.23	23.33	23.33	23.33	23.27	23.33	23.33	23.33
17	Meridian	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
18	Net_Meter	PV	17.08	17.03	17.08	17.08	17.08	17.03	17.08	17.08	17.08
19	New_Solar	PV	0.00	0.00	22.08	22.08	22.08	22.02	22.08	22.08	22.08
20	New_Solar_Feeder	PV	0.00	19.95	20.00	20.00	20.00	19.95	20.00	20.00	20.00
21	QA_Solar	PV	19.04	18.99	19.04	19.04	19.04	18.99	19.04	19.04	19.04
22	Siachen	PV	0.00	23.23	23.33	23.33	23.33	23.27	23.33	23.33	23.33
23	Zhenfa	PV	21.50	21.44	21.50	21.50	21.44	21.50	21.50	21.50	21.50
24	Zorlu	PV	0.00	20.86	20.17	20.17	20.17	20.11	20.17	20.17	20.17
25	Gharo	KE_PV	25.25	25.18	25.25	25.25	25.25	25.18	25.25	25.25	25.25
26	KE_New_Solar	KE_PV	0.00	0.00	22.08	22.08	22.08	22.02	22.08	22.08	22.08
27	Oursun	KE_PV	20.97	20.91	20.97	20.97	20.97	20.91	20.97	20.97	20.97
28	Act	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
29	Act_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
30	Artistic_wind	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
31	Artistic_Wind_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
32	Dawood	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
33	Din	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
34	FFC	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
35	FWEL-I	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
36	FWEL-II	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
37	Gul Ahmed	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
38	Gul_Electric	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
39	Hawa	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
40	Indus_Energy	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
41	Jhimpir	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
42	Lakeside	Wind	38.93	38.07	38.17	38.17	38.17	38.07	38.17	38.17	38.17
43	Liberty_Wind_1	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
44	Liberty_Wind_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
45	Master	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
46	Master_Green	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
47	Metro_Power	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
48	Metro_Wind	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
49	NASDA	Wind	38.93	38.07	38.17	38.17	38.17	38.07	38.17	38.17	38.17
50	New_Wind	Wind	0.00	0.00	41.28	41.28	41.28	41.17	41.28	41.28	41.28
51	Sachal	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
52	Sapphire_Wind	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
53	Tenaga	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
54	Three_Gorges_I	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
55	Three_Gorges_II	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
56	Three_Gorges_III	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
57	Trans_Atlantic	Wind	0.00	41.28	41.28	41.28	41.28	41.17	41.28	41.28	41.28
58	Tricom	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
59	Tricon_A	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
60	Tricon_B	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
61	Tricon_C	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
62	UEP	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
63	Western	Wind	0.00	37.19	37.19	37.19	37.19	37.09	37.19	37.19	37.19
64	Yunus	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
65	Zephyr	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
66	Zorlu_Wind	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
67	KE_New_Wind	KE_Wind	0.00	0.00	41.28	41.28	41.28	41.17	41.28	41.28	41.28
68	CASA	Interconnection	0.00	0.00	41.92	41.92	41.92	41.80	41.92	41.92	41.92
69	Arkari Gol	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.22	42.22
70	Asrit Kedam	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.72	49.72
71	Bata Kundu	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	54.76	54.76	54.79
72	Chowkel Khwar	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	44.57	44.57	44.57
73	CJ	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	50.50	50.50	50.50
74	Dowarian	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.85	48.85
75	Jagran-IV	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.09	49.09
76	Kalam Asrit	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.41	44.41
77	Mahl	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.53
78	Nagdar	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.87	48.87
79	Nila Da Katha	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	51.31	51.31	51.31
80	Rajdhani	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.46	58.46
81	Sharmai	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.94	50.94
82	Shounter	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.86	48.86

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#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% 								
83	Taunsa	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	55.02	55.02	55.02
84	Thakot-III	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.28
85	Turtonas Uzghor	KE_HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.85	51.89
86	Azad Pattan	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	52.77	52.77	52.77
87	Balakot	HPP Committed	0.00	0.00	0.00	0.00	0.00	41.21	41.21	41.21	41.21
88	Dasu	HPP Committed	0.00	0.00	0.00	64.47	64.47	64.29	64.47	64.47	64.47
89	Diamer Bhasha	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	Gabral Kalam	HPP Committed	0.00	0.00	0.00	0.00	0.00	33.77	33.77	33.77	33.77
91	Gorkin Matiltan	HPP Committed	0.00	0.00	42.83	42.83	42.83	42.71	42.83	42.83	42.83
92	Jagran-II	HPP Committed	50.39	50.39	50.53	50.53	50.53	50.39	50.53	50.53	50.53
93	Karot	HPP Committed	44.38	44.29	44.39	44.39	44.39	44.29	44.38	44.38	44.39
94	Keyal Khwar	HPP Committed	0.00	0.00	0.00	0.00	52.07	51.92	52.07	52.07	52.07
95	Kohala	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.14	56.14
96	Koto	HPP Committed	57.12	57.08	57.24	57.19	57.19	56.96	57.12	57.12	57.19
97	Lawi	HPP Committed	0.00	47.99	48.10	48.05	48.05	47.90	47.99	47.99	48.05
98	Madyan	HPP Committed	0.00	0.00	0.00	0.00	0.00	47.43	47.43	47.43	47.43
99	Mohmand Dam	HPP Committed	0.00	0.00	0.00	42.60	42.71	42.60	42.71	42.71	42.71
100	Suki Kinari	HPP Committed	0.00	48.93	49.07	49.07	49.07	48.93	49.07	49.07	49.07
101	Tarbela_Ext_5	HPP Committed	0.00	0.00	10.05	10.05	10.05	10.02	10.05	10.05	10.05
102	Allai Khwar	HPP Existing	44.25	44.20	44.32	44.32	44.32	44.20	44.32	44.32	44.32
103	Chashma	HPP Existing	48.58	48.45	48.58	48.58	48.58	48.45	48.58	48.58	48.58
104	Daral Khwar	HPP Existing	38.58	38.48	38.58	38.58	38.58	38.48	38.58	38.58	38.58
105	Dubair Khwar	HPP Existing	53.09	52.95	53.09	53.09	53.09	52.95	53.09	53.09	53.09
106	Ghazi Brotha	HPP Existing	52.78	52.63	52.78	52.78	52.78	52.63	52.78	52.78	52.78
107	Golen Gol	HPP Existing	9.15	9.12	9.15	9.15	9.15	9.12	9.15	9.15	9.15
108	Gulpur	HPP Existing	28.92	28.84	28.92	28.92	28.92	28.84	28.92	28.92	28.92
109	Jagran-I	HPP Existing	48.95	48.82	48.95	48.95	48.95	48.82	48.95	48.95	48.95
110	Jinnah	HPP Existing	25.74	25.67	25.74	25.74	25.74	25.67	25.74	25.74	25.74
111	Khan Khwar	HPP Existing	40.22	40.11	40.22	40.22	40.22	40.11	40.22	40.22	40.22
112	Malakand-III	HPP Existing	53.86	53.71	53.86	53.86	53.86	53.71	53.86	53.86	53.86
113	Mangla	HPP Existing	64.96	60.97	58.32	56.00	54.77	54.20	54.35	54.35	54.35
114	Neelum Jehlum	HPP Existing	51.69	51.54	51.69	51.69	51.69	51.54	51.69	51.69	51.69
115	New Bong	HPP Existing	55.49	55.34	55.49	55.49	55.49	55.34	55.49	55.49	55.49
116	Patrind	HPP Existing	43.76	43.64	43.76	43.76	43.76	43.64	43.76	43.76	43.76
117	Small Hydel	HPP Existing	45.02	44.90	45.02	45.02	45.02	44.90	45.02	45.02	45.02
118	Tarbela 1-14	HPP Existing	37.99	37.89	37.99	37.99	37.99	37.89	37.99	37.99	37.99
119	Tarbela_Ext_4	HPP Existing	30.12	30.04	30.12	30.12	30.12	30.04	30.12	30.12	30.12
120	Warsak	HPP Existing	50.64	50.50	50.64	50.64	50.64	50.50	50.64	50.64	50.64
121	Engro 90MW	CCGT_Gas	90.23	74.96	62.46	50.73	70.05	35.76	32.45	31.19	27.20
122	Foundation	CCGT_Gas	89.97	90.25	90.00	89.66	81.80	57.94	77.96	82.39	70.70
123	Guddu-I	CCGT_Gas	36.90	74.63	74.43	74.42	69.44	61.12	71.38	68.46	67.60
124	Guddu-II	CCGT_Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
125	Guddu-V (747)	CCGT_Gas	75.56	75.77	75.56	75.53	73.74	72.97	72.86	70.07	69.47

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
126	Liberty	CCGT_Gas	75.26	75.02	45.55	46.09	0.00	0.00	0.00	0.00	0.00
127	Uch	CCGT_Gas	86.08	86.32	86.08	85.39	79.23	43.56	44.57	47.72	0.00
128	Uch-II	CCGT_Gas	87.77	88.05	87.81	87.17	79.25	51.33	51.33	74.19	51.32
129	SNPC-I	KE_CCGT_Gas	91.98	92.25	91.96	91.34	83.10	35.39	40.97	85.56	41.10
130	SNPC-II	KE_CCGT_Gas	91.98	92.25	91.96	91.42	83.10	36.87	51.77	85.56	42.55
131	AES Lalpir	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
132	AES Pakgen	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
133	HUBCO	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
134	Jamshoro-I U1	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
135	Jamshoro-II U4	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
136	Muzaffargarh-I U1	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
137	Muzaffargarh-I U2	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
138	Muzaffargarh-I U3	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
139	Muzaffargarh-II U4	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
140	Saba	ST_RFO	14.38	21.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00
141	AGL	DG_RFO	36.12	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00
142	Atlas	DG_RFO	14.40	21.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
143	Engro 127MW	DG_RFO	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
144	HuB N	DG_RFO	36.12	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00
145	Kohinoor	DG_RFO	14.39	21.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
146	Liberty Tech	DG_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
147	Nishat C	DG_RFO	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
148	Nishat P	DG_RFO	36.81	22.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
149	C-1	Nuclear	80.43	80.65	80.43	80.43	80.43	80.65	80.43	80.43	80.43
150	C-2	Nuclear	79.61	79.83	79.61	79.61	79.61	79.83	79.61	79.61	79.61
151	C-3	Nuclear	81.01	81.23	81.01	81.01	81.01	81.23	81.01	81.01	81.01
152	C-4	Nuclear	81.01	81.23	81.01	81.01	81.01	81.23	81.01	81.01	81.01
153	K-2	Nuclear	85.06	85.30	85.07	85.06	85.06	85.29	85.05	85.05	85.05
154	K-3	Nuclear	85.66	85.90	85.67	85.66	85.66	85.89	85.65	85.65	85.65
155	Engro Thar	Local Coal	82.51	82.74	82.51	82.50	81.89	80.40	80.07	80.60	77.58
156	Gwadar	Local Coal	0.00	0.00	0.00	69.18	81.99	80.68	80.47	78.07	76.99
157	Lucky	Local Coal	85.08	85.31	85.08	85.07	85.07	85.21	84.75	85.02	85.07
158	Thal Nova	Local Coal	49.35	85.21	84.98	84.97	84.74	84.53	83.48	84.38	81.75
159	Thar TEL	Local Coal	84.98	85.21	84.98	84.97	84.97	84.08	83.78	84.09	81.95
160	Thar-I (SSRL)	Local Coal	42.14	85.21	84.98	84.98	84.98	84.61	84.29	84.38	84.31
161	K.E_NEW_L.Coal	KE_Local Coal	0.00	0.00	0.00	0.00	83.33	83.06	82.74	82.88	83.07
162	China HUBCO	Imported Coal	51.57	51.57	51.57	51.57	51.57	51.57	51.57	51.57	51.57
163	Jamshoro Coal	Imported Coal	49.36	83.95	83.64	79.90	28.57	16.41	19.86	22.70	21.56
164	Port Qasim	Imported Coal	48.72	48.72	48.72	48.72	48.72	48.72	48.72	48.72	48.72
165	Sahiwal Coal	Imported Coal	48.02	48.02	48.02	48.02	48.02	48.02	48.01	48.01	48.01
166	FPCL	KE_Imported Coal	82.15	77.19	18.20	18.75	10.97	10.33	14.54	14.46	14.50
167	Davis	DG_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
168	Balloki	CCGT_RLNG	4.23	1.98	1.03	1.92	2.22	0.73	1.31	1.22	1.14
169	Bhikki	CCGT_RLNG	1.21	0.77	0.02	0.60	0.65	0.29	0.48	0.63	0.61

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#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% 								
170	FKPCL	CCGT_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
171	Halmore	CCGT_RLNG	37.73	37.73	37.73	22.68	0.30	0.00	0.30	0.30	0.30
172	Haveli	CCGT_RLNG	11.09	5.89	3.48	5.34	4.28	1.61	1.92	2.03	2.31
173	KAPCO 1	CCGT_RLNG	35.31	35.38	35.25	0.00	0.00	0.00	0.00	0.00	0.00
174	KAPCO 2	CCGT_RLNG	11.86	11.83	11.89	0.00	0.00	0.00	0.00	0.00	0.00
175	KAPCO 3	CCGT_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
176	Nandipur	CCGT_RLNG	36.38	36.38	36.38	21.87	0.00	0.00	0.00	0.28	0.29
177	Orient	CCGT_RLNG	37.73	23.21	0.00	0.00	0.30	0.00	0.30	0.30	0.30
178	Rousch	CCGT_RLNG	0.23	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
179	Saif	CCGT_RLNG	37.73	37.73	37.73	22.68	0.00	0.00	0.10	0.30	0.30
180	Saphire	CCGT_RLNG	37.73	37.73	37.73	22.68	0.27	0.00	0.30	0.30	0.30
181	Trimmu	CCGT_RLNG	26.53	21.00	12.36	11.90	8.41	3.65	5.52	6.92	7.02
182	BQPS2	KE_CCGT_RLNG	85.24	83.52	29.84	25.80	16.42	9.17	13.47	14.12	14.08
183	BQPS3	KE_CCGT_RLNG	89.85	89.80	78.82	82.62	28.99	19.44	20.79	23.55	22.04
184	KCCPP	KE_CCGT_RLNG	85.17	82.46	22.16	18.43	11.25	7.86	10.21	13.00	12.39
185	KTGTPS	KE_CCGT_RLNG	45.16	40.58	8.61	10.11	6.67	2.90	4.06	5.02	5.51
186	SGTPS	KE_CCGT_RLNG	48.00	44.44	9.21	11.12	7.11	3.16	4.14	5.20	7.45
187	BQPS1-U1	KE_ST_RLNG	10.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
188	BQPS1-U5	KE_ST_RLNG	29.34	30.27	1.66	1.71	0.46	0.76	1.00	1.06	1.39
189	BQPS1-U6	KE_ST_RLNG	16.15	15.84	1.43	1.54	0.30	0.15	0.63	0.75	0.96
190	BQPS1-U2	KE_GT_RLNG	22.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: (All numbers highlighted in yellow color, in this table, represent retirement of the corresponding project.)

6.6. Year-wise Discounted and Un-Discounted Cost

The year wise cost breakup is shown in Table 6-5 and 6-6.

Table 6-5: Year wise Discounted Cost (Million US\$)

FY	FO&M Cost	Generation Cost	Total Cost	Objective Function (Cumulative)
2023	1,795	7,523	9,319	9,319
2024	1,896	6,573	8,469	17,788
2025	2,067	4,781	6,848	24,635
2026	2,072	3,994	6,066	30,701
2027	2,098	2,986	5,084	35,786
2028	2,179	2,460	4,638	40,424
2029	2,084	2,311	4,395	44,819
2030	2,017	2,162	4,179	48,998
2031	2,013	1,923	3,936	52,934

Table 6-6: Year wise Un-Discounted Cost (Million US\$)

FY	FO&M Cost	Generation Cost	Total Cost	Objective Function (Cumulative)
2023	1,795	7,523	9,319	9,319
2024	2,086	7,230	9,316	18,634
2025	2,501	5,785	8,286	26,920
2026	2,758	5,316	8,073	34,994
2027	3,072	4,372	7,444	42,438
2028	3,509	3,961	7,470	49,908
2029	3,692	4,094	7,786	57,694
2030	3,931	4,213	8,144	65,838

FY	FO&M Cost	Generation Cost	Total Cost	Objective Function (Cumulative)
2031	4,315	4,122	8,437	74,275

6.7. Salient Features of the IGCEP

In order to balance a projected peak load of 41,338 MW by the year 2030-31, the PLEXOS model proposes 69,372 MW of installed generation capacity; salient features of the study are as follows:

- a. Significant Induction of VREs (clean and indigenous)
- b. Substantial utilization of hydro-based power
- c. Induction of indigenous coal-based power
- d. Balancing the overall basket price with increased share of hydro power and REs
- e. Optimal indigenization: less reliance on imported fuel i.e., Imported Coal, RFO, RLNG etc.
- f. Substantial reduction in carbon emissions owing to induction of REs and hydro
- g. All optimized generation projects are indigenous without any imported fuel

Meanwhile, a capacity of 8,021 MW is meant to be retired by the year 2030-31. In order to provide a quick understanding of the generation mix of the IGCEP 2022-31, the report includes the Table 6-7 which highlights addition and retirement of different types of generation capacities. Moreover, fuel-wise capacity in megawatts, energy in GWh and their monthly share in the total generated energy, over the period of this plan, which are further illustrated by the Chart 6-4 through 6-6, Chart 6-7 through 6-9 and Chart 6-10 through 6-11 respectively.

Table 6-7: Year wise Installed Generation Capacity Addition (MW)

FY	Local Coal	Hydro	RLNG	Nuclear	Imported Coal	RE	Local Gas	Furnace Oil	Cross Border	Net Yearly Addition	Cumulative Total
Jun-22	1,320	10,593	9,789	3,620	4,020	2,802	2,744	3,633	-	-	38,521
2023	1,980	205	1,263	-	660	630	-	-	-	4,738	43,259
2024	-	314	-420	-	-	1,330	-	-	-	1,224	44,483
2025	-	2,347	-	-	-	5,082	-	-	1,000	8,429	52,912
2026	300	630	-1,300	-	-	3,230	-	-	-	2,860	55,772
2027	990	2,558	-	-	-	1,560	-225	-1,423	-	3,460	59,232
2028	-	545	-	-	-	3,583	-	-	-	4,128	63,360
2029	-	876	-	-	-	1,355	-	-727	-	1,504	64,863
2030	-	1,514	-172	-	-	680	-	-136	-	1,886	66,749
2031	-	2,979	-450	-	-	680	-586	-	-	2,623	69,372
Total	4,590	22,560	8,710	3,620	4,680	20,932	1,933	1,347	1,000	30,852	69,372

6.8. Comparison of Scenarios

In addition to the base case, six scenarios have been developed to facilitate the decision makers to reach an informed decision. Scenario-I and Scenario-II comprise of Low Demand Forecast (Average GDP GR 3.40%) and High Demand Forecast (Average GDP GR 5.42%) respectively, as compared to base case demand (Average GDP GR 4.30%), whereas, Scenario-III, Scenario-IV, Scenario-V and Scenario-VI have base case demand along with Diamer Bhasha HPP in 2029, Chashma Nuclear (C-5) in 2029, 1,320 MW local coal-based power projects in 2027 & 2030 each year and VRE unconstrained, respectively.

The results show that base case has optimized capacity addition of 8,350 MW_p of solar PV (includes utility scale and feeder based/DG), 4,928 MW wind, 3,544 MW hydro and 990 MW local coal, throughout the study horizon. In Scenario-I (Low Demand), the optimization decreases candidate solar PV, wind and hydro by 2,749 MW_p, 1,063 MW, 298 MW respectively as compared to the base case by the year 2030-31. In Scenario-II (High Demand), apart from base case additions, the optimization increases candidate solar PV, wind, hydro, local coal and imported coal by 170 MW_p, 2091 MW, 340 MW, 990 MW and 660 MW respectively.

For Scenario-III (Diamer Bhasha HPP in 2029), 4,170 MW more hydro is inducted in the system, whereas, the optimization decreases candidate solar and wind by 1,567 MW_p and 978 MW respectively as compared to the base case by the year 2030-31. In Scenario-IV (Chashma

Nuclear C-5 for Energy Security), the optimization decreases candidate solar PV and hydro by 781 MW_p and 298 MW respectively whereas it increases the wind capacity by 178 MW, as compared to the base case by the year 2030-31. In Scenario-V (1,320 MW Local coal inclusion in 2027 & 2030), the optimization decreases candidate solar PV, wind and hydro by 1,303 MW_p, 1,117 MW of 298 MW respectively as compared to the base case by the year 2030-31. Finally in Scenario-VI (Unconstrained VRE), the optimization decreases solar PV by 1,295 MW_p whereas it increases the wind capacity by 644 MW, as compared to the base case.

A comparison of CODs for all the candidate projects (HPPs and thermal) optimized by the tool for the base case along with scenarios mentioned above is given in Annexure B-6.

The installed capacities for base case and all the scenarios for the year 2030-31 are summarized in Table 6-8.

Table 6-8: Scenario-wise Installed Capacity (MW) by 2030-31

Category	Base	Low Demand	High Demand	Diamer Bhasha HPP in 2029	Chashma Nuclear (C-5) for Energy Security	1,320 MW Local Coal inclusion in 2027 & 2030	Un-constrained VRE
Imported Coal	4,680	4,680	5,340	4,680	4,680	4,680	4,680
Local Coal	4,590	4,590	5,580	4,590	4,590	7,230	4,590
RLNG	8,710	8,710	8,710	8,710	8,710	8,710	8,710
Gas	1,933	1,933	1,933	1,933	1,933	1,933	1,933
Nuclear	3,620	3,620	3,620	3,620	4,820	3,620	3,620
Bagasse	394	394	394	394	394	394	394
Solar PV	13,670	10,921	13,840	12,103	12,889	12,367	12,375
HPP	22,560	22,262	22,900	26,731	22,262	22,262	22,560
Cross Border	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Wind	6,868	5,805	8,959	5,890	7,046	5,751	7,512
RFO	1,347	1,347	1,347	1,347	1,347	1,347	1,347
Total (MW)	69,372	65,262	73,623	70,998	69,671	69,294	68,721

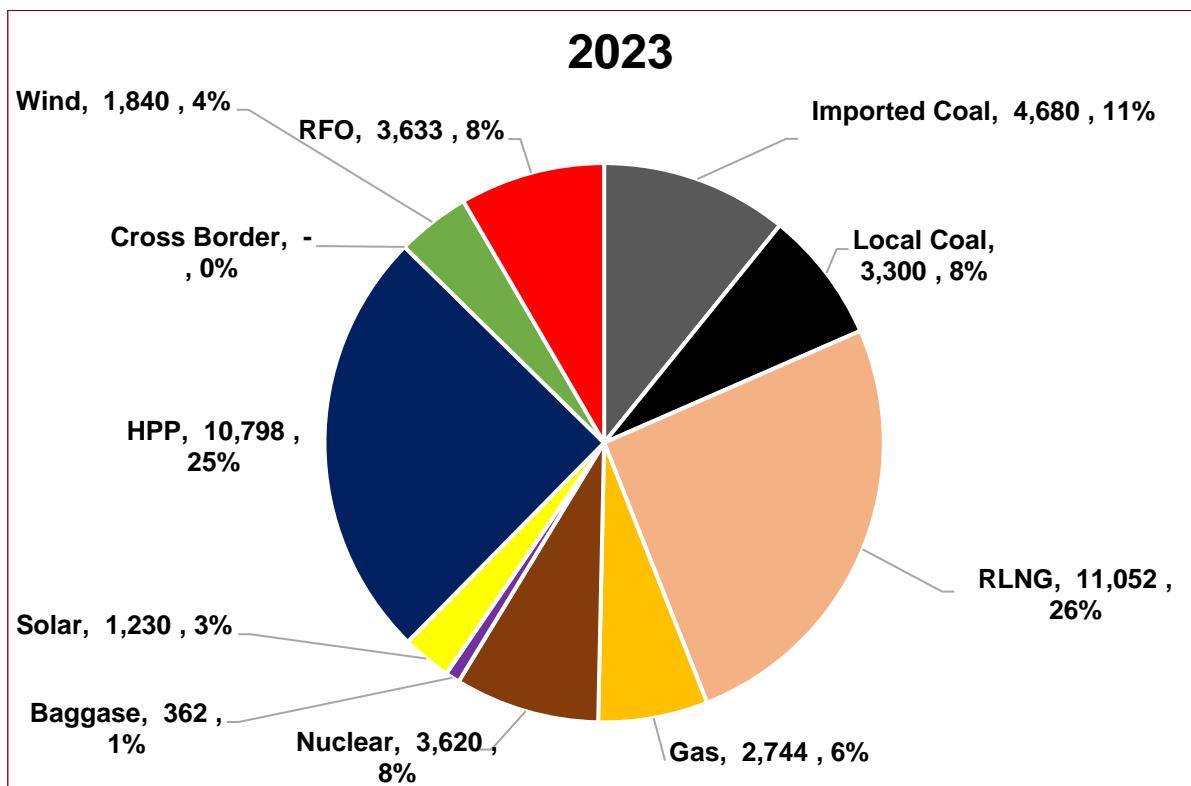


Chart 6-4: IGCEP Generation Mix 2023 (43,259 MW)

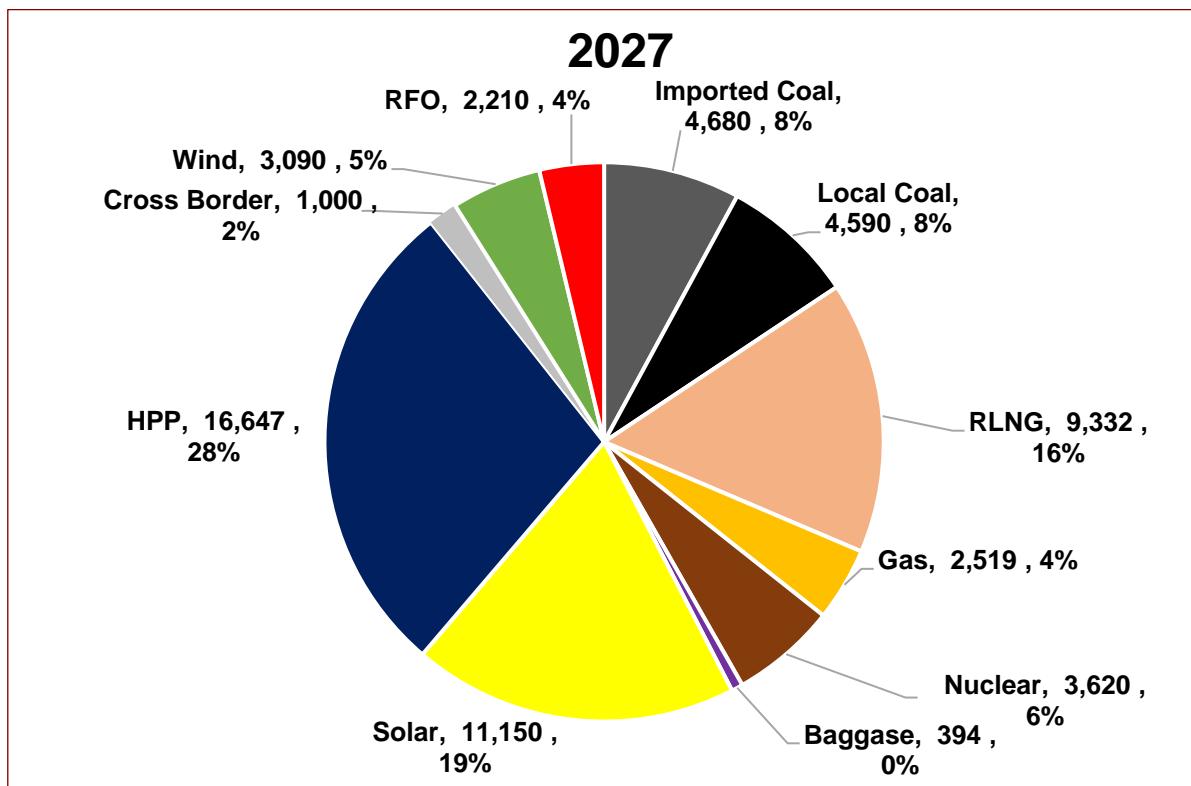


Chart 6-5: IGCEP Generation Mix 2027 (59,232 MW)

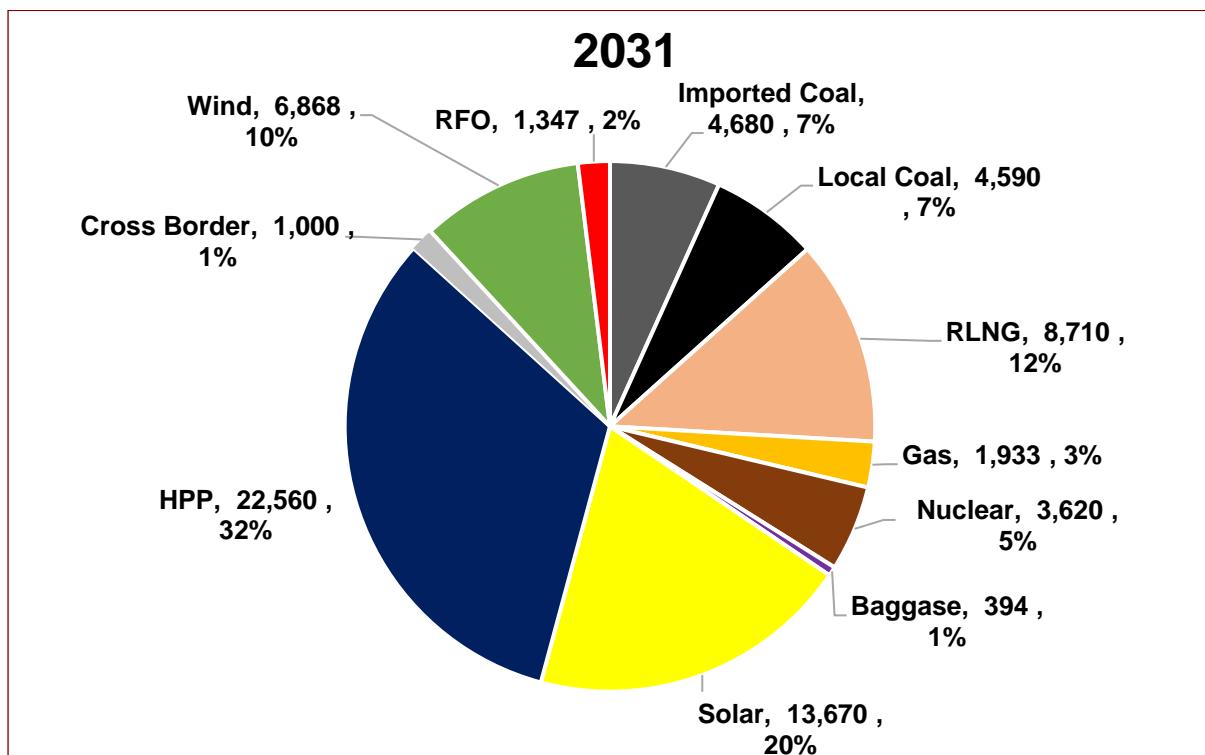


Chart 6-6: IGCEP Generation Mix 2031 (69,372 MW)

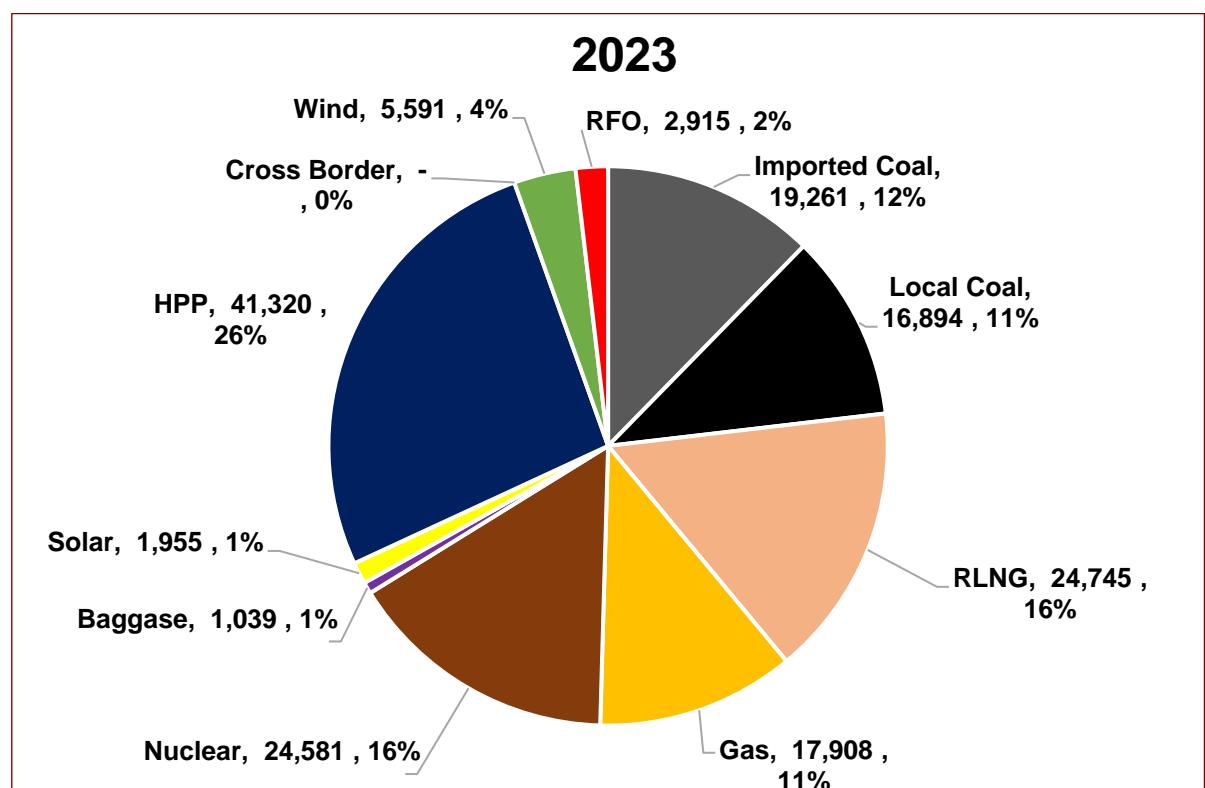


Chart 6-7: IGCEP Generation Mix 2023 (156,210 GWh)

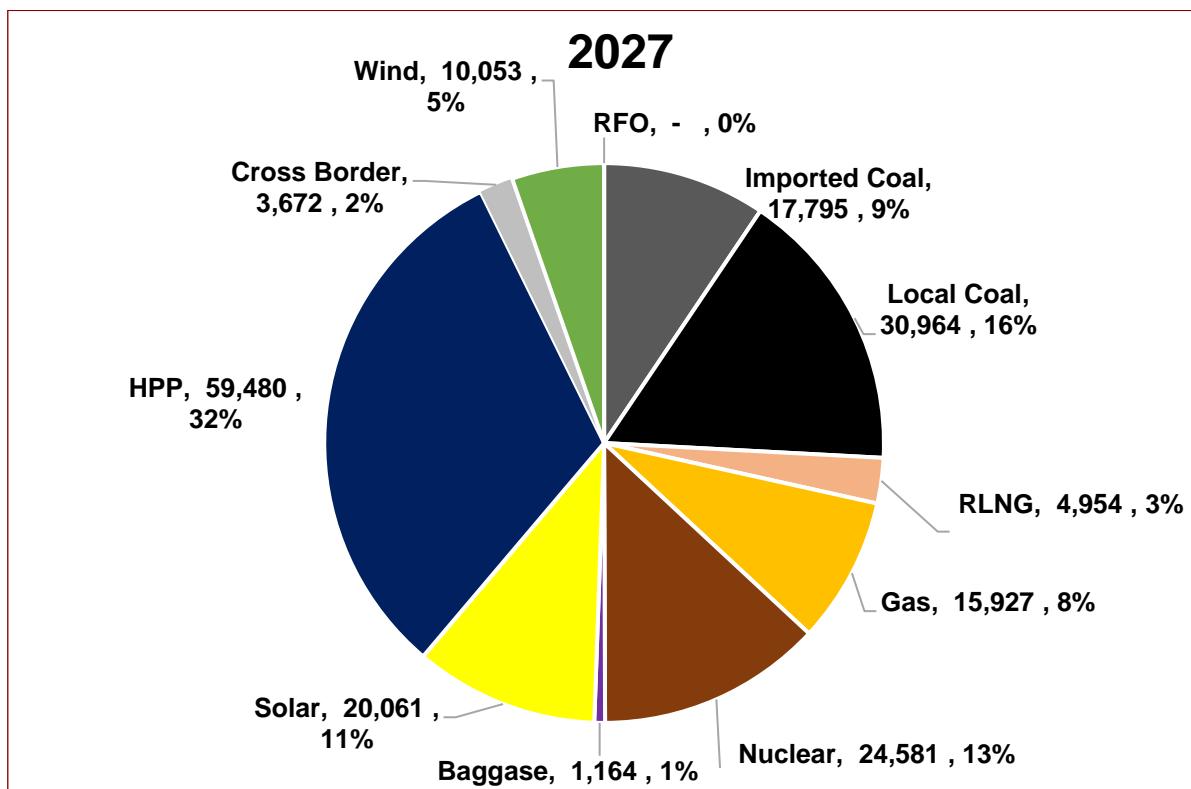


Chart 6-8: IGCEP Generation Mix 2027 (188,651 GWh)

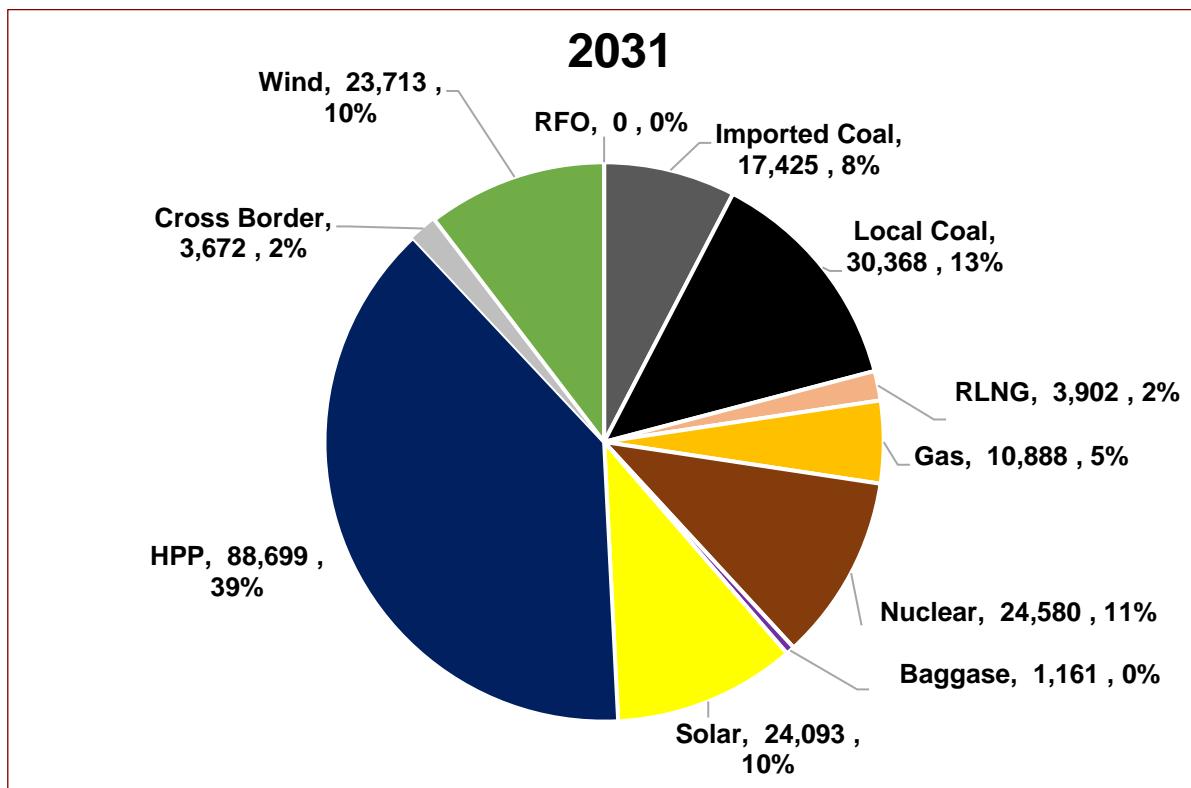


Chart 6-9: IGCEP Generation Mix 2031 (228,501 GWh)

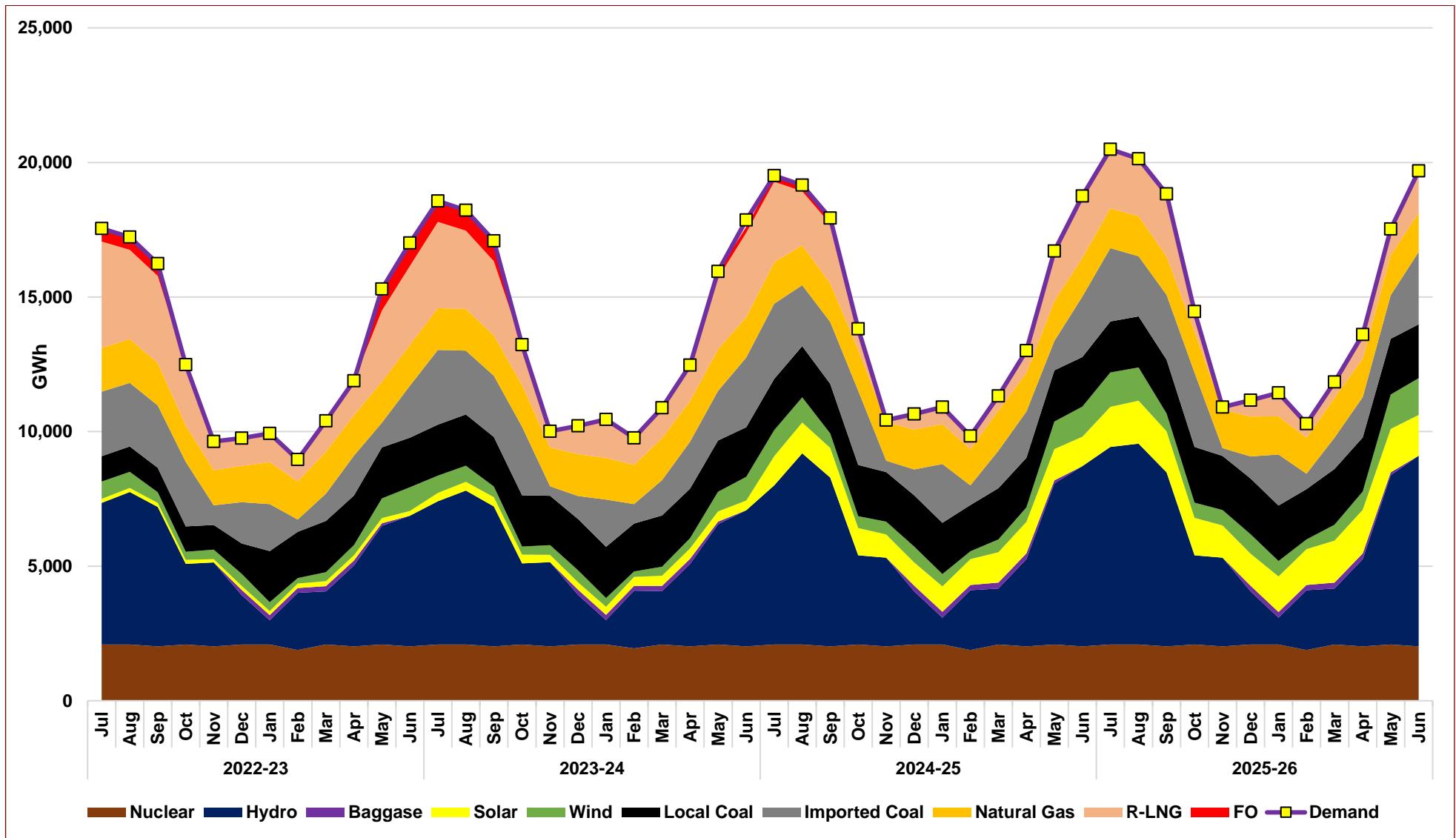


Chart 6-10: IGCEP Monthly Generation Mix 2023-26 (GWh)

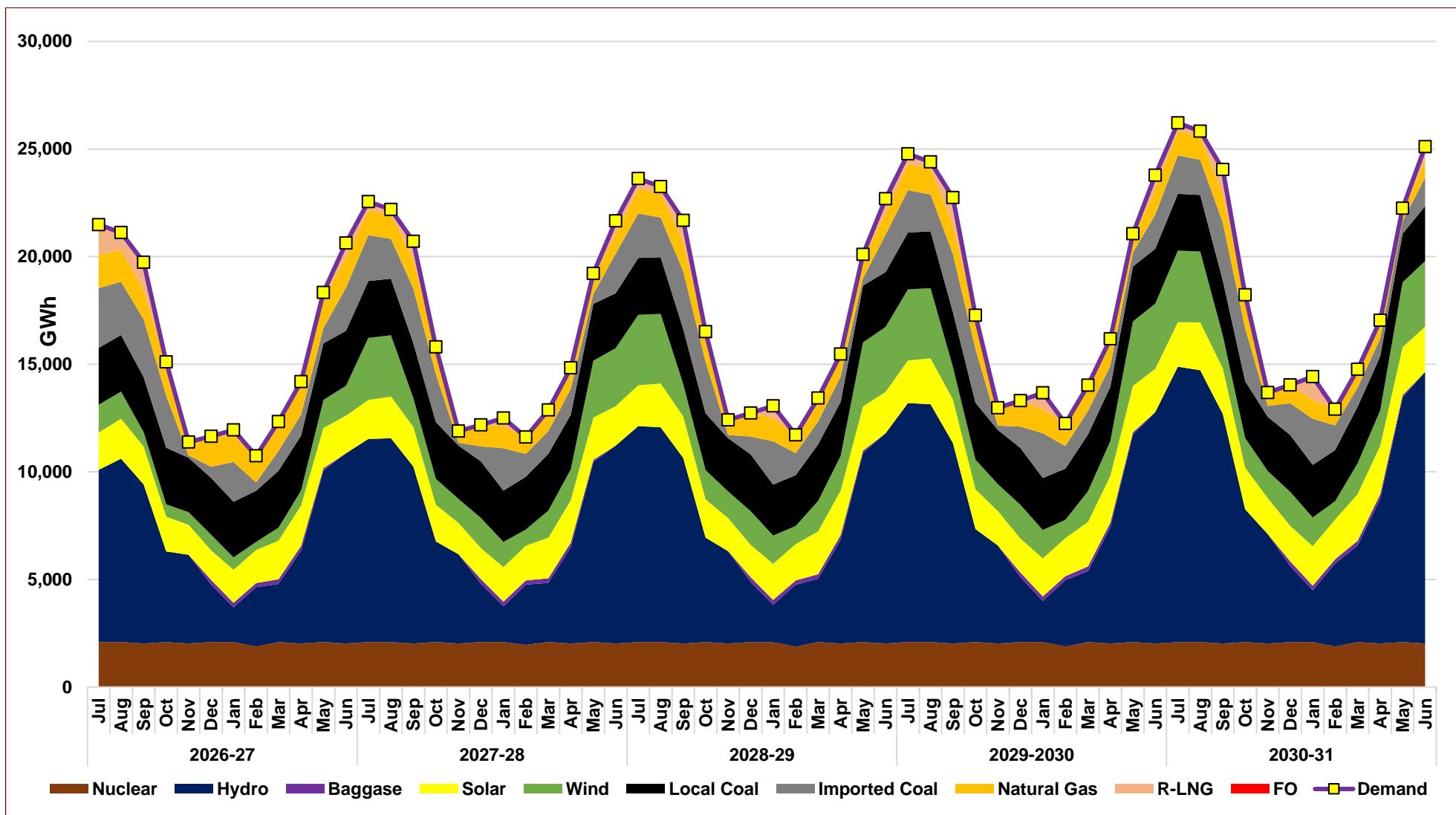


Chart 6-11: IGCEP Monthly Generation Mix 2027-31 (GWh)

6.9. Strategy for Feedback

There is no room bigger than the room for improvement. The IGCEP has been prepared after taking inputs from all the relevant agencies; the PSP Team is more than willing to discuss and incorporate further suggestions from the stakeholders to shape it into a meaningful output. As per PC-4 of the prevailing Grid Code, NEPRA will review and approve the IGCEP. All kind of suggestions, comments and concerns are most welcome at **comments.igcep@ntdc.com.pk; +92-42-99200695**. For wider dissemination and seeking generous feedback, the IGCEP 2022-31 would be published on the NTDC website.

J. THE WAY FORWARD

7. The Way Forward

A few suggestions are offered in this section to further enhance the contents and quality of the future editions of the IGCEP as well as the planning process on the whole.

7.1 Proposed Actions for the Future Generation Plans

- a. More options for Demand Side Management (DSM) other than energy efficiency targets, provided by NEECA for the IGCEP 2022-31, shall be explored for next iterations of the IGCEP by coordinating and working closely with all relevant entities in the country.
- b. Power generation policies should be regularly reviewed and updated to align the policy instruments with the latest trends in generation technologies and other factors that can influence both the demand and supply side of the electricity business.
- c. Access to relevant and quality data must be facilitated. A central data repository may be formed to facilitate planners and policy makers, having specific data privileges and to ensure access to quality data, for data modeling and decision making. In a similar vein, project execution entities should enhance and accelerate their response, with respect to provision of project data to NTDC, for updating of the IGCEP, in a precise and timely manner.
- d. Keeping in view the latest technological changes and latest advancements in the power supply and delivery business, customized trainings should be provided, especially for the power system planners, system operators, and DISCO staff.

7.2 Making Way for the High Share of Renewables in the Grid

In order to ensure indigenization of energy mix with higher share of clean energy, future plans are required to be aligned with international best practices pertaining to renewable energy.

7.2.1 Hybridization of Variable Renewable Energy Projects

- a. Though not envisaged in the prevailing schemes, wind power projects can provide grid support such as frequency regulation, voltage regulation, and reserve power provided hybridization is opted with solar PV as well as battery energy storage. Grid impact and economic implication studies for individual wind power project will need to be carried out by the stakeholders.
- b. The combination of wind and solar PV has the advantage that the two sources will complement each other since the peak operating times for each system occur at different times of the day and year. The power generation of such a hybrid system including battery storage, is more continuous i.e., fluctuates less in terms of time and frequency if these are developed and operated jointly. Enabling environment including regulatory and commercial arrangements as well as technical studies should be undertaken for this purpose to maximize the value of indigenous energy resources. The relevant project execution agencies should provide data hybrid RE technologies.

- c. All the stakeholders including the sponsors should join hands on setting up and sustaining an energy forecasting system with consensus on some suitable business model for the above purpose. This will significantly help in combatting the existing challenges with respect to dispatch of renewable energy.

7.2.2 Operational Challenges and Solutions for VRE Integration

System operational performance and grid flexibility studies are required to be carried out for VRE intermittency management to ensure its optimal region wise penetration by considering ramping up/down capability by synchronous generators in the system and FACTS / BESS applications. The quantum and/or timelines of wind and solar may vary in future as a result of these studies.

In order to utilize huge renewable resource potential of Pakistan in a sustainable manner, the VRE projects supported by appropriate energy storage should be able to provide the following grid support:

- a. Base load operation for certain number of hours.
- b. Support in frequency control & regulation and maintaining the reactive power balance.
- c. Reserve power even when the renewable resource is not available.

Further, those technologies should be promoted which can be manufactured locally with the ultimate goal of achieving manufacturing of complete WTG, solar PV and associated equipment. All stakeholders should try to maximize local value addition.

7.3 Focusing on Indigenization through Harnessing the Potential of Local Coal

Thar coal reserves are estimated by the Geological Survey of Pakistan to be approximately 175 billion tons – making it one of the largest lignite coal reserves in the world. Thar coalfield, Block II area has exploitable lignite coal reserves of 1.57 billion tons. The total mining capacity of the project is expected to be 20.6 MT/annum. (Source: Engro report).

The power system planners should be communicated, by the project execution agencies, of the study-based analysis of block-wise potential of Thar coal that can be exploited for generation of electric power so it can be adequately modelled in the generation capacity expansion software for the next iterations. Similarly, the precision and authenticity of data and information pertaining to hydrology of upcoming hydro power projects needs to be validated by the concerned project execution agencies in the most meticulous manner.

7.4 Tapping Nuclear Potential

Sustainability of generation is a key factor in power system planning. Nuclear generation is a sustainable energy resource and is also important to mitigate the climate change issues. The nuclear power project is of base load nature, have higher capital cost but lower operational cost with much longer life as compared to other baseload project. Nuclear generation is a very reliable source of energy all around the year especially during low / lean hydro months in Pakistan. Moreover, the addition of nuclear power Project can diversify energy mix of the country in years to come. The location of the potential nuclear power project at Chashma is near northern/mid-country load centers, thus requiring relatively lower transmission evacuation infrastructure as compared to the remotely located baseload power projects.

Therefore, there is a need to compare the viability of the nuclear power project with other indigenous baseload power projects by considering their respective generation and transmission evacuation costs.

7.5 Thinking, Synergizing and Enhancing the Vision Beyond the Borders

It is a well-known fact that there is a severe lack of research culture in the country. It is high time that concrete initiatives are taken to inculcate a thinking culture in the power sector of Pakistan. Role of academia, which is currently restricted to at best a couple of initiatives, may be further encouraged and enhanced by launching certain projects especially envisioned for this purpose. Academia along with the established think-tanks may add much needed value to the power sector interventions in all three segments. For this purpose, securing maximum benefits from the regional and international experience is critical. Power sector professionals need to know the success as well as failure stories of rest of the world in order to customize the best strategies for power sector of Pakistan. Perhaps our professionals and decision makers need to understand that borders are not the hurdles but opportunities for exponential growth.

ANNEXURES

(A - H)

Annexure A. Load Forecast Data

A-1. Projected GDP Growth Rate by Sector - Normal Scenario

FY	GDP Growth Rate (%)			
	Total	Commercial	Industrial	Agriculture
2022	5.97	7.18	8.39	3.75
2023	4.41	5.88	6.53	2.58
2024	4.46	4.23	6.36	2.76
2025	4.36	4.29	5.06	3.26
2026	4.06	4.42	5.56	2.46
2027	3.86	3.97	4.86	2.66
2028	4.16	3.82	5.36	2.86
2029	3.96	4.07	5.26	2.76
2030	3.76	3.80	4.56	2.76
2031	4.06	3.72	4.86	2.86

A-2. Projected GDP Growth Rate by Sector - Low Scenario

FY	GDP Growth Rate (%)			
	Total	Commercial	Industrial	Agriculture
2022	5.97	7.18	8.39	3.75
2023	3.41	5.88	5.53	1.58
2024	3.46	3.23	5.36	1.76
2025	3.36	3.29	4.06	2.26
2026	3.06	3.42	4.56	1.46
2027	2.86	2.97	3.86	1.66
2028	3.16	2.82	4.36	1.86
2029	2.96	3.07	4.26	1.76
2030	2.76	2.80	3.56	1.76
2031	3.06	2.72	3.86	1.86

A-3. Projected GDP Growth Rate by Sector - High Scenario

FY	GDP Growth Rate (%)			
	Total	Commercial	Industrial	Agriculture
2022	5.97	7.18	8.39	3.75
2023	5.66	5.63	7.77	3.83
2024	5.70	5.60	7.60	4.00
2025	5.60	5.60	6.30	4.50
2026	5.30	5.30	6.80	3.70
2027	5.10	5.10	6.10	3.90
2028	5.40	5.30	6.60	4.10
2029	5.20	5.10	6.50	4.00
2030	5.00	5.10	5.80	4.00
2031	5.30	5.30	6.10	4.10

A-4. Historical GDP at constant cost factor 2015-16, Consumer Price Index

FY	GDP				Consumer Price Index (CPI)	CPI (G.R)
	Total	Commercial	Industrial	Agriculture		
	(Rs. Million)					
1970	3,477,476	1,517,378	477,776	1,729,191	1.68	-
1971	3,520,384	1,556,098	508,239	1,676,108	1.80	7.40%
1972	3,602,006	1,611,306	500,689	1,734,279	2.01	11.40%
1973	3,846,978	1,766,671	552,502	1,763,158	2.30	14.60%
1974	4,133,676	1,939,625	598,978	1,836,870	2.90	26.30%
1975	4,294,016	2,134,321	610,694	1,797,951	3.56	22.60%
1976	4,433,709	2,165,345	640,637	1,878,401	3.77	5.90%
1977	4,559,744	2,230,936	659,513	1,925,846	4.11	9.00%
1978	4,912,256	2,465,328	722,262	1,980,167	4.40	7.20%
1979	5,183,791	2,615,929	777,330	2,041,501	4.81	9.30%
1980	5,563,617	2,770,440	861,038	2,176,410	5.35	11.20%

FY	GDP				Consumer Price Index (CPI)	CPI (G.R)
	Total	Commercial	Industrial	Agriculture		
	(Rs. Million)					
1981	5,919,785	2,952,677	941,818	2,256,034	6.15	15.00%
1982	6,367,416	3,185,884	1,042,956	2,362,607	6.63	7.80%
1983	6,799,664	3,480,310	1,094,458	2,466,669	7.10	7.00%
1984	7,069,819	3,755,140	1,171,753	2,347,665	7.57	6.70%
1985	7,685,466	4,052,662	1,263,542	2,604,130	8.16	7.80%
1986	8,174,492	4,286,484	1,365,891	2,759,042	8.44	3.50%
1987	8,649,496	4,537,778	1,483,977	2,848,812	8.92	5.60%
1988	9,206,192	4,844,842	1,629,723	2,926,623	9.57	7.40%
1989	9,648,855	5,029,418	1,705,522	3,127,690	10.35	8.10%
1990	10,091,613	5,254,644	1,815,185	3,222,480	11.29	9.10%
1991	10,653,444	5,528,425	1,939,678	3,382,383	12.72	12.60%
1992	11,475,327	5,902,079	2,089,644	3,703,754	13.91	9.40%
1993	11,735,975	6,175,579	2,204,839	3,507,972	15.18	9.10%
1994	12,268,880	6,435,085	2,304,984	3,691,351	16.99	11.90%
1995	12,775,892	6,743,837	2,320,908	3,933,790	19.05	12.10%
1996	13,618,986	7,080,474	2,430,537	4,394,954	21.01	10.30%
1997	13,850,875	7,336,143	2,422,634	4,400,387	23.63	12.50%
1998	14,334,813	7,456,814	2,570,784	4,599,181	25.16	6.50%
1999	14,934,552	7,829,010	2,697,295	4,688,803	26.09	3.70%
2000	15,517,929	8,154,084	2,731,596	4,974,532	27.42	5.10%
2001	15,823,202	8,406,031	2,844,471	4,866,220	28.11	2.50%
2002	16,315,604	8,806,394	2,921,215	4,871,251	29.16	3.70%
2003	17,086,643	9,265,776	3,044,976	5,073,273	29.72	1.90%
2004	18,365,293	9,806,968	3,540,180	5,196,531	32.23	8.50%
2005	20,010,403	10,639,778	3,969,088	5,533,564	35.05	8.70%

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

FY	GDP				Consumer Price Index (CPI)	CPI (G.R)
	Total	Commercial	Industrial	Agriculture		
	(Rs. Million)					
2006	21,174,660	11,329,945	4,132,022	5,882,009	37.73	7.60%
2007	22,347,017	11,962,655	4,451,424	6,083,380	40.37	7.00%
2008	23,461,708	12,553,428	4,828,575	6,193,327	35.05	-13.20%
2009	23,546,340	12,720,576	4,577,158	6,409,945	37.73	7.60%
2010	24,153,955	13,128,428	4,733,888	6,424,659	40.37	7.00%
2011	25,029,238	13,645,735	4,947,262	6,550,711	71.85	78.00%
2012	25,989,532	14,245,756	5,073,292	6,787,987	79.76	11.00%
2013	26,946,755	14,977,029	5,111,364	6,969,568	85.63	7.40%
2014	28,039,002	15,644,927	5,342,921	7,143,565	93.01	8.60%
2015	29,176,784	16,327,237	5,619,686	7,295,725	97.22	4.50%
2016	30,508,205	17,261,613	5,939,636	7,306,957	100.00	2.90%
2017	31,914,207	18,232,012	6,213,295	7,468,900	104.81	4.80%
2018	33,859,620	19,317,324	6,783,864	7,758,432	109.72	4.70%
2019	34,916,041	20,284,070	6,800,675	7,831,296	117.18	6.80%
2020	34,586,665	20,038,838	6,409,966	8,137,860	129.76	10.70%
2021	36,572,644	21,241,331	6,910,607	8,420,705	140.56	8.30%
2022	38,755,090	22,555,934	7,407,709	8,791,447	156.08	11.04%

A-5. Category-wise Nominal Tariff

Nominal Tariff (Excluding K Electric) (Rs/kWh)									
Year	Dom	Com	Ind	Agr	Year	Dom	Com	Ind	Agr
1973	0.20	0.27	0.14	0.10	1998	1.85	6.55	4.11	1.87
1974	0.20	0.32	0.18	0.11	1999	2.35	7.18	4.48	2.33
1975	0.21	0.36	0.21	0.12	2000	2.33	7.04	4.16	2.31
1976	0.23	0.46	0.28	0.16	2001	2.59	7.04	4.16	2.58
1977	0.25	0.53	0.34	0.16	2002	3.18	7.08	4.19	2.93
1978	0.24	0.60	0.37	0.14	2003	3.34	7.03	4.42	3.33
1979	0.29	0.72	0.46	0.21	2004	4.34	6.85	4.46	3.51
1980	0.35	0.95	0.57	0.28	2005	3.40	6.60	4.25	3.49
1981	0.40	1.00	0.63	0.32	2006	3.68	8.07	5.09	3.57
1982	0.42	1.08	0.68	0.36	2007	3.76	8.21	5.17	3.64
1983	0.43	1.18	0.76	0.38	2008	4.36	10.10	6.56	3.55
1984	0.44	1.21	0.76	0.43	2009	5.40	11.54	7.48	5.02
1985	0.44	1.23	0.78	0.38	2010	6.54	13.24	8.94	6.15
1986	0.49	1.43	0.92	0.43	2011	7.31	14.90	9.60	7.99
1987	0.48	1.40	0.89	0.37	2012	8.41	16.64	10.90	9.35
1988	0.52	1.71	1.11	0.40	2013	8.83	17.87	12.18	11.38
1989	0.62	2.13	1.33	0.46	2014	9.48	21.27	15.83	12.02
1990	0.66	2.46	1.50	0.55	2015	10.22	22.24	15.39	14.00
1991	0.76	2.76	1.66	0.57	2016	10.48	20.17	13.75	12.66
1992	0.81	3.16	1.89	0.63	2017	10.65	20.22	14.12	10.64
1993	0.84	3.31	1.99	0.66	2018	11.14	21.04	14.92	11.25
1994	0.96	3.86	2.29	0.74	2019	12.86	26.12	18.23	11.29
1995	1.10	4.27	2.68	0.94	2020	13.62	29.77	23.18	10.60
1996	1.36	5.37	3.36	1.31	2021	14.29	31.10	22.48	13.65
1997	1.56	5.66	3.75	1.63	2022	18.52	36.99	28.23	16.84

A-6. Category-wise Real Tariff

Real Tariff (Excluding K Electric) (Rs/kWh)									
Year	Dom	Com	Ind	Agr	Year	Dom	Com	Ind	Agr
1973	8.58	11.56	6.23	4.33	1998	7.36	26.03	16.33	7.43
1974	6.85	10.96	6.07	3.69	1999	9.00	27.53	17.19	8.95
1975	5.88	10.16	5.97	3.37	2000	8.51	25.66	15.18	8.43
1976	6.11	12.33	7.47	4.12	2001	9.21	25.03	14.79	9.17
1977	6.09	13.01	8.17	3.83	2002	10.92	24.29	14.36	10.04
1978	5.50	13.55	8.50	3.26	2003	11.24	23.65	14.87	11.20
1979	5.93	14.90	9.61	4.37	2004	13.46	21.25	13.84	10.89
1980	6.46	17.69	10.68	5.32	2005	9.70	18.83	12.13	9.96
1981	6.43	16.26	10.26	5.23	2006	9.75	21.39	13.49	9.46
1982	6.28	16.25	10.20	5.41	2007	9.31	20.34	12.81	9.02
1983	6.10	16.62	10.65	5.41	2008	12.43	28.83	18.72	10.14
1984	5.79	16.02	10.10	5.63	2009	14.32	30.58	19.83	13.32
1985	5.38	15.03	9.62	4.70	2010	16.21	32.79	22.14	15.23
1986	5.86	16.92	10.89	5.12	2011	10.18	20.74	13.36	11.11
1987	5.33	15.66	10.00	4.13	2012	10.55	20.87	13.66	11.72
1988	5.46	17.89	11.61	4.17	2013	10.31	20.87	14.22	13.29
1989	6.01	20.62	12.85	4.42	2014	10.19	22.87	17.02	12.92
1990	5.85	21.78	13.31	4.83	2015	10.51	22.88	15.83	14.40
1991	5.98	21.73	13.02	4.44	2016	10.48	20.17	13.75	12.66
1992	5.79	22.68	13.57	4.54	2017	10.16	19.29	13.47	10.16
1993	5.54	21.81	13.10	4.36	2018	10.15	19.18	13.60	10.25
1994	5.65	22.69	13.48	4.34	2019	10.97	22.29	15.56	9.63
1995	5.79	22.43	14.08	4.91	2020	10.50	22.94	17.86	8.17
1996	6.48	25.56	16.00	6.22	2021	10.17	22.13	15.99	9.71
1997	6.59	23.93	15.85	6.90	2022	11.87	23.70	18.09	10.79

A-7. Category-wise Electricity Consumption (Excluding K Electric)-GWh

Year	Dom	Com	Ind	Agr	Street-Light	Bulk	Others	Total
1970	367	125	1,646	956	20	487	0	3,600
1971	382	152	1,689	1,080	24	638	0	3,966
1972	392	142	2,109	997	75	422	0	4,137
1973	462	165	2,236	1,184	22	530	0	4,599
1974	523	179	2,267	1,142	20	569	42	4,742
1975	566	184	2,245	1,531	20	604	63	5,212
1976	678	222	2,262	1,386	26	697	45	5,315
1977	780	246	2,357	1,400	29	597	43	5,452
1978	1,004	305	2,596	1,718	42	784	42	6,490
1979	1,240	336	2,770	1,666	70	856	43	6,981
1980	1,564	389	3,154	2,057	50	900	46	8,160
1981	1,858	445	3,482	2,125	58	1,056	44	9,068
1982	2,408	574	3,960	2,357	74	873	42	10,288
1983	2,866	634	4,427	2,546	78	992	44	11,587
1984	3,470	739	4,708	2,663	75	1,069	38	12,762
1985	3,887	796	5,061	2,783	77	1,115	37	13,756
1986	4,513	875	5,894	2,880	90	1,215	36	15,504
1987	5,357	991	6,436	3,452	110	1,361	38	17,745
1988	6,290	1,054	7,236	4,394	117	1,571	40	20,702
1989	6,939	1,068	7,578	4,356	127	1,795	35	21,982
1990	7,647	1,106	8,360	5,004	148	1,646	38	24,121
1991	8,617	1,152	9,115	5,596	178	1,700	33	26,585
1992	9,691	1,192	10,213	5,823	229	1,799	29	29,267
1993	11,220	1,303	10,913	5,595	195	1,925	27	31,272
1994	11,963	1,318	10,532	5,743	216	1,964	27	32,131
1995	13,448	1,490	10,604	6,220	252	2,112	22	35,032
1996	14,792	1,648	10,335	6,657	301	2,377	20	36,925

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

Year	Dom	Com	Ind	Agr	Street-Light	Bulk	Others	Total
1997	15,594	1,757	10,115	7,018	308	2,485	19	38,529
1998	16,367	1,768	10,238	6,888	307	2,694	16	39,422
1999	16,927	1,825	9,945	5,575	159	2,646	15	38,900
2000	18,942	2,003	10,773	4,512	150	2,676	15	40,910
2001	20,019	2,120	11,744	4,896	146	2,634	14	43,384
2002	20,549	2,285	12,637	5,582	149	2,662	12	45,204
2003	20,855	2,516	13,462	5,986	166	2,626	10	47,421
2004	22,668	2,884	14,476	6,624	192	2,796	9	51,492
2005	24,049	3,192	15,568	6,921	227	2,892	12	55,278
2006	27,009	3,768	16,596	7,873	279	3,031	13	62,405
2007	28,944	4,289	17,603	8,097	316	3,252	13	67,419
2008	28,711	4,358	17,299	8,380	340	3,319	11	66,489
2009	27,755	4,203	16,035	8,695	347	3,188	10	65,248
2010	29,479	4,465	16,372	9,585	371	3,357	10	68,847
2011	30,972	4,683	17,700	8,847	374	3,607	10	71,642
2012	30,365	4,563	18,403	8,414	360	3,509	43	71,341
2013	30,329	4,435	18,636	7,548	351	3,659	60	70,481
2014	33,325	4,795	20,550	8,130	351	3,872	32	76,496
2015	34,567	4,853	21,086	7,866	330	3,909	33	78,071
2016	37,123	5,417	21,150	8,364	295	4,239	34	81,682
2017	41,412	6,114	20,067	9,063	298	4,566	31	86,628
2018	46,114	6,753	23,274	9,978	319	5,014	450	97,030
2019	45,590	6,629	24,285	9,676	291	5,082	2,335	98,844
2020	47,643	6,260	21,489	9,642	273	4,887	2,597	98,197
2021	49,814	6,688	24,663	10,116	314	4,973	2,802	99,370
2022	52,407	7,387	28,115	5,382	10,922	347	3,306	107,866

A-8. Category-wise Number of Consumers (Excluding K Electric)

Year	Dom	Com	Ind	Agr	Street Light	Bulk & Others	Total
1971	930,350	238,147	64,494	50,212	587	434	1,284,224
1972	998,922	258,328	67,056	52,343	663	477	1,377,789
1973	1,070,192	275,273	72,158	58,472	684	530	1,477,309
1974	1,137,676	300,219	78,277	63,730	718	534	1,581,154
1975	1,232,621	322,252	80,730	69,687	740	560	1,706,590
1976	1,347,122	347,167	85,250	76,508	801	524	1,857,372
1977	1,498,747	376,284	91,365	81,813	926	722	2,049,857
1978	1,670,213	422,901	95,036	90,341	1,018	832	2,280,341
1979	1,866,550	462,950	100,946	95,666	1,315	787	2,528,214
1980	2,049,728	471,757	101,228	98,268	1,477	821	2,723,279
1981	2,479,453	571,800	111,484	104,108	2,090	1,010	3,269,945
1982	2,732,903	624,900	115,890	111,278	2,161	1,118	3,588,250
1983	2,989,397	674,600	119,417	114,390	2,390	1,225	3,901,419
1984	3,261,362	724,462	123,508	118,265	2,511	1,428	4,231,536
1985	3,500,171	770,465	128,441	120,905	2,447	1,541	4,523,970
1986	3,779,838	834,127	133,573	124,918	2,647	1,684	4,876,787
1987	4,106,424	898,118	139,537	130,034	2,801	1,772	5,278,686
1988	4,525,987	964,377	147,439	136,860	3,017	1,943	5,779,623
1989	5,077,686	1,039,033	153,042	143,869	3,462	2,075	6,419,167
1990	5,467,690	1,088,932	158,800	149,554	3,453	2,250	6,870,679
1991	5,805,382	1,134,754	162,624	152,169	3,531	2,261	7,260,721
1992	6,219,656	1,185,723	169,436	155,305	3,759	2,362	7,736,241
1993	6,622,977	1,221,223	172,145	153,088	3,829	2,488	8,175,750
1994	6,995,561	1,257,887	174,577	157,710	3,730	2,577	8,592,042
1995	7,376,032	1,342,946	179,392	162,303	3,954	2,649	9,067,276
1996	7,783,832	1,344,975	181,092	165,114	3,990	2,728	9,481,731
1997	8,154,894	1,354,940	184,301	167,245	4,064	3,168	9,868,612
1998	8,455,442	1,396,973	186,539	170,562	4,645	2,911	10,217,072
1999	8,911,587	1,517,199	190,084	173,078	4,708	2,979	10,799,635
2000	9,553,828	1,653,870	194,566	174,456	4,892	3,045	11,584,657

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

Year	Dom	Com	Ind	Agr	Street Light	Bulk & Others	Total
2001	10,045,035	1,737,199	195,511	180,411	4,993	3,195	12,166,344
2002	10,482,804	1,803,132	199,839	184,032	4,854	3,361	12,678,022
2003	11,043,530	1,867,226	206,336	191,961	5,441	3,739	13,318,233
2004	11,737,078	1,935,462	210,296	198,829	5,800	3,873	14,091,338
2005	12,490,189	1,983,216	212,233	200,756	6,171	3,677	14,896,242
2006	13,389,762	2,068,312	222,283	220,501	6,550	3,753	15,911,161
2007	14,354,365	2,151,971	233,162	236,255	6,990	3,811	16,986,554
2008	15,226,711	2,229,403	242,401	245,640	7,337	3,874	17,955,366
2009	15,859,373	2,291,628	253,089	258,368	7,680	3,976	18,674,114
2010	16,673,015	2,362,312	263,507	271,268	8,034	4,088	19,582,224
2011	17,322,140	2,421,221	273,067	280,603	8,386	4,066	20,309,483
2012	17,978,395	2,482,702	286,401	286,287	8,698	4,128	21,046,611
2013	18,713,537	2,550,808	296,849	301,115	9,107	4,184	21,875,600
2014	19,323,307	2,635,086	305,294	310,578	9,369	4,236	22,587,870
2015	20,148,495	2,723,708	315,116	318,081	9,554	4,293	23,519,247
2016	21,040,707	2,814,234	325,816	321,055	9,857	5,030	24,516,699
2017	21,991,479	2,905,517	336,045	323,524	10,124	5,114	25,571,803
2018	23,173,856	3,028,054	339,853	315,021	10,426	149,335	27,016,545
2019	24,465,300	3,144,247	342,949	326,656	10,567	183,350	28,473,069
2020	25,803,759	3,245,508	348,087	344,690	10,932	204,393	29,957,369
2021	27,227,283	3,359,777	357,366	359,124	11,284	210,353	31,529,604
2022	28,743,039	3,475,468	367,736	369,356	11,807	222,390	33,189,796

Annexure B. Generation Planning Data

B-1(i). NTDC Existing Installed Capacity (As of June 2022)

Sr. No.	Name of Power Project	Fuel	Installed Capacity	Dependable Capacity		
			(MW)			
Public Sector						
WAPDA Hydro						
1	Allai Khwar	Hydro	121	121		
2	Chashma	Hydro	184	184		
3	Dubair Khwar	Hydro	130	130		
4	Ghazi Brotha	Hydro	1,450	1,450		
5	Golen Gol	Hydro	108	108		
6	Jinnah	Hydro	96	96		
7	Khan Khwar	Hydro	72	72		
8	Mangla	Hydro	1,140	1,140		
9	Neelum Jehlum	Hydro	969	969		
11	Tarbela 1-14	Hydro	3,478	3,478		
12	Tarbela_Ext_04	Hydro	1,410	1,410		
13	Warsak	Hydro	243	243		
Small Hydel						
14	Gomal Zam	Hydro	17	17		
15	Rasul	Hydro	22	22		
16	Dargai	Hydro	20	20		
17	Nandipur	Hydro	14	14		
18	Shadiwal	Hydro	14	14		
19	Chichoki	Hydro	13	13		
20	Kurram Garhi	Hydro	4	4		
21	Renala	Hydro	1	1		
22	Chitral	Hydro	1	1		
23	Jabban	Hydro	22	22		
24	Ranolia	Hydro	18	18		
Total Small Hydel			146	146		
Sub Total: WAPDA Hydro			9,547	9,547		
GENCOs						
25	Jamshoro - I U1	RFO	250	200		
26	Jamshoro - II U4	RFO	200	170		
27	Jamshoro - II U2	RFO	-	-		
28	Jamshoro - II U3	RFO	-	-		
Sub Total: GENCOs – I			450	370		
29	Guddu - I U (11-13)	Gas	415	391		
30	Guddu - II U (5-10)	Gas	620	537		
31	Guddu 747	Gas	747	721		

Sr. No.	Name of Power Project	Fuel	Installed Capacity	Dependable Capacity
			(MW)	
Sub Total: GENCOs – II			1,782	1,649
32	Muzaffargarh - I U1	RFO	210	190
33	Muzaffargarh - I U2	RFO	210	183
34	Muzaffargarh - I U3	RFO	210	184
35	Muzaffargarh - II U4	RFO	320	272
36	Muzaffargarh - II U5	RFO	-	-
37	Muzaffargarh - II U6	RFO	-	-
38	GTPS Block 4 U (5-9)	RLNG	0	0
39	Nandipur	RLNG	525	491
Sub Total: GENCOs – III			1,475	1,320
Total GENCOs (Public Sector)			3,707	3,339
Nuclear				
40	CHASHNUPP - I	Nuclear	325	300
41	CHASHNUPP-II	Nuclear	325	300
42	CHASHNUPP-III	Nuclear	340	315
43	CHASHNUPP-IV	Nuclear	340	315
44	K-2	Nuclear	1,145	1,059
45	K-3	Nuclear	1,145	1,059
Sub Total: Nuclear			3,620	3,348
Private Sector				
Hydel IPPs				
46	Jagran - I	Hydro	30	30
47	Malakand - III	Hydro	81	81
48	New Bong	Hydro	84	84
49	Daral Khwar	Hydro	37	37
50	Gul Pur	Hydro	103	103
51	Patrind	Hydro	150	150
52	Karot	Hydro	720	720
Sub Total: IPPs Hydro			1,205	1,205
Thermal IPPs				
53	AES Pakgen	RFO	365	335
54	AGL	RFO	163	153
55	Altern	Gas	0	0
56	Atlas	RFO	219	209
57	Balloki	RLNG	1,223	1,147
58	Bhikki	RLNG	1,180	1,108
59	China HUBCO	Imp. Coal	1,320	1,249
60	Davis	RLNG	14	10
61	Engro	Gas	217	217
62	Engro Thar	Local Coal	660	545
63	FKPCL	RLNG	172	147

Sr. No.	Name of Power Project	Fuel	Installed Capacity	Dependable Capacity
			(MW)	
64	Foundation	Gas	184	161
65	Halmore	RLNG	225	191
66	Haveli	RLNG	1,230	1,158
67	HCPC	Gas	0	0
68	HuB N	RFO	225	208
69	HUBCO	RFO	1,292	1,108
70	KAPCO 1	RLNG	400	344
71	KAPCO 2	RLNG	900	743
72	KAPCO 3	RLNG	300	258
73	Kohinoor	RFO	131	117
74	Lalpir	RFO	362	338
75	Liberty	Gas	225	208
76	Liberty Tech	RFO	202	192
77	Nishat C	RFO	209	191
78	Nishat P	RFO	202	191
79	Orient	RLNG	225	197
80	Port Qasim	Imp. Coal	1,320	1,243
81	Rousch	RLNG	450	389
82	Saba	RFO	136	112
83	Sahiwal Coal	Imp. Coal	1,320	1,244
84	Saif	RLNG	225	197
85	Sapphire	RLNG	225	196
86	Uch	Gas	586	535
87	Uch-II	Gas	393	370
88	Lucky Coal	Local Coal	660	606
89	Punjab Thermal	RLNG	0	0
Sub Total (IPPs Fossil Fuels)			17,161	15,616
Bagasse Based Power Projects				
90	Almoiz	Bagasse	36	36
91	Chanar	Bagasse	22	22
92	Chiniot	Bagasse	63	63
93	Fatima Energy (FEL)	Bagasse	120	120
94	Hamza	Bagasse	15	15
95	JDW - II	Bagasse	26	26
96	JDW - III	Bagasse	27	27
97	Ryk_Mills	Bagasse	30	30
98	Thal_Layyah	Bagasse	25	25
Sub Total Bagasse			364	364
Wind Power Projects				
99	Act/Tapal Wind	Wind	30	30
100	Artistic_Wind	Wind	50	50

Sr. No.	Name of Power Project	Fuel	Installed Capacity	Dependable Capacity
			(MW)	
101	Artistic_Wind-2	Wind	50	50
102	Dawood	Wind	50	50
103	Din Wind Energy	Wind	50	50
104	FFC	Wind	50	50
105	FWEL-I	Wind	50	50
106	FWEL-II	Wind	50	50
107	Gul Ahmed	Wind	50	50
108	Gul Ahmed-II	Wind	50	50
109	Hawa	Wind	50	50
110	Indus	Wind	50	50
111	Jhimpir	Wind	50	50
112	Lakeside Wind	Wind	50	50
113	Liberty Wind-I	Wind	50	50
114	Master	Wind	50	50
115	Master Green	Wind	50	50
116	Metro_Wind	Wind	50	50
117	Metro_Wind-II	Wind	60	60
118	NASDA Green Wind	Wind	50	50
119	Sachal	Wind	50	50
120	Sapphire_Wind	Wind	50	50
121	Tapal Wind-2	Wind	50	50
122	Tenaga	Wind	50	50
123	Three_Gorges_I	Wind	50	50
124	Three_Gorges_II	Wind	50	50
125	Three_Gorges_III	Wind	50	50
126	Tricom	Wind	50	50
127	Tricon_A	Wind	50	50
128	Tricon_B	Wind	50	50
129	Tricon_C	Wind	50	50
130	UEP	Wind	99	99
131	Yunus	Wind	50	50
132	Zephyr	Wind	50	50
133	Zorlu_Wind	Wind	56	56
134	Liberty Wind-II	Wind	50	50
Sub Total (Wind)			1,845	1,845
Solar Power Projects				
135	Appolo Solar	Solar PV	100	100
136	Best	Solar PV	100	100
137	Crest	Solar PV	100	100
138	QA_Solar	Solar PV	100	100

Sr. No.	Name of Power Project	Fuel	Installed Capacity	Dependable Capacity
			(MW)	
139	Zhenfa	Solar PV	100	100
	Sub Total Solar Power Project		500	500
	Total Public Sector		16,874	16,234
	Total Private Sector		21,075	19,531
	Total Installed Capacity (MW)		37,949	35,765

B-1 (ii). K-Electric Existing Installed Capacity (As of June 2022)

Sr. No.	Name of Power Project	Fuel	Installed Capacity	Dependable Capacity
			MW	
1	BQPS1-U1	RLNG	210	167
2	BQPS1-U2	RLNG	210	169
3	BQPS1-U5	RLNG	210	175
4	BQPS1-U6	RLNG	210	167
5	BQPS2	RLNG	573	480
6	KCCPP	RLNG	248	211
7	BQPS3	RLNG	918	900
8	KTGTPS	RLNG	107	89
9	SGTPS	RLNG	107	89
10	SNPC-I	Gas	52	50
11	SNPC-II	Gas	52	50
12	FPCL	Imp. Coal	60	52
13	Tapal	RFO	126	120
14	GAEL	RFO	136	123
15	Oursun	Solar PV	50	50
16	Gharo	Solar PV	50	50
	Total Installed Capacity (MW)		3,319	2,941

B-2. Cost Data of Existing, Committed and Candidate Thermal Projects

#	Project Name	Fuel	Fixed O&M	Variable O&M	Fuel Cost	Heat Rate	Unit Cost	
			(\$/kW/Year)	(\$/MWh)	(\$/GJ)	(GJ/MWh)	(\$/MWh)	Rs/kWh
Existing Power Projects								
1	K-3	Uranium	52.20	0.00	0.47	10.00	4.70	0.84
2	K-2	Uranium	52.28	0.00	0.47	10.00	4.77	0.85
3	C-3	Uranium	99.91	0.00	0.49	10.91	5.35	0.95
4	C-1	Uranium	135.48	0.00	0.50	10.91	5.47	0.97

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#	Project Name	Fuel	Fixed O&M	Variable O&M	Fuel Cost	Heat Rate	Unit Cost	
			(\$/kW/Year)	(\$/MWh)	(\$/GJ)	(GJ/MWh)	(\$/MWh)	Rs/kWh
5	C-2	Uranium	124.60	0.00	0.58	10.91	6.33	1.13
6	C-4	Uranium	99.08	0.00	0.61	10.91	6.65	1.18
7	Lucky	Local Coal	25.39	2.94	0.95	9.23	11.71	2.08
8	Uch (Below 152GWh)	Gas	13.10	2.50	1.22	7.65	11.80	2.10
9	Liberty (Below 61GWh)	Gas	60.23	3.09	1.74	7.07	15.38	2.74
10	Engro Thar	Local Coal	26.6+312.36	6.21	1.47	9.66	20.37	3.62
11	Guddu 747 CC	Gas	18.44	3.72	4.56	7.32	37.12	6.61
12	Guddu-I U (11-13)	Gas	25.12	0.39	4.56	9.00	41.48	7.38
13	Foundation	Gas	23.01	4.03	5.06	7.68	42.84	7.62
14	Uch-II	Gas	26.00	2.33	5.33	8.19	46.02	8.19
15	Guddu-II U (5-10)	Gas	25.12	0.39	4.56	10.00	46.04	8.19
16	Uch (Above 152GWh)	Gas	13.10	2.50	5.86	7.65	47.34	8.42
17	Engro 90MW	Gas	16.67	3.56	5.06	9.73	52.82	9.40
18	Liberty (Above 61GWh)	Gas	60.23	3.09	8.70	7.07	64.56	11.49
19	Port Qasim	Imported Coal	28.07	1.24	14.15	9.01	128.71	22.90
20	Haveli	RLNG	12.34	1.33	20.87	6.53	137.58	24.48
21	Balloki	RLNG	12.64	1.48	20.87	6.58	138.80	24.70
22	Bhikki	RLNG	18.44	3.72	20.87	6.59	141.28	25.14
23	Sahiwal Coal	Imported Coal	24.87	1.22	17.50	8.51	150.09	26.71
24	China HUBCO	Imported Coal	26.64	3.02	17.39	8.95	158.73	28.25
25	Orient	RLNG	26.59	2.49	23.11	7.25	170.10	30.27
26	Halmore	RLNG	19.84	4.25	23.11	7.25	171.69	30.55
27	Saphire	RLNG	19.57	4.19	23.11	7.25	171.80	30.57
28	Saif	RLNG	20.32	4.23	23.11	7.25	171.86	30.58
29	Nandipur	RLNG	18.51	4.20	23.11	7.35	173.99	30.96
30	KAPCO 1	RLNG	19.22	2.48	20.87	8.38	177.38	31.56
31	AGL	RFO	26.96	9.84	20.38	8.66	186.38	33.17
32	Rousch	RLNG	19.22	2.62	20.87	8.84	187.06	33.29
33	Liberty Tech	RFO	23.86	10.60	21.30	8.50	191.62	34.10

#	Project Name	Fuel	Fixed O&M	Variable O&M	Fuel Cost	Heat Rate	Unit Cost	
			(\$/kW/Year)	(\$/MWh)	(\$/GJ)	(GJ/MWh)	(\$/MWh)	Rs/kWh
34	KAPCO 2	RLNG	19.22	2.89	20.87	9.19	194.74	34.65
35	Kohinoor	RFO	19.22	5.57	21.52	8.97	198.59	35.34
36	HuB N	RFO	23.78	8.47	24.58	7.95	203.86	36.28
37	KAPCO 3	RLNG	19.22	5.58	20.87	9.51	203.99	36.30
38	Engro 127MW	HSD	16.67	3.56	28.97	7.06	208.03	37.02
39	FKPCL	RLNG	19.22	7.04	12.63	15.99	208.89	37.17
40	Jamshoro-I U1	RFO	17.55	0.52	17.70	11.79	209.20	37.23
41	ATLAS	RFO	22.66	9.72	23.65	8.49	210.55	37.47
42	Saba	RFO	19.22	1.60	21.56	9.81	213.11	37.92
43	Lalpir	RFO	19.22	1.60	21.67	10.10	220.38	39.22
44	HUBCO	RFO	15.43	1.62	21.12	10.37	220.71	39.28
45	Jamshoro-II U4	RFO	17.55	0.52	17.70	12.62	223.76	39.82
46	Nishat P	RFO	23.49	9.72	22.34	9.71	226.59	40.32
47	Nishat C	RFO	23.45	9.70	21.39	10.17	227.14	40.42
48	AES Pakgen	RFO	19.22	1.60	21.63	10.43	227.16	40.42
49	Altern	Gas	86.77	6.48	22.56	9.79	227.34	40.45
50	Davis	RLNG	21.02	5.38	22.56	9.90	228.72	40.70
51	Muzaffargarh-II U4	RFO	27.54	0.91	21.02	11.72	247.19	43.99
52	Muzaffargarh-I U3	RFO	27.54	0.91	21.02	11.74	247.56	44.05
53	Muzaffargarh-I U1	RFO	27.54	0.91	21.02	11.99	252.98	45.02
54	Muzaffargarh-I U2	RFO	27.54	0.91	21.02	12.16	256.40	45.63

Committed Power Projects

55	Thar-I (SSRL)	Local Coal	25.4+71.81	6.20	1.47	9.23	19.72	3.51
56	Thal Nova	Local Coal	27.16+71.81	6.20	1.47	9.73	20.45	3.64
57	Thar TEL	Local Coal	27.16+71.81	6.20	1.47	9.73	20.45	3.64
58	Gwadar	Local Coal	33.77	1.15	2.80	9.66	28.21	5.02
59	Jamshoro Coal U1	Imported Coal	5.06	2.85	6.17	8.71	56.59	10.07
60	Trimmu	RLNG	13.29	3.14	20.87	5.89	125.96	22.42

Candidate Power Projects

61	New_Nuclear	Uranium	73.89	0.00	0.47	9.57	4.50	0.80
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#	Project Name	Fuel	Fixed O&M	Variable O&M	Fuel Cost	Heat Rate	Unit Cost	
			(\$/kW/Year)	(\$/MWh)	(\$/GJ)	(GJ/MWh)	(\$/MWh)	Rs/kWh
62	C-5	Uranium	73.89	0.00	0.47	9.57	4.50	0.80
63	NEW_L.Coal II	Local Coal	25.17+71.81	5.93	0.88	9.23	14.07	2.50
64	NEW_L.Coal 660	Local Coal	26.6+71.81	6.21	0.88	9.23	14.35	2.55
65	NEW_L.Coal 330	Local Coal	26.6 +71.81	6.21	0.88	9.73	14.79	2.63
66	Jamshoro Coal U2	Imported Coal	5.06	2.85	6.17	9.11	59.05	10.51
67	New_CCGT	RLNG	13.29	3.14	20.87	5.89	125.96	22.42
68	NEW_Imp.Coal	Imported Coal	26.64	3.02	17.39	9.23	163.57	29.11
69	NEW_OCGT	RLNG	13.29	3.14	20.87	9.46	200.62	35.70

B-3. Indexed Capital Cost Calculations of Candidate Hydro Power Projects

#	Name of Project	Capacity (MW)	Capital Cost with IDC (Million US\$)			Rev. Mar. 22 Capital Cost with IDC (Million US\$)			Build Cost
			Local	Foreign	Total	Local	Foreign	Total	
1	Thakot-III	1490	1279.6	962.9	2242.5	1019.80	1074.88	2094.69	1,406
2	Dowarian	40	42	18	60	38.58	19.45	58.03	1,451
3	Nagdar	35	36.75	15.75	52.5	33.76	17.02	50.78	1,451
4	Shounter	48	53.76	23.04	76.8	49.38	24.90	74.28	1,547
5	Asrit Kedam	215	260.132	111.44	371.572	207.07	146.70	353.77	1,645
6	Kalam Asrit	238	269.93	129.8	399.73	271.52	131.88	403.40	1,695
7	Jagran-IV	22	27.41	11.75	39.16	25.18	12.70	37.87	1,722
8	CJ	25	28.5	19	47.5	21.37	21.68	43.05	1,722
9	Mahl	640	767.5	502.5	1270	570.91	554.16	1125.07	1,758
10	Taunsa	135	143	104	247	128.58	111.08	239.66	1,775
11	Bata Kundi	99	108.42	79.787	188.207	84.22	93.24	177.45	1,792
12	Ashkot	300	204.67	329.8	534.47	204.73	335.08	539.81	1,799
13	Turtonas Uzghor	82.25	10.692	122.958	133.65	18.38	131.21	149.58	1,819
14	Patan	2400	2235	2335	4570	1765.07	2765.01	4530.08	1,888
15	Chowkel Khwar	60	70	50	120	61.76	51.63	113.38	1,890
16	Arkari Gol	99	137.25	77.3	214.55	105.56	89.43	195.00	1,970
17	Rajdhani	132	0	173	173	0.00	264.64	264.64	2,005

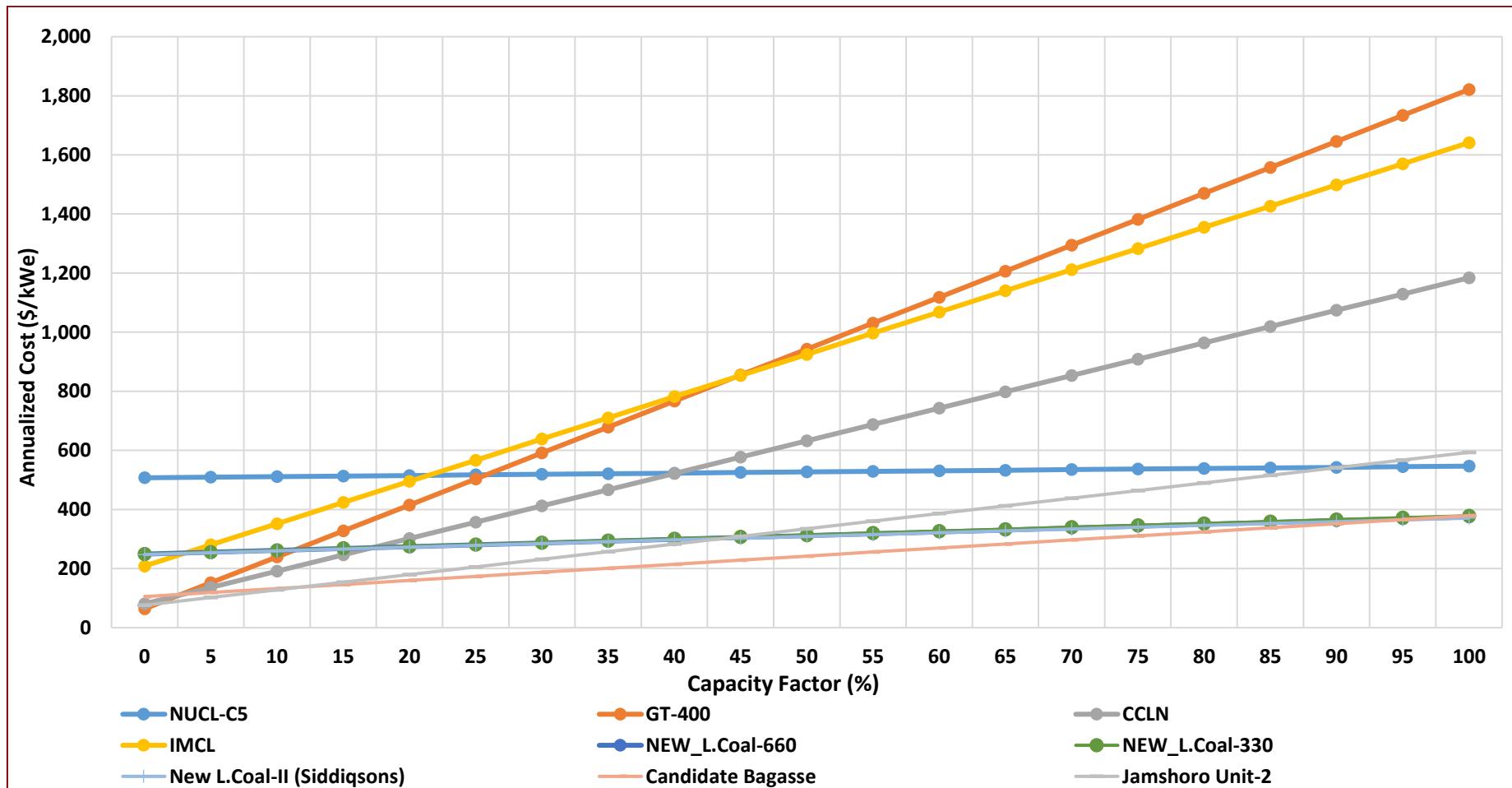
Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Name of Project	Capacity (MW)	Capital Cost with IDC (Million US\$)			Rev. Mar. 22 Capital Cost with IDC (Million US\$)			Build Cost
			Local	Foreign	Total	Local	Foreign	Total	
18	Nila Da Katha	31.3	0	58.4	58.4	0.00	64.22	64.22	2,052
19	Artistic-II	55.032	81.5185	31.9815	113.5	81.54	32.49	114.04	2,072
20	Naran	188	269.4	161.9	431.3	234.17	192.44	426.62	2,269
21	Lower Spat Gah	496	247	829	1076	233.65	898.12	1131.77	2,282
22	Chakothi Hattian	500	0	983.12	983.13	0.00	1163.88	1163.88	2,328
23	Kari Mashkur	495	761.04	403.53	1164.57	719.91	437.17	1157.09	2,338
24	Shigo Kas	102	257.88	48.89	306.77	185.35	55.09	240.44	2,357
25	Sharmai	152.12	232.279	137.298	369.577	215.38	146.65	362.02	2,380
26	Gabral Utror	79	147.0	52.6	199.7	135.03	56.88	191.91	2,429
27	Chiniot_HPP	80	188.5	25.75	214.25	167.32	27.90	195.22	2,440
28	Harighel-Majeedgala	40.32	70.301	37.858	108.159	54.96	44.23	99.19	2,460
29	Kalkot Barikot	47	91.94	28.3	120.24	87.83	28.75	116.59	2,481
30	Mujigram	64.26	142.477	35.619	178.096	120.68	42.50	163.18	2,539
31	Bankhwar	35	67.17	25.91	93.08	61.70	28.00	89.70	2,563
32	Tangar	25.91	35.28	34.209	69.489	27.13	39.58	66.71	2,575
33	Gumat Nar	49.5	130.82	30.2	161.02	102.28	35.28	137.56	2,779
34	Trappi	32	77.4	19.3	96.7	68.61	20.94	89.56	2,799
35	Kaigah-III	21.1	27.72	33.62	61.34	22.59	37.14	59.73	2,831

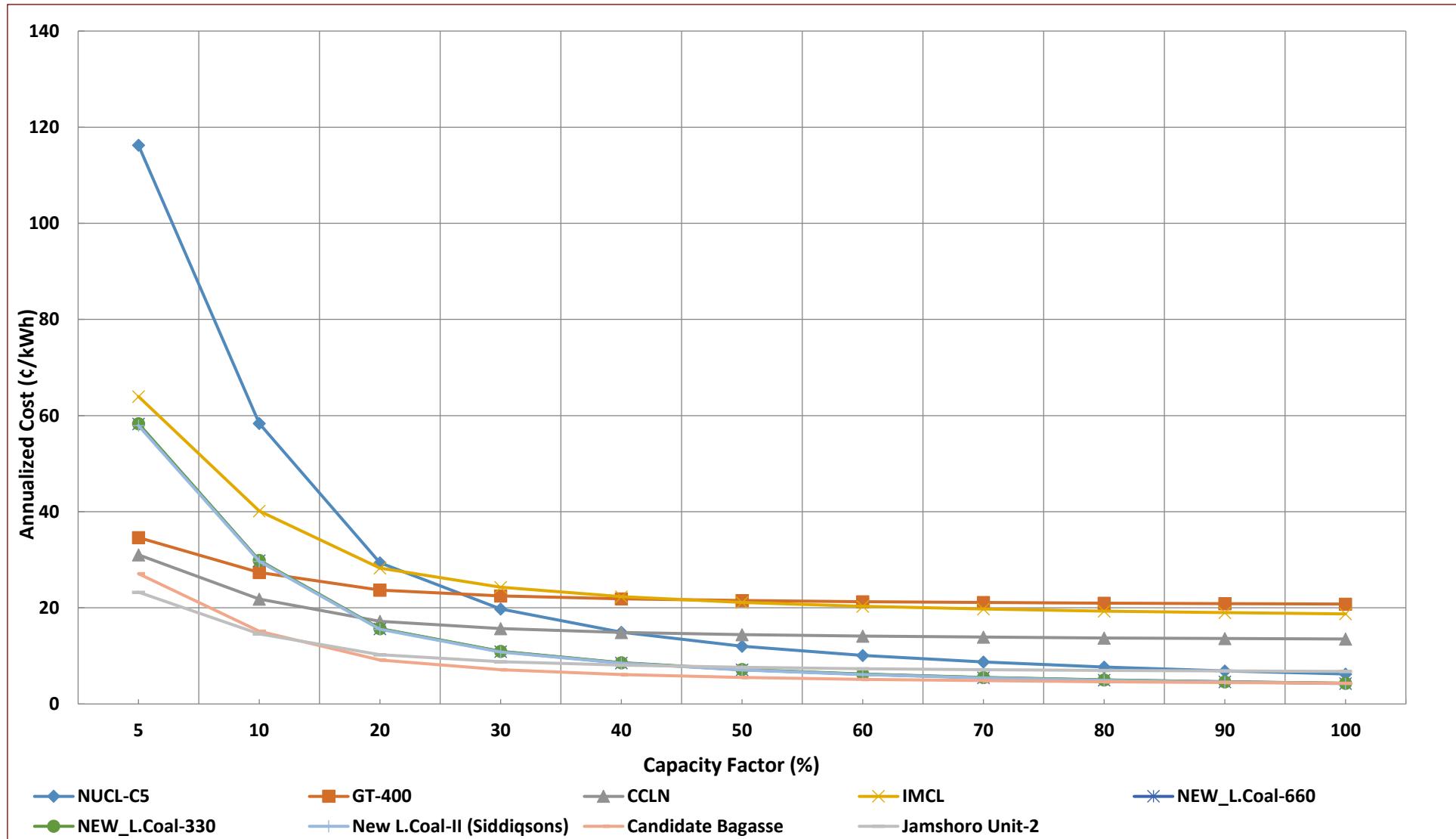
#	Name of Project	Capacity (MW)	Capital Cost with IDC (Million US\$)			Rev. Mar. 22 Capital Cost with IDC (Million US\$)			Build Cost
			Local	Foreign	Total	Local	Foreign	Total	
36	Patrak Sheringhal	22	46.75	20.48	67.23	44.66	20.81	65.47	2,976
37	Kaigah-II	39.6	39.21	80.71	119.92	29.61	90.94	120.55	3,044
38	Shalfalam	60	0	170.18	170.18	0.00	184.37	184.37	3,073
39	Ghorband	20.6	48.4	21.0	69.4	40.97	25.01	65.98	3,203
40	Athmuqam	450	0	1315	1315	0.00	1449.56	1449.56	3,221
41	Luat	49	47.33	107.525	154.855	36.16	124.40	160.56	3,277
42	Kaigah	545	0	1564.8	1564.8	0.00	1866.11	1866.11	3,424
43	Artistic-I	62.606	187.47	49.37	236.84	172.19	53.35	225.54	3,603
44	Istaro-Booni	72	150	110	260	129.43	130.73	260.16	3,613
45	Jagran-III	35	64.64	60.98	125.62	55.49	74.82	130.31	3,723
46	Gahret	377	1351.03	486.59	1837.62	1041.03	568.50	1609.53	4,269

B-4. Screening Curve for Candidate Thermal Projects

B - 4.1. Screening Curve For Candidate Thermal Projects (\$/kW/Yr)



B - 4.2 Screening Curve for candidate Projects (¢/kWh)



B-5. Annualized Cost of Candidate Hydro Power Projects

#	Power Project	Project Executing Agency	Installed Capacity	Earliest Availability	FO&M	Installed Cost	Annual Energy	Economic Life	Project Factor	Annualized Cost of Energy	
			(MW)	(Year)	(\$/kW/Yr)	((\$/kW))	(GWh)	(Years)	(%)	c/kWh	\$/kW/Yr
1	Thakot-III	WAPDA	1490	2030	20.01	1,406	7407	50	57%	3.25	161.80
2	Bata Kundi	GoKPK	99	2028	5.73	1,792	511	49	59%	3.62	186.67
3	Nagdar	AJK	35	2029	10.10	1,451	152	30	50%	3.78	163.99
4	Dowarian	AJK	40	2029	10.10	1,451	174	30	50%	3.78	163.99
5	Asrit Kedam	PEDO	215	2029	9.88	1,645	945	80	50%	3.97	174.50
6	Taunsa	PPDB	135	2028	13.92	1,775	651	50	55%	4.00	192.96
7	Shounter	AJK	48	2029	10.10	1,547	208	30	50%	4.01	174.25
8	CJ	PPDB	25	2028	14.05	1,722	111	50	51%	4.24	187.73
9	Jagran-IV	AJK	22	2029	10.10	1,722	96	30	50%	4.42	192.72
10	Harighel-Majeedgala	AJK	40.32	2028	1.05	2,460	227	50	64%	4.43	249.17
11	Patan	WAPA	2400	2031	43.29	1,888	12520	50	60%	4.48	233.66
12	Kalam Asrit	PEDO	238	2029	9.84	1,695	944	50	45%	4.56	180.79
13	Mahl	PPIB	640	2030	16.89	1,758	2694	50	48%	4.61	194.19
14	Ashkot	PPIB	300	2030	15.64	1,799	1263	50	48%	4.68	197.13
15	Rajdhani	PPIB	132	2029	39.17	2,005	677	50	59%	4.71	241.38
16	Nila Da Katha	PEDO	31.3	2028	11.39	2,052	142	30	52%	5.06	229.02
17	Chakothi Hattian	PPIB	500	2031	13.64	2,328	2430	50	55%	5.11	248.42
18	Turtonas Uzghor	PPIB	82.25	2029	54.52	1,819	381	50	53%	5.14	237.95
19	Chowkel Khwar	PEDO	60	2028	10.83	1,890	241	30	46%	5.26	211.29

#	Power Project	Project Executing Agency	Installed Capacity	Earliest Availability	FO&M	Installed Cost	Annual Energy	Economic Life	Project Factor	Annualized Cost of Energy	
			(MW)	(Year)	(\$/kW/Yr)	(\$/kW)	(GWh)	(Years)	(%)	c/kWh	\$/kW/Yr
20	Ghorband	GoKPK	20.6	2028	24.19	3,203	134	50	74%	5.35	347.25
21	Shigo Kas	PEDO	102	2029	41.21	2,357	525	80	59%	5.38	277.05
22	Kari Mashkur	GoKPK	495	2029	15.95	2,338	2204	50	51%	5.65	251.72
23	Mujigram	GoKPK	64.26	2031	12.99	2,539	304	50	54%	5.69	269.10
24	Artistic-II	PEDO	55.032	2028	13.01	2,072	212	60	44%	5.74	220.91
25	Trappi	PEDO	32	2028	1.30	2,799	165	30	59%	5.78	298.17
26	Arkari Gol	PEDO	99	2029	23.81	1,970	379	50	44%	5.81	222.46
27	Sharmai	PEDO	152.12	2029	31.65	2,380	690	100	52%	5.95	269.65
28	Naran	GoKPK	188	2029	5.71	2,269	704	50	43%	6.26	234.58
29	Kaigah-III	PEDO	21.1	2029	0.16	2,831	101	30	55%	6.26	300.47
30	Gumat Nar	AJK	49.5	2029	1.56	2,779	220	50	51%	6.34	281.85
31	Lower Spat Gah	PEDO	496	2030	2.08	2,282	1898	30	44%	6.38	244.13
32	Kalkot Barikot	GoKPK	47	2029	8.68	2,481	186	50	45%	6.55	258.86
33	Kaigah-II	PEDO	39.6	2029	0.47	3,044	190	30	55%	6.73	323.41
34	Gabral Utror	PEDO	79	2028	20.58	2,429	311	40	45%	6.84	269.00
35	Tangar	PEDO	25.91	2028	33.56	2,575	116	30	51%	6.84	306.70
36	Chiniot_HPP	WAPDA	80	2028	4.51	2,440	275	50	39%	7.30	250.63
37	Shalfalam	PEDO	60	2029	7.96	3,073	269	30	51%	7.44	333.92
38	Luat	AJK	49	2029	1.48	3,277	213	50	50%	7.65	331.98
39	Artistic-I	PEDO	62.606	2028	27.97	3,603	307	60	56%	7.95	389.41
40	Patrak Sheringhal	GoKPK	22	2029	8.78	2,976	85	50	44%	7.95	308.93

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#	Power Project	Project Executing Agency	Installed Capacity	Earliest Availability	FO&M	Installed Cost	Annual Energy	Economic Life	Project Factor	Annualized Cost of Energy	
			(MW)	(Year)	(\$/kW/Yr)	(\$/kW))	(GWh)	(Years)	(%)	c/kWh	\$/kW/Yr
41	Athmuqam	PPIB	450	2029	28.10	3,221	1982	50	50%	8.02	353.00
42	Bankhwar	PEDO	35	2028	22.51	2,563	124	40	40%	8.05	284.57
43	Jagran-III	AJK	35	2029	1.28	3,723	162	30	53%	8.54	396.22
44	Gahret	GoKPK	377	2031	15.71	4,269	1768	50	54%	9.52	446.31
45	Istaro-Booni	GoKPK	72	2031	12.17	3,613	279	50	44%	9.73	376.61
46	Kaigah	PPIB	545	2031	37.14	3,424	374	50	8%	55.74	382.49

B-6. Candidate Hydro projects COD optimized by PLEXOS for different scenarios

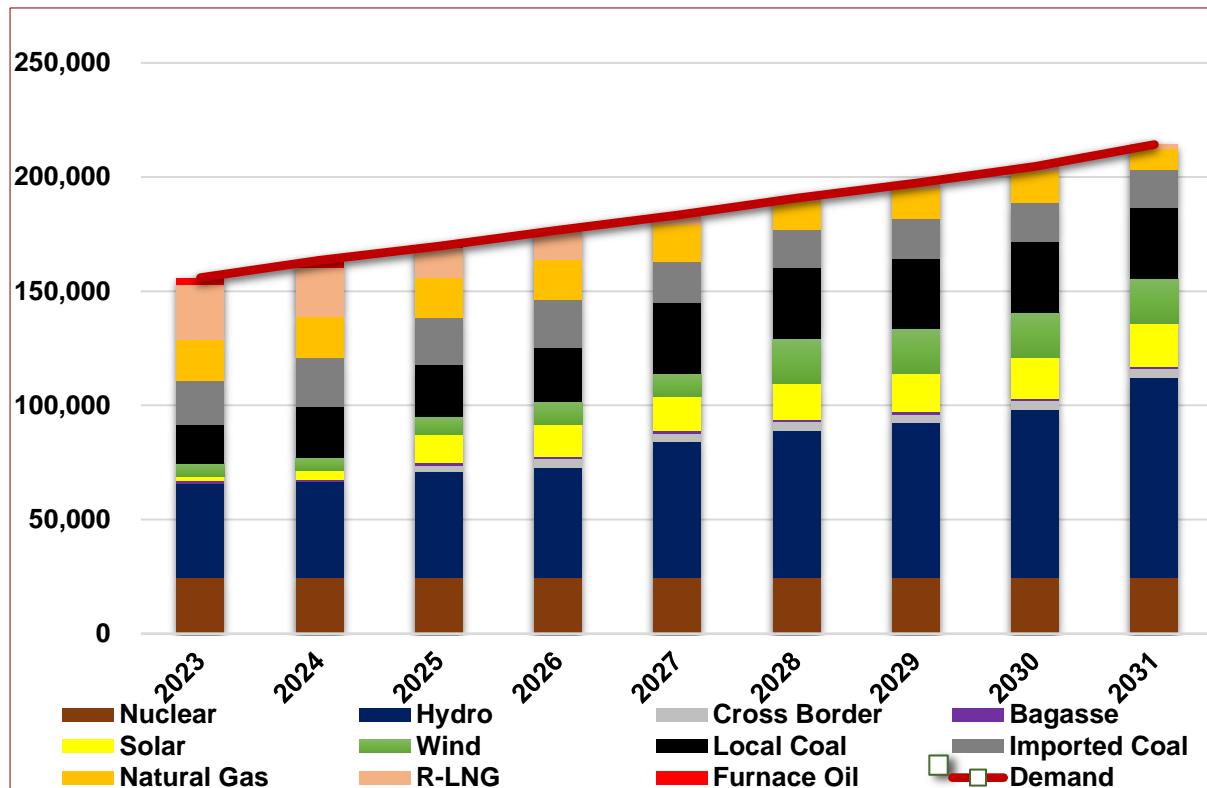
#	Candidate Plants Name	Category	Capacity	COD given to PLEXOS	Base Case	Scenarios					
						Low Demand	High Demand	Bhasha in 2029	C-5 in 2029	Local Coal in 2027 & 2030	Unconstrained VRE
				Year	Year	Year	Year	Year	Year	Year	Year
1	Artistic-I	Hydro	63	Jun-28	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
2	Artistic-II	Hydro	55	Jun-28	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
3	Bankhwar	Hydro	35	Jun-28	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
4	Bata Kundi	Hydro	99	Jun-28	2029	2029	2029	2030	2029	2029	2029
5	Chiniot_HPP	Hydro	80	Jun-28	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
6	Chowkel Khwar	Hydro	60	Jun-28	2029	Not Picked	2029	Not Picked	Not Picked	Not Picked	2029
7	CJ	Hydro	25	Jun-28	2029	2029	2029	2029	2029	2029	2029
8	Gabral Utror	Hydro	79	Jun-28	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
9	Ghorband	Hydro	21	Jun-28	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
10	Harighel-Majeedgala	Hydro	40	Jun-28	Not Picked	Not Picked	2029	Not Picked	Not Picked	Not Picked	Not Picked
11	Nila Da Katha	Hydro	31	Jun-28	2029	2029	2029	Not Picked	2029	2029	2029
12	Tangar	Hydro	26	Jun-28	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
13	Taunsa	Hydro	135	Jun-28	2029	2029	2029	2030	2029	2029	2029
14	Trappi	Hydro	32	Jun-28	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
15	Rajdhani	Hydro	132	Feb-29	2030	2030	2030	2030	2030	2030	2030

#	Candidate Plants Name	Category	Capacity	COD given to PLEXOS	Base Case	Scenarios					
						Low Demand	High Demand	Bhasha in 2029	C-5 in 2029	Local Coal in 2027 & 2030	Unconstrained VRE
						Year	Year	Year	Year	Year	Year
16	Kalam Asrit	Hydro	238	Mar-29	2030	Not Picked	2030	Not Picked	Not Picked	Not Picked	2030
17	Athmuqam	Hydro	450	May-29	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
18	Arkari Gol	Hydro	99	Jun-29	2030	2030	2030	2030	2030	2030	2030
19	Asrit Kedam	Hydro	215	Jun-29	2030	2030	2030	2030	2030	2030	2030
20	Dowarian	Hydro	40	Jun-29	2030	2030	2030	2030	2030	2030	2030
21	Gumat Nar	Hydro	50	Jun-29	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
22	Jagran-III	Hydro	35	Jun-29	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
23	Jagran-IV	Hydro	22	Jun-29	2030	2030	2030	2030	2030	2030	2030
24	Kaigah-II	Hydro	40	Jun-29	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
25	Kaigah-III	Hydro	21	Jun-29	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
26	Kalkot Barikot	Hydro	47	Jun-29	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
27	Kari Mashkur	Hydro	495	Jun-29	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
28	Luat	Hydro	49	Jun-29	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
29	Nagdar	Hydro	35	Jun-29	2030	2030	2030	2030	2030	2030	2030
30	Naran	Hydro	188	Jun-29	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
31	Patrak Sheringhal	Hydro	22	Jun-29	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked

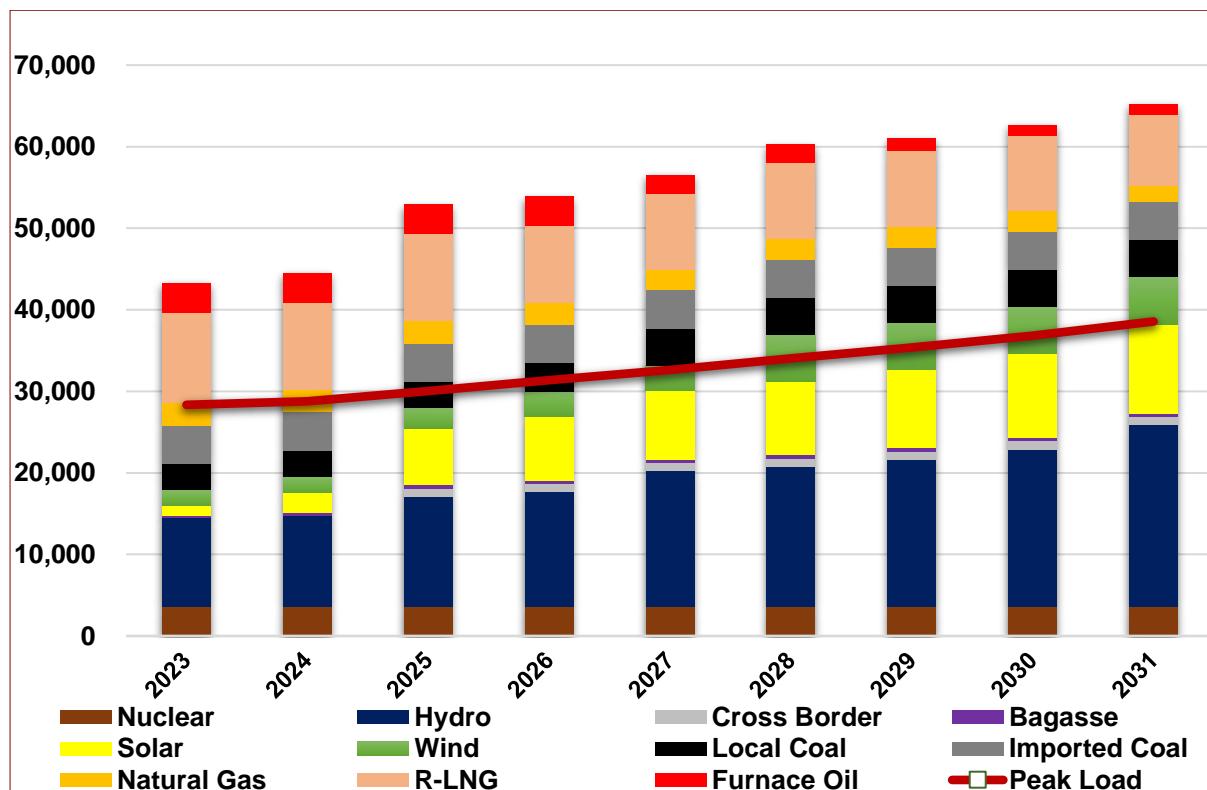
#	Candidate Plants Name	Category	Capacity	COD given to PLEXOS	Base Case	Scenarios					
						Low Demand	High Demand	Bhasha in 2029	C-5 in 2029	Local Coal in 2027 & 2030	Unconstrained VRE
						Year	Year	Year	Year	Year	Year
32	Shalfalam	Hydro	60	Jun-29	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
33	Sharmai	Hydro	152	Jun-29	2030	2030	2030	2030	2030	2030	2030
34	Shigo Kas	Hydro	102	Jun-29	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
35	Shounter	Hydro	48	Jun-29	2030	2030	2030	2030	2030	2030	2030
36	Turtonas Uzghor	Hydro	82	Jun-29	2030	2030	2030	2030	2030	2030	2030
37	Thakot-III	Hydro	1,490	Oct-29	2031	2031	2031	2031	2031	2031	2031
38	Mahl	Hydro	640	Jan-30	2031	2031	2031	2031	2031	2031	2031
39	Ashkot	Hydro	300	Mar-30	Not Picked	Not Picked	2031	Not Picked	Not Picked	Not Picked	Not Picked
40	Lower Spat Gah	Hydro	496	May-30	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
41	Gahret	Hydro	377	Dec-30	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
42	Istaro-Booni	Hydro	72	Dec-30	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
43	Mujigram	Hydro	64	Dec-30	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
44	Patan	Hydro	2,400	Jan-31	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
45	Chakothi Hattian	Hydro	500	Jan-31	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked
46	Kaigah	Hydro	545	Feb-31	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked	Not Picked

Annexure C. Low Demand Scenario

C-1. Annual Energy Generation Vs Annual Energy Demand (GWh) - Country



C-2. Installed Capacity Vs Peak Demand (MW) - Country



C-3. Optimized Generation Capacity Additions (MW)

Fiscal Year	Coal Fired Steam Local Coal	Coal Fired Steam Local Coal KE	HPP	HPP KE	Solar Utility MW _p	Solar Feeder MW _p	Solar KE MW _p	Wind NTDC	Wind KE	Bagasse	Per Year Capacity Addition	Cumulative Capacity Addition
2024	-	-	-	-	-	500	-	-	-	-	500	500
2025	-	-	-	-	3,120	750	150	500	50	-	4,570	5,070
2026	-	-	-	-	181	-	150	500	50	-	881	5,951
2027	-	990	-	-	-	-	150	-	50	-	1,190	7,141
2028	-	-	-	-	-	-	150	2,515	50	-	2,715	9,856
2029	-	-	290	-	-	-	150	-	50	-	490	10,346
2030	-	-	743	82	-	-	150	-	50	-	1,025	11,372
2031	-	-	2,130	-	-	-	150	-	50	-	2,330	13,702
Total	-	990	3,163	82	3,301	1,250	1,050	3,515	350	-	13,702	

C-4. List of Projects upto 2031 (Committed + Optimized)

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2022-23							
1	Thar TEL	Local Coal	330	300	PPIB	LOS (Issued)	Commissioned
2	Net Meter	Solar	480	480	AEDB	Committed	Dec-22
3	Trimmu	CCGT_RLNG	1,263	1,243	PPIB	LOS (Issued)	Dec-22
4	Mangla (U #5-6)	Hydro	70	70	WAPDA	Mangla Refurbishment	Dec-22
5	Koto	Hydro	40.8	40.8	GoKPK	PC-1 Approved	Dec-22
6	Jamshoro Coal (U #1)	Imported Coal	660	627	GENCO	PC-1 Approved	Dec-22
7	Thal Nova	Local Coal	330	300	PPIB	LOS (Issued)	Dec-22
8	Thar-I (SSRL)	Local Coal	1,320	1,214	PPIB	LOS (Issued)	Dec-22
9	Jagran-II (U #1)	Hydro	12	12	AJK-HEB	PC-1 Approved	Apr-23
10	Helios	Solar	50	50	AEDB	Category-II Project	Apr-23
11	HNDS	Solar	50	50	AEDB	Category-II Project	Apr-23
12	Meridian	Solar	50	50	AEDB	Category-II Project	Apr-23
13	Mangla (U #3-4)	Hydro	70	70	WAPDA	Mangla Refurbishment	May-23
14	Jagran-II (U #2)	Hydro	12	12	AJK-HEB	PC-1 Approved	May-23
Generation Additions in 2022-23 (MW)			4,738	4,519			
Cumulative Addition up till 2023 (MW)			4,738	4,519			
2023-24							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-23
2	New_Solar_DG	Solar	500	500	Yet to be determined	Optimized	Jul-23
3	Jagran-II (U #3-4)	Hydro	24	24	AJK-HEB	PC-1 Approved	Jul-23
4	Siachen	Solar	100	100	GoS	Category-II Project	Sep-23
5	Manjhand	Solar	50	50	GoS	PC-1 Approved	Sep-23
6	Zorlu	Solar	100	100	PPDB	Category-II Project	Dec-23

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
7	Lawi	Hydro	69	69	GoKPK	PC-1 Approved	Apr-24
8	Suki Kinari (U #1)	Hydro	221	221	PPIB	LOS (Issued)	May-24
9	Trans_Atlantic	Wind	50	50	AEDB	Category-II Project	Jun-24
10	Western	Wind	50	50	AEDB	Category-II Project	Jun-24
Generation Additions in 2023-24 (MW)			1,644	1,644			
Cumulative Addition up till 2024 (MW)			6,382	6,163			
2024-25							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-24
2	Mangla (U #1-2)	Hydro	70	70	WAPDA	Mangla Refurbishment	Jul-24
3	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-24
4	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-24
5	New_Solar_DG	Solar	750	750	Yet to be determined	Optimized	Jul-24
6	New_Solar_Utility	Solar	3,120	3,120	Yet to be determined	Optimized	Jul-24
7	New_Wind	Wind	500	500	Yet to be determined	Optimized	Jul-24
8	Gorkin Matiltan	Hydro	84	84	GoKPK	PC-1 Approved	Jul-24
9	Tarbela Ext5 (U #1)	Hydro	510	510	WAPDA	PC-1 Approved	Jul-24
10	Suki Kinari (U #2)	Hydro	221	221	PPIB	LOS (Issued)	Jul-24
11	CASA	Cross Border Interconnection	1,000	1,000	NTDC	G2G	Aug-24
12	Tarbela Ext5 (U #2)	Hydro	510	510	WAPDA	PC-1 Approved	Aug-24
13	Shahtaj	Bagasse	32	32	AEDB	Category-I Project	Aug-24
14	Tarbela Ext5 (U #3)	Hydro	510	510	WAPDA	PC-1 Approved	Sep-24
15	Suki Kinari (U #3)	Hydro	221	221	PPIB	LOS (Issued)	Sep-24
16	Suki Kinari (U #4)	Hydro	221	221	PPIB	LOS (Issued)	Nov-24
Generation Additions in 2024-25 (MW)			8,429	8,429			
Cumulative Addition up till 2025 (MW)			14,811	14,592			

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2025-26							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-25
2	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-25
3	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-25
4	New_Solar_Utility	Solar	181	181	Yet to be determined	Optimized	Jul-25
5	New_Wind	Wind	500	500	Yet to be determined	Optimized	Jul-25
6	Gwadar	Local Coal	300	273	PPIB	LOS (Issued)	Aug-25
7	Mangla (U #9-10)	Hydro	70	70	WAPDA	Mangla Refurbishment	Sep-25
8	Dasu (U #1)	Hydro	360	360	WAPDA	PC-1 Approved	May-26
9	Mohmand Dam (U #1)	Hydro	200	200	WAPDA	PC-1 Approved	May-26
Generation Additions in 2025-26 (MW)			2,291	2,264			
Cumulative Addition up till 2026 (MW)			17,102	16,856			
2026-27							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-26
2	KE_New_Local Coal	Local Coal	990	912	Yet to be determined	Optimized	Jul-26
3	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-26
4	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-26
5	Dasu (U #2)	Hydro	360	360	WAPDA	PC-1 Approved	Jul-26
6	Mohmand Dam (U #2)	Hydro	200	200	WAPDA	PC-1 Approved	Jul-26
7	Dasu (U #3)	Hydro	360	360	WAPDA	PC-1 Approved	Aug-26
8	Mohmand Dam (U #3)	Hydro	200	200	WAPDA	PC-1 Approved	Sep-26
9	Mangla (U #7-8)	Hydro	30	30	WAPDA	Mangla Refurbishment	Nov-26
10	Dasu (U #4)	Hydro	360	360	WAPDA	PC-1 Approved	Nov-26
11	Mohmand Dam (U #4)	Hydro	200	200	WAPDA	PC-1 Approved	Nov-26
12	Dasu (U #5)	Hydro	360	360	WAPDA	PC-1 Approved	Feb-27

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
13	Keyal Khwar (U #1)	Hydro	64	64	WAPDA	PC-1 Approved	Feb-27
14	Dasu (U #6)	Hydro	360	360	WAPDA	PC-1 Approved	May-27
15	Keyal Khwar (U #2)	Hydro	64	64	WAPDA	PC-1 Approved	May-27
Generation Additions in 2026-27 (MW)			4,228	4,150			
Cumulative Addition up till 2027 (MW)			21,330	21,006			
2027-28							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-27
2	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-27
3	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-27
4	New_Wind	Wind	2,515	2,515	Yet to be determined	Optimized	Jul-27
5	Gabral Kalam	Hydro	88	88	GoKPK	PC-1 Approved	Nov-27
6	Madyan	Hydro	157	157	GoKPK	PC-1 Approved	Nov-27
7	Balakot	Hydro	300	300	GoKPK	PC-1 Approved	Dec-27
Generation Additions in 2027-28 (MW)			3,740	3,740			
Cumulative Addition up till 2028 (MW)			25,070	24,746			
2028-29							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-28
2	Bata Kundii	Hydro	99	99	GoKPK	Optimized	Jul-28
3	CJ	Hydro	25	25	PPDB	Optimized	Jul-28
4	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-28
5	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-28
6	Nila Da Katha	Hydro	31.3	31.3	PEDO	Optimized	Jul-28
7	Taunsa	Hydro	135	135	PPDB	Optimized	Jul-28
8	Azad Pattan (U #1)	Hydro	175	175	PPIB	LOS (Issued)	Dec-28
9	Azad Pattan (U #2)	Hydro	175	175	PPIB	LOS (Issued)	Mar-29

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
10	Azad Pattan (U #3)	Hydro	175	175	PPIB	LOS (Issued)	Jun-29
Generation Additions in 2028-29 (MW)			1,496	1,496			
Cumulative Addition up till 2029 (MW)			26,566	26,242			
2029-30							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-29
2	Arkari Gol	Hydro	99	99	PEDO	Optimized	Jul-29
3	Asrit Kedam	Hydro	215	215	PEDO	Optimized	Jul-29
4	Dowarian	Hydro	40	40	AJK-HEB	Optimized	Jul-29
5	Jagran-IV	Hydro	22	22	AJK-HEB	Optimized	Jul-29
6	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-29
7	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-29
8	Nagdar	Hydro	35	35	AJK-HEB	Optimized	Jul-29
9	Rajdhani	Hydro	132	132	PPIB	Optimized	Jul-29
10	Sharmai	Hydro	152.12	152.12	PEDO	Optimized	Jul-29
11	Shounter	Hydro	48	48	AJK-HEB	Optimized	Jul-29
12	Turtonas Uzghor	Hydro	82.25	82.25	KE	Optimized	Jul-29
13	Azad Pattan (U #4)	Hydro	175	175	PPIB	LOS (Issued)	Sep-29
14	Kohala (U #1)	Hydro	275	275	PPIB	LOS (Issued)	Jun-30
Generation Additions in 2029-30 (MW)			1,956	1,956			
Cumulative Addition up till 2030 (MW)			28,521	28,197			
2030-31							
1	Mahl	Hydro	640	640	PPIB	Optimized	Jul-30
2	Thakot-III	Hydro	1,490	1,490	WAPDA	Optimized	Jul-30
3	Net Meter	Solar	480	480	AEDB	Committed	Jul-30
4	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-30

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
5	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-30
6	Kohala (U #2)	Hydro	275	275	PPIB	LOS (Issued)	Aug-30
7	Kohala (U #3)	Hydro	275	275	PPIB	LOS (Issued)	Oct-30
8	Kohala (U #4)	Hydro	275	275	PPIB	LOS (Issued)	Dec-30
9	Kohala (U #5)	Hydro	12	12	PPIB	LOS (Issued)	Feb-31
10	Kohala (U #6)	Hydro	12	12	PPIB	LOS (Issued)	Mar-31
Generation Additions in 2030-31 (MW)			3,659	3,659			
Cumulative Addition up till 2031 (MW)			32,180	31,856			

C-5. Annual Capacity Factors (%age)

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%age								
1	Almoiz	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
2	Chanar	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
3	Chiniot	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
4	Fatima	Bagasse	6.53	6.55	6.53	6.53	6.48	6.35	6.33	6.43	6.03
5	Hamza	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
6	JDW-II	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
7	JDW-III	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
8	Ryk_Mills	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
9	Shahtaj	Bagasse	0.00	0.00	45.62	45.62	45.62	45.77	45.62	45.62	45.62
10	Thal_Layyah	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
11	Appolo	PV	18.96	18.91	18.96	18.96	18.96	18.91	18.96	18.96	18.96
12	Best	PV	18.94	18.89	18.94	18.94	18.94	18.89	18.94	18.94	18.94
13	Crest	PV	19.19	19.13	19.19	19.19	19.19	19.13	19.19	19.19	19.19
14	Helios	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
15	HNDS	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
16	Manjhand	PV	0.00	23.23	23.33	23.33	23.33	23.27	23.33	23.33	23.33
17	Meridian	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
18	Net_Meter	PV	17.08	17.03	17.08	17.08	17.08	17.03	17.08	17.08	17.08
19	New_Solar	PV	0.00	0.00	22.08	22.08	22.08	22.02	22.08	22.08	22.08
20	New_Solar_Feeder	PV	0.00	19.95	20.00	20.00	20.00	19.95	20.00	20.00	20.00
21	QA_Solar	PV	19.04	18.99	19.04	19.04	19.04	18.99	19.04	19.04	19.04
22	Siachen	PV	0.00	23.23	23.33	23.33	23.33	23.27	23.33	23.33	23.33
23	Zhenfa	PV	21.50	21.44	21.50	21.50	21.50	21.44	21.50	21.50	21.50
24	Zorlu	PV	0.00	20.17	20.17	20.17	20.17	20.11	20.17	20.17	20.17
25	Gharo	KE_PV	25.25	25.18	25.25	25.25	25.25	25.18	25.25	25.25	25.25
26	KE_New_Solar	KE_PV	0.00	0.00	22.08	22.08	22.08	22.02	22.08	22.08	22.08
27	Oursun	KE_PV	20.97	20.91	20.97	20.97	20.97	20.91	20.97	20.97	20.97
28	Act	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
29	Act_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
30	Artistic_wind	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
31	Artistic_Wind_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
32	Dawood	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
33	Din	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
34	FFC	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
35	FWEL-I	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
36	FWEL-II	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
37	Gul Ahmed	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
38	Gul_Electric	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
39	Hawa	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
40	Indus_Energy	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
41	Jhimpir	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
42	Lakeside	Wind	38.93	38.07	38.17	38.17	38.17	38.07	38.17	38.17	38.17
43	Liberty_Wind_1	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
44	Liberty_Wind_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
45	Master	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
46	Master_Green	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
47	Metro_Power	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
48	Metro_Wind	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
49	NASDA	Wind	38.93	38.07	38.17	38.17	38.17	38.07	38.17	38.17	38.17
50	New_Wind	Wind	0.00	0.00	41.28	41.28	41.28	41.17	41.28	41.28	41.28
51	Sachal	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
52	Sapphire_Wind	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
53	Tenaga	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
54	Three_Gorges_I	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
55	Three_Gorges_II	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
56	Three_Gorges_III	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
57	Trans_Atlantic	Wind	0.00	41.17	41.28	41.28	41.28	41.17	41.28	41.28	41.28
58	Tricom	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
59	Tricon_A	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
60	Tricon_B	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
61	Tricon_C	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
62	UEP	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
63	Western	Wind	0.00	37.19	37.19	37.19	37.19	37.09	37.19	37.19	37.19
64	Yunus	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
65	Zephyr	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
66	Zorlu_Wind	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
67	KE_New_Wind	KE_Wind	0.00	0.00	41.28	41.28	41.28	41.17	41.28	41.28	41.28
68	CASA	Interconnection	0.00	0.00	41.80	41.92	41.92	41.80	41.92	41.92	41.92
69	Arkari Gol	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.22	42.22
70	Asrit Kedam	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.72	49.72
71	Bata Kundu	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	54.76	54.79	54.79
72	CJ	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	50.50	50.50	50.50
73	Dowarian	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.85	48.85
74	Jagran-IV	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.09	49.09
75	Mahl	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.53
76	Nagdar	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.87	48.87
77	Nila Da Katha	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	51.31	51.31	51.31
78	Rajdhani	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.46	58.46
79	Sharmai	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.94	50.94
80	Shounte	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.86	48.86
81	Taunsa	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	55.02	55.02	55.02
82	Thakot-III	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.33	
83	Turtonas Uzghor	KE_HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	51.90	51.90	

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
84	Azad Pattan	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	52.77	54.06	52.77
85	Balakot	HPP Committed	0.00	0.00	0.00	0.00	0.00	41.21	41.21	41.21	41.21
86	Dasu	HPP Committed	0.00	0.00	0.00	64.47	69.96	64.29	64.47	64.47	64.47
87	Diamer Bhasha	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
88	Gabral Kalam	HPP Committed	0.00	0.00	0.00	0.00	0.00	32.37	33.77	33.77	33.77
89	Gorkin Matiltan	HPP Committed	0.00	0.00	42.71	42.83	42.83	42.71	42.83	42.83	42.83
90	Jagran-II	HPP Committed	50.39	50.39	50.53	50.53	50.53	50.39	50.53	50.53	50.53
91	Karot	HPP Committed	44.39	44.29	44.39	44.39	44.39	44.29	44.38	44.39	44.39
92	Keyal Khwar	HPP Committed	0.00	0.00	0.00	0.00	52.07	51.92	52.07	52.07	52.07
93	Kohala	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.14	56.14
94	Koto	HPP Committed	57.03	57.08	57.24	57.24	57.24	57.03	57.12	57.19	57.23
95	Lawi	HPP Committed	0.00	47.99	48.10	48.10	48.10	47.96	47.99	48.05	48.08
96	Madyan	HPP Committed	0.00	0.00	0.00	0.00	0.00	47.43	47.43	47.43	47.43
97	Mohmand Dam	HPP Committed	0.00	0.00	0.00	42.71	46.36	42.60	42.71	42.71	42.71
98	Suki Kinari	HPP Committed	0.00	49.07	49.07	49.07	49.07	48.93	49.07	49.07	49.07
99	Tarbela_Ext_5	HPP Committed	0.00	0.00	10.05	10.05	10.05	10.02	10.05	10.05	10.05
100	Allai Khwar	HPP Existing	44.32	44.20	44.32	44.32	44.32	44.20	44.32	44.32	44.32
101	Chashma	HPP Existing	48.58	48.45	48.58	48.58	48.58	48.45	48.58	48.58	48.58
102	Daral Khwar	HPP Existing	38.58	38.48	38.58	38.58	38.58	38.48	38.58	38.58	38.58
103	Dubair Khwar	HPP Existing	53.09	52.95	53.09	53.09	53.09	52.95	53.09	53.09	53.09
104	Ghazi Brotha	HPP Existing	52.78	52.63	52.78	52.78	52.78	52.63	52.78	52.78	52.78
105	Golen Gol	HPP Existing	9.15	9.12	9.15	9.15	9.15	9.12	9.15	9.15	9.15
106	Gulpur	HPP Existing	28.92	28.84	28.92	28.92	28.92	28.84	28.92	28.92	28.92
107	Jagran-I	HPP Existing	48.95	48.82	48.95	48.95	48.95	48.82	48.95	48.95	48.95
108	Jinnah	HPP Existing	25.74	25.67	25.74	25.74	25.74	25.67	25.74	25.74	25.74
109	Khan Khwar	HPP Existing	40.22	40.11	40.22	40.22	40.22	40.11	40.22	40.22	40.22
110	Malakand-III	HPP Existing	53.86	53.71	53.86	53.86	53.86	53.71	53.86	53.86	53.86
111	Mangla	HPP Existing	64.98	60.97	58.32	56.00	54.77	54.20	54.35	54.35	54.35
112	Neelum Jehlum	HPP Existing	51.69	51.54	51.69	51.69	51.69	51.54	51.69	51.69	51.69
113	New Bong	HPP Existing	55.49	55.34	55.49	55.49	55.49	55.34	55.49	55.49	55.49
114	Patrind	HPP Existing	43.76	43.64	43.76	43.76	43.76	43.64	43.76	43.76	43.76
115	Small Hydel	HPP Existing	45.02	44.90	45.02	45.02	45.02	44.90	45.02	45.02	45.02
116	Tarbela 1-14	HPP Existing	37.99	37.89	37.99	37.99	37.99	37.89	37.99	37.99	37.99
117	Tarbela_Ext_4	HPP Existing	30.12	30.04	30.12	30.12	30.12	30.04	30.12	30.12	30.12
118	Warsak	HPP Existing	50.64	50.50	50.64	50.64	50.64	50.50	50.64	50.64	50.64
119	Engro 90MW	CCGT_Gas	90.23	74.96	62.46	50.73	70.05	35.95	32.76	29.09	23.52
120	Foundation	CCGT_Gas	89.99	90.25	90.00	89.98	83.20	57.94	81.65	78.21	57.94
121	Guddu-I	CCGT_Gas	36.91	74.63	74.43	74.42	70.00	67.61	70.32	70.23	21.84
122	Guddu-II	CCGT_Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
123	Guddu-V (747)	CCGT_Gas	75.56	75.77	75.56	75.56	75.56	73.42	74.52	74.13	68.63
124	Liberty	CCGT_Gas	74.56	75.02	43.44	60.65	0.00	0.00	0.00	0.00	0.00
125	Uch	CCGT_Gas	86.08	86.32	86.08	86.08	81.50	43.68	44.89	47.93	0.00

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% 								
126	Uch-II	CCGT_Gas	87.79	88.05	87.81	87.78	80.86	51.33	63.13	65.75	51.31
127	SNPC-I	KE_CCGT_Gas	91.98	92.25	92.00	91.98	84.72	31.21	83.14	80.20	28.14
128	SNPC-II	KE_CCGT_Gas	91.98	92.25	92.00	91.98	84.72	32.98	83.30	80.28	29.75
129	AES Lalpir	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
130	AES Pakgen	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
131	HUBCO	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
132	Jamshoro-I U1	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
133	Jamshoro-II U4	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
134	Muzaffargarh-I U1	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
135	Muzaffargarh-I U2	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
136	Muzaffargarh-I U3	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
137	Muzaffargarh-II U4	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
138	Saba	ST_RFO	14.38	21.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00
139	AGL	DG_RFO	36.12	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00
140	Atlas	DG_RFO	14.40	21.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
141	Engro 127MW	DG_RFO	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
142	HuB N	DG_RFO	36.12	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00
143	Kohinoor	DG_RFO	14.39	21.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
144	Liberty Tech	DG_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
145	Nishat C	DG_RFO	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
146	Nishat P	DG_RFO	36.81	22.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
147	C-1	Nuclear	80.43	80.65	80.43	80.43	80.43	80.65	80.43	80.43	80.43
148	C-2	Nuclear	79.61	79.83	79.61	79.61	79.61	79.83	79.61	79.61	79.61
149	C-3	Nuclear	81.01	81.23	81.01	81.01	81.01	81.23	81.01	81.01	81.01
150	C-4	Nuclear	81.01	81.23	81.01	81.01	81.01	81.23	81.01	81.01	81.01
151	K-2	Nuclear	85.07	85.30	85.07	85.07	85.07	85.29	85.05	85.06	85.06
152	K-3	Nuclear	85.67	85.90	85.67	85.67	85.67	85.90	85.65	85.66	85.66
153	Engro Thar	Local Coal	82.51	82.74	82.51	82.51	82.51	81.95	81.89	81.95	78.86
154	Gwadar	Local Coal	0.00	0.00	0.00	69.18	83.34	82.42	82.26	82.75	78.74
155	Lucky	Local Coal	85.08	85.31	85.08	85.08	85.08	85.31	85.07	85.08	85.08
156	Thal Nova	Local Coal	49.35	85.21	84.98	84.98	84.98	84.91	84.67	84.98	84.59
157	Thar TEL	Local Coal	84.98	85.21	84.98	84.98	84.98	84.69	84.63	84.74	84.97
158	Thar-I (SSRL)	Local Coal	42.14	85.21	84.98	84.98	84.98	85.20	84.98	84.98	84.98
159	K.E_NEW_L.Coal	KE_Local Coal	0.00	0.00	0.00	0.00	83.33	83.55	83.33	83.33	83.33
160	China HUBCO	Imported Coal	51.57	51.57	51.57	51.57	51.57	51.57	51.57	51.57	51.57
161	Jamshoro Coal	Imported Coal	49.15	83.08	81.57	81.67	35.39	13.92	18.42	18.98	13.28
162	Port Qasim	Imported Coal	48.72	48.72	48.72	48.72	48.72	48.72	48.72	48.72	48.72
163	Sahiwal Coal	Imported Coal	48.02	48.02	48.02	48.02	48.02	48.02	48.01	48.01	48.02
164	FPCL	KE_Imported Coal	82.16	77.03	16.03	17.36	10.24	7.20	9.94	10.64	9.09
165	Davis	DG_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
166	Balloki	CCGT_RLNG	3.94	1.59	0.58	1.22	0.74	0.29	0.31	0.39	0.29
167	Bhikki	CCGT_RLNG	1.10	0.71	0.00	0.09	0.27	0.02	0.17	0.26	0.15

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% 								
168	FKPCL	CCGT_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
169	Halmore	CCGT_RLNG	37.73	37.73	37.73	22.68	0.00	0.00	0.00	0.00	0.00
170	Haveli	CCGT_RLNG	10.33	4.91	2.10	3.71	2.51	0.70	1.33	1.22	0.75
171	KAPCO 1	CCGT_RLNG	35.22	35.38	35.26	0.00	0.00	0.00	0.00	0.00	0.00
172	KAPCO 2	CCGT_RLNG	11.90	11.83	11.88	0.00	0.00	0.00	0.00	0.00	0.00
173	KAPCO 3	CCGT_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
174	Nandipur	CCGT_RLNG	36.38	36.38	36.38	21.87	0.00	0.00	0.00	0.00	0.00
175	Orient	CCGT_RLNG	37.73	22.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
176	Rousch	CCGT_RLNG	0.15	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
177	Saif	CCGT_RLNG	37.73	37.73	37.73	22.68	0.00	0.00	0.00	0.00	0.00
178	Saphire	CCGT_RLNG	37.73	37.73	37.73	22.68	0.00	0.00	0.00	0.00	0.00
179	Trimmu	CCGT_RLNG	25.29	13.45	9.19	9.70	6.94	2.15	2.82	2.77	2.81
180	BQPS2	KE_CCGT_RLNG	85.17	82.97	26.83	23.29	14.60	5.42	7.82	9.36	8.06
181	BQPS3	KE_CCGT_RLNG	89.73	89.68	61.34	83.52	25.41	13.58	16.06	16.89	13.98
182	KCCPP	KE_CCGT_RLNG	80.09	82.24	18.47	17.23	10.33	3.80	6.34	6.24	6.57
183	KTGTPS	KE_CCGT_RLNG	44.68	38.50	5.76	6.27	3.76	1.91	2.15	2.00	1.55
184	SGTPS	KE_CCGT_RLNG	47.49	42.85	6.71	7.60	4.09	2.31	2.53	2.47	1.82
185	BQPS1-U1	KE_ST_RLNG	9.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
186	BQPS1-U5	KE_ST_RLNG	28.50	28.19	1.52	1.52	0.00	0.00	0.00	0.00	0.02
187	BQPS1-U6	KE_ST_RLNG	15.15	14.10	1.09	1.13	0.00	0.00	0.00	0.00	0.00
188	BQPS1-U2	KE_GT_RLNG	21.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(All numbers in yellow color, in this table, represent retirement of the corresponding project.)

C-6. Year-wise Installed Capacity Addition (MW)

FY	Local Coal	Hydro	RLNG	Nuclear	Imported Coal	RE	Local Gas	Furnace Oil	Cross Border	Net Yearly Addition	Cumulative Total
Jun-22	1,320	10,593	9,789	3,620	4,020	2,802	2,744	3,633	-	-	38,521
2023	1,980	205	1,263	-	660	630	-	-	-	4,738	43,259
2024	-	314	-420	-	-	1,330	-	-	-	1,224	44,483
2025	-	2,347	-	-	-	5,082	-	-	1,000	8,429	52,912
2026	300	630	-1,300	-	-	1,361	-	-	-	991	53,903
2027	990	2,558	-	-	-	680	-225	-1,292	-	2,711	56,614
2028	-	545	-	-	-	3,195	-	-131	-	3,609	60,223
2029	-	816	-	-	-	680	-	-727	-	769	60,991
2030	-	1,276	-172	-	-	680	-	-136	-	1,648	62,639
2031	-	2,979	-450	-	-	680	-586	-	-	2,623	65,262
Total	4,590	22,262	8,710	3,620	4,680	17,120	1,933	1,347	1,000	26,742	65,262

C-7. IGCEP Generation Mix 2023-2031 (GWh)

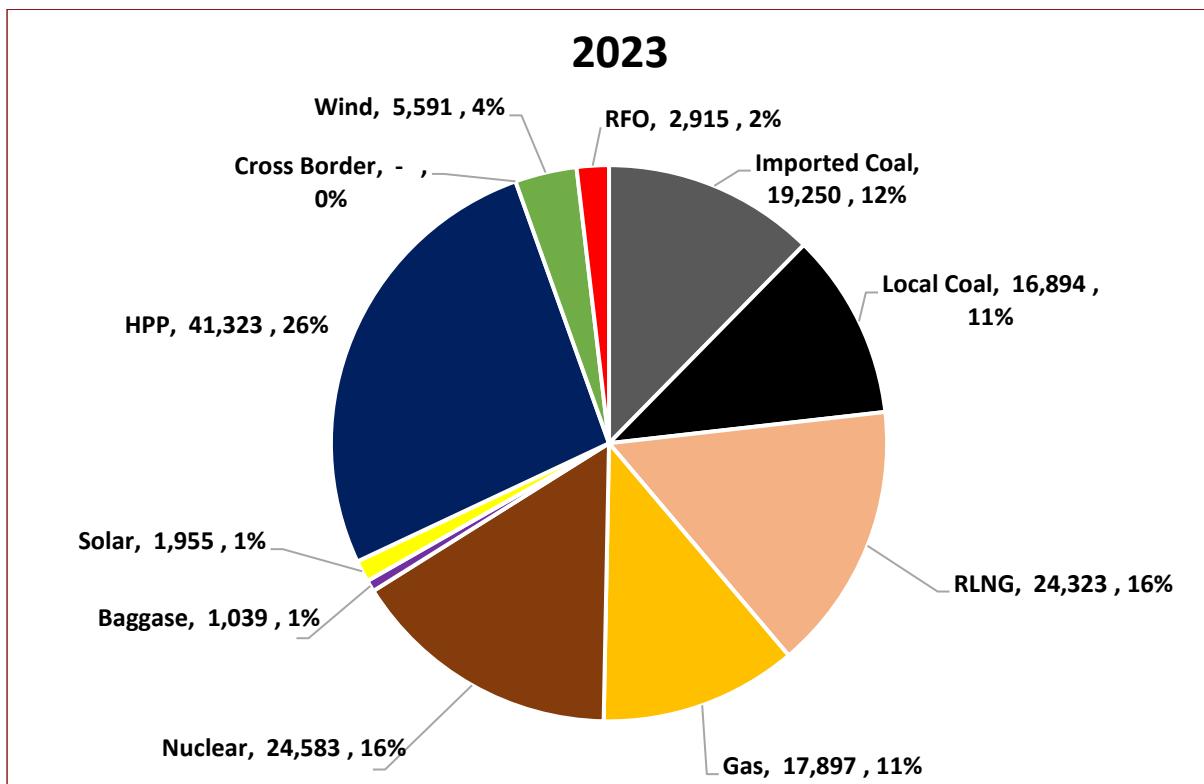


Chart C-1: IGCEP Generation Mix 2023 (GWh)

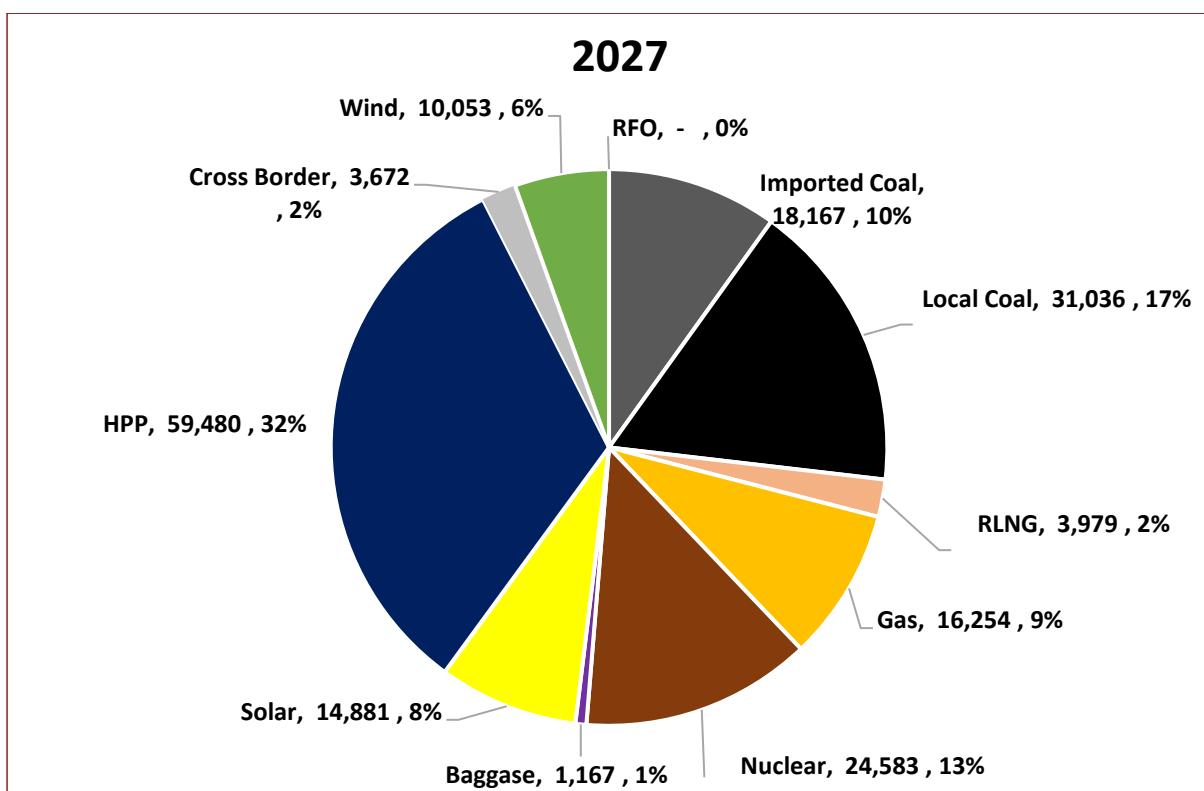


Chart C-2: IGCEP Generation Mix 2027 (GWh)

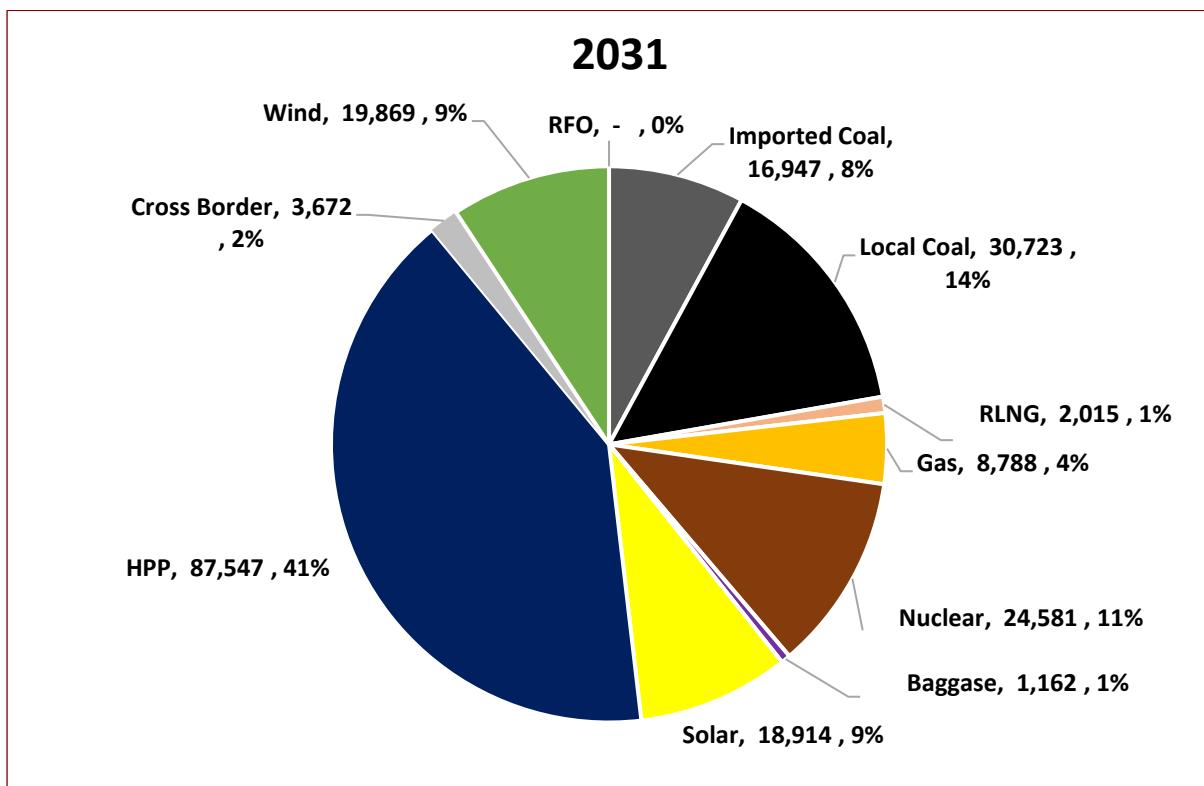


Chart C-3: IGCEP Generation Mix 2031 (GWh)

C-8. IGCEP Generation Mix 2022-31 (MW)

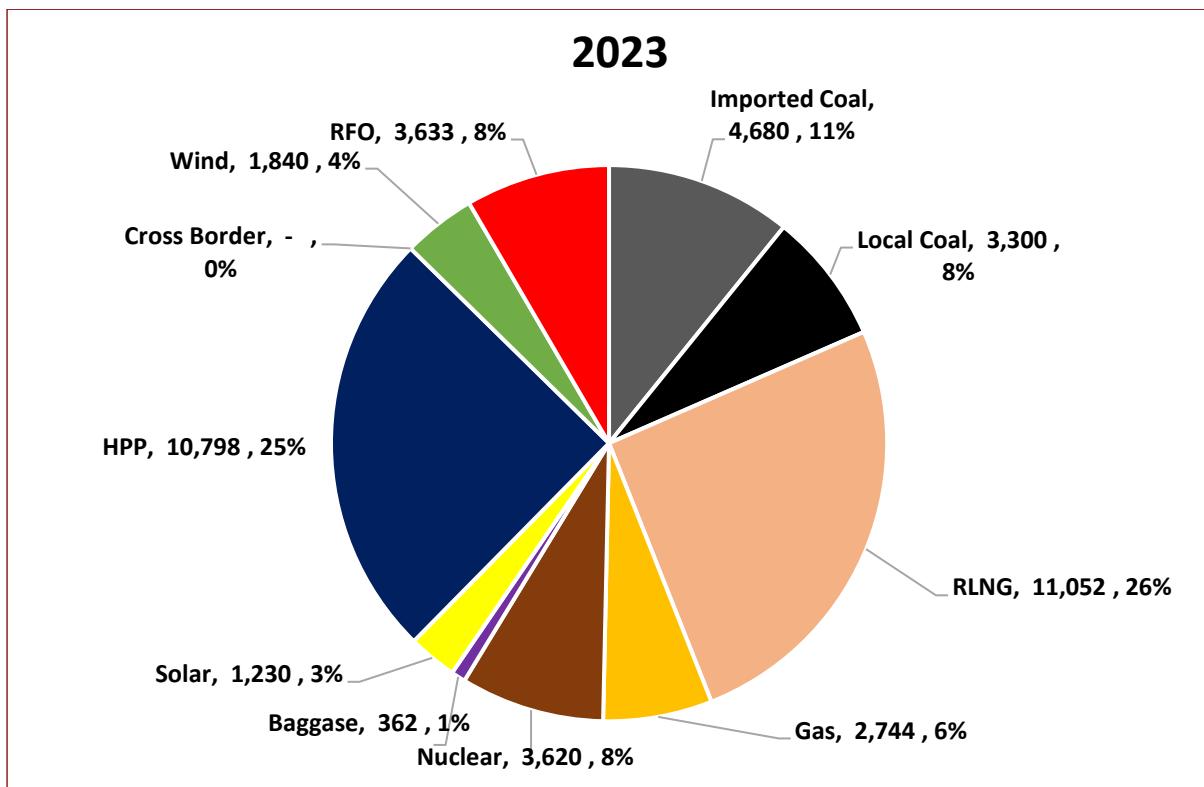


Chart C-4: IGCEP Generation Mix 2023 (MW)

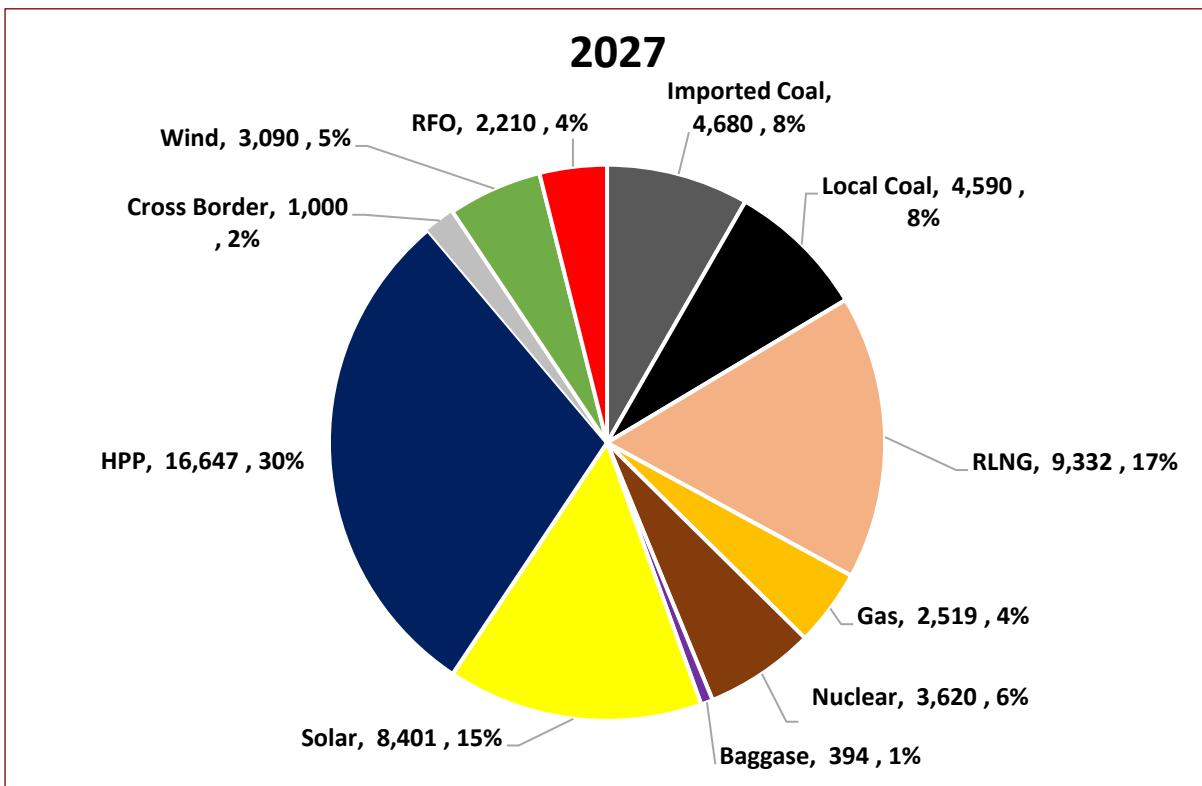


Chart C-5: IGCEP Generation Mix 2027 (MW)

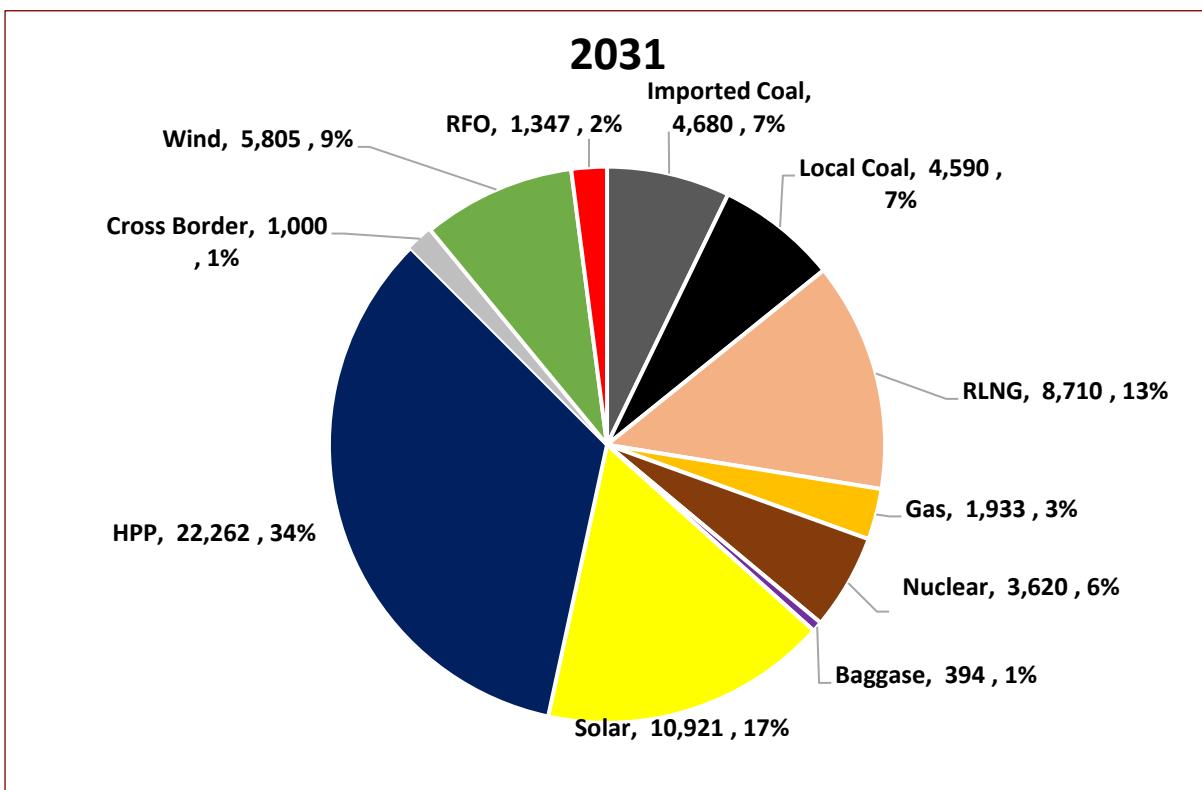
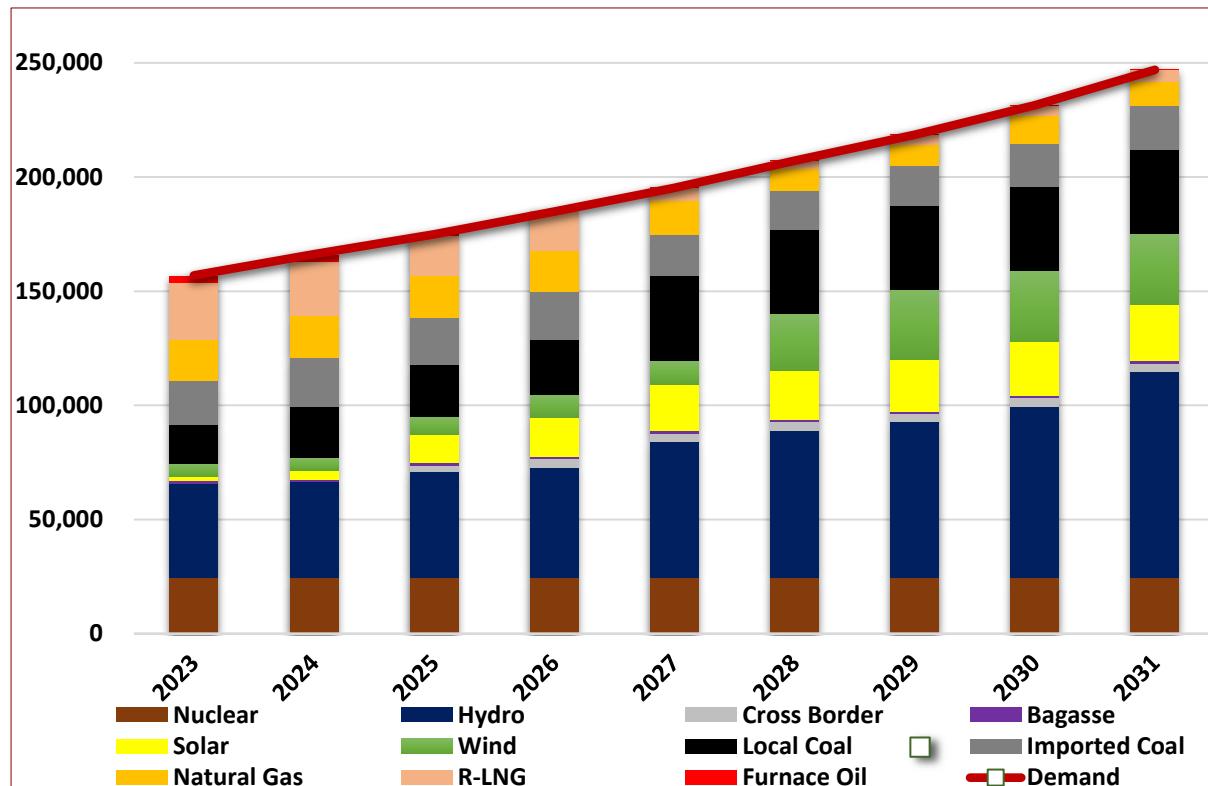


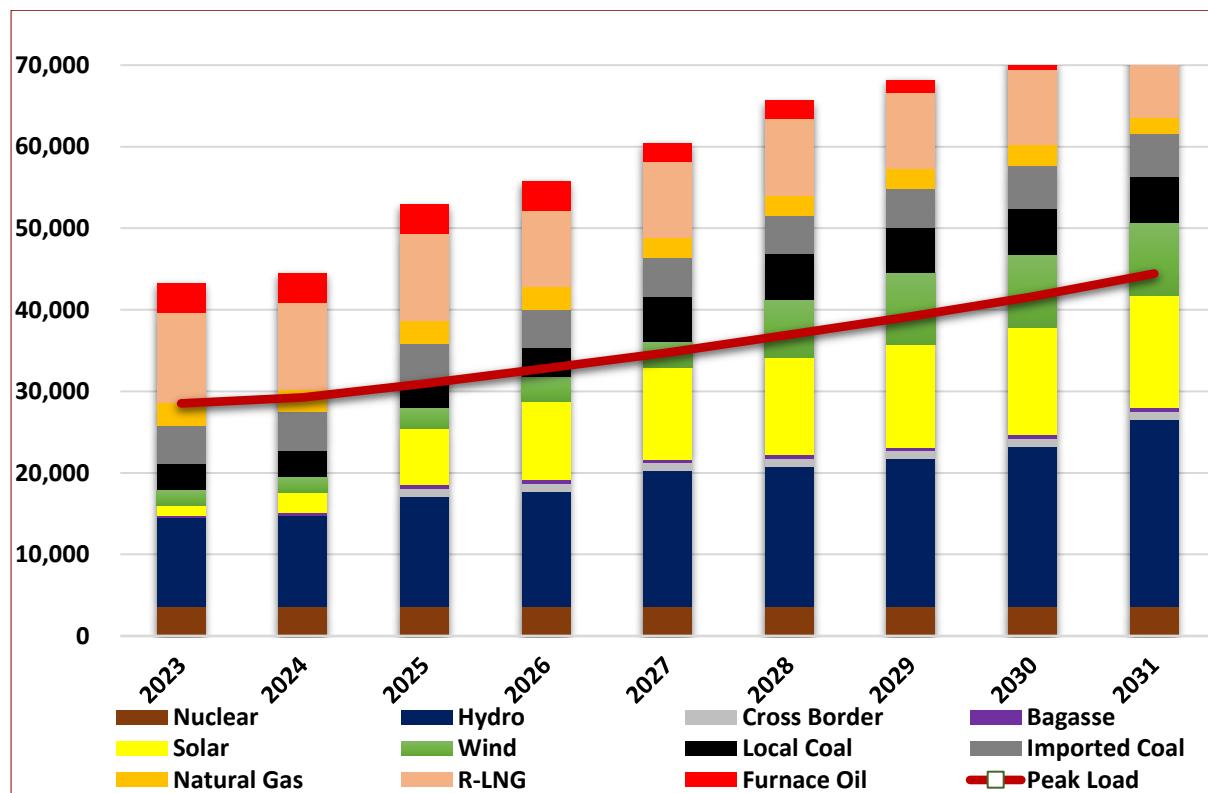
Chart C-6: IGCEP Generation Mix 2031 (MW)

Annexure D. High Demand Scenario

D-1. Annual Energy Generation Vs Annual Energy Demand (GWh) - Country



D-2. Installed Capacity Vs Peak Demand (MW) - Country



D-3. Optimized Generation Capacity Additions (MW)

Fiscal Year	Coal Fired Steam Imported Coal	Coal Fired Steam Local Coal	Coal Fired Steam Local Coal KE	HPP	HPP KE	Solar Utility MW _p	Solar Feeder MW _p	Solar KE MW _p	Wind NTDC	Wind KE	Bagasse	Per Year Capacity Addition	Cumulative Capacity Addition
2024	-	-	-	-	-	-	500	-	-	-	-	500	500
2025	-	-	-	-	-	3,120	750	150	500	50	-	4,570	5,070
2026	-	-	-	-	-	1,300	750	150	500	50	-	2,750	7,820
2027	-	990	990	-	-	1,050	-	150	-	50	-	3,230	11,050
2028	-	-	-	-	-	-	-	150	3,997	50	-	4,197	15,247
2029	-	-	-	391	-	-	-	150	1,672	50	-	2,263	17,510
2030	660	-	-	981	82	-	-	150	-	50	-	1,923	19,433
2031	-	-	-	2,430	-	-	-	150	-	50	-	2,630	22,063
Total	660	990	990	3,802	82	5,470	2,000	1,050	6,669	350	-	22,063	

D-4. List of Projects upto 2031 (Committed + Optimized)

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2022-23							
1	Thar TEL	Local Coal	330	300	PPIB	LOS (Issued)	Commissioned
2	Net Meter	Solar	480	480	AEDB	Committed	Dec-22
3	Trimmu	CCGT_RLNG	1,263	1,243	PPIB	LOS (Issued)	Dec-22
4	Mangla (U #5-6)	Hydro	70	70	WAPDA	Mangla Refurbishment	Dec-22
5	Koto	Hydro	40.8	40.8	GoKPK	PC-1 Approved	Dec-22
6	Jamshoro Coal (U #1)	Imported Coal	660	627	GENCO	PC-1 Approved	Dec-22
7	Thal Nova	Local Coal	330	300	PPIB	LOS (Issued)	Dec-22
8	Thar-I (SSRL)	Local Coal	1,320	1,214	PPIB	LOS (Issued)	Dec-22
9	Jagran-II (U #1)	Hydro	12	12	AJK-HEB	PC-1 Approved	Apr-23
10	Helios	Solar	50	50	AEDB	Category-II Project	Apr-23
11	HNDS	Solar	50	50	AEDB	Category-II Project	Apr-23
12	Meridian	Solar	50	50	AEDB	Category-II Project	Apr-23
13	Mangla (U #3-4)	Hydro	70	70	WAPDA	Mangla Refurbishment	May-23
14	Jagran-II (U #2)	Hydro	12	12	AJK-HEB	PC-1 Approved	May-23
Generation Additions in 2022-23 (MW)			4,738	4,519			
Cumulative Addition up till 2023 (MW)			4,738	4,519			
2023-24							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-23
2	New_Solar_DG	Solar	500	500	Yet to be determined	Optimized	Jul-23
3	Jagran-II (U #3-4)	Hydro	24	24	AJK-HEB	PC-1 Approved	Jul-23
4	Siachen	Solar	100	100	GoS	Category-II Project	Sep-23
5	Manjhand	Solar	50	50	GoS	PC-1 Approved	Sep-23
6	Zorlu	Solar	100	100	PPDB	Category-II Project	Dec-23

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#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
7	Lawi	Hydro	69	69	GoKPK	PC-1 Approved	Apr-24
8	Suki Kinari (U #1)	Hydro	221	221	PPIB	LOS (Issued)	May-24
9	Trans_Atlantic	Wind	50	50	AEDB	Category-II Project	Jun-24
10	Western	Wind	50	50	AEDB	Category-II Project	Jun-24
Generation Additions in 2023-24 (MW)			1,644	1,644			
Cumulative Addition up till 2024 (MW)			6,382	6,163			
2024-25							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-24
2	Mangla (U #1-2)	Hydro	70	70	WAPDA	Mangla Refurbishment	Jul-24
3	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-24
4	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-24
5	New_Solar_DG	Solar	750	750	Yet to be determined	Optimized	Jul-24
6	New_Solar_Utility	Solar	3,120	3,120	Yet to be determined	Optimized	Jul-24
7	New_Wind	Wind	500	500	Yet to be determined	Optimized	Jul-24
8	Gorkin Matiltan	Hydro	84	84	GoKPK	PC-1 Approved	Jul-24
9	Tarbela Ext5 (U #1)	Hydro	510	510	WAPDA	PC-1 Approved	Jul-24
10	Suki Kinari (U #2)	Hydro	221	221	PPIB	LOS (Issued)	Jul-24
11	CASA	Cross Border Interconnection	1,000	1,000	NTDC	G2G	Aug-24
12	Tarbela Ext5 (U #2)	Hydro	510	510	WAPDA	PC-1 Approved	Aug-24
13	Shahtaj	Bagasse	32	32	AEDB	Category-I Project	Aug-24
14	Tarbela Ext5 (U #3)	Hydro	510	510	WAPDA	PC-1 Approved	Sep-24
15	Suki Kinari (U #3)	Hydro	221	221	PPIB	LOS (Issued)	Sep-24
16	Suki Kinari (U #4)	Hydro	221	221	PPIB	LOS (Issued)	Nov-24
Generation Additions in 2024-25 (MW)			8,429	8,429			
Cumulative Addition up till 2025 (MW)			14,811	14,592			

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2025-26							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-25
2	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-25
3	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-25
4	New_Solar_DG	Solar	750	750	Yet to be determined	Optimized	Jul-25
5	New_Solar_Utility	Solar	1,300	1,300	Yet to be determined	Optimized	Jul-25
6	New_Wind	Wind	500	500	Yet to be determined	Optimized	Jul-25
7	Gwadar	Local Coal	300	273	PPIB	LOS (Issued)	Aug-25
8	Mangla (U #9-10)	Hydro	70	70	WAPDA	Mangla Refurbishment	Sep-25
9	Dasu (U #1)	Hydro	360	360	WAPDA	PC-1 Approved	May-26
10	Mohmand Dam (U #1)	Hydro	200	200	WAPDA	PC-1 Approved	May-26
Generation Additions in 2025-26 (MW)			4,160	4,133			
Cumulative Addition up till 2026 (MW)			18,971	18,725			
2026-27							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-26
2	KE_New_Local Coal	Local Coal	990	912	Yet to be determined	Optimized	Jul-26
3	New_Local Coal	Local Coal	990	911	Yet to be determined	Optimized	Jul-26
4	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-26
5	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-26
6	New_Solar_Utility	Solar	1,050	1,050	Yet to be determined	Optimized	Jul-26
7	Dasu (U #2)	Hydro	360	360	WAPDA	PC-1 Approved	Jul-26
8	Mohmand Dam (U #2)	Hydro	200	200	WAPDA	PC-1 Approved	Jul-26
9	Dasu (U #3)	Hydro	360	360	WAPDA	PC-1 Approved	Aug-26
10	Mohmand Dam (U #3)	Hydro	200	200	WAPDA	PC-1 Approved	Sep-26
11	Mangla (U #7-8)	Hydro	30	30	WAPDA	Mangla Refurbishment	Nov-26

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#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
12	Dasu (U #4)	Hydro	360	360	WAPDA	PC-1 Approved	Nov-26
13	Mohmand Dam (U #4)	Hydro	200	200	WAPDA	PC-1 Approved	Nov-26
14	Dasu (U #5)	Hydro	360	360	WAPDA	PC-1 Approved	Feb-27
15	Keyal Khwar (U #1)	Hydro	64	64	WAPDA	PC-1 Approved	Feb-27
16	Dasu (U #6)	Hydro	360	360	WAPDA	PC-1 Approved	May-27
17	Keyal Khwar (U #2)	Hydro	64	64	WAPDA	PC-1 Approved	May-27
Generation Additions in 2026-27 (MW)			6,268	6,111			
Cumulative Addition up till 2027 (MW)			25,239	24,836			

2027-28

1	Net Meter	Solar	480	480	AEDB	Committed	Jul-27
2	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-27
3	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-27
4	New_Wind	Wind	3,997	3,997	Yet to be determined	Optimized	Jul-27
5	Gabral Kalam	Hydro	88	88	GoKPK	PC-1 Approved	Nov-27
6	Madyan	Hydro	157	157	GoKPK	PC-1 Approved	Nov-27
7	Balakot	Hydro	300	300	GoKPK	PC-1 Approved	Dec-27
Generation Additions in 2027-28 (MW)			5,222	5,222			
Cumulative Addition up till 2028 (MW)			30,461	30,058			

2028-29

1	Net Meter	Solar	480	480	AEDB	Committed	Jul-28
2	Bata Kundti	Hydro	99	99	GoKPK	Optimized	Jul-28
3	Chowkel Khwar	Hydro	60	60	PEDO	Optimized	Jul-28
4	CJ	Hydro	25	25	PPDB	Optimized	Jul-28
5	Harighel-Majeedgala	Hydro	40.3	40.3	AJK-PPC	Optimized	Jul-28
6	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-28

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
7	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-28
8	New_Wind	Wind	1,672	1,672	Yet to be determined	Optimized	Jul-28
9	Nila Da Katha	Hydro	31.3	31.3	PEDO	Optimized	Jul-28
10	Taunsa	Hydro	135	135	PPDB	Optimized	Jul-28
11	Azad Pattan (U #1)	Hydro	175	175	PPIB	LOS (Issued)	Dec-28
12	Azad Pattan (U #2)	Hydro	175	175	PPIB	LOS (Issued)	Mar-29
13	Azad Pattan (U #3)	Hydro	175	175	PPIB	LOS (Issued)	Jun-29
Generation Additions in 2028-29 (MW)		3,268	3,268				
Cumulative Addition up till 2029 (MW)		33,729	33,326				
2029-30							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-29
2	Arkari Gol	Hydro	99	99	PEDO	Optimized	Jul-29
3	Asrit Kedam	Hydro	215	215	PEDO	Optimized	Jul-29
4	Dowarian	Hydro	40	40	AJK-HEB	Optimized	Jul-29
5	Jagran-IV	Hydro	22	22	AJK-HEB	Optimized	Jul-29
6	Jamshoro Coal (U #2)	Imported Coal	660	627	GENCO	Optimized	Jul-29
7	Kalam Asrit	Hydro	238	238	PEDO	Optimized	Jul-29
8	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-29
9	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-29
10	Nagdar	Hydro	35	35	AJK-HEB	Optimized	Jul-29
11	Rajdhani	Hydro	132	132	PPIB	Optimized	Jul-29
12	Sharmai	Hydro	152.12	152.12	PEDO	Optimized	Jul-29
13	Shounte	Hydro	48	48	AJK-HEB	Optimized	Jul-29
14	Turtonas Uzghor	Hydro	82.25	82.25	KE	Optimized	Jul-29
15	Azad Pattan (U #4)	Hydro	175	175	PPIB	LOS (Issued)	Sep-29

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#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
16	Kohala (U #1)	Hydro	275	275	PPIB	LOS (Issued)	Jun-30
Generation Additions in 2029-30 (MW)			2,854	2,821			
Cumulative Addition up till 2030 (MW)			36,582	36,146			
2030-31							
1	Mahl	Hydro	640	640	PPIB	Optimized	Jul-30
2	Ashkot	Hydro	300	300	PPIB	Optimized	Jul-30
3	Thakot-III	Hydro	1,490	1,490	WAPDA	Optimized	Jul-30
4	Net Meter	Solar	480	480	AEDB	Committed	Jul-30
5	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-30
6	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-30
7	Kohala (U #2)	Hydro	275	275	PPIB	LOS (Issued)	Aug-30
8	Kohala (U #3)	Hydro	275	275	PPIB	LOS (Issued)	Oct-30
9	Kohala (U #4)	Hydro	275	275	PPIB	LOS (Issued)	Dec-30
10	Kohala (U #5)	Hydro	12	12	PPIB	LOS (Issued)	Feb-31
11	Kohala (U #6)	Hydro	12	12	PPIB	LOS (Issued)	Mar-31
Generation Additions in 2030-31 (MW)			3,959	3,959			
Cumulative Addition up till 2031 (MW)			40,541	40,105			

D-5. Annual Capacity Factors (%age)

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%age								
1	Almoiz	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
2	Chanar	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
3	Chiniot	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
4	Fatima	Bagasse	6.53	6.55	6.53	6.53	6.18	6.20	6.13	5.95	5.90
5	Hamza	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
6	JDW-II	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
7	JDW-III	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
9	Ryk_Mills	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
10	Shahtaj	Bagasse	0.00	0.00	45.77	45.62	45.62	45.77	45.62	45.62	45.62
11	Thal_Layyah	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
12	Appolo	PV	18.96	18.91	18.96	18.96	18.96	18.91	18.96	18.96	18.96
13	Best	PV	18.94	18.89	18.94	18.94	18.94	18.89	18.94	18.94	18.94
14	Crest	PV	19.19	19.13	19.19	19.19	19.19	19.13	19.19	19.19	19.19
15	Helios	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
16	HNDS	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
17	Manjhand	PV	0.00	23.23	23.33	23.33	23.33	23.27	23.33	23.33	23.33
18	Meridian	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
19	Net_Meter	PV	17.08	17.03	17.08	17.08	17.08	17.03	17.08	17.08	17.08
20	New_Solar	PV	0.00	0.00	22.08	22.08	22.08	22.02	22.08	22.08	22.08
21	New_Solar_Feeder	PV	0.00	19.95	20.00	20.00	20.00	19.95	20.00	20.00	20.00
22	QA_Solar	PV	19.04	18.99	19.04	19.04	19.04	18.99	19.04	19.04	19.04
23	Siachen	PV	0.00	23.23	23.33	23.33	23.33	23.27	23.33	23.33	23.33
24	Zhenfa	PV	21.50	21.44	21.50	21.50	21.50	21.44	21.50	21.50	21.50
25	Zorlu	PV	0.00	20.86	20.17	20.17	20.17	20.11	20.17	20.17	20.17
26	Gharo	KE_PV	25.25	25.18	25.25	25.25	25.25	25.18	25.25	25.25	25.25
27	KE_New_Solar	KE_PV	0.00	0.00	22.08	22.08	22.08	22.02	22.08	22.08	22.08
28	Oursun	KE_PV	20.97	20.91	20.97	20.97	20.97	20.91	20.97	20.97	20.97
29	Act	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.97	30.99	30.99
30	Act_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	36.85	37.19	37.19
31	Artistic_wind	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
32	Artistic_Wind_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	36.85	37.19	37.19
33	Dawood	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.68	30.99	30.99
34	Din	Wind	37.94	37.09	37.19	37.19	37.19	37.09	36.20	37.19	37.19
35	FFC	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.68	34.86	34.86
36	FWEL-I	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.68	34.86	34.86
37	FWEL-II	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.68	34.86	34.86
38	Gul Ahmed	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.68	30.99	30.99
39	Gul_Electric	Wind	37.94	37.09	37.19	37.19	37.19	37.09	36.85	36.85	37.19
40	Hawa	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.68	34.86	34.86
41	Indus_Energy	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
42	Jhimpir	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86

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#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% %								
43	Lakeside	Wind	38.93	38.07	38.17	38.17	38.17	38.07	37.15	38.17	38.17
44	Liberty_Wind_1	Wind	37.94	37.09	37.19	37.19	37.19	37.09	36.85	37.19	37.19
45	Liberty_Wind_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	36.85	36.85	37.19
46	Master	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.68	30.68	30.99
47	Master_Green	Wind	37.94	37.09	37.19	37.19	37.19	37.09	36.54	37.19	37.19
48	Metro_Power	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.66	31.99	31.99
49	Metro_Wind	Wind	37.94	37.09	37.19	37.19	37.19	37.09	36.20	37.19	37.19
50	NASDA	Wind	38.93	38.07	38.17	38.17	38.17	38.07	37.15	38.17	38.17
51	New_Wind	Wind	0.00	0.00	41.28	41.28	41.28	41.17	41.28	41.28	41.28
52	Sachal	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.68	30.68	30.99
53	Sapphire_Wind	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.68	30.68	30.99
54	Tenaga	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.68	30.99	30.99
55	Three_Gorges_I	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.66	31.99
56	Three_Gorges_II	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
57	Three_Gorges_III	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.68	34.86	34.86
58	Trans_Atlantic	Wind	0.00	41.28	41.28	41.28	41.28	41.17	40.82	40.93	41.28
59	Tricom	Wind	37.94	37.09	37.19	37.19	37.19	37.09	36.20	37.13	37.19
60	Tricon_A	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
61	Tricon_B	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
62	Tricon_C	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.68	34.86	34.86
63	UEP	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.68	30.99	30.99
64	Western	Wind	0.00	37.19	37.19	37.19	37.19	37.09	36.20	37.19	37.19
65	Yunus	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
66	Zephyr	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.68	34.86	34.86
67	Zorlu_Wind	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.66	31.99	31.99
68	KE_New_Wind	KE_Wind	0.00	0.00	41.28	41.28	41.28	41.17	41.11	41.28	41.28
69	CASA	Interconnection	0.00	0.00	41.80	41.92	41.92	41.80	41.92	41.92	41.92
70	Arkari Gol	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.22	42.22
73	Ashkot	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.58
74	Asrit Kedam	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.72	49.72
77	Bata Kundii	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	54.56	54.59	54.76
80	Chowkel Khwar	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	44.57	44.57	44.57
81	CJ	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	50.50	50.50	50.50
82	Dowarian	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.85	48.85
87	Harighel-Majeedgala	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	63.10	63.10	63.43
90	Jagran-IV	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.09	49.09
94	Kalam Asrit	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.41	44.41
99	Mahl	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.53
101	Nagdar	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.87	48.87
103	Nila Da Katha	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	51.31	51.31	51.31
107	Rajdhani	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.46	58.46
109	Sharmai	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	50.94	50.94	

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
111	Shounter	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.86	48.86
114	Taunsa	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	55.02	55.02	55.02
116	Thakot-III	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.27
118	Turtonas Uzghor	KE_HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.85	51.89
119	Azad Pattan	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	52.77	54.06	52.77
120	Balakot	HPP Committed	0.00	0.00	0.00	0.00	0.00	41.21	41.21	41.21	41.21
121	Dasu	HPP Committed	0.00	0.00	0.00	64.47	64.47	64.29	64.47	64.47	64.47
122	Diamer Bhasha	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
123	Gabral Kalam	HPP Committed	0.00	0.00	0.00	0.00	0.00	33.77	33.77	33.77	33.77
124	Gorkin Matiltan	HPP Committed	0.00	0.00	42.71	42.83	42.83	42.71	42.80	42.80	42.83
125	Jagran-II	HPP Committed	50.39	50.39	50.53	50.53	50.53	50.39	50.53	50.53	50.53
126	Karot	HPP Committed	44.39	44.29	44.39	44.39	44.39	44.29	44.37	44.37	44.39
127	Keyal Khwar	HPP Committed	0.00	0.00	0.00	0.00	52.07	51.92	52.07	52.07	52.07
128	Kohala	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.14	56.14
129	Koto	HPP Committed	57.12	57.08	57.24	57.19	57.19	56.96	57.12	57.12	57.15
130	Lawi	HPP Committed	0.00	47.96	48.10	48.05	48.05	47.90	47.96	47.96	48.05
131	Madyan	HPP Committed	0.00	0.00	0.00	0.00	0.00	47.43	47.43	47.43	47.43
132	Mohmand Dam	HPP Committed	0.00	0.00	0.00	42.71	46.36	42.60	42.71	42.71	42.71
133	Suki Kinari	HPP Committed	0.00	49.07	49.07	49.07	49.07	48.93	49.07	49.07	49.07
134	Tarbela_Ext_5	HPP Committed	0.00	0.00	10.05	10.05	10.05	10.02	10.05	10.05	10.05
135	Allai Khwar	HPP Existing	44.32	44.20	44.32	44.32	44.32	44.20	44.28	44.28	44.32
136	Chashma	HPP Existing	48.58	48.45	48.58	48.58	48.58	48.45	48.58	48.58	48.58
137	Daral Khwar	HPP Existing	38.58	38.48	38.58	38.58	38.58	38.48	38.58	38.58	38.58
138	Dubair Khwar	HPP Existing	53.09	52.95	53.09	53.09	53.09	52.95	53.09	53.09	53.09
139	Ghazi Brotha	HPP Existing	52.78	52.63	52.78	52.78	52.78	52.63	52.78	52.78	52.78
140	Golen Gol	HPP Existing	9.15	9.12	9.15	9.15	9.15	9.12	9.15	9.15	9.15
141	Gulpur	HPP Existing	28.92	28.84	28.92	28.92	28.92	28.84	28.92	28.92	28.92
142	Jagran-I	HPP Existing	48.95	48.82	48.95	48.95	48.95	48.82	48.95	48.95	48.95
143	Jinnah	HPP Existing	25.74	25.67	25.74	25.74	25.74	25.67	25.74	25.74	25.74
144	Khan Khwar	HPP Existing	40.22	40.11	40.22	40.22	40.22	40.11	40.17	40.21	40.22
145	Malakand-III	HPP Existing	53.86	53.71	53.86	53.86	53.86	53.71	53.86	53.86	53.86
146	Mangla	HPP Existing	64.98	60.97	58.32	56.00	54.77	54.20	54.35	54.35	54.35
147	Neelum Jehlum	HPP Existing	51.66	51.54	51.69	51.69	51.69	51.54	51.65	51.65	51.69
148	New Bong	HPP Existing	55.49	55.34	55.49	55.49	55.49	55.34	55.49	55.49	55.49
149	Patrind	HPP Existing	43.76	43.64	43.76	43.76	43.76	43.64	43.76	43.76	43.76
150	Small Hydel	HPP Existing	45.02	44.90	45.02	45.02	45.02	44.90	45.02	45.02	45.02
151	Tarbela 1-14	HPP Existing	37.99	37.89	37.99	37.99	37.99	37.89	37.99	37.99	37.99
152	Tarbela_Ext_4	HPP Existing	30.12	30.04	30.12	30.12	30.12	30.04	30.12	30.12	30.12
153	Warsak	HPP Existing	50.64	50.50	50.64	50.64	50.64	50.50	50.64	50.64	50.64
154	Engro 90MW	CCGT_Gas	90.23	74.96	62.46	50.73	70.05	35.75	31.35	31.34	27.54
155	Foundation	CCGT_Gas	89.97	90.25	89.99	89.97	81.28	57.94	57.94	80.23	75.40
156	Guddu-I	CCGT_Gas	36.90	74.63	74.43	74.42	67.50	17.86	21.86	66.63	64.80

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
157	Guddu-II	CCGT_Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
158	Guddu-V (747)	CCGT_Gas	75.56	75.77	75.56	75.56	72.16	63.05	56.72	68.56	68.87
159	Liberty	CCGT_Gas	75.99	75.02	74.31	72.91	0.00	0.00	0.00	0.00	0.00
160	Uch	CCGT_Gas	86.08	86.32	86.08	85.50	63.77	43.41	43.78	47.71	0.00
161	Uch-II	CCGT_Gas	87.77	88.05	87.80	87.57	78.68	51.33	51.33	51.31	51.32
162	SNPC-I	KE_CCGT_Gas	91.98	92.25	91.99	91.98	82.80	39.74	41.60	74.20	46.24
163	SNPC-II	KE_CCGT_Gas	91.98	92.25	91.99	91.98	83.28	41.39	43.05	83.67	56.89
164	AES Lalpir	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
165	AES Pakgen	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
166	HUBCO	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
167	Jamshoro-I U1	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
168	Jamshoro-II U4	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
169	Muzaffargarh-I U1	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	Muzaffargarh-I U2	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
171	Muzaffargarh-I U3	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
172	Muzaffargarh-II U4	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
173	Saba	ST_RFO	14.38	21.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00
174	AGL	DG_RFO	36.12	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.29
175	Atlas	DG_RFO	14.40	21.72	0.00	0.00	0.00	0.00	0.00	0.00	0.04
176	Engro 127MW	DG_RFO	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01
177	HuB N	DG_RFO	36.12	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00
178	Kohinoor	DG_RFO	14.39	21.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
179	Liberty Tech	DG_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29
180	Nishat C	DG_RFO	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00	0.29
181	Nishat P	DG_RFO	36.81	22.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
183	C-1	Nuclear	80.43	80.65	80.43	80.43	80.43	80.65	80.43	80.43	80.43
184	C-2	Nuclear	79.61	79.83	79.61	79.61	79.61	79.83	79.61	79.61	79.61
185	C-3	Nuclear	81.01	81.23	81.01	81.01	81.01	81.23	81.01	81.01	81.01
186	C-4	Nuclear	81.01	81.23	81.01	81.01	81.01	81.23	81.01	81.01	81.01
188	K-2	Nuclear	85.06	85.30	85.07	85.06	85.06	85.29	85.02	85.03	85.05
189	K-3	Nuclear	85.66	85.90	85.67	85.66	85.66	85.88	85.61	85.63	85.65
191	Engro Thar	Local Coal	82.51	82.74	82.51	82.50	81.41	79.92	78.96	78.07	76.97
192	Gwadar	Local Coal	0.00	0.00	0.00	69.18	81.61	80.19	78.82	77.50	76.91
193	Lucky	Local Coal	85.08	85.31	85.08	85.07	85.07	85.01	84.18	84.48	84.97
194	NEW_L.Coal 660	Local Coal	0.00	0.00	0.00	0.00	83.33	82.97	82.16	82.46	82.94
195	New_L.Coal II	Local Coal	0.00	0.00	0.00	0.00	83.33	83.07	82.46	82.46	83.04
196	Thal Nova	Local Coal	49.35	85.21	84.98	84.97	84.67	82.71	82.65	82.90	80.03
197	Thar TEL	Local Coal	84.98	85.21	84.98	84.97	84.48	82.85	82.34	82.58	80.50
198	Thar-I (SSRL)	Local Coal	42.14	85.21	84.98	84.98	84.98	83.88	83.29	83.55	83.80
199	K.E_NEW_L.Coal	KE_Local Coal	0.00	0.00	0.00	0.00	83.33	82.87	82.42	82.58	82.74
200	China HUBCO	Imported Coal	51.57	51.57	51.57	51.57	51.57	51.57	51.57	51.57	51.57
201	Jamshoro Coal	Imported Coal	49.36	85.03	84.99	83.98	28.68	15.80	18.76	21.39	22.87

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% %								
202	Jamshoro Coal 2	Imported Coal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.64	24.98
203	Port Qasim	Imported Coal	48.72	48.72	48.72	48.72	48.72	48.72	48.72	48.72	48.72
204	Sahiwal Coal	Imported Coal	48.02	48.02	48.02	48.02	48.02	48.01	48.01	48.01	48.01
205	FPCL	KE_Imported Coal	82.15	78.47	22.29	42.21	12.61	12.02	15.04	15.59	20.19
206	Davis	DG_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26
207	Balloki	CCGT_RLNG	4.59	2.53	1.68	4.18	2.87	1.21	1.71	1.44	1.51
208	Bhikki	CCGT_RLNG	1.32	0.83	0.41	1.37	0.94	0.37	1.11	1.12	1.15
209	FKPCL	CCGT_RLNG	0.00	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
210	Halmore	CCGT_RLNG	37.73	37.73	37.73	22.68	0.30	0.30	0.30	0.30	0.61
211	Haveli	CCGT_RLNG	11.90	7.22	5.85	8.77	5.08	1.73	2.53	2.49	3.60
212	KAPCO 1	CCGT_RLNG	35.31	35.38	35.30	0.00	0.00	0.00	0.00	0.00	0.00
213	KAPCO 2	CCGT_RLNG	11.86	11.83	11.87	0.00	0.00	0.00	0.00	0.00	0.00
214	KAPCO 3	CCGT_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
215	Nandipur	CCGT_RLNG	36.38	36.38	36.38	21.87	0.08	0.00	0.29	0.29	0.30
216	Orient	CCGT_RLNG	37.73	23.29	0.00	0.61	0.30	0.30	0.43	0.49	0.61
217	Rousch	CCGT_RLNG	0.31	0.46	0.00	0.16	0.00	0.00	0.17	0.29	0.00
218	Saif	CCGT_RLNG	37.73	37.73	37.73	22.68	0.30	0.00	0.30	0.30	0.31
219	Saphire	CCGT_RLNG	37.73	37.73	37.73	22.78	0.30	0.15	0.30	0.30	0.61
220	Trimmu	CCGT_RLNG	29.06	29.94	16.19	16.11	9.09	4.09	6.32	6.84	8.38
221	BQPS2	KE_CCGT_RLNG	85.48	83.92	48.60	78.07	19.29	10.55	14.59	14.88	15.99
222	BQPS3	KE_CCGT_RLNG	89.95	89.93	85.42	83.65	30.83	22.29	24.43	26.33	28.99
223	KCPP	KE_CCGT_RLNG	85.37	82.70	24.86	26.41	11.98	9.26	11.27	13.87	14.62
224	KTGTPS	KE_CCGT_RLNG	45.54	42.45	10.27	13.47	7.86	3.27	4.93	6.26	7.22
225	SGTPS	KE_CCGT_RLNG	48.76	45.65	11.36	14.60	8.02	4.46	5.94	6.66	8.79
226	BQPS1-U1	KE_ST_RLNG	11.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
227	BQPS1-U5	KE_ST_RLNG	30.31	32.47	2.00	2.89	0.99	1.22	1.58	1.72	2.65
228	BQPS1-U6	KE_ST_RLNG	17.13	17.52	1.54	2.18	0.56	0.92	1.53	1.52	2.05
229	BQPS1-U2	KE_GT_RLNG	23.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(All numbers in yellow color, in this table, represent retirement of the corresponding project.)

D-6. Year-wise Installed Capacity Addition (MW)

FY	Local Coal	Hydro	RLNG	Nuclear	Imported Coal	RE	Local Gas	Furnace Oil	Cross Border	Net Yearly Addition	Cumulative Total
Jun-22	1,320	10,593	9,789	3,620	4,020	2,802	2,744	3,633	-	-	38,521
2023	1,980	205	1,263	-	660	630	-	-	-	4,738	43,259
2024	-	314	-420	-	-	1,330	-	-	-	1,224	44,483
2025	-	2,347	-	-	-	5,082	-	-	1,000	8,429	52,912
2026	300	630	-1,300	-	-	3,230	-	-	-	2,860	55,772
2027	1,980	2,558	-	-	-	1,730	-225	-1,292	-	4,751	60,523
2028	-	545	-	-	-	4,677	-	-131	-	5,091	65,614
2029	-	916	-	-	-	2,352	-	-727	-	2,541	68,155
2030	-	1,514	-172	-	660	680	-	-136	-	2,546	70,700
2031	-	3,279	-450	-	-	680	-586	-	-	2,923	73,623
Total	5,580	22,900	8,710	3,620	5,340	23,193	1,933	1,347	1,000	35,103	73,623

D-7. IGCEP Generation Mix 2023-2031 (GWh)

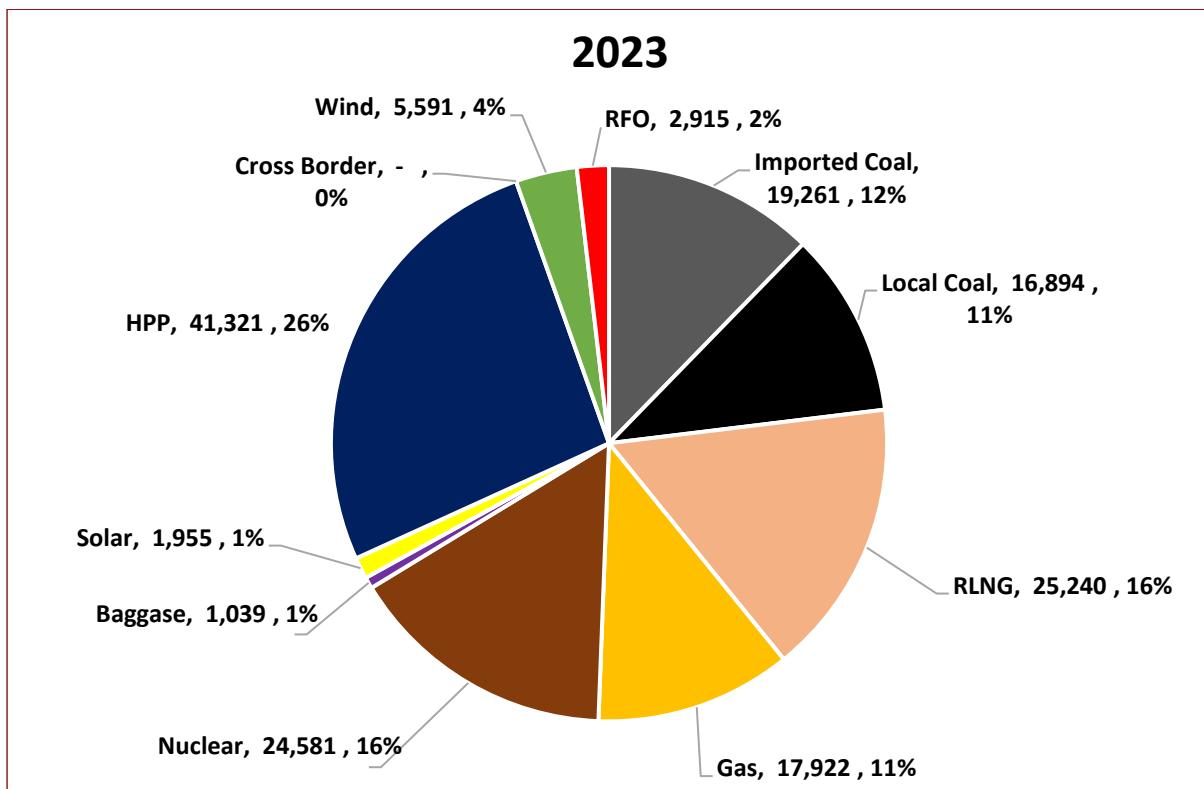


Chart D-1: IGCEP Generation Mix 2023 (GWh)

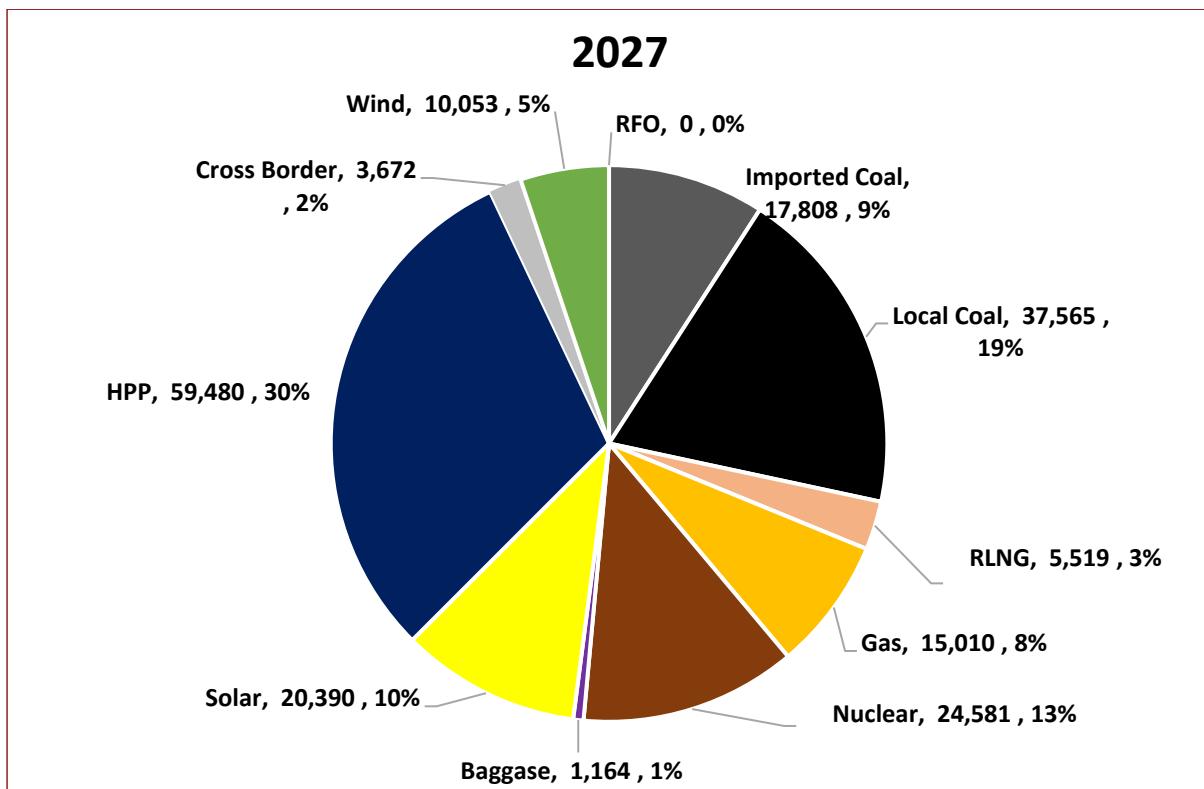


Chart D-2: IGCEP Generation Mix 2027 (GWh)

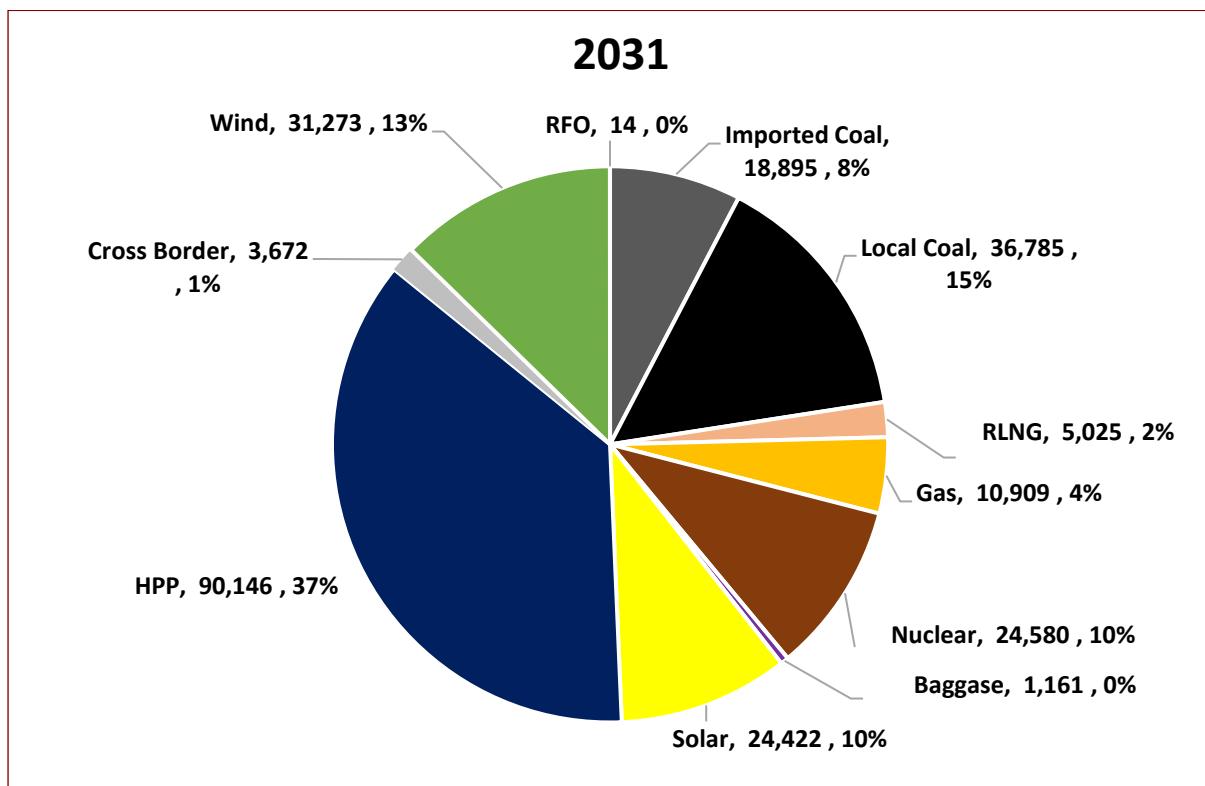


Chart D-3: IGCEP Generation Mix 2031 (GWh)

D-8. IGCEP Generation Mix 2023-31 (MW)

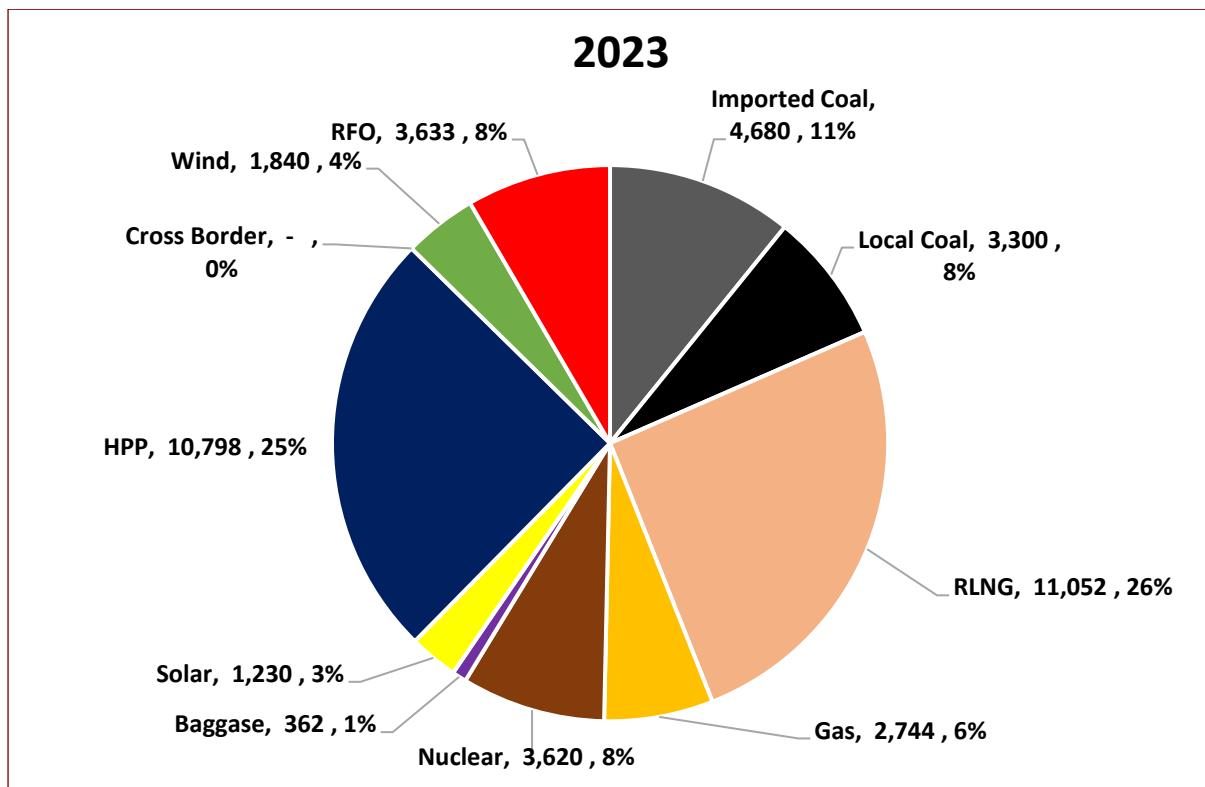


Chart D-4: IGCEP Generation Mix 2023 (MW)

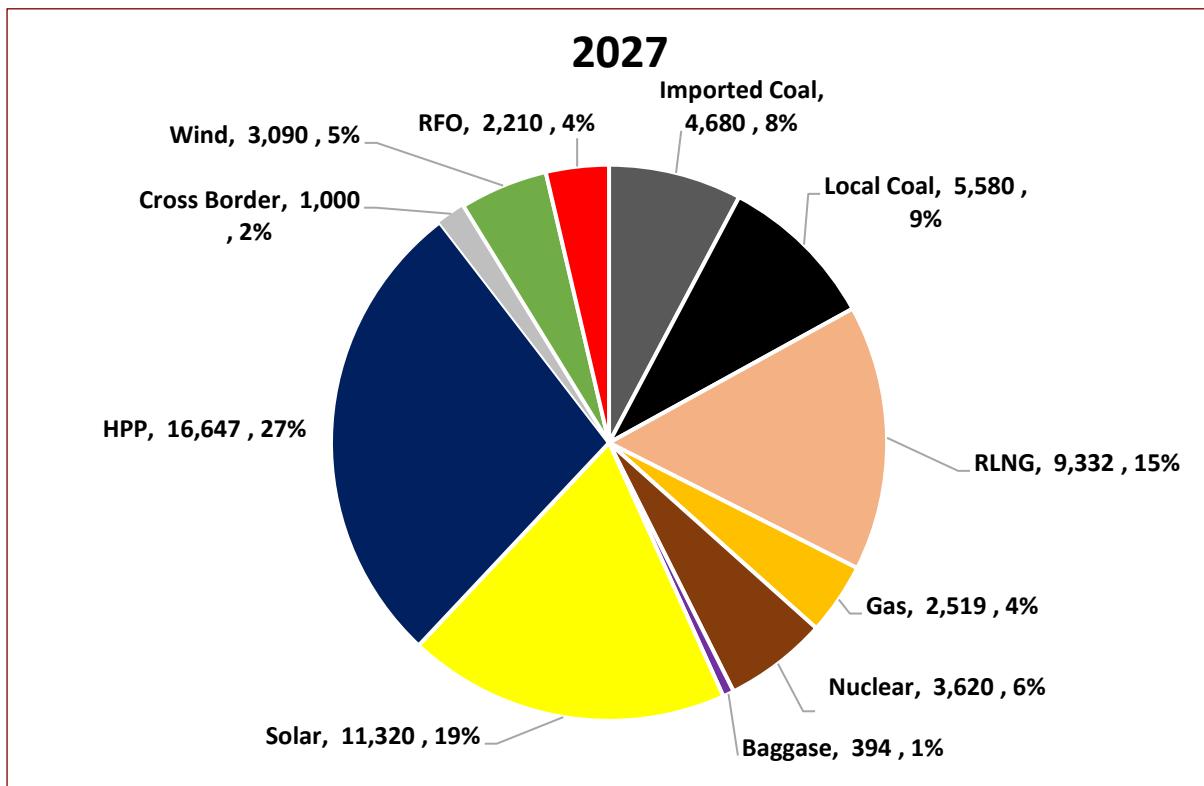


Chart D-5: IGCEP Generation Mix 2027 (MW)

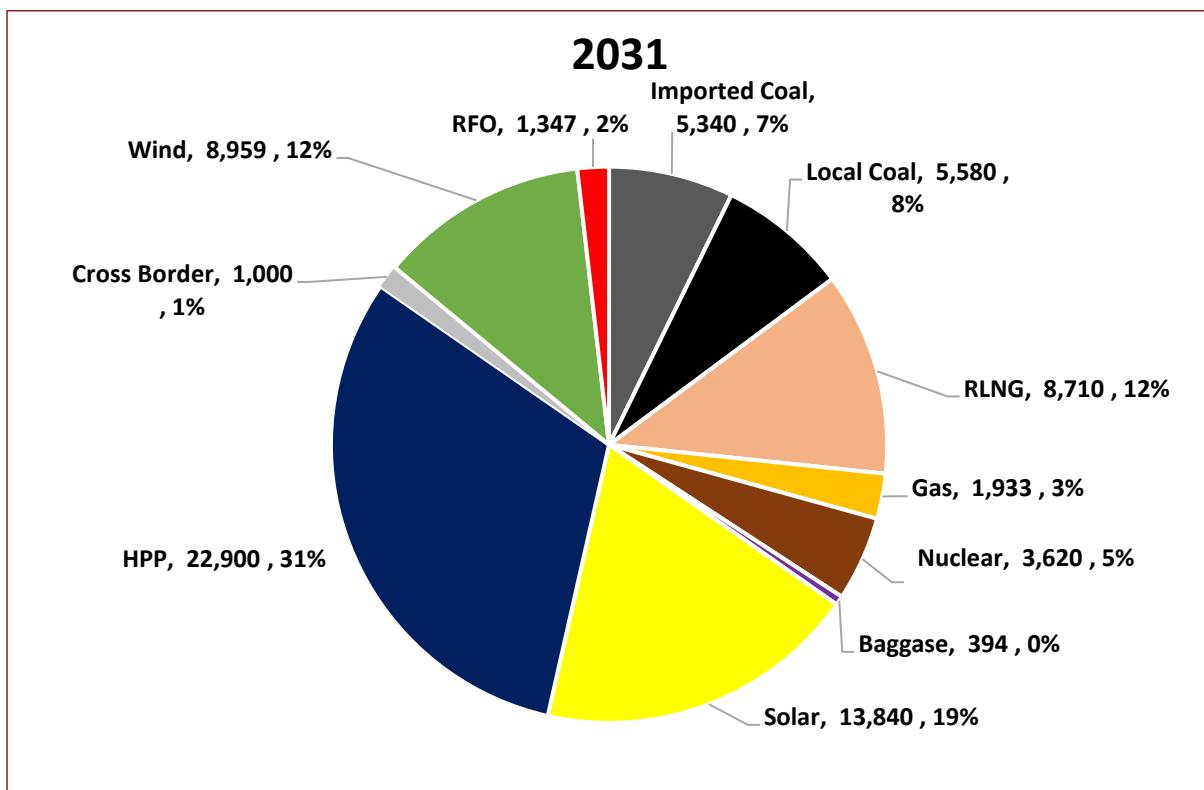
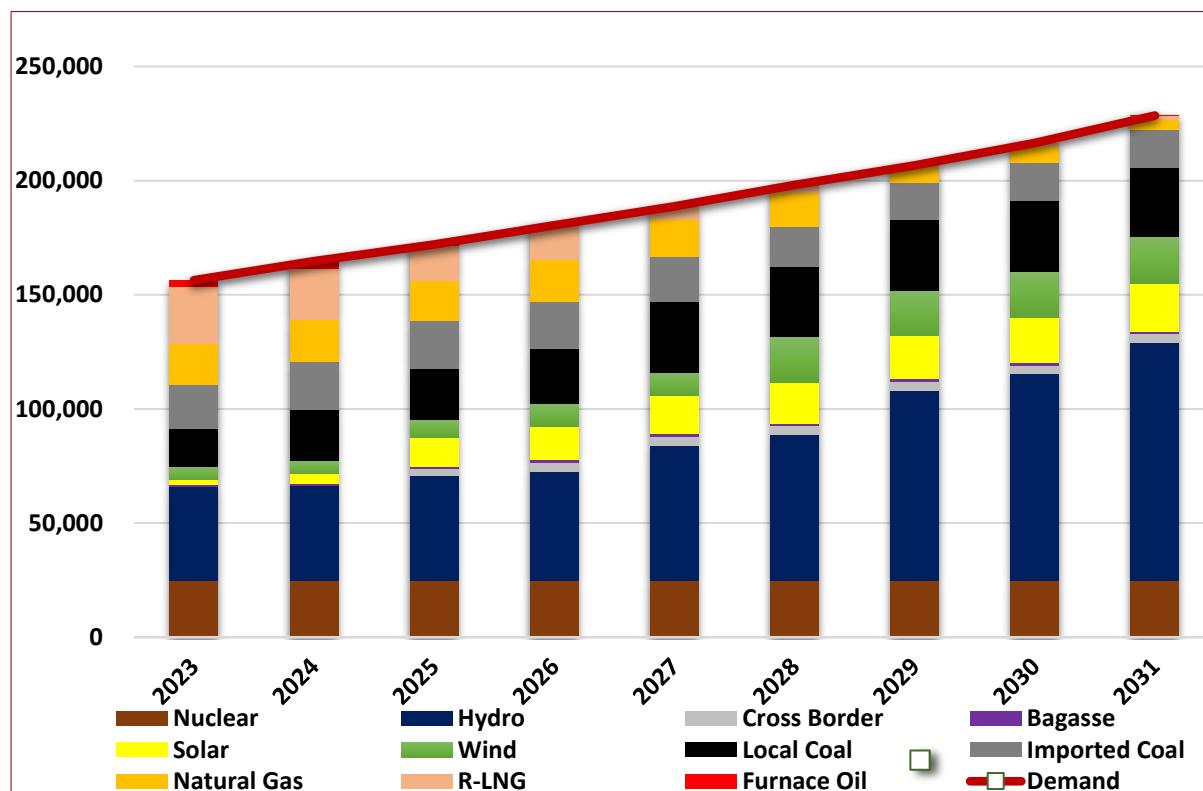


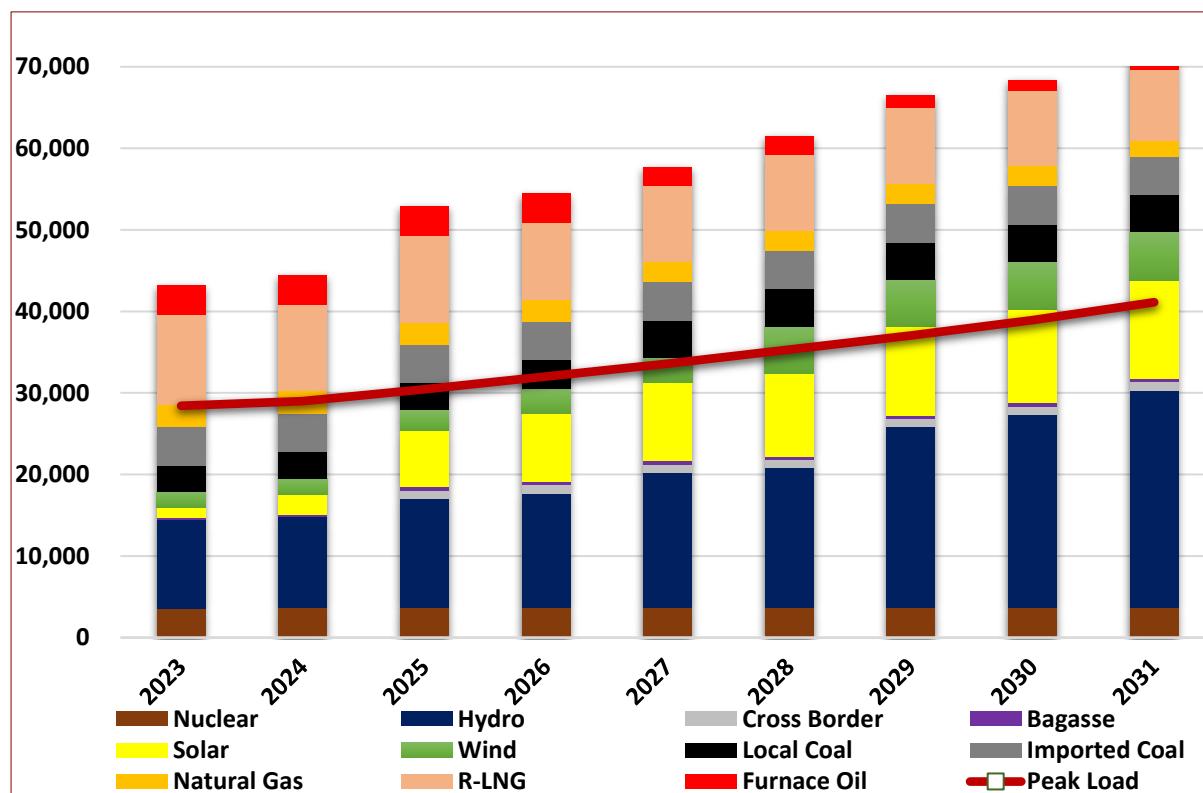
Chart D-6: IGCEP Generation Mix 2031 (MW)

Annexure E. Diamer Bhasha HPP in 2029

E-1. Annual Energy Generation Vs Annual Energy Demand (GWh) - Country



E-2. Installed Capacity Vs Peak Demand (MW) - Country



E-3. Optimized Generation Capacity Additions (MW)

Fiscal Year	Coal Fired Steam Local Coal	Coal Fired Steam Local Coal KE	HPP	HPP KE	Solar Utility MW _p	Solar Feeder MW _p	Solar KE MW _p	Wind NTDC	Wind KE	Bagasse	Per Year Capacity Addition	Cumulative Capacity Addition
2024	-	-	-	-	-	500	-	-	-	-	500	500
2025	-	-	-	-	3,120	750	150	500	50	-	4,570	5,070
2026	-	-	-	-	-	750	150	500	50	-	1,450	6,520
2027	-	990	-	-	613	-	150	-	50	-	1,803	8,323
2028	-	-	-	-	-	-	150	2,600	50	-	2,800	11,123
2029	-	-	4,525*	-	-	-	150	-	50	-	4,725	15,848
2030	-	-	977	82	-	-	150	-	50	-	1,259	17,107
2031	-	-	2,130	-	-	-	150	-	50	-	2,330	19,437
Total	-	990	7,632	82	3,733	2,000	1,050	3,600	350	-	19,437	

*4,200 MW Diamer Bhasha HPP has been represented here.

E-4. List of Projects upto 2031 (Committed + Optimized)

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2022-23							
1	Thar TEL	Local Coal	330	300	PPIB	LOS (Issued)	Commissioned
2	Net Meter	Solar	480	480	AEDB	Committed	Dec-22
3	Trimmu	CCGT_RLNG	1,263	1,243	PPIB	LOS (Issued)	Dec-22
4	Mangla (U #5-6)	Hydro	70	70	WAPDA	Mangla Refurbishment	Dec-22
5	Koto	Hydro	40.8	40.8	GoKPK	PC-1 Approved	Dec-22
6	Jamshoro Coal (U #1)	Imported Coal	660	627	GENCO	PC-1 Approved	Dec-22
7	Thal Nova	Local Coal	330	300	PPIB	LOS (Issued)	Dec-22
8	Thar-I (SSRL)	Local Coal	1,320	1,214	PPIB	LOS (Issued)	Dec-22
9	Jagran-II (U #1)	Hydro	12	12	AJK-HEB	PC-1 Approved	Apr-23
10	Helios	Solar	50	50	AEDB	Category-II Project	Apr-23
11	HNDS	Solar	50	50	AEDB	Category-II Project	Apr-23
12	Meridian	Solar	50	50	AEDB	Category-II Project	Apr-23
13	Mangla (U #3-4)	Hydro	70	70	WAPDA	Mangla Refurbishment	May-23
14	Jagran-II (U #2)	Hydro	12	12	AJK-HEB	PC-1 Approved	May-23
Generation Additions in 2022-23 (MW)			4,738	4,519			
Cumulative Addition up till 2023 (MW)			4,738	4,519			
2023-24							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-23
2	New_Solar_DG	Solar	500	500	Yet to be determined	Optimized	Jul-23
3	Jagran-II (U #3-4)	Hydro	24	24	AJK-HEB	PC-1 Approved	Jul-23
4	Siachen	Solar	100	100	GoS	Category-II Project	Sep-23
5	Manjhand	Solar	50	50	GoS	PC-1 Approved	Sep-23
6	Zorlu	Solar	100	100	PPDB	Category-II Project	Dec-23

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
7	Lawi	Hydro	69	69	GoKPK	PC-1 Approved	Apr-24
8	Suki Kinari (U #1)	Hydro	221	221	PPIB	LOS (Issued)	May-24
9	Trans_Atlantic	Wind	50	50	AEDB	Category-II Project	Jun-24
10	Western	Wind	50	50	AEDB	Category-II Project	Jun-24
Generation Additions in 2023-24 (MW)			1,644	1,644			
Cumulative Addition up till 2024 (MW)			6,382	6,163			
2024-25							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-24
2	Mangla (U #1-2)	Hydro	70	70	WAPDA	Mangla Refurbishment	Jul-24
3	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-24
4	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-24
5	New_Solar_DG	Solar	750	750	Yet to be determined	Optimized	Jul-24
6	New_Solar_Utility	Solar	3,120	3,120	Yet to be determined	Optimized	Jul-24
7	New_Wind	Wind	500	500	Yet to be determined	Optimized	Jul-24
8	Gorkin Matiltan	Hydro	84	84	GoKPK	PC-1 Approved	Jul-24
9	Tarbela Ext5 (U #1)	Hydro	510	510	WAPDA	PC-1 Approved	Jul-24
10	Suki Kinari (U #2)	Hydro	221	221	PPIB	LOS (Issued)	Jul-24
11	CASA	Cross Border Interconnection	1,000	1,000	NTDC	G2G	Aug-24
12	Tarbela Ext5 (U #2)	Hydro	510	510	WAPDA	PC-1 Approved	Aug-24
13	Shahtaj	Bagasse	32	32	AEDB	Category-I Project	Aug-24
14	Tarbela Ext5 (U #3)	Hydro	510	510	WAPDA	PC-1 Approved	Sep-24
15	Suki Kinari (U #3)	Hydro	221	221	PPIB	LOS (Issued)	Sep-24
16	Suki Kinari (U #4)	Hydro	221	221	PPIB	LOS (Issued)	Nov-24
Generation Additions in 2024-25 (MW)			8,429	8,429			
Cumulative Addition up till 2025 (MW)			14,811	14,592			

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2025-26							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-25
2	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-25
3	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-25
4	New_Solar_DG	Solar	750	750	Yet to be determined	Optimized	Jul-25
5	New_Wind	Wind	500	500	Yet to be determined	Optimized	Jul-25
6	Gwadar	Local Coal	300	273	PPIB	LOS (Issued)	Aug-25
7	Mangla (U #9-10)	Hydro	70	70	WAPDA	Mangla Refurbishment	Sep-25
8	Dasu (U #1)	Hydro	360	360	WAPDA	PC-1 Approved	May-26
9	Mohmand Dam (U #1)	Hydro	200	200	WAPDA	PC-1 Approved	May-26
Generation Additions in 2025-26 (MW)			2,860	2,833			
Cumulative Addition up till 2026 (MW)			17,671	17,425			
2026-27							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-26
2	KE_New_Local Coal	Local Coal	990	912	Yet to be determined	Optimized	Jul-26
3	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-26
4	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-26
5	New_Solar_Utility	Solar	613	613	Yet to be determined	Optimized	Jul-26
6	Dasu (U #2)	Hydro	360	360	WAPDA	PC-1 Approved	Jul-26
7	Mohmand Dam (U #2)	Hydro	200	200	WAPDA	PC-1 Approved	Jul-26
8	Dasu (U #3)	Hydro	360	360	WAPDA	PC-1 Approved	Aug-26
9	Mohmand Dam (U #3)	Hydro	200	200	WAPDA	PC-1 Approved	Sep-26
10	Mangla (U #7-8)	Hydro	30	30	WAPDA	Mangla Refurbishment	Nov-26
11	Dasu (U #4)	Hydro	360	360	WAPDA	PC-1 Approved	Nov-26
12	Mohmand Dam (U #4)	Hydro	200	200	WAPDA	PC-1 Approved	Nov-26

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
13	Dasu (U #5)	Hydro	360	360	WAPDA	PC-1 Approved	Feb-27
14	Keyal Khwar (U #1)	Hydro	64	64	WAPDA	PC-1 Approved	Feb-27
15	Dasu (U #6)	Hydro	360	360	WAPDA	PC-1 Approved	May-27
16	Keyal Khwar (U #2)	Hydro	64	64	WAPDA	PC-1 Approved	May-27
Generation Additions in 2026-27 (MW)		4,841	4,763				
Cumulative Addition up till 2027 (MW)		22,512	22,188				
2027-28							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-27
2	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-27
3	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-27
4	New_Wind	Wind	2,600	2,600	Yet to be determined	Optimized	Jul-27
5	Gabral Kalam	Hydro	88	88	GoKPK	PC-1 Approved	Nov-27
6	Madyan	Hydro	157	157	GoKPK	PC-1 Approved	Nov-27
7	Balakot	Hydro	300	300	GoKPK	PC-1 Approved	Dec-27
Generation Additions in 2027-28 (MW)		3,825	3,825				
Cumulative Addition up till 2028 (MW)		26,337	26,013				
2028-29							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-28
2	CJ	Hydro	25	25	PPDB	Optimized	Jul-28
3	Diamer Bhasha	Hydro	4,500	4,500	WAPDA	Committed with Cost	Jul-28
4	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-28
5	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-28
6	Azad Pattan (U #1)	Hydro	175	175	PPIB	LOS (Issued)	Dec-28
7	Azad Pattan (U #2)	Hydro	175	175	PPIB	LOS (Issued)	Mar-29
8	Azad Pattan (U #3)	Hydro	175	175	PPIB	LOS (Issued)	Jun-29

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#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
Generation Additions in 2028-29 (MW)			5,731	5,731			
Cumulative Addition up till 2029 (MW)			32,067	31,743			
2029-30							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-29
2	Arkari Gol	Hydro	99	99	PEDO	Optimized	Jul-29
3	Asrit Kedam	Hydro	215	215	PEDO	Optimized	Jul-29
4	Bata Kundī	Hydro	99	99	GoKPK	Optimized	Jul-29
5	Dowarian	Hydro	40	40	AJK-HEB	Optimized	Jul-29
6	Jagran-IV	Hydro	22	22	AJK-HEB	Optimized	Jul-29
7	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-29
8	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-29
9	Nagdar	Hydro	35	35	AJK-HEB	Optimized	Jul-29
10	Rajdhani	Hydro	132	132	PPIB	Optimized	Jul-29
11	Sharmai	Hydro	152.12	152.12	PEDO	Optimized	Jul-29
12	Shounter	Hydro	48	48	AJK-HEB	Optimized	Jul-29
13	Taunsa	Hydro	135	135	PPDB	Optimized	Jul-29
14	Turtonas Uzghor	Hydro	82.25	82.25	KE	Optimized	Jul-29
15	Azad Pattan (U #4)	Hydro	175	175	PPIB	LOS (Issued)	Sep-29
16	Kohala (U #1)	Hydro	275	275	PPIB	LOS (Issued)	Jun-30
Generation Additions in 2029-30 (MW)			2,190	2,190			
Cumulative Addition up till 2030 (MW)			34,257	33,933			
2030-31							
1	Mahl	Hydro	640	640	PPIB	Optimized	Jul-30
2	Thakot-III	Hydro	1,490	1,490	WAPDA	Optimized	Jul-30
3	Net Meter	Solar	480	480	AEDB	Committed	Jul-30

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
4	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-30
5	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-30
6	Kohala (U #2)	Hydro	275	275	PPIB	LOS (Issued)	Aug-30
7	Kohala (U #3)	Hydro	275	275	PPIB	LOS (Issued)	Oct-30
8	Kohala (U #4)	Hydro	275	275	PPIB	LOS (Issued)	Dec-30
9	Kohala (U #5)	Hydro	12	12	PPIB	LOS (Issued)	Feb-31
10	Kohala (U #6)	Hydro	12	12	PPIB	LOS (Issued)	Mar-31
Generation Additions in 2030-31 (MW)		3,659	3,659				
Cumulative Addition up till 2031 (MW)		37,916	37,592				

E-5. Annual Capacity Factors (%)age)

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
1	Almoiz	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
2	Chanar	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
3	Chiniot	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
4	Fatima	Bagasse	6.53	6.55	6.53	6.53	6.43	6.40	6.38	6.38	1.18
5	Hamza	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
6	JDW-II	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
7	JDW-III	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
8	Ryk_Mills	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
9	Shahtaj	Bagasse	0.00	0.00	45.62	45.62	45.62	45.77	45.62	45.62	45.62
10	Thal_Layyah	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
11	Appolo	PV	18.96	18.91	18.96	18.96	18.96	18.91	18.96	18.96	18.96
12	Best	PV	18.94	18.89	18.94	18.94	18.94	18.89	18.94	18.94	18.94
13	Crest	PV	19.19	19.13	19.19	19.19	19.19	19.13	19.19	19.19	19.19
14	Helios	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
15	HNDS	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
16	Manjhand	PV	0.00	23.23	23.33	23.33	23.33	23.27	23.33	23.33	23.33
17	Meridian	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
18	Net_Meter	PV	17.08	17.03	17.08	17.08	17.08	17.03	17.08	17.08	17.08
19	New_Solar	PV	0.00	0.00	22.08	22.08	22.08	22.02	22.08	22.08	22.08
20	New_Solar_Feeder	PV	0.00	19.95	20.00	20.00	20.00	19.95	20.00	20.00	20.00
21	QA_Solar	PV	19.04	18.99	19.04	19.04	19.04	18.99	19.04	19.04	19.04
22	Siachen	PV	0.00	23.23	23.33	23.33	23.33	23.27	23.33	23.33	23.33
23	Zhenfa	PV	21.50	21.44	21.50	21.50	21.50	21.44	21.50	21.50	21.50
24	Zorlu	PV	0.00	20.17	20.17	20.17	20.17	20.11	20.17	20.17	20.17
25	Gharo	KE_PV	25.25	25.18	25.25	25.25	25.25	25.18	25.25	25.25	25.25
26	KE_New_Solar	KE_PV	0.00	0.00	22.08	22.08	22.08	22.02	22.08	22.08	22.08
27	Oursun	KE_PV	20.97	20.91	20.97	20.97	20.97	20.91	20.97	20.97	20.97
28	Act	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
29	Act_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
30	Artistic_wind	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
31	Artistic_Wind_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
32	Dawood	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
33	Din	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
34	FFC	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
35	FWEL-I	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
36	FWEL-II	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
37	Gul Ahmed	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
38	Gul_Electric	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
39	Hawa	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
40	Indus_Energy	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
41	Jhimpir	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
42	Lakeside	Wind	38.93	38.07	38.17	38.17	38.17	38.07	38.17	38.17	38.17
43	Liberty_Wind_1	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
44	Liberty_Wind_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
45	Master	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
46	Master_Green	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
47	Metro_Power	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
48	Metro_Wind	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
49	NASDA	Wind	38.93	38.07	38.17	38.17	38.17	38.07	38.17	38.17	38.17
50	New_Wind	Wind	0.00	0.00	41.28	41.28	41.28	41.17	41.28	41.28	41.28
51	Sachal	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
52	Sapphire_Wind	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
53	Tenaga	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
54	Three_Gorges_I	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
55	Three_Gorges_II	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
56	Three_Gorges_III	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
57	Trans_Atlantic	Wind	0.00	41.28	41.28	41.28	41.28	41.17	41.28	41.28	41.28
58	Tricom	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
59	Tricon_A	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
60	Tricon_B	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
61	Tricon_C	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
62	UEP	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
63	Western	Wind	0.00	37.19	37.19	37.19	37.19	37.09	37.19	37.19	37.19
64	Yunus	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
65	Zephyr	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
66	Zorlu_Wind	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
67	KE_New_Wind	KE_Wind	0.00	0.00	41.28	41.28	41.28	41.17	41.28	41.28	41.28
68	CASA	Interconnection	0.00	0.00	41.92	41.92	41.92	41.80	41.92	41.92	41.92
69	Arkari Gol	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.22	42.22
70	Asrit Kedam	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.72	49.72
71	Bata Kundti	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	54.79	54.79
72	CJ	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.50	50.50
73	Dowarian	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.85	48.85
74	Jagran-IV	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.09	49.09
75	Mahl	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.53
76	Nagdar	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.87	48.87
77	Rajdhani	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.46	58.46
78	Sharmai	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.94	50.94
79	Shounter	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.86	48.86
80	Taunsa	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.02	55.02
81	Thakot-III	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.34
82	Turtonas Uzghor	KE_HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.90	51.90
83	Azad Pattan	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	52.77	54.06	52.77

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#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
84	Balakot	HPP Committed	0.00	0.00	0.00	0.00	0.00	41.21	41.21	41.21	41.21
85	Dasu	HPP Committed	0.00	0.00	0.00	64.29	69.96	64.29	64.47	64.47	64.47
86	Diamer Bhasha	HPP Committed	0.00	0.00	0.00	0.00	0.00	43.71	43.71	43.71	43.71
87	Gabral Kalam	HPP Committed	0.00	0.00	0.00	0.00	0.00	32.37	33.77	33.77	33.77
88	Gorkin Matiltan	HPP Committed	0.00	0.00	42.83	42.83	42.83	42.71	42.83	42.83	42.83
89	Jagran-II	HPP Committed	50.53	50.39	50.53	50.53	50.53	50.39	50.53	50.53	50.53
90	Karot	HPP Committed	44.39	44.29	44.39	44.39	44.39	44.29	44.39	44.39	44.39
91	Keyal Khwar	HPP Committed	0.00	0.00	0.00	0.00	52.07	51.92	52.07	52.07	52.07
92	Kohala	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.14	56.14
93	Koto	HPP Committed	57.24	57.08	57.24	57.23	57.24	56.96	57.24	57.24	57.24
94	Lawi	HPP Committed	0.00	47.90	48.10	48.08	48.10	47.90	48.10	48.10	48.10
95	Madyan	HPP Committed	0.00	0.00	0.00	0.00	0.00	47.43	47.43	47.43	47.43
96	Mohmand Dam	HPP Committed	0.00	0.00	0.00	42.60	46.36	42.60	42.71	42.71	42.71
97	Suki Kinari	HPP Committed	0.00	49.07	45.52	49.07	49.07	48.93	49.07	49.07	49.07
98	Tarbela_Ext_5	HPP Committed	0.00	0.00	10.05	10.05	10.05	10.02	10.05	10.05	10.05
99	Allai Khwar	HPP Existing	44.32	44.20	44.32	44.32	44.32	44.20	44.32	44.32	44.32
100	Chashma	HPP Existing	48.58	48.45	48.58	48.58	48.58	48.45	48.58	48.58	48.58
101	Daral Khwar	HPP Existing	38.58	38.48	38.58	38.58	38.58	38.48	38.58	38.58	38.58
102	Dubair Khwar	HPP Existing	53.09	52.95	53.09	53.09	53.09	52.95	53.09	53.09	53.09
103	Ghazi Brotha	HPP Existing	52.78	52.63	52.78	52.78	52.78	52.63	52.78	52.78	52.78
104	Golen Gol	HPP Existing	9.15	9.12	9.15	9.15	9.15	9.12	9.15	9.15	9.15
105	Gulpur	HPP Existing	28.92	28.84	28.92	28.92	28.92	28.84	28.92	28.92	28.92
106	Jagran-I	HPP Existing	48.95	48.82	48.95	48.95	48.95	48.82	48.95	48.95	48.95
107	Jinnah	HPP Existing	25.74	25.67	25.74	25.74	25.74	25.67	25.74	25.74	25.74
108	Khan Khwar	HPP Existing	40.22	40.11	40.22	40.22	40.22	40.11	40.22	40.22	40.22
109	Malakand-III	HPP Existing	53.86	53.71	53.86	53.86	53.86	53.71	53.86	53.86	53.86
110	Mangla	HPP Existing	64.95	60.97	58.32	56.00	54.77	54.20	54.35	54.35	54.35
111	Neelum Jehlum	HPP Existing	51.69	51.54	51.69	51.69	51.69	51.54	51.69	51.69	51.69
112	New Bong	HPP Existing	55.49	55.34	55.49	55.49	55.49	55.34	55.49	55.49	55.49
113	Patrind	HPP Existing	43.76	43.64	43.76	43.76	43.76	43.64	43.76	43.76	43.76
114	Small Hydel	HPP Existing	45.00	44.90	45.02	45.02	45.02	44.90	45.02	45.02	45.02
115	Tarbela 1-14	HPP Existing	37.99	37.89	37.99	37.99	37.99	37.89	37.99	37.99	37.99
116	Tarbela_Ext_4	HPP Existing	30.12	30.04	30.12	30.12	30.12	30.04	30.12	30.12	30.12
117	Warsak	HPP Existing	50.64	50.50	50.64	50.64	50.64	50.50	50.64	50.64	50.64
118	Engro 90MW	CCGT_Gas	90.23	74.96	62.46	50.72	70.05	38.59	29.25	25.26	21.71
119	Foundation	CCGT_Gas	89.97	90.25	90.00	89.98	82.88	82.08	57.94	57.94	57.94
120	Guddu-I	CCGT_Gas	36.90	74.63	74.43	74.42	73.29	72.23	7.66	8.46	7.95
121	Guddu-II	CCGT_Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
122	Guddu-V (747)	CCGT_Gas	75.56	75.77	75.56	75.56	75.44	74.52	16.42	36.68	10.09
123	Liberty	CCGT_Gas	75.26	75.02	45.55	73.15	0.00	0.00	0.00	0.00	0.00
124	Uch	CCGT_Gas	86.08	86.32	86.08	86.08	81.30	65.31	40.44	40.55	0.00
125	Uch-II	CCGT_Gas	87.77	88.05	87.81	87.78	80.86	79.63	51.33	51.33	51.33

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
126	SNPC-I	KE_CCGT_Gas	91.98	92.25	91.96	91.99	84.72	83.71	28.73	26.89	27.34
127	SNPC-II	KE_CCGT_Gas	91.98	92.25	91.96	91.99	84.72	83.71	29.97	27.94	29.24
128	AES Lalpir	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
129	AES Pakgen	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
130	HUBCO	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
131	Jamshoro-I U1	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
132	Jamshoro-II U4	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
133	Muzaffargarh-I U1	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
134	Muzaffargarh-I U2	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
135	Muzaffargarh-I U3	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
136	Muzaffargarh-II U4	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
137	Saba	ST_RFO	14.38	21.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00
138	AGL	DG_RFO	36.12	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00
139	Atlas	DG_RFO	14.40	21.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
140	Engro 127MW	DG_RFO	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
141	Hub N	DG_RFO	36.12	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00
142	Kohinoor	DG_RFO	14.39	21.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
143	Liberty Tech	DG_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
144	Nishat C	DG_RFO	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
145	Nishat P	DG_RFO	36.81	22.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
146	C-1	Nuclear	80.43	80.65	80.43	80.43	80.43	80.65	80.43	80.43	80.43
147	C-2	Nuclear	79.61	79.83	79.61	79.61	79.61	79.83	79.61	79.61	79.61
148	C-3	Nuclear	81.01	81.23	81.01	81.01	81.01	81.23	81.01	81.01	81.01
149	C-4	Nuclear	81.01	81.23	81.01	81.01	81.01	81.23	81.01	81.01	81.01
150	K-2	Nuclear	85.06	85.30	85.07	85.07	85.07	85.29	85.07	85.07	85.07
151	K-3	Nuclear	85.66	85.90	85.67	85.67	85.67	85.89	85.67	85.67	85.67
152	Engro Thar	Local Coal	82.51	82.74	82.51	82.51	82.51	82.15	81.69	81.50	79.84
153	Gwadar	Local Coal	0.00	0.00	0.00	69.18	83.34	82.94	81.11	80.57	67.09
154	Lucky	Local Coal	85.08	85.31	85.08	85.08	85.08	85.31	85.08	85.08	85.08
155	Thal Nova	Local Coal	49.35	85.21	84.98	84.98	84.98	84.61	84.38	84.77	84.44
156	Thar TEL	Local Coal	84.98	85.21	84.98	84.98	84.98	84.61	84.47	84.68	84.17
157	Thar-I (SSRL)	Local Coal	42.14	85.21	84.98	84.98	84.98	85.10	84.93	84.98	84.98
158	K.E_NEW_L.Coal	KE_Local Coal	0.00	0.00	0.00	0.00	83.33	83.55	83.34	83.34	83.34
159	China HUBCO	Imported Coal	51.57	51.57	51.57	51.57	51.57	51.57	51.57	51.57	51.57
160	Jamshoro Coal	Imported Coal	49.36	83.95	83.64	83.65	60.94	20.51	7.04	7.91	7.40
161	Port Qasim	Imported Coal	48.72	48.72	48.72	48.72	48.72	48.72	48.72	48.72	48.72
162	Sahiwal Coal	Imported Coal	48.02	48.02	48.02	48.02	48.02	48.01	48.02	48.02	48.02
163	FPCL	KE_Imported Coal	82.15	77.19	18.20	22.64	15.48	13.85	3.65	3.48	8.11
164	Davis	DG_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
165	Balloki	CCGT_RLNG	4.23	1.98	1.03	2.32	2.22	0.81	0.00	0.00	0.00
166	Bhikki	CCGT_RLNG	1.21	0.77	0.02	0.66	0.65	0.29	0.00	0.00	0.00
167	FKPCL	CCGT_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% %								
168	Halmore	CCGT_RLNG	37.73	37.73	37.73	22.68	0.26	0.00	0.00	0.00	0.00
169	Haveli	CCGT_RLNG	11.09	5.89	3.48	5.70	4.64	1.92	0.26	0.19	0.20
170	KAPCO 1	CCGT_RLNG	35.31	35.38	35.25	0.00	0.00	0.00	0.00	0.00	0.00
171	KAPCO 2	CCGT_RLNG	11.86	11.83	11.89	0.00	0.00	0.00	0.00	0.00	0.00
172	KAPCO 3	CCGT_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
173	Nandipur	CCGT_RLNG	36.38	36.38	36.38	21.87	0.00	0.00	0.00	0.00	0.00
174	Orient	CCGT_RLNG	37.73	23.21	0.00	0.00	0.30	0.00	0.00	0.00	0.00
175	Rousch	CCGT_RLNG	0.23	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
176	Saif	CCGT_RLNG	37.73	37.73	37.73	22.68	0.00	0.00	0.00	0.00	0.00
177	Saphire	CCGT_RLNG	37.73	37.73	37.73	22.68	0.30	0.00	0.00	0.00	0.00
178	Trimmu	CCGT_RLNG	26.53	21.00	12.36	12.90	9.69	4.65	0.80	0.65	0.41
179	BQPS2	KE_CCGT_RLNG	85.24	83.52	29.84	59.15	20.88	10.57	3.09	3.28	7.52
180	BQPS3	KE_CCGT_RLNG	89.85	89.80	78.82	83.84	32.21	21.90	10.73	13.40	15.81
181	KCCPP	KE_CCGT_RLNG	85.17	82.46	22.16	20.39	16.43	9.08	2.32	2.13	3.64
182	KTGTPS	KE_CCGT_RLNG	45.16	40.58	8.61	10.37	8.38	3.24	1.56	1.24	1.55
183	SGTPS	KE_CCGT_RLNG	48.00	44.44	9.21	11.53	8.67	3.48	1.59	1.26	1.76
184	BQPS1-U1	KE_ST_RLNG	10.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
185	BQPS1-U5	KE_ST_RLNG	29.34	30.27	1.66	1.71	0.46	0.77	0.72	0.75	1.10
186	BQPS1-U6	KE_ST_RLNG	16.15	15.84	1.43	1.54	0.30	0.28	0.30	0.46	0.67
187	BQPS1-U2	KE_GT_RLNG	22.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(All numbers in yellow color, in this table, represent retirement of the corresponding project.)

E-6. Year-wise Installed Capacity Addition (MW)

FY	Local Coal	Hydro	RLNG	Nuclear	Imported Coal	RE	Local Gas	Furnace Oil	Cross Border	Net Yearly Addition	Cumulative Total
Jun-22	1,320	10,593	9,789	3,620	4,020	2,802	2,744	3,633	-	-	38,521
2023	1,980	205	1,263	-	660	630	-	-	-	4,738	43,259
2024	-	314	-420	-	-	1,330	-	-	-	1,224	44,483
2025	-	2,347	-	-	-	5,082	-	-	1,000	8,429	52,912
2026	300	630	-1,300	-	-	1,930	-	-	-	1,560	54,472
2027	990	2,558	-	-	-	1,293	-225	-1,292	-	3,324	57,796
2028	-	545	-	-	-	3,280	-	-131	-	3,694	61,490
2029	-	5,051	-	-	-	680	-	-727	-	5,004	66,493
2030	-	1,510	-172	-	-	680	-	-136	-	1,882	68,375
2031	-	2,979	-450	-	-	680	-586	-	-	2,623	70,998
Total	4,590	26,731	8,710	3,620	4,680	18,387	1,933	1,347	1,000	32,478	70,998

E-7. IGCEP Generation Mix 2023-2031 (GWh)

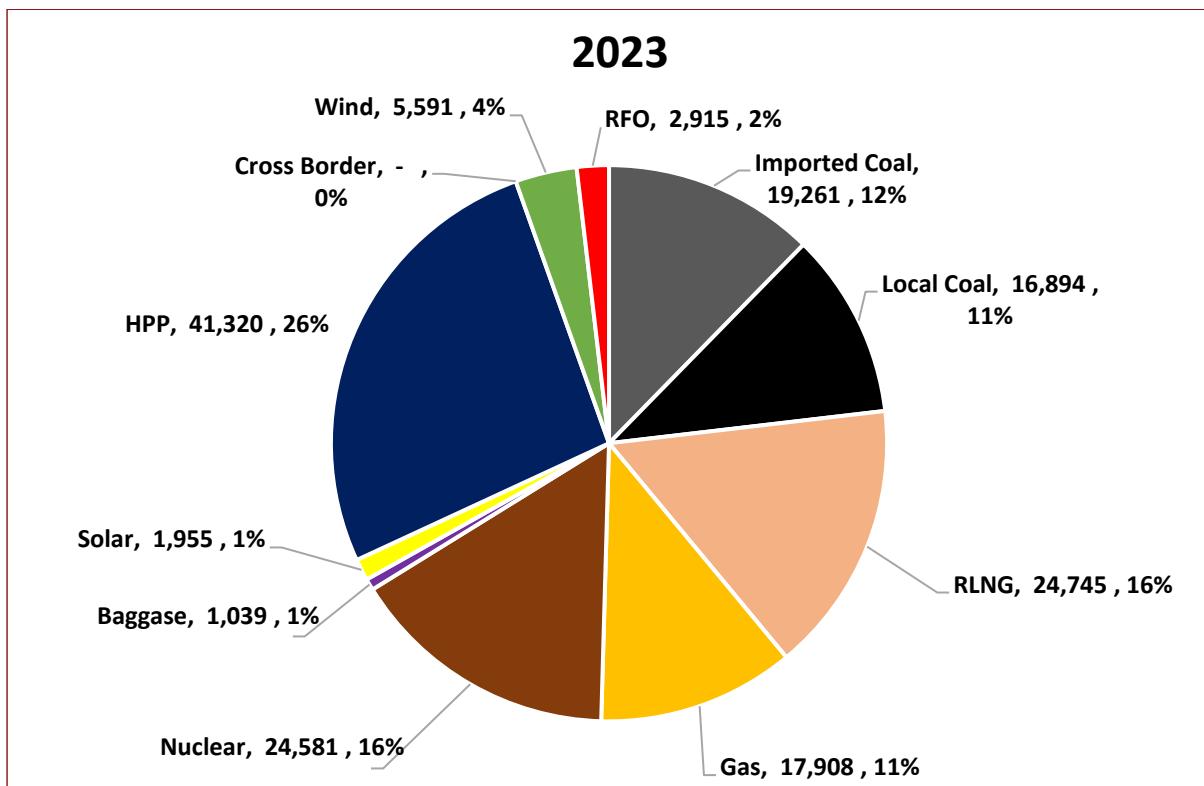


Chart E-1: IGCEP Generation Mix 2023 (GWh)

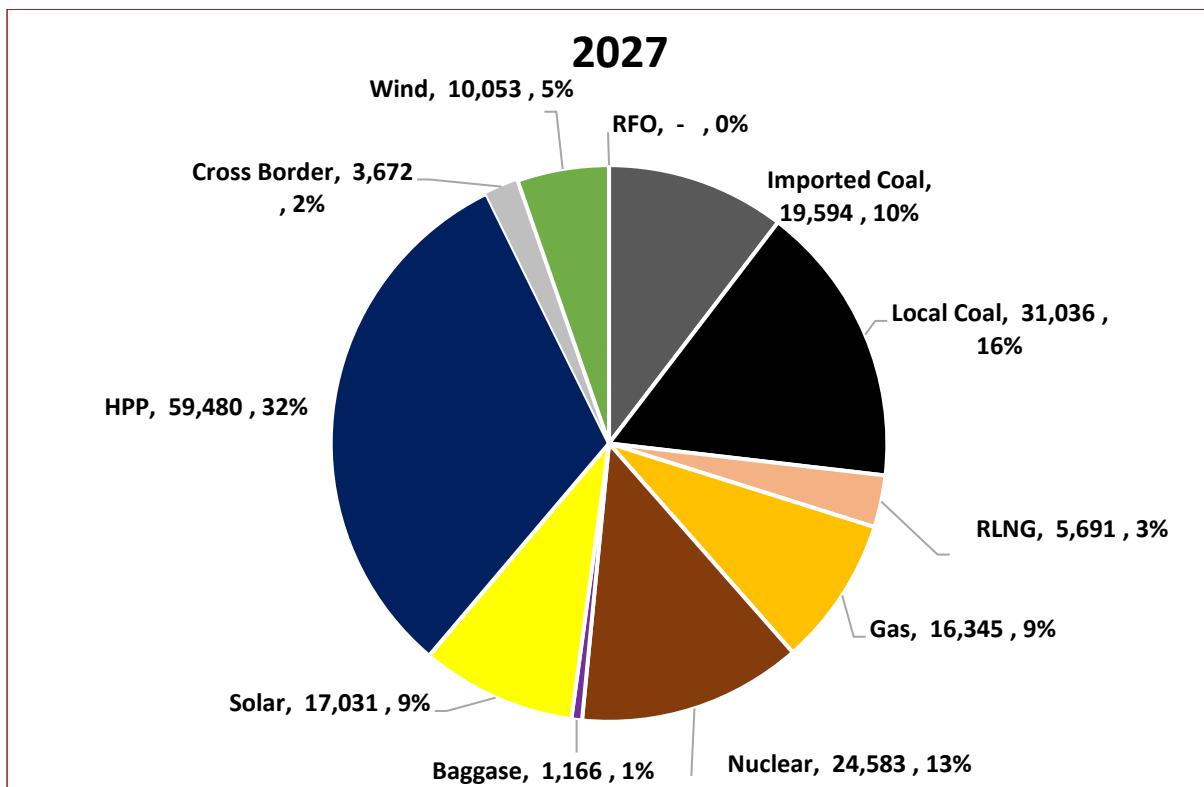


Chart E-2: IGCEP Generation Mix 2027 (GWh)

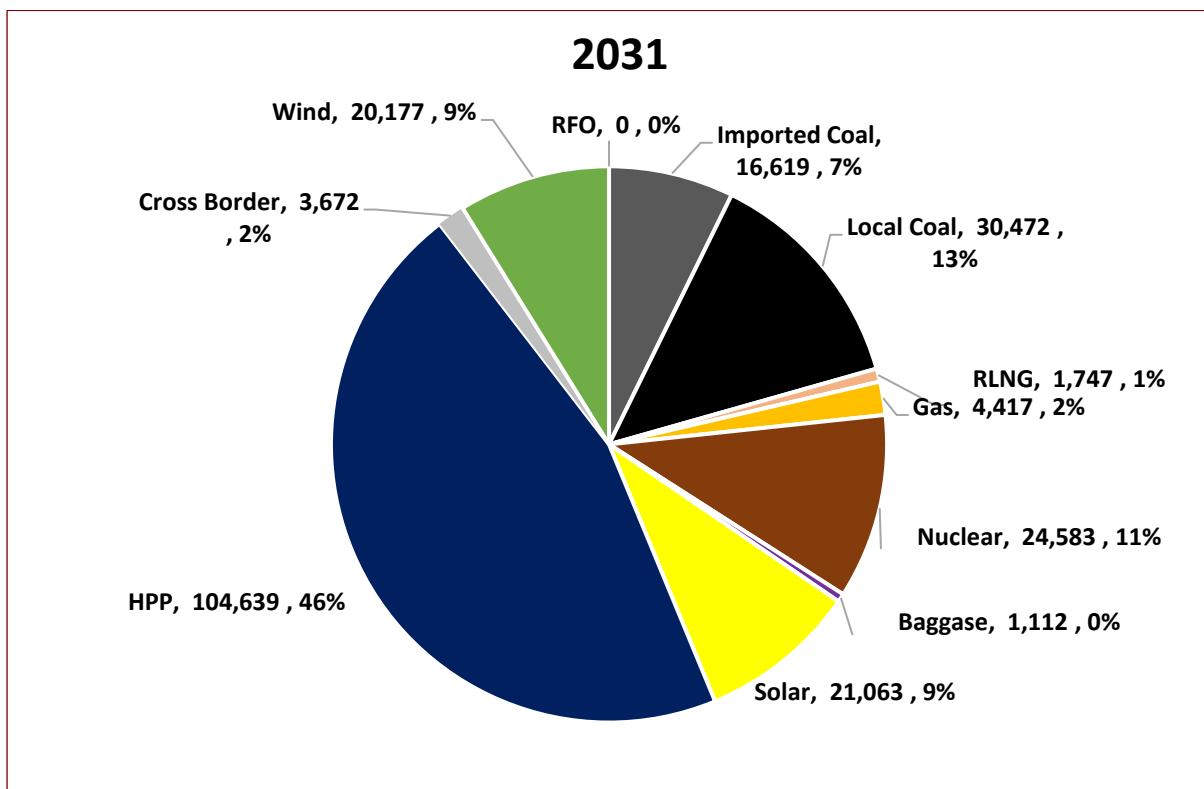


Chart E-3: IGCEP Generation Mix 2031 (GWh)

E-8. IGCEP Generation Mix 2023-31 (MW)

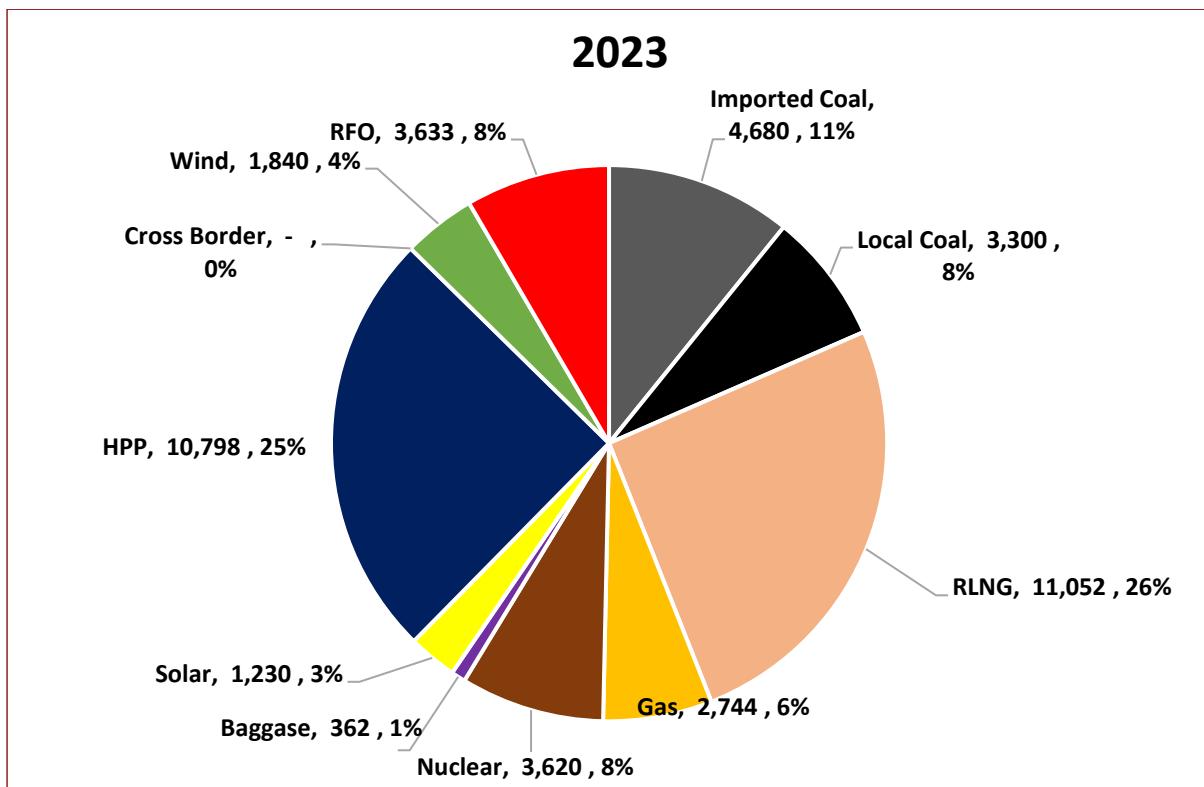


Chart E-4: IGCEP Generation Mix 2023 (MW)

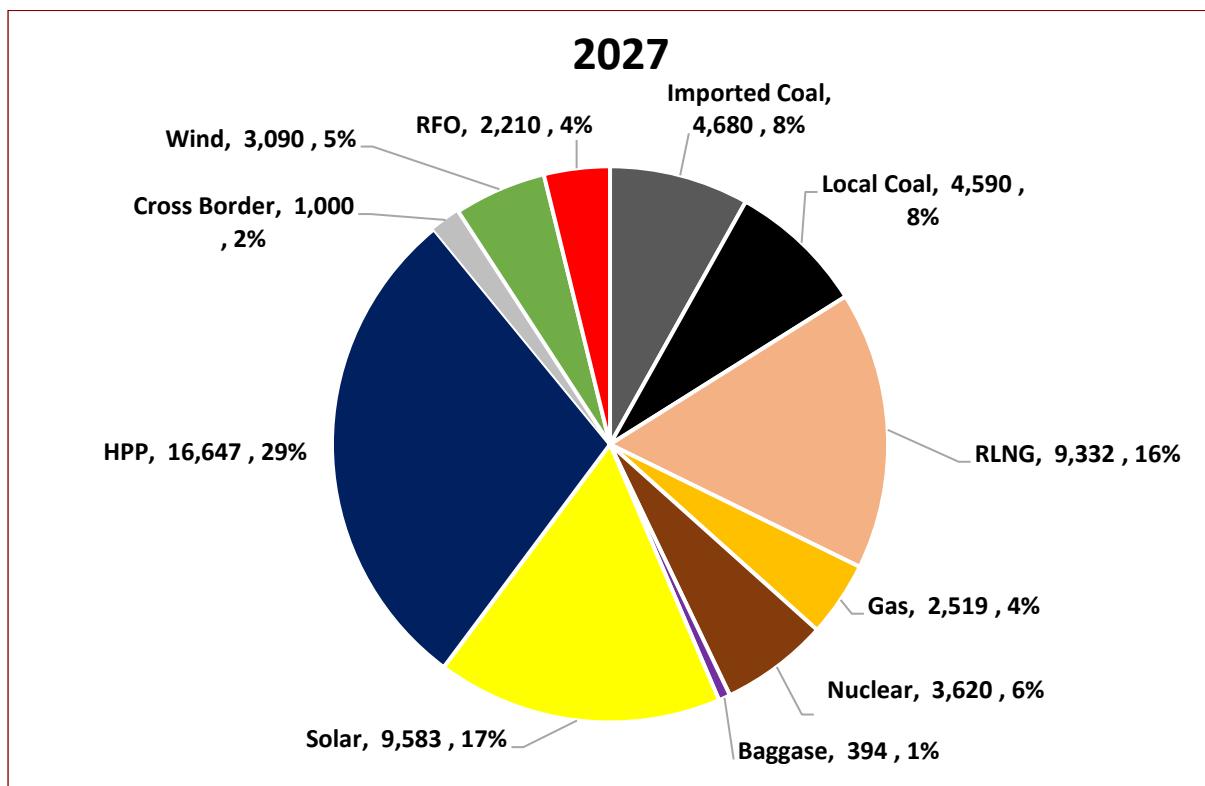


Chart E-5: IGCEP Generation Mix 2027 (MW)

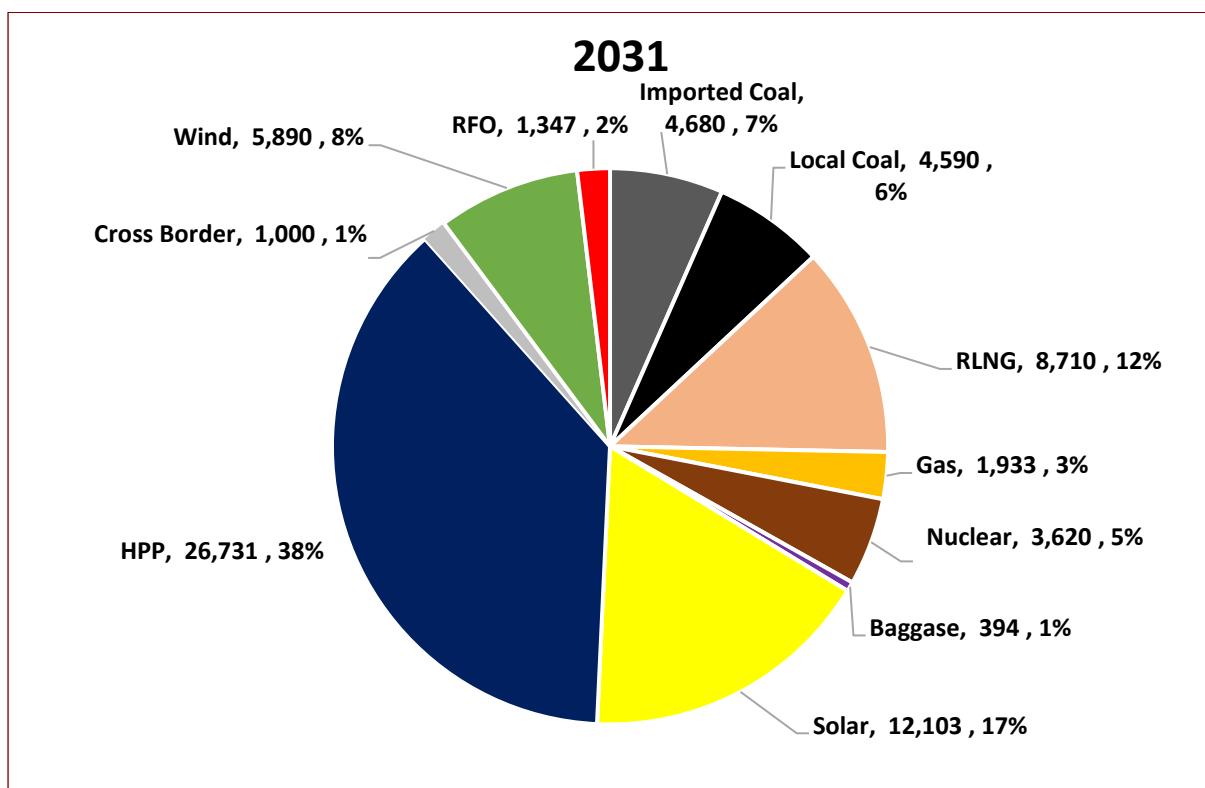
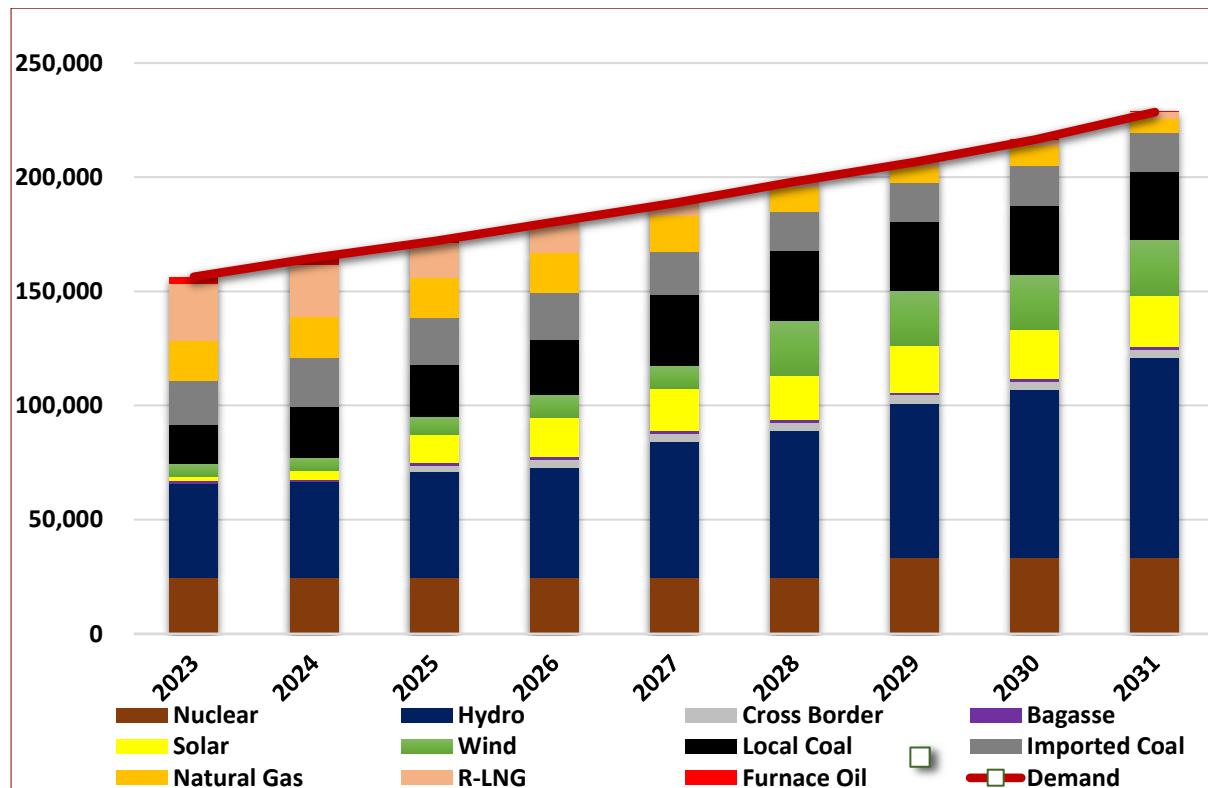


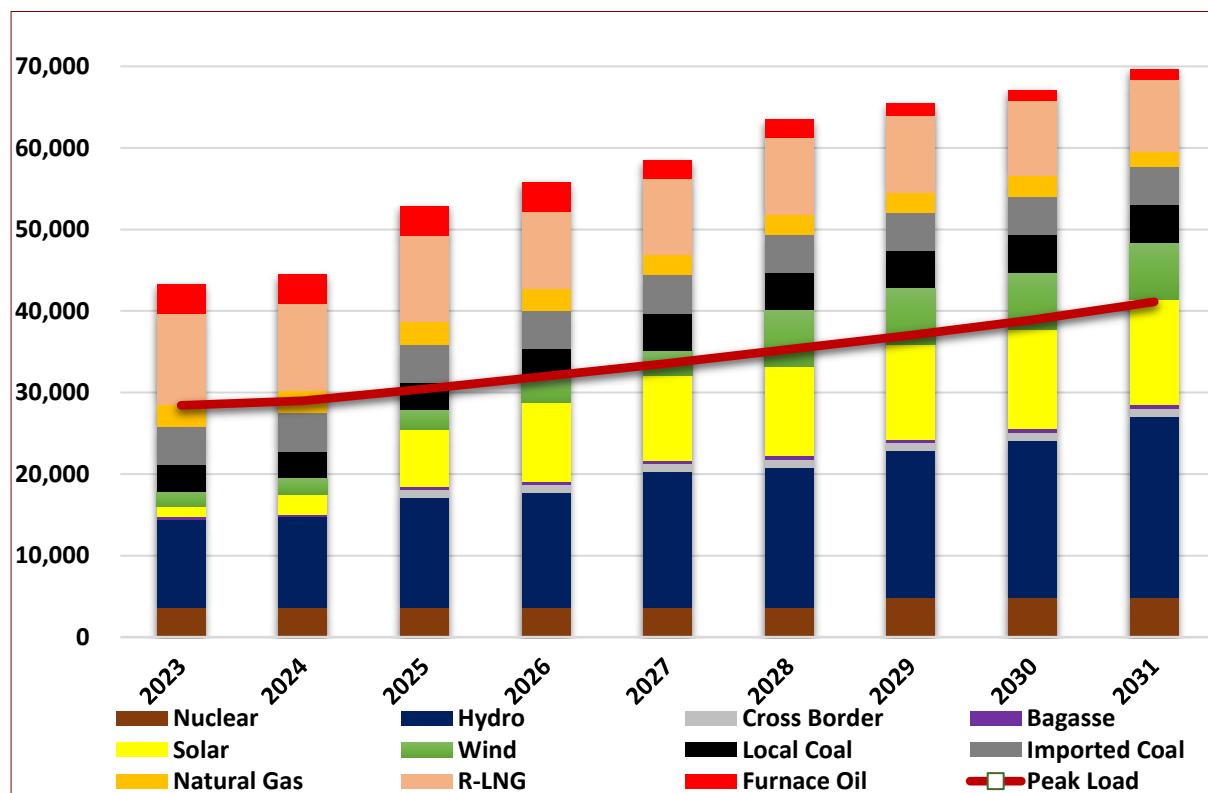
Chart E-6: IGCEP Generation Mix 2031 (MW)

Annexure F. Chashma Nuclear (C-5) for Energy Security

F-1. Annual Energy Generation Vs Annual Energy Demand (GWh) - Country



F-2. Installed Capacity Vs Peak Demand (MW) - Country



F-3. Optimized Generation Capacity Additions (MW)

Fiscal Year	Coal Fired Steam Local Coal	Coal Fired Steam Local Coal KE	Nuclear	HPP	HPP KE	Solar Utility MWp	Solar Feeder MWp	Solar KE MWp	Wind NTDC	Wind KE	Bagasse	Per Year Capacity Addition	Cumulative Capacity Addition
2024	-	-	-	-	-	-	500	-	-	-	-	500	500
2025	-	-	-	-	-	3,120	750	150	500	50	-	4,570	5,070
2026	-	-	-	-	-	1,300	750	150	500	50	-	2,750	7,820
2027	-	990	-	-	-	99	-	150	-	50	-	1,289	9,109
2028	-	-	-	-	-	-	-	150	3,756	50	-	3,956	13,065
2029	-	-	1,200	290	-	-	-	150	-	50	-	1,690	14,755
2030	-	-	-	743	82	-	-	150	-	50	-	1,025	15,781
2031	-	-	-	2,130	-	-	-	150	-	50	-	2,330	18,111
Total	-	990	1,200	3,163	82	4,519	2,000	1,050	4,756	350	-	18,111	

F-4. List of Projects upto 2031 (Committed + Optimized)

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2022-23							
1	Thar TEL	Local Coal	330	300	PPIB	LOS (Issued)	Commissioned
2	Net Meter	Solar	480	480	AEDB	Committed	Dec-22
3	Trimmu	CCGT_RLNG	1,263	1,243	PPIB	LOS (Issued)	Dec-22
4	Mangla (U #5-6)	Hydro	70	70	WAPDA	Mangla Refurbishment	Dec-22
5	Koto	Hydro	40.8	40.8	GoKPK	PC-1 Approved	Dec-22
6	Jamshoro Coal (U #1)	Imported Coal	660	627	GENCO	PC-1 Approved	Dec-22
7	Thal Nova	Local Coal	330	300	PPIB	LOS (Issued)	Dec-22
8	Thar-I (SSRL)	Local Coal	1,320	1,214	PPIB	LOS (Issued)	Dec-22
9	Jagran-II (U #1)	Hydro	12	12	AJK-HEB	PC-1 Approved	Apr-23
10	Helios	Solar	50	50	AEDB	Category-II Project	Apr-23
11	HNDS	Solar	50	50	AEDB	Category-II Project	Apr-23
12	Meridian	Solar	50	50	AEDB	Category-II Project	Apr-23
13	Mangla (U #3-4)	Hydro	70	70	WAPDA	Mangla Refurbishment	May-23
14	Jagran-II (U #2)	Hydro	12	12	AJK-HEB	PC-1 Approved	May-23
Generation Additions in 2022-23 (MW)		4,738	4,519				
Cumulative Addition up till 2023 (MW)		4,738	4,519				
2023-24							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-23
2	New_Solar_DG	Solar	500	500	Yet to be determined	Optimized	Jul-23
3	Jagran-II (U #3-4)	Hydro	24	24	AJK-HEB	PC-1 Approved	Jul-23
4	Siachen	Solar	100	100	GoS	Category-II Project	Sep-23
5	Manjhand	Solar	50	50	GoS	PC-1 Approved	Sep-23
6	Zorlu	Solar	100	100	PPDB	Category-II Project	Dec-23

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
7	Lawi	Hydro	69	69	GoKPK	PC-1 Approved	Apr-24
8	Suki Kinari (U #1)	Hydro	221	221	PPIB	LOS (Issued)	May-24
9	Trans_Atlantic	Wind	50	50	AEDB	Category-II Project	Jun-24
10	Western	Wind	50	50	AEDB	Category-II Project	Jun-24
Generation Additions in 2023-24 (MW)		1,644	1,644				
Cumulative Addition up till 2024 (MW)		6,382	6,163				
2024-25							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-24
2	Mangla (U #1-2)	Hydro	70	70	WAPDA	Mangla Refurbishment	Jul-24
3	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-24
4	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-24
5	New_Solar_DG	Solar	750	750	Yet to be determined	Optimized	Jul-24
6	New_Solar_Utility	Solar	3,120	3,120	Yet to be determined	Optimized	Jul-24
7	New_Wind	Wind	500	500	Yet to be determined	Optimized	Jul-24
8	Gorkin Matiltan	Hydro	84	84	GoKPK	PC-1 Approved	Jul-24
9	Tarbela Ext5 (U #1)	Hydro	510	510	WAPDA	PC-1 Approved	Jul-24
10	Suki Kinari (U #2)	Hydro	221	221	PPIB	LOS (Issued)	Jul-24
11	CASA	Cross Border Interconnection	1,000	1,000	NTDC	G2G	Aug-24
12	Tarbela Ext5 (U #2)	Hydro	510	510	WAPDA	PC-1 Approved	Aug-24
13	Shahtaj	Bagasse	32	32	AEDB	Category-I Project	Aug-24
14	Tarbela Ext5 (U #3)	Hydro	510	510	WAPDA	PC-1 Approved	Sep-24
15	Suki Kinari (U #3)	Hydro	221	221	PPIB	LOS (Issued)	Sep-24
16	Suki Kinari (U #4)	Hydro	221	221	PPIB	LOS (Issued)	Nov-24
Generation Additions in 2024-25 (MW)		8,429	8,429				
Cumulative Addition up till 2025 (MW)		14,811	14,592				
2025-26							

Annexure-F. Chashma Nuclear (C-5) as Committed project in 2029

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-25
2	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-25
3	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-25
4	New_Solar_DG	Solar	750	750	Yet to be determined	Optimized	Jul-25
5	New_Solar_Utility	Solar	1,300	1,300	Yet to be determined	Optimized	Jul-25
6	New_Wind	Wind	500	500	Yet to be determined	Optimized	Jul-25
7	Gwadar	Local Coal	300	273	PPIB	LOS (Issued)	Aug-25
8	Mangla (U #9-10)	Hydro	70	70	WAPDA	Mangla Refurbishment	Sep-25
9	Dasu (U #1)	Hydro	360	360	WAPDA	PC-1 Approved	May-26
10	Mohmand Dam (U #1)	Hydro	200	200	WAPDA	PC-1 Approved	May-26
Generation Additions in 2025-26 (MW)			4,160	4,133			
Cumulative Addition up till 2026 (MW)			18,971	18,725			
2026-27							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-26
2	KE_New_Local Coal	Local Coal	990	912	Yet to be determined	Optimized	Jul-26
3	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-26
4	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-26
5	New_Solar_Utility	Solar	99	99	Yet to be determined	Optimized	Jul-26
6	Dasu (U #2)	Hydro	360	360	WAPDA	PC-1 Approved	Jul-26
7	Mohmand Dam (U #2)	Hydro	200	200	WAPDA	PC-1 Approved	Jul-26
8	Dasu (U #3)	Hydro	360	360	WAPDA	PC-1 Approved	Aug-26
9	Mohmand Dam (U #3)	Hydro	200	200	WAPDA	PC-1 Approved	Sep-26
10	Mangla (U #7-8)	Hydro	30	30	WAPDA	Mangla Refurbishment	Nov-26
11	Dasu (U #4)	Hydro	360	360	WAPDA	PC-1 Approved	Nov-26
12	Mohmand Dam (U #4)	Hydro	200	200	WAPDA	PC-1 Approved	Nov-26
13	Dasu (U #5)	Hydro	360	360	WAPDA	PC-1 Approved	Feb-27

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
14	Keyal Khwar (U #1)	Hydro	64	64	WAPDA	PC-1 Approved	Feb-27
15	Dasu (U #6)	Hydro	360	360	WAPDA	PC-1 Approved	May-27
16	Keyal Khwar (U #2)	Hydro	64	64	WAPDA	PC-1 Approved	May-27
Generation Additions in 2026-27 (MW)			4,327	4,249			
Cumulative Addition up till 2027 (MW)			23,298	22,974			
2027-28							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-27
2	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-27
3	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-27
4	New_Wind	Wind	3,756	3,756	Yet to be determined	Optimized	Jul-27
5	Gabral Kalam	Hydro	88	88	GoKPK	PC-1 Approved	Nov-27
6	Madyan	Hydro	157	157	GoKPK	PC-1 Approved	Nov-27
7	Balakot	Hydro	300	300	GoKPK	PC-1 Approved	Dec-27
Generation Additions in 2027-28 (MW)			4,981	4,981			
Cumulative Addition up till 2028 (MW)			28,279	27,955			
2028-29							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-28
2	Bata Kundii	Hydro	99	99	GoKPK	Optimized	Jul-28
3	C-5	Nuclear	1200	60	PAEC	Committed with Cost	Jul-28
4	CJ	Hydro	25	25	PPDB	Optimized	Jul-28
5	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-28
6	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-28
7	Nila Da Katha	Hydro	31.3	31.3	PEDO	Optimized	Jul-28
8	Taunsa	Hydro	135	135	PPDB	Optimized	Jul-28
9	Azad Pattan (U #1)	Hydro	175	175	PPIB	LOS (Issued)	Dec-28
10	Azad Pattan (U #2)	Hydro	175	175	PPIB	LOS (Issued)	Mar-29

Annexure-F. Chashma Nuclear (C-5) as Committed project in 2029

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
11	Azad Pattan (U #3)	Hydro	175	175	PPIB	LOS (Issued)	Jun-29
Generation Additions in 2028-29 (MW)			2,696	1,556			
Cumulative Addition up till 2029 (MW)			30,975	29,511			
2029-30							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-29
2	Arkari Gol	Hydro	99	99	PEDO	Optimized	Jul-29
3	Asrit Kedam	Hydro	215	215	PEDO	Optimized	Jul-29
4	Dowarian	Hydro	40	40	AJK-HEB	Optimized	Jul-29
5	Jagran-IV	Hydro	22	22	AJK-HEB	Optimized	Jul-29
6	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-29
7	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-29
8	Nagdar	Hydro	35	35	AJK-HEB	Optimized	Jul-29
9	Rajdhani	Hydro	132	132	PPIB	Optimized	Jul-29
10	Sharmai	Hydro	152.12	152.12	PEDO	Optimized	Jul-29
11	Shounter	Hydro	48	48	AJK-HEB	Optimized	Jul-29
12	Turtonas Uzghor	Hydro	82.25	82.25	KE	Optimized	Jul-29
13	Azad Pattan (U #4)	Hydro	175	175	PPIB	LOS (Issued)	Sep-29
14	Kohala (U #1)	Hydro	275	275	PPIB	LOS (Issued)	Jun-30
Generation Additions in 2029-30 (MW)			1,956	1,956			
Cumulative Addition up till 2030 (MW)			32,930	31,466			
2030-31							
1	Mahl	Hydro	640	640	PPIB	Optimized	Jul-30
2	Thakot-III	Hydro	1,490	1,490	WAPDA	Optimized	Jul-30
3	Net Meter	Solar	480	480	AEDB	Committed	Jul-30
4	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-30
5	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-30

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
6	Kohala (U #2)	Hydro	275	275	PPIB	LOS (Issued)	Aug-30
7	Kohala (U #3)	Hydro	275	275	PPIB	LOS (Issued)	Oct-30
8	Kohala (U #4)	Hydro	275	275	PPIB	LOS (Issued)	Dec-30
9	Kohala (U #5)	Hydro	12	12	PPIB	LOS (Issued)	Feb-31
10	Kohala (U #6)	Hydro	12	12	PPIB	LOS (Issued)	Mar-31
Generation Additions in 2030-31 (MW)			3,659	3,659			
Cumulative Addition up till 2031 (MW)			36,589	35,125			

F-5. Annual Capacity Factors (%age)

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
1	Almoiz	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
2	Chanar	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
3	Chiniot	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
4	Fatima	Bagasse	6.53	6.55	6.53	6.48	6.38	6.25	6.18	5.93	5.88
5	Hamza	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
6	JDW-II	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
7	JDW-III	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
8	Ryk_Mills	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
9	Shahtaj	Bagasse	0.00	0.00	45.77	45.62	45.62	45.77	45.62	45.62	45.62
10	Thal_Layyah	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
11	Appolo	PV	18.96	18.91	18.96	18.96	18.96	18.91	18.96	18.96	18.96
12	Best	PV	18.94	18.89	18.94	18.94	18.94	18.89	18.94	18.94	18.94
13	Crest	PV	19.19	19.13	19.19	19.19	19.19	19.13	19.19	19.19	19.19
14	Helios	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
15	HNDS	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
16	Manjhand	PV	0.00	23.23	23.33	23.33	23.33	23.27	23.33	23.33	23.33
17	Meridian	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
18	Net_Meter	PV	17.08	17.03	17.08	17.08	17.08	17.03	17.08	17.08	17.08
19	New_Solar	PV	0.00	0.00	22.08	22.08	22.08	22.02	22.08	22.08	22.08
20	New_Solar_Feeder	PV	0.00	19.95	20.00	20.00	20.00	19.95	20.00	20.00	20.00
21	QA_Solar	PV	19.04	18.99	19.04	19.04	19.04	18.99	19.04	19.04	19.04
22	Siachen	PV	0.00	23.23	23.33	23.33	23.33	23.27	23.33	23.33	23.33
23	Zhenfa	PV	21.50	21.44	21.50	21.50	21.50	21.44	21.50	21.50	21.50
24	Zorlu	PV	0.00	20.86	20.17	20.17	20.17	20.11	20.17	20.17	20.17
25	Gharo	KE_PV	25.25	25.18	25.25	25.25	25.25	25.18	25.25	25.25	25.25
26	KE_New_Solar	KE_PV	0.00	0.00	22.08	22.08	22.08	22.02	22.08	22.08	22.08
27	Oursun	KE_PV	20.97	20.91	20.97	20.97	20.97	20.91	20.97	20.97	20.97
28	Act	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
29	Act_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
30	Artistic_wind	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
31	Artistic_Wind_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
32	Dawood	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
33	Din	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
34	FFC	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
35	FWEL-I	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
36	FWEL-II	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
37	Gul Ahmed	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
38	Gul_Electric	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
39	Hawa	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
40	Indus_Energy	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
41	Jhimpir	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% 								
42	Lakeside	Wind	38.93	38.07	38.17	38.17	38.17	38.07	38.17	38.17	38.17
43	Liberty_Wind_1	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
44	Liberty_Wind_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
45	Master	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
46	Master_Green	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
47	Metro_Power	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
48	Metro_Wind	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
49	NASDA	Wind	38.93	38.07	38.17	38.17	38.17	38.07	38.17	38.17	38.17
50	New_Wind	Wind	0.00	0.00	41.28	41.28	41.28	41.17	41.28	41.28	41.28
51	Sachal	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
52	Sapphire_Wind	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
53	Tenaga	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
54	Three_Gorges_I	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
55	Three_Gorges_II	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
56	Three_Gorges_III	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
57	Trans_Atlantic	Wind	0.00	41.17	41.28	41.28	41.28	41.17	41.28	41.28	41.28
58	Tricom	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
59	Tricon_A	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
60	Tricon_B	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
61	Tricon_C	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
62	UEP	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
63	Western	Wind	0.00	37.19	37.19	37.19	37.19	37.09	37.19	37.19	37.19
64	Yunus	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
65	Zephyr	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
66	Zorlu_Wind	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
67	KE_New_Wind	KE_Wind	0.00	0.00	41.28	41.28	41.28	41.17	41.28	41.28	41.28
68	CASA	Interconnection	0.00	0.00	41.80	41.92	41.92	41.80	41.92	41.92	41.92
69	Arkari Gol	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.22	42.22
70	Asrit Kedam	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.72	49.72
71	Bata Kundu	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	54.76	54.76	54.79
72	CJ	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	50.50	50.50	50.50
73	Dowarian	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.85	48.85
74	Jagran-IV	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.09	49.09
75	Mahl	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.53
76	Nagdar	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.87	48.87
77	Nila Da Katha	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	51.31	51.31	51.31
78	Rajdhani	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.46	58.46
79	Sharmai	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.94	50.94
80	Shounteer	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.86	48.86
81	Taunsa	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	55.02	55.02	55.02
82	Thakot-III	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.29
83	Turtonas Uzghor	KE_HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	51.85	51.90	

Annexure-F. Chashma Nuclear (C-5) as Committed project in 2029

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% 								
84	Azad Pattan	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	52.77	54.06	52.77
85	Balakot	HPP Committed	0.00	0.00	0.00	0.00	0.00	41.21	41.21	41.21	41.21
86	Dasu	HPP Committed	0.00	0.00	0.00	64.47	69.96	64.29	64.47	64.47	64.47
87	Diamer Bhasha	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
88	Gabral Kalam	HPP Committed	0.00	0.00	0.00	0.00	0.00	33.77	33.77	33.77	33.77
89	Gorkin Matiltan	HPP Committed	0.00	0.00	42.83	42.83	42.83	42.71	42.83	42.83	42.83
90	Jagran-II	HPP Committed	50.53	50.39	50.53	50.53	50.53	50.39	50.53	50.53	50.53
91	Karot	HPP Committed	44.39	44.29	44.39	44.39	44.39	44.29	44.38	44.38	44.38
92	Keyal Khwar	HPP Committed	0.00	0.00	0.00	0.00	52.07	51.92	52.07	52.07	52.07
93	Kohala	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.14	56.14
94	Koto	HPP Committed	57.12	57.08	57.24	57.19	57.19	56.96	57.12	57.12	57.15
95	Lawi	HPP Committed	0.00	47.90	48.10	48.05	48.05	47.90	47.99	47.99	48.05
96	Madyan	HPP Committed	0.00	0.00	0.00	0.00	0.00	47.43	47.43	47.43	47.43
97	Mohmand Dam	HPP Committed	0.00	0.00	0.00	42.60	46.36	42.60	42.71	42.71	42.71
98	Suki Kinari	HPP Committed	0.00	48.93	48.93	49.07	49.07	48.93	49.07	49.07	49.07
99	Tarbela_Ext_5	HPP Committed	0.00	0.00	10.02	10.05	10.05	10.02	10.05	10.05	10.05
100	Allai Khwar	HPP Existing	44.32	44.20	44.32	44.32	44.32	44.20	44.32	44.32	44.32
101	Chashma	HPP Existing	48.58	48.45	48.58	48.58	48.58	48.45	48.58	48.58	48.58
102	Daral Khwar	HPP Existing	38.58	38.48	38.58	38.58	38.58	38.48	38.58	38.58	38.58
103	Dubair Khwar	HPP Existing	53.09	52.95	53.09	53.09	53.09	52.95	53.09	53.09	53.09
104	Ghazi Brotha	HPP Existing	52.78	52.63	52.78	52.78	52.78	52.63	52.78	52.78	52.78
105	Golen Gol	HPP Existing	9.15	9.12	9.15	9.15	9.15	9.12	9.15	9.15	9.15
106	Gulpur	HPP Existing	28.92	28.84	28.92	28.92	28.92	28.84	28.92	28.92	28.92
107	Jagran-I	HPP Existing	48.95	48.82	48.95	48.95	48.95	48.82	48.95	48.95	48.95
108	Jinnah	HPP Existing	25.74	25.67	25.74	25.74	25.74	25.67	25.74	25.74	25.74
109	Khan Khwar	HPP Existing	40.22	40.11	40.22	40.22	40.22	40.11	40.22	40.22	40.22
110	Malakand-III	HPP Existing	53.86	53.71	53.86	53.86	53.86	53.71	53.86	53.86	53.86
111	Mangla	HPP Existing	64.98	60.97	58.32	56.00	54.77	54.20	54.35	54.35	54.35
112	Neelum Jehlum	HPP Existing	51.65	51.54	51.69	51.69	51.69	51.54	51.69	51.69	51.69
113	New Bong	HPP Existing	55.49	55.34	55.49	55.49	55.49	55.34	55.49	55.49	55.49
114	Patrind	HPP Existing	43.76	43.64	43.76	43.76	43.76	43.64	43.76	43.76	43.76
115	Small Hydel	HPP Existing	45.00	44.90	45.02	45.02	45.02	44.90	45.02	45.02	45.02
116	Tarbela 1-14	HPP Existing	37.99	37.89	37.99	37.99	37.99	37.89	37.99	37.99	37.99
117	Tarbela_Ext_4	HPP Existing	30.12	30.04	30.12	30.12	30.12	30.04	30.12	30.12	30.12
118	Warsak	HPP Existing	50.64	50.50	50.64	50.64	50.64	50.50	50.64	50.64	50.64
119	Engro 90MW	CCGT_Gas	90.23	74.96	62.46	50.73	70.05	36.03	29.65	27.98	24.08
120	Foundation	CCGT_Gas	89.97	90.25	90.00	89.66	82.64	57.94	57.94	57.94	57.94
121	Guddu-I	CCGT_Gas	36.90	74.63	74.43	74.42	70.82	27.73	15.91	18.39	16.57
122	Guddu-II	CCGT_Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
123	Guddu-V (747)	CCGT_Gas	75.56	75.77	75.56	75.53	74.68	72.31	22.29	53.03	30.90
124	Liberty	CCGT_Gas	75.26	75.02	45.55	46.09	0.00	0.00	0.00	0.00	0.00
125	Uch	CCGT_Gas	86.08	86.32	86.08	85.39	80.31	43.54	42.49	43.47	0.00
126	Uch-II	CCGT_Gas	87.77	88.05	87.81	87.17	80.36	51.33	51.33	51.31	51.32

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% 								
127	SNPC-I	KE_CCGT_Gas	91.98	92.25	91.96	91.34	84.39	34.13	33.12	32.08	33.02
128	SNPC-II	KE_CCGT_Gas	91.98	92.25	91.96	91.42	84.39	35.73	34.37	33.30	34.79
129	AES Lalpir	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
130	AES Pakgen	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
131	HUBCO	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
132	Jamshoro-I U1	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
133	Jamshoro-II U4	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
134	Muzaffargarh-I U1	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
135	Muzaffargarh-I U2	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
136	Muzaffargarh-I U3	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
137	Muzaffargarh-II U4	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
138	Saba	ST_RFO	14.38	21.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00
139	AGL	DG_RFO	36.12	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00
140	Atlas	DG_RFO	14.40	21.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
141	Engro 127MW	DG_RFO	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
142	Hub N	DG_RFO	36.12	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00
143	Kohinoor	DG_RFO	14.39	21.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
144	Liberty Tech	DG_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
145	Nishat C	DG_RFO	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
146	Nishat P	DG_RFO	36.81	22.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
147	C-1	Nuclear	80.43	80.65	80.43	80.43	80.43	80.65	80.43	80.43	80.43
148	C-2	Nuclear	79.61	79.83	79.61	79.61	79.61	79.83	79.61	79.61	79.61
149	C-3	Nuclear	81.01	81.23	81.01	81.01	81.01	81.23	81.01	81.01	81.01
150	C-4	Nuclear	81.01	81.23	81.01	81.01	81.01	81.23	81.01	81.01	81.01
151	C-5	Nuclear	0.00	0.00	0.00	0.00	0.00	0.00	89.02	89.16	89.19
152	K-2	Nuclear	85.06	85.30	85.07	85.06	85.06	85.29	85.05	85.05	85.05
153	K-3	Nuclear	85.66	85.90	85.67	85.66	85.66	85.89	85.65	85.65	85.65
154	Engro Thar	Local Coal	82.51	82.74	82.51	82.50	82.48	80.66	79.51	77.00	76.04
155	Gwadar	Local Coal	0.00	0.00	0.00	69.18	83.04	80.92	78.68	76.92	76.52
156	Lucky	Local Coal	85.08	85.31	85.08	85.07	85.07	85.09	84.49	84.71	84.91
157	Thal Nova	Local Coal	49.35	85.21	84.98	84.97	84.97	83.64	82.57	82.49	79.37
158	Thar TEL	Local Coal	84.98	85.21	84.98	84.97	84.97	83.84	82.34	82.71	79.82
159	Thar-I (SSRL)	Local Coal	42.14	85.21	84.98	84.98	84.98	84.34	83.71	84.02	82.88
160	K.E_NEW_L.Coal	KE_Local Coal	0.00	0.00	0.00	0.00	83.33	83.06	82.54	82.74	82.60
161	China HUBCO	Imported Coal	51.57	51.57	51.57	51.57	51.57	51.57	51.57	51.57	51.57
162	Jamshoro Coal	Imported Coal	49.36	83.95	83.64	79.90	44.10	15.03	12.21	16.55	13.24
163	Port Qasim	Imported Coal	48.72	48.72	48.72	48.72	48.72	48.72	48.72	48.72	48.72
164	Sahiwal Coal	Imported Coal	48.02	48.02	48.02	48.02	48.02	48.01	48.01	48.01	48.01
165	FPCL	KE_Imported Coal	82.15	77.19	18.20	18.75	15.44	9.88	8.50	11.24	10.34
166	Davis	DG_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
167	Balloki	CCGT_RLNG	4.23	1.98	1.03	1.92	2.23	0.60	0.48	0.75	0.72
168	Bhikki	CCGT_RLNG	1.21	0.77	0.02	0.60	0.65	0.29	0.26	0.29	0.29
169	FKPCL	CCGT_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Annexure-F. Chashma Nuclear (C-5) as Committed project in 2029

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% 								
170	Halmore	CCGT_RLNG	37.73	37.73	37.73	22.68	0.30	0.00	0.00	0.24	0.30
171	Haveli	CCGT_RLNG	11.09	5.89	3.48	5.34	4.38	1.58	1.40	1.39	1.15
172	KAPCO 1	CCGT_RLNG	35.31	35.38	35.25	0.00	0.00	0.00	0.00	0.00	0.00
173	KAPCO 2	CCGT_RLNG	11.86	11.83	11.89	0.00	0.00	0.00	0.00	0.00	0.00
174	KAPCO 3	CCGT_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
175	Nandipur	CCGT_RLNG	36.38	36.38	36.38	21.87	0.00	0.00	0.00	0.00	0.00
176	Orient	CCGT_RLNG	37.73	23.21	0.00	0.00	0.30	0.00	0.00	0.30	0.30
177	Rousch	CCGT_RLNG	0.23	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
178	Saif	CCGT_RLNG	37.73	37.73	37.73	22.68	0.00	0.00	0.00	0.00	0.00
179	Saphire	CCGT_RLNG	37.73	37.73	37.73	22.68	0.27	0.00	0.00	0.00	0.01
180	Trimmu	CCGT_RLNG	26.53	21.00	12.36	11.90	8.86	2.73	2.29	3.08	3.64
181	BQPS2	KE_CCGT_RLNG	85.24	83.52	29.84	25.80	18.82	8.60	7.17	8.66	9.53
182	BQPS3	KE_CCGT_RLNG	89.85	89.80	78.82	82.62	31.10	18.41	16.11	18.54	18.69
183	KCPP	KE_CCGT_RLNG	85.17	82.46	22.16	18.43	12.14	6.32	4.80	6.64	8.90
184	KTGTPS	KE_CCGT_RLNG	45.16	40.58	8.61	10.11	7.44	2.59	2.79	2.54	3.09
185	SGTPS	KE_CCGT_RLNG	48.00	44.44	9.21	11.12	8.05	2.85	2.85	2.84	3.33
186	BQPS1-U1	KE_ST_RLNG	10.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
187	BQPS1-U5	KE_ST_RLNG	29.34	30.27	1.66	1.71	0.46	0.59	0.72	1.05	1.39
188	BQPS1-U6	KE_ST_RLNG	16.15	15.84	1.43	1.54	0.30	0.01	0.30	0.75	0.96
189	BQPS1-U2	KE_GT_RLNG	22.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(All numbers in yellow color, in this table, represent retirement of the corresponding project.)

F-6. Year-wise Installed Capacity Addition (MW)

FY	Local Coal	Hydro	RLNG	Nuclear	Imported Coal	RE	Local Gas	Furnace Oil	Cross Border	Net Yearly Addition	Cumulative Total
2022	1,320	10,593	9,789	3,620	4,020	2,802	2,744	3,633	-	-	38,521
2023	1,980	205	1,263	-	660	630	-	-	-	4,738	43,259
2024	-	314	-420	-	-	1,330	-	-	-	1,224	44,483
2025	-	2,347	-	-	-	5,082	-	-	1,000	8,429	52,912
2026	300	630	-1,300	-	-	3,230	-	-	-	2,860	55,772
2027	990	2,558	-	-	-	779	-225	-1,292	-	2,810	58,582
2028	-	545	-	-	-	4,436	-	-131	-	4,850	63,432
2029	-	816	-	1,200	-	680	-	-727	-	1,969	65,400
2030	-	1,276	-172	-	-	680	-	-136	-	1,648	67,048
2031	-	2,979	-450	-	-	680	-586	-	-	2,623	69,671
Total	4,590	22,262	8,710	4,820	4,680	20,329	1,933	1,347	1,000	31,151	69,671

F-7. IGCEP Generation Mix 2023-2031 (GWh)

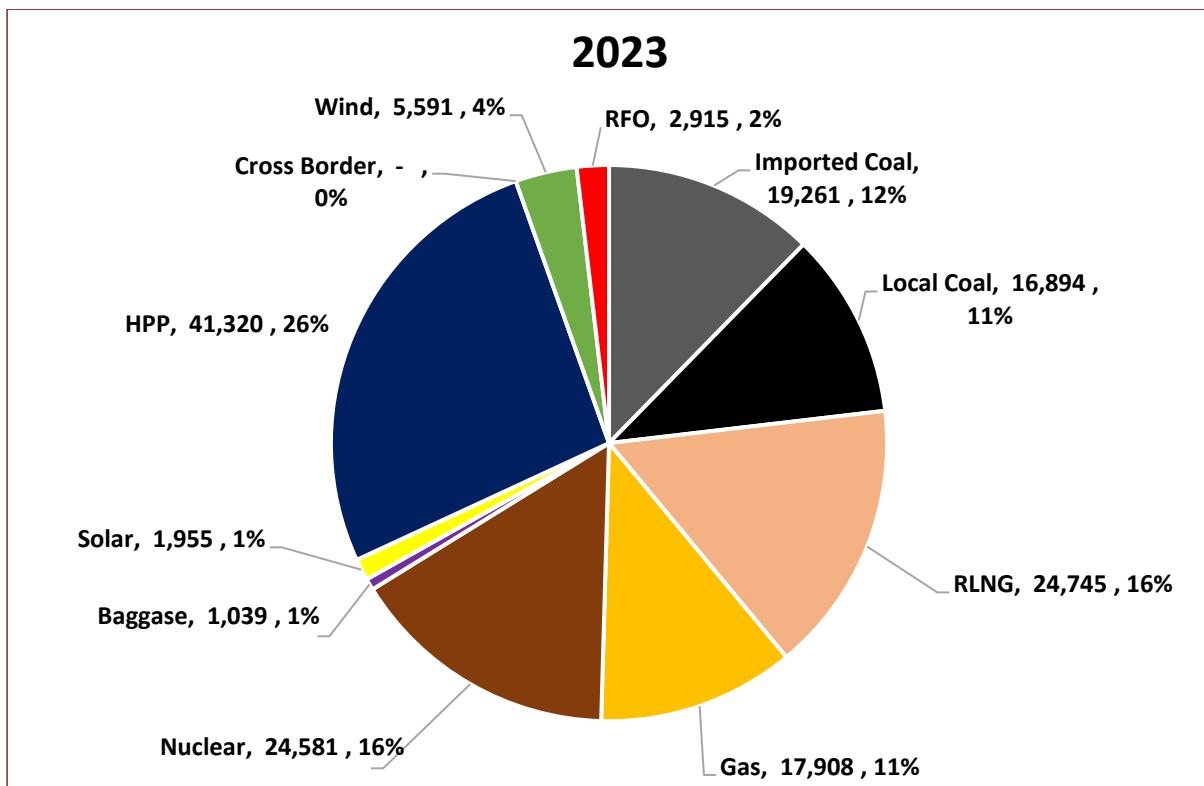


Chart F-1: IGCEP Generation Mix 2023 (GWh)

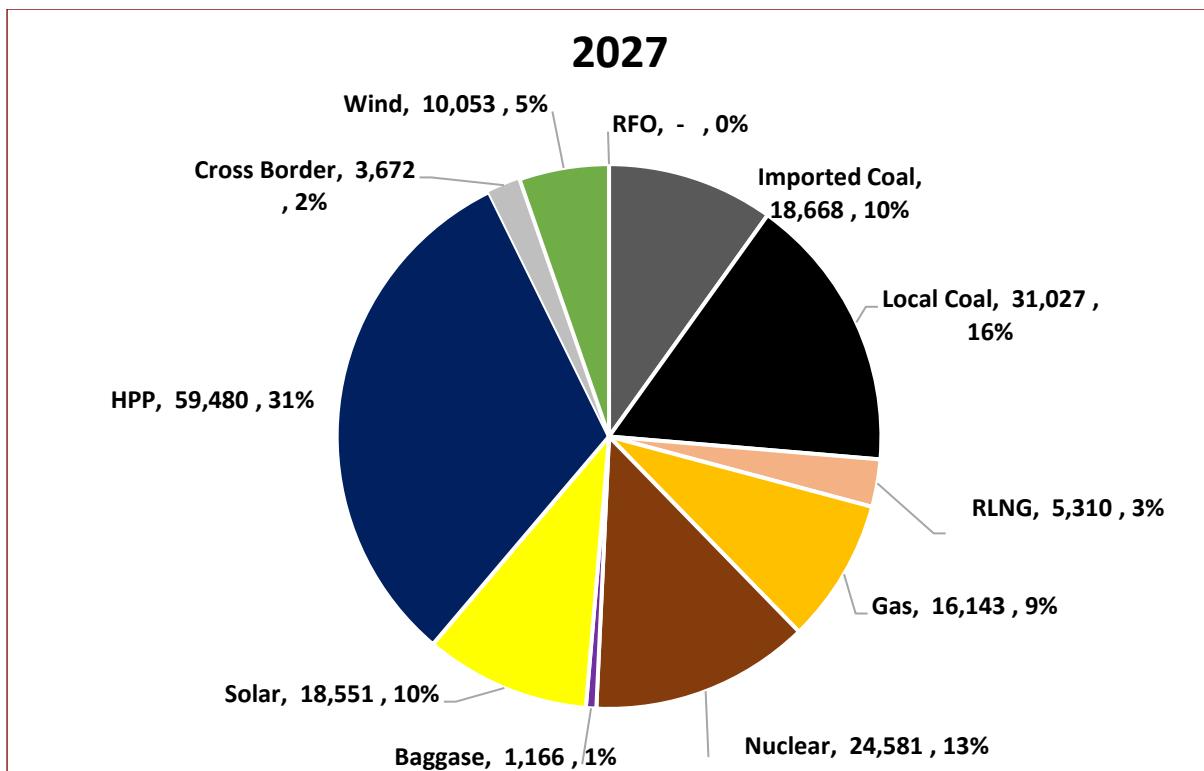


Chart F-2: IGCEP Generation Mix 2027 (GWh)

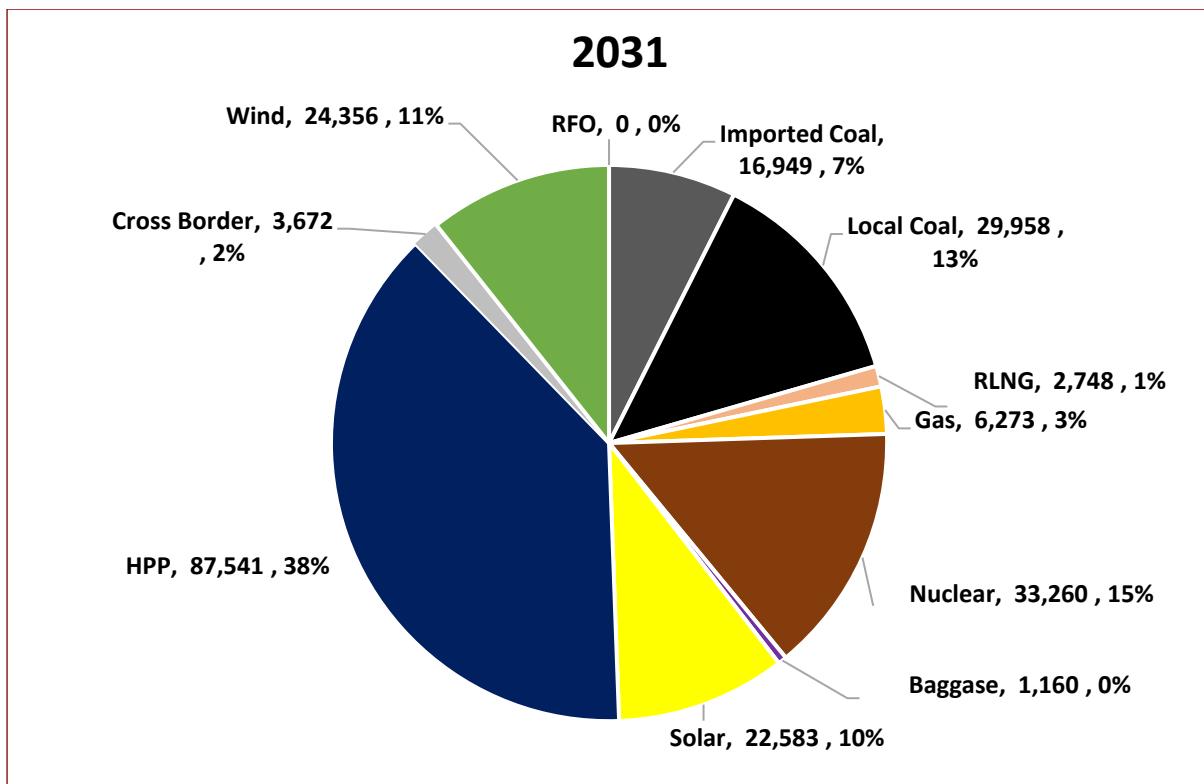


Chart F-3: IGCEP Generation Mix 2031 (GWh)

F-8. IGCEP Generation Mix 2023-31 (MW)

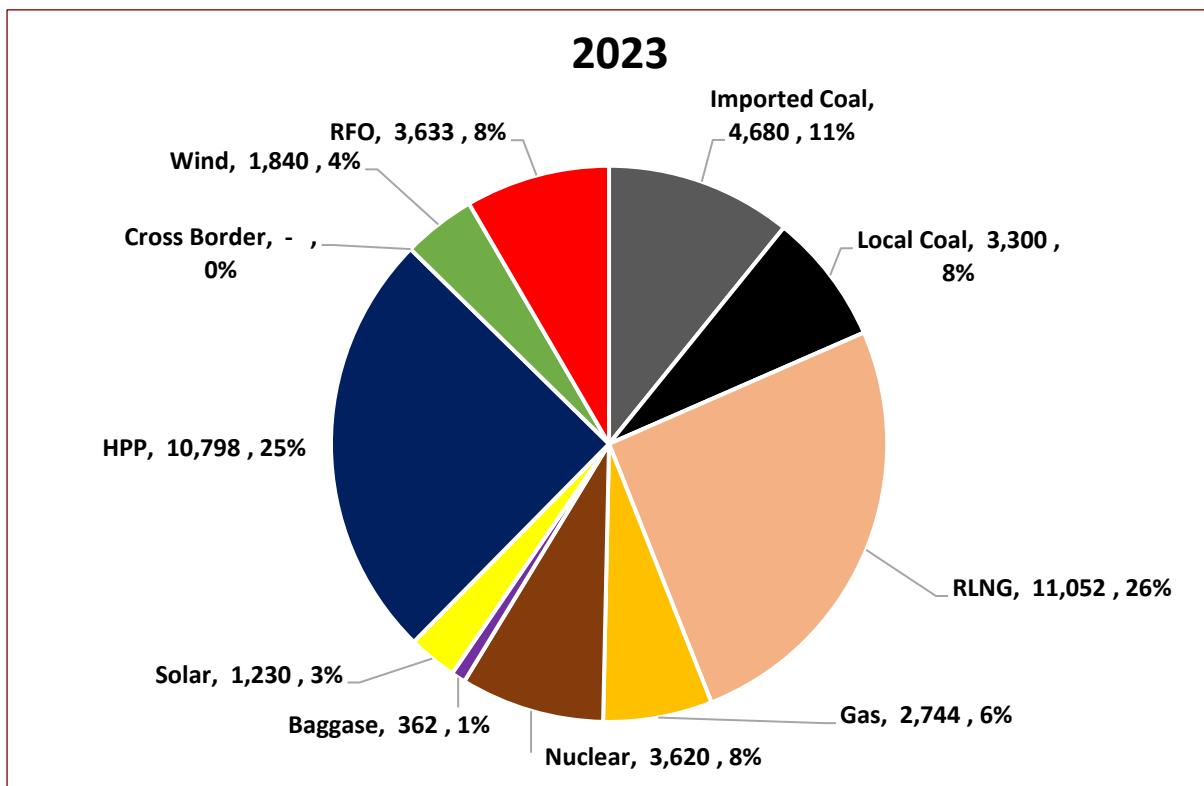


Chart F-4: IGCEP Generation Mix 2023 (MW)

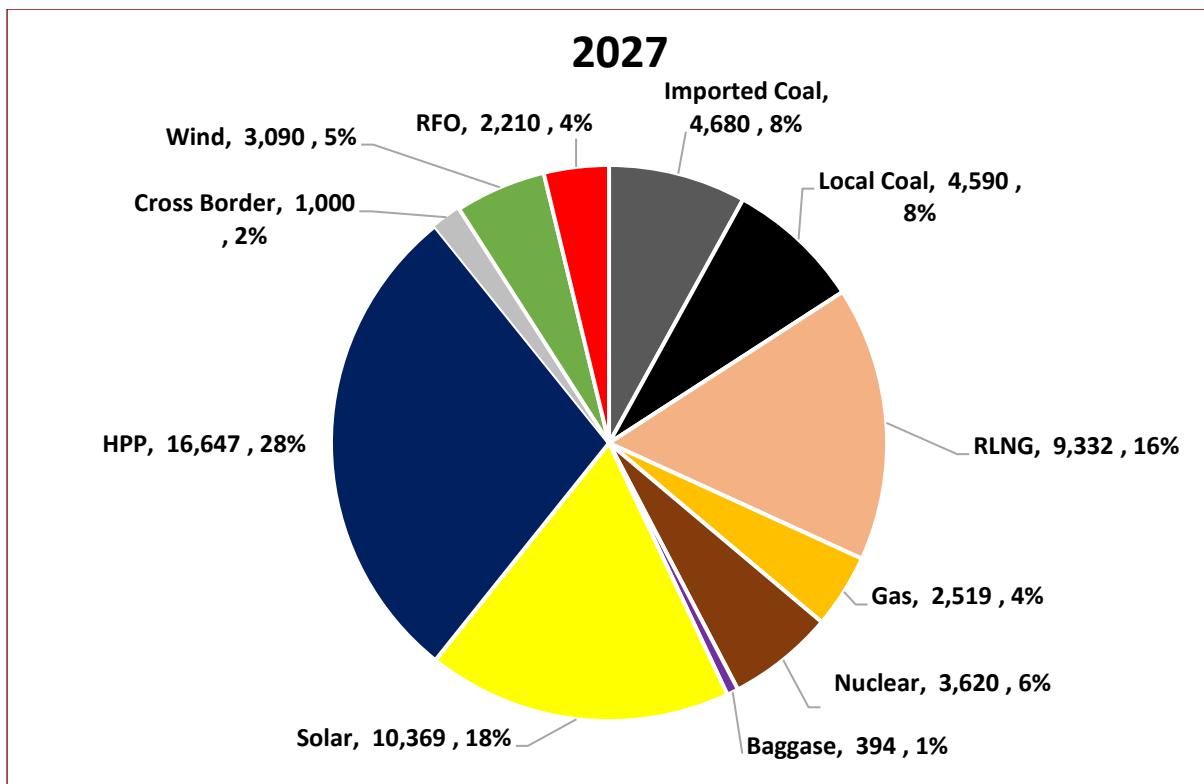


Chart F-5: IGCEP Generation Mix 2027 (MW)

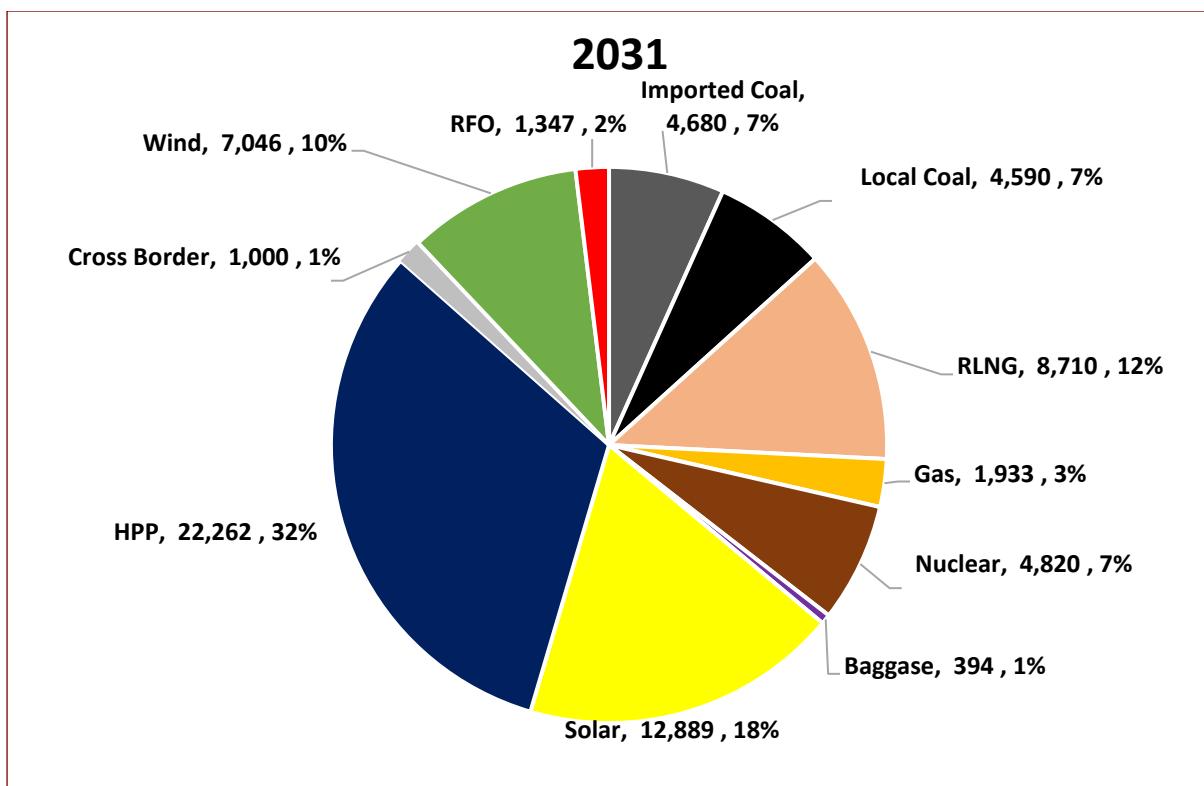
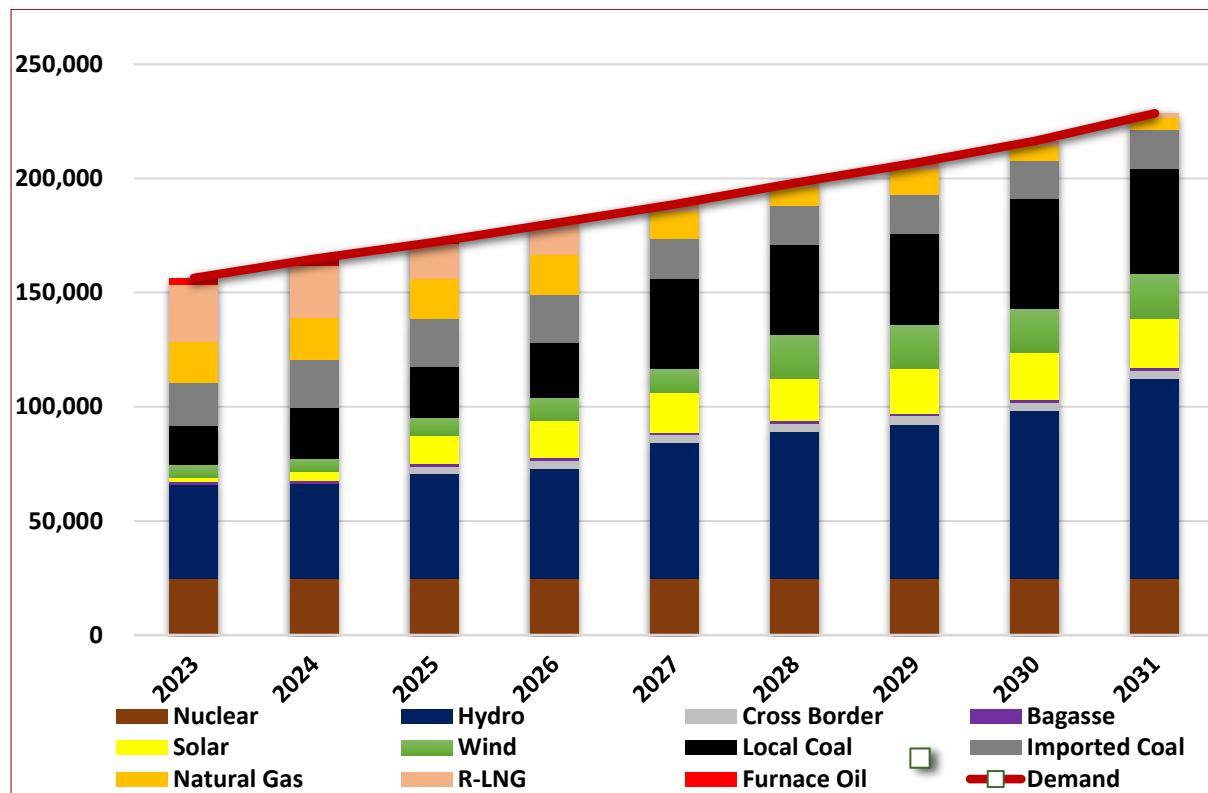


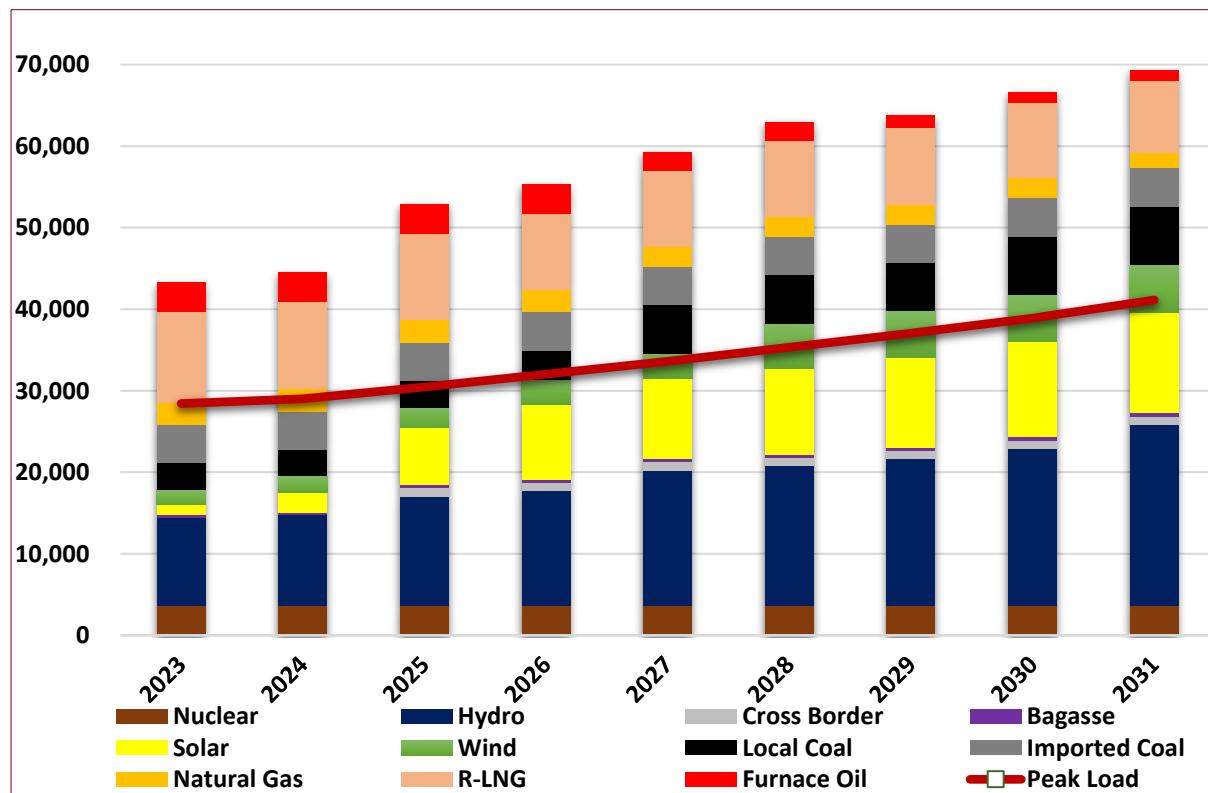
Chart F-6: IGCEP Generation Mix 2031 (MW)

Annexure G. Local Coal inclusion in 2027 and 2030

G-1. Annual Energy Generation Vs Annual Energy Demand (GWh) - Country



G-2. Installed Capacity Vs Peak Demand (MW) - Country



G-3. Optimized Generation Capacity Additions (MW)

Fiscal Year	Coal Fired Steam Local Coal	Coal Fired Steam Local Coal KE	HPP	HPP KE	Solar Utility MW _p	Solar Feeder MW _p	Solar KE MW _p	Wind NTDC	Wind KE	Bagasse	Per Year Capacity Addition	Cumulative Capacity Addition
2024	-	-	-	-	-	500	-	-	-	-	500	500
2025	-	-	-	-	3,120	750	150	500	50	-	4,570	5,070
2026	-	-	-	-	1,300	327	150	500	50	-	2,327	7,397
2027	1,320	990	-	-	-	-	150	-	50	-	2,510	9,907
2028	-	-	-	-	-	-	150	2,461	50	-	2,661	12,568
2029	-	-	290	-	-	-	150	-	50	-	490	13,058
2030	1,320	-	743	82	-	-	150	-	50	-	2,345	15,404
2031	-	-	2,130	-	-	-	150	-	50	-	2,330	17,734
Total	2,640	990	3,163	82	4,420	1,577	1,050	3,461	350	-	17,734	

G-4. List of Projects upto 2031 (Committed + Optimized)

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2022-23							
1	Thar TEL	Local Coal	330	300	PPIB	LOS (Issued)	Commissioned
2	Net Meter	Solar	480	480	AEDB	Committed	Dec-22
3	Trimmu	CCGT_RLNG	1,263	1,243	PPIB	LOS (Issued)	Dec-22
4	Mangla (U #5-6)	Hydro	70	70	WAPDA	Mangla Refurbishment	Dec-22
5	Koto	Hydro	40.8	40.8	GoKPK	PC-1 Approved	Dec-22
6	Jamshoro Coal (U #1)	Imported Coal	660	627	GENCO	PC-1 Approved	Dec-22
7	Thal Nova	Local Coal	330	300	PPIB	LOS (Issued)	Dec-22
8	Thar-I (SSRL)	Local Coal	1,320	1,214	PPIB	LOS (Issued)	Dec-22
9	Jagran-II (U #1)	Hydro	12	12	AJK-HEB	PC-1 Approved	Apr-23
10	Helios	Solar	50	50	AEDB	Category-II Project	Apr-23
11	HNDS	Solar	50	50	AEDB	Category-II Project	Apr-23
12	Meridian	Solar	50	50	AEDB	Category-II Project	Apr-23
13	Mangla (U #3-4)	Hydro	70	70	WAPDA	Mangla Refurbishment	May-23
14	Jagran-II (U #2)	Hydro	12	12	AJK-HEB	PC-1 Approved	May-23
Generation Additions in 2022-23 (MW)			4,738	4,519			
Cumulative Addition up till 2023 (MW)			4,738	4,519			
2023-24							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-23
2	New_Solar_DG	Solar	500	500	Yet to be determined	Optimized	Jul-23
3	Jagran-II (U #3-4)	Hydro	24	24	AJK-HEB	PC-1 Approved	Jul-23
4	Siachen	Solar	100	100	GoS	Category-II Project	Sep-23
5	Manjhand	Solar	50	50	GoS	PC-1 Approved	Sep-23
6	Zorlu	Solar	100	100	PPDB	Category-II Project	Dec-23

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
7	Lawi	Hydro	69	69	GoKPK	PC-1 Approved	Apr-24
8	Suki Kinari (U #1)	Hydro	221	221	PPIB	LOS (Issued)	May-24
9	Trans_Atlantic	Wind	50	50	AEDB	Category-II Project	Jun-24
10	Western	Wind	50	50	AEDB	Category-II Project	Jun-24
Generation Additions in 2023-24 (MW)			1,644	1,644			
Cumulative Addition up till 2024 (MW)			6,382	6,163			
2024-25							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-24
2	Mangla (U #1-2)	Hydro	70	70	WAPDA	Mangla Refurbishment	Jul-24
3	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-24
4	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-24
5	New_Solar_DG	Solar	750	750	Yet to be determined	Optimized	Jul-24
6	New_Solar_Utility	Solar	3,120	3,120	Yet to be determined	Optimized	Jul-24
7	New_Wind	Wind	500	500	Yet to be determined	Optimized	Jul-24
8	Gorkin Matiltan	Hydro	84	84	GoKPK	PC-1 Approved	Jul-24
9	Tarbela Ext5 (U #1)	Hydro	510	510	WAPDA	PC-1 Approved	Jul-24
10	Suki Kinari (U #2)	Hydro	221	221	PPIB	LOS (Issued)	Jul-24
11	CASA	Cross Border Interconnection	1,000	1,000	NTDC	G2G	Aug-24
12	Tarbela Ext5 (U #2)	Hydro	510	510	WAPDA	PC-1 Approved	Aug-24
13	Shahtaj	Bagasse	32	32	AEDB	Category-I Project	Aug-24
14	Tarbela Ext5 (U #3)	Hydro	510	510	WAPDA	PC-1 Approved	Sep-24
15	Suki Kinari (U #3)	Hydro	221	221	PPIB	LOS (Issued)	Sep-24
16	Suki Kinari (U #4)	Hydro	221	221	PPIB	LOS (Issued)	Nov-24
Generation Additions in 2024-25 (MW)			8,429	8,429			
Cumulative Addition up till 2025 (MW)			14,811	14,592			

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2025-26							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-25
2	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-25
3	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-25
4	New_Solar_DG	Solar	327	327	Yet to be determined	Optimized	Jul-25
5	New_Solar_Utility	Solar	1,300	1,300	Yet to be determined	Optimized	Jul-25
6	New_Wind	Wind	500	500	Yet to be determined	Optimized	Jul-25
7	Gwadar	Local Coal	300	273	PPIB	LOS (Issued)	Aug-25
8	Mangla (U #9-10)	Hydro	70	70	WAPDA	Mangla Refurbishment	Sep-25
9	Dasu (U #1)	Hydro	360	360	WAPDA	PC-1 Approved	May-26
10	Mohmand Dam (U #1)	Hydro	200	200	WAPDA	PC-1 Approved	May-26
Generation Additions in 2025-26 (MW)			3,737	3,710			
Cumulative Addition up till 2026 (MW)			18,548	18,302			
2026-27							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-26
2	KE_New_Local Coal	Local Coal	990	912	Yet to be determined	Optimized	Jul-26
3	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-26
4	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-26
5	New_Local Coal	Local Coal	1,320	1,214	Yet to be determined	Optimized	Jul-26
6	Dasu (U #2)	Hydro	360	360	WAPDA	PC-1 Approved	Jul-26
7	Mohmand Dam (U #2)	Hydro	200	200	WAPDA	PC-1 Approved	Jul-26
8	Dasu (U #3)	Hydro	360	360	WAPDA	PC-1 Approved	Aug-26
9	Mohmand Dam (U #3)	Hydro	200	200	WAPDA	PC-1 Approved	Sep-26
10	Mangla (U #7-8)	Hydro	30	30	WAPDA	Mangla Refurbishment	Nov-26
11	Dasu (U #4)	Hydro	360	360	WAPDA	PC-1 Approved	Nov-26

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
12	Mohmand Dam (U #4)	Hydro	200	200	WAPDA	PC-1 Approved	Nov-26
13	Dasu (U #5)	Hydro	360	360	WAPDA	PC-1 Approved	Feb-27
14	Keyal Khwar (U #1)	Hydro	64	64	WAPDA	PC-1 Approved	Feb-27
15	Dasu (U #6)	Hydro	360	360	WAPDA	PC-1 Approved	May-27
16	Keyal Khwar (U #2)	Hydro	64	64	WAPDA	PC-1 Approved	May-27
Generation Additions in 2026-27 (MW)			5,548	5,364			
Cumulative Addition up till 2027 (MW)			24,096	23,666			
2027-28							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-27
2	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-27
3	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-27
4	New_Wind	Wind	2,461	2,461	Yet to be determined	Optimized	Jul-27
5	Gabral Kalam	Hydro	88	88	GoKPK	PC-1 Approved	Nov-27
6	Madyan	Hydro	157	157	GoKPK	PC-1 Approved	Nov-27
7	Balakot	Hydro	300	300	GoKPK	PC-1 Approved	Dec-27
Generation Additions in 2027-28 (MW)			3,686	3,686			
Cumulative Addition up till 2028 (MW)			27,782	27,352			
2028-29							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-28
2	Bata Kundti	Hydro	99	99	GoKPK	Optimized	Jul-28
3	CJ	Hydro	25	25	PPDB	Optimized	Jul-28
4	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-28
5	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-28
6	Nila Da Katha	Hydro	31.3	31.3	PEDO	Optimized	Jul-28
7	Taunsa	Hydro	135	135	PPDB	Optimized	Jul-28

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
8	Azad Pattan (U #1)	Hydro	175	175	PPIB	LOS (Issued)	Dec-28
9	Azad Pattan (U #2)	Hydro	175	175	PPIB	LOS (Issued)	Mar-29
10	Azad Pattan (U #3)	Hydro	175	175	PPIB	LOS (Issued)	Jun-29
Generation Additions in 2028-29 (MW)			1,496	1,496			
Cumulative Addition up till 2029 (MW)			29,278	28,848			
2029-30							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-29
2	Arkari Gol	Hydro	99	99	PEDO	Optimized	Jul-29
3	Asrit Kedam	Hydro	215	215	PEDO	Optimized	Jul-29
4	Dowarian	Hydro	40	40	AJK-HEB	Optimized	Jul-29
5	Jagran-IV	Hydro	22	22	AJK-HEB	Optimized	Jul-29
6	New_Local Coal	Local Coal	1,320	1,214	Yet to be determined	Optimized	Jul-29
7	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-29
8	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-29
9	Nagdar	Hydro	35	35	AJK-HEB	Optimized	Jul-29
10	Rajdhani	Hydro	132	132	PPIB	Optimized	Jul-29
11	Sharmai	Hydro	152.12	152.12	PEDO	Optimized	Jul-29
12	Shounter	Hydro	48	48	AJK-HEB	Optimized	Jul-29
13	Turtonas Uzghor	Hydro	82.25	82.25	KE	Optimized	Jul-29
14	Azad Pattan (U #4)	Hydro	175	175	PPIB	LOS (Issued)	Sep-29
15	Kohala (U #1)	Hydro	275	275	PPIB	LOS (Issued)	Jun-30
Generation Additions in 2029-30 (MW)			3,276	3,170			
Cumulative Addition up till 2030 (MW)			32,553	32,017			
2030-31							
1	Mahl	Hydro	640	640	PPIB	Optimized	Jul-30

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2	Thakot-III	Hydro	1,490	1,490	WAPDA	Optimized	Jul-30
3	Net Meter	Solar	480	480	AEDB	Committed	Jul-30
4	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-30
5	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-30
6	Kohala (U #2)	Hydro	275	275	PPIB	LOS (Issued)	Aug-30
7	Kohala (U #3)	Hydro	275	275	PPIB	LOS (Issued)	Oct-30
8	Kohala (U #4)	Hydro	275	275	PPIB	LOS (Issued)	Dec-30
9	Kohala (U #5)	Hydro	12	12	PPIB	LOS (Issued)	Feb-31
10	Kohala (U #6)	Hydro	12	12	PPIB	LOS (Issued)	Mar-31
Generation Additions in 2030-31 (MW)			3,659	3,659			
Cumulative Addition up till 2031 (MW)			36,212	35,676			

G-5. Annual Capacity Factors (%age)

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%age								
1	Almoiz	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
2	Chanar	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
3	Chiniot	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
4	Fatima	Bagasse	6.53	6.55	6.53	6.53	0.88	6.25	6.23	4.02	1.03
5	Hamza	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
6	JDW-II	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
7	JDW-III	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
8	Ryk_Mills	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
9	Shahtaj	Bagasse	0.00	0.00	45.77	45.62	45.62	45.77	45.62	45.62	45.62
10	Thal_Layyah	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
11	Appolo	PV	18.96	18.91	18.96	18.96	18.96	18.91	18.96	18.96	18.96
12	Best	PV	18.94	18.89	18.94	18.94	18.94	18.89	18.94	18.94	18.94
13	Crest	PV	19.19	19.13	19.19	19.19	19.19	19.13	19.19	19.19	19.19
14	Helios	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
15	HNDS	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
16	Manjhand	PV	0.00	23.23	23.33	23.33	23.33	23.27	23.33	23.33	23.33
17	Meridian	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
18	Net_Meter	PV	17.08	17.03	17.08	17.08	17.08	17.03	17.08	17.08	17.08
19	New_Solar	PV	0.00	0.00	22.08	22.08	22.08	22.02	22.08	22.08	22.08
20	New_Solar_Feeder	PV	0.00	19.95	20.00	20.00	20.00	19.95	20.00	20.00	20.00
21	QA_Solar	PV	19.04	18.99	19.04	19.04	19.04	18.99	19.04	19.04	19.04
22	Siachen	PV	0.00	23.23	23.33	23.33	23.33	23.27	23.33	23.33	23.33
23	Zhenfa	PV	21.50	21.44	21.50	21.50	21.50	21.44	21.50	21.50	21.50
24	Zorlu	PV	0.00	20.86	20.17	20.17	20.17	20.11	20.17	20.17	20.17
25	Gharo	KE_PV	25.25	25.18	25.25	25.25	25.25	25.18	25.25	25.25	25.25
26	KE_New_Solar	KE_PV	0.00	0.00	22.08	22.08	22.08	22.02	22.08	22.08	22.08
27	Oursun	KE_PV	20.97	20.91	20.97	20.97	20.97	20.91	20.97	20.97	20.97
28	Act	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
29	Act_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
30	Artistic_wind	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
31	Artistic_Wind_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
32	Dawood	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
33	Din	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
34	FFC	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
35	FWEL-I	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
36	FWEL-II	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
37	Gul Ahmed	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
38	Gul_Electric	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
39	Hawa	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
40	Indus_Energy	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
41	Jhimpir	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86

Annexure-G. Local Coal Inclusion in 2027 and 2030

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% %								
42	Lakeside	Wind	38.93	38.07	38.17	38.17	38.17	38.07	38.17	38.17	38.17
43	Liberty_Wind_1	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
44	Liberty_Wind_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
45	Master	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
46	Master_Green	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
47	Metro_Power	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
48	Metro_Wind	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
49	NASDA	Wind	38.93	38.07	38.17	38.17	38.17	38.07	38.17	38.17	38.17
50	New_Wind	Wind	0.00	0.00	41.28	41.28	41.28	41.17	41.28	41.28	41.28
51	Sachal	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
52	Sapphire_Wind	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
53	Tenaga	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
54	Three_Gorges_I	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
55	Three_Gorges_II	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
56	Three_Gorges_III	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
57	Trans_Atlantic	Wind	0.00	41.28	41.28	41.28	41.28	41.17	41.28	41.28	41.28
58	Tricom	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
59	Tricon_A	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
60	Tricon_B	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
61	Tricon_C	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
62	UEP	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
63	Western	Wind	0.00	37.19	37.19	37.19	37.19	37.09	37.19	37.19	37.19
64	Yunus	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
65	Zephyr	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
66	Zorlu_Wind	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
67	KE_New_Wind	KE_Wind	0.00	0.00	41.28	41.28	41.28	41.17	41.28	41.28	41.28
68	CASA	Interconnection	0.00	0.00	41.92	41.92	41.92	41.80	41.92	41.92	41.92
69	Arkari Gol	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.22	42.22
70	Asrit Kedam	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.72	49.72
71	Bata Kundu	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	54.76	54.79	54.79
72	CJ	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	50.50	50.50	50.50
73	Dowarian	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.85	48.85
74	Jagran-IV	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.09	49.09
75	Mahl	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.53
76	Nagdar	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.87	48.87
77	Nila Da Katha	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	51.31	51.31	51.31
78	Rajdhani	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.46	58.46
79	Sharmai	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.94	50.94
80	Shounter	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.86	48.86
81	Taunsa	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	55.02	55.02	55.02
82	Thakot-III	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.33	
83	Turtonas Uzghor	KE_HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	51.90	51.90	

Indicative Generation Capacity Expansion Plan (IGCEP) 2022-31

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% 								
84	Azad Pattan	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	52.77	54.06	52.77
85	Balakot	HPP Committed	0.00	0.00	0.00	0.00	0.00	41.21	41.21	41.21	41.21
86	Dasu	HPP Committed	0.00	0.00	0.00	64.29	64.29	64.29	64.47	64.47	64.47
87	Diamer Bhasha	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
88	Gabral Kalam	HPP Committed	0.00	0.00	0.00	0.00	0.00	33.77	33.77	33.77	33.77
89	Gorkin Matiltan	HPP Committed	0.00	0.00	42.83	42.83	42.83	42.71	42.83	42.83	42.83
90	Jagran-II	HPP Committed	50.53	50.39	50.53	50.53	50.53	50.39	50.53	50.53	50.53
91	Karot	HPP Committed	44.39	44.29	44.39	44.39	44.39	44.29	44.38	44.39	44.39
92	Keyal Khwar	HPP Committed	0.00	0.00	0.00	0.00	52.07	51.92	52.07	52.07	52.07
93	Kohala	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.14	56.14
94	Koto	HPP Committed	56.96	57.08	57.24	57.19	57.19	56.96	57.12	57.19	57.19
95	Lawi	HPP Committed	0.00	47.99	48.10	48.05	48.05	47.90	47.99	48.05	48.10
96	Madyan	HPP Committed	0.00	0.00	0.00	0.00	0.00	47.43	47.43	47.43	47.43
97	Mohmand Dam	HPP Committed	0.00	0.00	0.00	42.71	42.71	42.60	42.71	42.71	42.71
98	Suki Kinari	HPP Committed	0.00	48.93	49.07	49.07	49.07	48.93	49.07	49.07	49.07
99	Tarbela_Ext_5	HPP Committed	0.00	0.00	10.05	10.05	10.05	10.02	10.05	10.05	10.05
100	Allai Khwar	HPP Existing	44.32	44.20	44.32	44.32	44.32	44.20	44.32	44.32	44.32
101	Chashma	HPP Existing	48.58	48.45	48.58	48.58	48.58	48.45	48.58	48.58	48.58
102	Daral Khwar	HPP Existing	38.58	38.48	38.58	38.58	38.58	38.48	38.58	38.58	38.58
103	Dubair Khwar	HPP Existing	53.09	52.95	53.09	53.09	53.09	52.95	53.09	53.09	53.09
104	Ghazi Brotha	HPP Existing	52.78	52.63	52.78	52.78	52.78	52.63	52.78	52.78	52.78
105	Golen Gol	HPP Existing	9.15	9.12	9.15	9.15	9.15	9.12	9.15	9.15	9.15
106	Gulpur	HPP Existing	28.92	28.84	28.92	28.92	28.92	28.84	28.92	28.92	28.92
107	Jagran-I	HPP Existing	48.95	48.82	48.95	48.95	48.95	48.82	48.95	48.95	48.95
108	Jinnah	HPP Existing	25.74	25.67	25.74	25.74	25.74	25.67	25.74	25.74	25.74
109	Khan Khwar	HPP Existing	40.22	40.11	40.22	40.22	40.22	40.11	40.22	40.22	40.22
110	Malakand-III	HPP Existing	53.86	53.71	53.86	53.86	53.86	53.71	53.86	53.86	53.86
111	Mangla	HPP Existing	64.95	60.97	58.32	56.00	54.77	54.20	54.35	54.35	54.35
112	Neelum Jehlum	HPP Existing	51.68	51.54	51.69	51.69	51.69	51.54	51.69	51.69	51.69
113	New Bong	HPP Existing	55.49	55.34	55.49	55.49	55.49	55.34	55.49	55.49	55.49
114	Patrind	HPP Existing	43.76	43.64	43.76	43.76	43.76	43.64	43.76	43.76	43.76
115	Small Hydel	HPP Existing	45.02	44.90	45.02	45.02	45.02	44.90	45.02	45.02	45.02
116	Tarbela 1-14	HPP Existing	37.99	37.89	37.99	37.99	37.99	37.89	37.99	37.99	37.99
117	Tarbela_Ext_4	HPP Existing	30.12	30.04	30.12	30.12	30.12	30.04	30.12	30.12	30.12
118	Warsak	HPP Existing	50.64	50.50	50.64	50.64	50.64	50.50	50.64	50.64	50.64
119	Engro 90MW	CCGT_Gas	90.23	74.96	62.46	50.72	45.22	32.82	31.82	25.87	22.92
120	Foundation	CCGT_Gas	89.97	90.25	90.00	89.97	57.94	57.94	57.94	57.94	57.94
121	Guddu-I	CCGT_Gas	36.90	74.63	74.43	74.42	59.07	16.35	46.44	16.37	14.88
122	Guddu-II	CCGT_Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
123	Guddu-V (747)	CCGT_Gas	75.56	75.77	75.56	75.56	69.19	43.55	70.60	18.84	17.40
124	Liberty	CCGT_Gas	75.26	75.02	45.55	72.24	0.00	0.00	0.00	0.00	0.00
125	Uch	CCGT_Gas	86.08	86.32	86.08	85.47	48.34	40.81	43.35	42.11	0.00

Annexure-G. Local Coal Inclusion in 2027 and 2030

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% %								
126	Uch-II	CCGT_Gas	87.77	88.05	87.81	87.44	51.31	51.33	51.33	51.30	51.33
127	SNPC-I	KE_CCGT_Gas	91.98	92.25	91.96	91.98	41.21	33.17	34.72	31.29	28.89
128	SNPC-II	KE_CCGT_Gas	91.98	92.25	91.96	91.98	42.36	34.64	36.35	32.01	32.58
129	AES Lalpir	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
130	AES Pakgen	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
131	HUBCO	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
132	Jamshoro-I U1	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
133	Jamshoro-II U4	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
134	Muzaffargarh-I U1	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
135	Muzaffargarh-I U2	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
136	Muzaffargarh-I U3	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
137	Muzaffargarh-II U4	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
138	Saba	ST_RFO	14.38	21.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00
139	AGL	DG_RFO	36.12	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00
140	Atlas	DG_RFO	14.40	21.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
141	Engro 127MW	DG_RFO	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
142	HuB N	DG_RFO	36.12	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00
143	Kohinoor	DG_RFO	14.39	21.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
144	Liberty Tech	DG_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
145	Nishat C	DG_RFO	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
146	Nishat P	DG_RFO	36.81	22.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
147	C-1	Nuclear	80.43	80.65	80.43	80.43	80.43	80.65	80.43	80.43	80.43
148	C-2	Nuclear	79.61	79.83	79.61	79.61	79.61	79.83	79.61	79.61	79.61
149	C-3	Nuclear	81.01	81.23	81.01	81.01	81.01	81.23	81.01	81.01	81.01
150	C-4	Nuclear	81.01	81.23	81.01	81.01	81.01	81.23	81.01	81.01	81.01
151	K-2	Nuclear	85.06	85.30	85.07	85.06	85.06	85.29	85.05	85.05	85.06
152	K-3	Nuclear	85.66	85.90	85.67	85.66	85.66	85.89	85.65	85.65	85.65
153	Engro Thar	Local Coal	82.51	82.74	82.51	82.50	81.41	80.16	81.19	75.17	71.18
154	Gwadar	Local Coal	0.00	0.00	0.00	69.18	76.74	77.09	80.56	72.06	25.36
155	Lucky	Local Coal	85.08	85.31	85.08	85.07	85.08	85.31	85.07	85.07	85.07
156	NEW_L.Coal 660	Local Coal	0.00	0.00	0.00	0.00	83.34	83.56	83.30	83.33	83.33
157	Thal Nova	Local Coal	49.35	85.21	84.98	84.97	84.80	84.61	84.38	82.61	78.90
158	Thar TEL	Local Coal	84.98	85.21	84.98	84.97	84.96	84.34	84.38	83.13	78.58
159	Thar-I (SSRL)	Local Coal	42.14	85.21	84.98	84.98	84.97	84.61	84.42	84.38	83.17
160	K.E_NEW_L.Coal	KE_Local Coal	0.00	0.00	0.00	0.00	83.33	83.34	83.33	82.87	82.99
161	China HUBCO	Imported Coal	51.57	51.57	51.57	51.57	51.57	51.57	51.57	51.57	51.57
162	Jamshoro Coal	Imported Coal	49.36	83.95	83.64	81.22	20.90	11.32	18.15	11.59	10.29
163	Port Qasim	Imported Coal	48.72	48.72	48.72	48.72	48.72	48.72	48.72	48.72	48.72
164	Sahiwal Coal	Imported Coal	48.02	48.02	48.02	48.02	48.02	48.02	48.01	48.01	48.02
165	FPCL	KE_Imported Coal	82.15	77.19	18.20	19.64	8.25	6.68	10.04	6.93	9.73
166	Davis	DG_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
167	Balloki	CCGT_RLNG	4.23	1.98	1.03	2.04	0.60	0.29	0.57	0.35	0.35

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#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% 								
168	Bhikki	CCGT_RLNG	1.21	0.77	0.02	0.60	0.22	0.07	0.29	0.24	0.25
169	FKPCL	CCGT_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	Halmore	CCGT_RLNG	37.73	37.73	37.73	22.68	0.00	0.00	0.00	0.00	0.00
171	Haveli	CCGT_RLNG	11.09	5.89	3.48	5.43	2.14	0.80	1.75	0.95	0.94
172	KAPCO 1	CCGT_RLNG	35.31	35.38	35.25	0.00	0.00	0.00	0.00	0.00	0.00
173	KAPCO 2	CCGT_RLNG	11.86	11.83	11.89	0.00	0.00	0.00	0.00	0.00	0.00
174	KAPCO 3	CCGT_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
175	Nandipur	CCGT_RLNG	36.38	36.38	36.38	21.87	0.00	0.00	0.00	0.00	0.00
176	Orient	CCGT_RLNG	37.73	23.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00
177	Rousch	CCGT_RLNG	0.23	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
178	Saif	CCGT_RLNG	37.73	37.73	37.73	22.68	0.00	0.00	0.00	0.00	0.00
179	Saphire	CCGT_RLNG	37.73	37.73	37.73	22.68	0.00	0.00	0.00	0.00	0.00
180	Trimmu	CCGT_RLNG	26.53	21.00	12.36	12.12	5.27	2.14	3.61	2.00	1.56
181	BQPS2	KE_CCGT_RLNG	85.24	83.52	29.84	27.75	10.09	5.61	9.10	5.72	7.23
182	BQPS3	KE_CCGT_RLNG	89.85	89.80	78.82	83.03	20.30	14.56	18.34	14.97	16.89
183	KCPP	KE_CCGT_RLNG	85.17	82.46	22.16	18.63	8.46	4.33	8.02	4.29	4.03
184	KTGTPS	KE_CCGT_RLNG	45.16	40.58	8.61	10.11	4.07	2.28	3.10	2.74	2.79
185	SGTPS	KE_CCGT_RLNG	48.00	44.44	9.21	11.15	4.30	2.64	3.16	2.84	3.02
186	BQPS1-U1	KE_ST_RLNG	10.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
187	BQPS1-U5	KE_ST_RLNG	29.34	30.27	1.66	1.71	0.16	0.46	0.98	0.75	1.10
188	BQPS1-U6	KE_ST_RLNG	16.15	15.84	1.43	1.54	0.00	0.01	0.34	0.46	0.67
189	BQPS1-U2	KE_GT_RLNG	22.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(All numbers in yellow color, in this table, represent retirement of the corresponding project.)

G-6. Year-wise Installed Capacity Addition (MW)

FY	Local Coal	Hydro	RLNG	Nuclear	Imported Coal	RE	Local Gas	Furnace Oil	Cross Border	Net Yearly Addition	Cumulative Total
2022	1,320	10,593	9,789	3,620	4,020	2,802	2,744	3,633	-	-	38,521
2023	1,980	205	1,263	-	660	630	-	-	-	4,738	43,259
2024	-	314	-420	-	-	1,330	-	-	-	1,224	44,483
2025	-	2,347	-	-	-	5,082	-	-	1,000	8,429	52,912
2026	300	630	-1,300	-	-	2,807	-	-	-	2,437	55,349
2027	2,310	2,558	-	-	-	680	-225	-1,292	-	4,031	59,380
2028	-	545	-	-	-	3,141	-	-131	-	3,555	62,935
2029	-	816	-	-	-	680	-	-727	-	769	63,703
2030	1,320	1,276	-172	-	-	680	-	-136	-	2,968	66,671
2031	-	2,979	-450	-	-	680	-586	-	-	2,623	69,294
Total	7,230	22,262	8,710	3,620	4,680	18,512	1,933	1,347	1,000	30,774	69,294

G-7. IGCEP Generation Mix 2023-2031 (GWh)

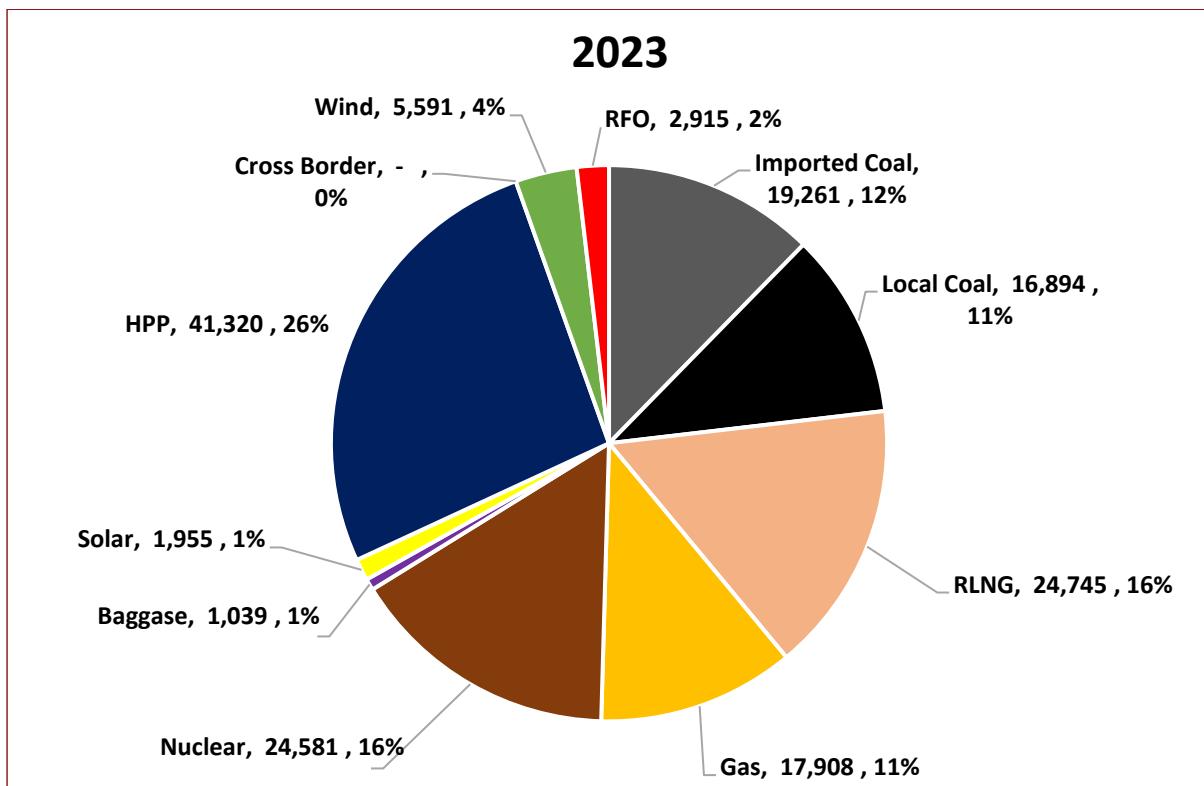


Chart G-1: IGCEP Generation Mix 2023 (GWh)

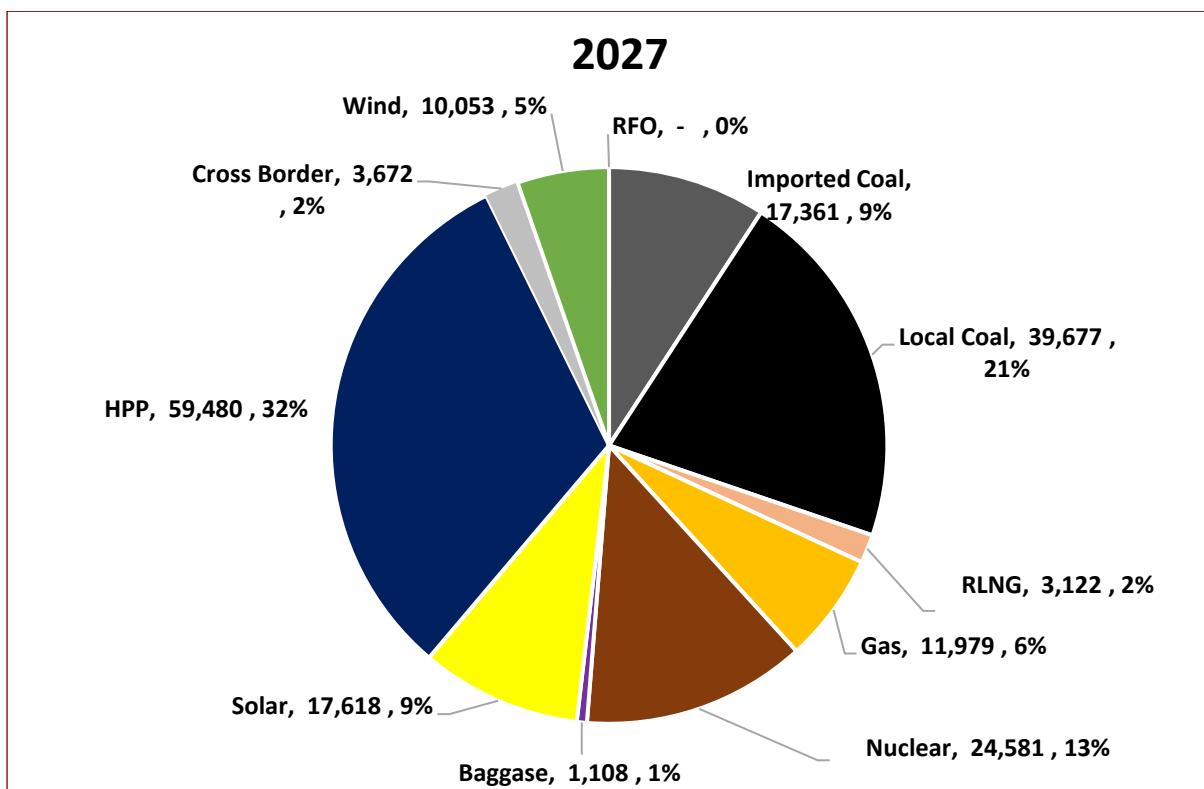


Chart G-2: IGCEP Generation Mix 2027 (GWh)

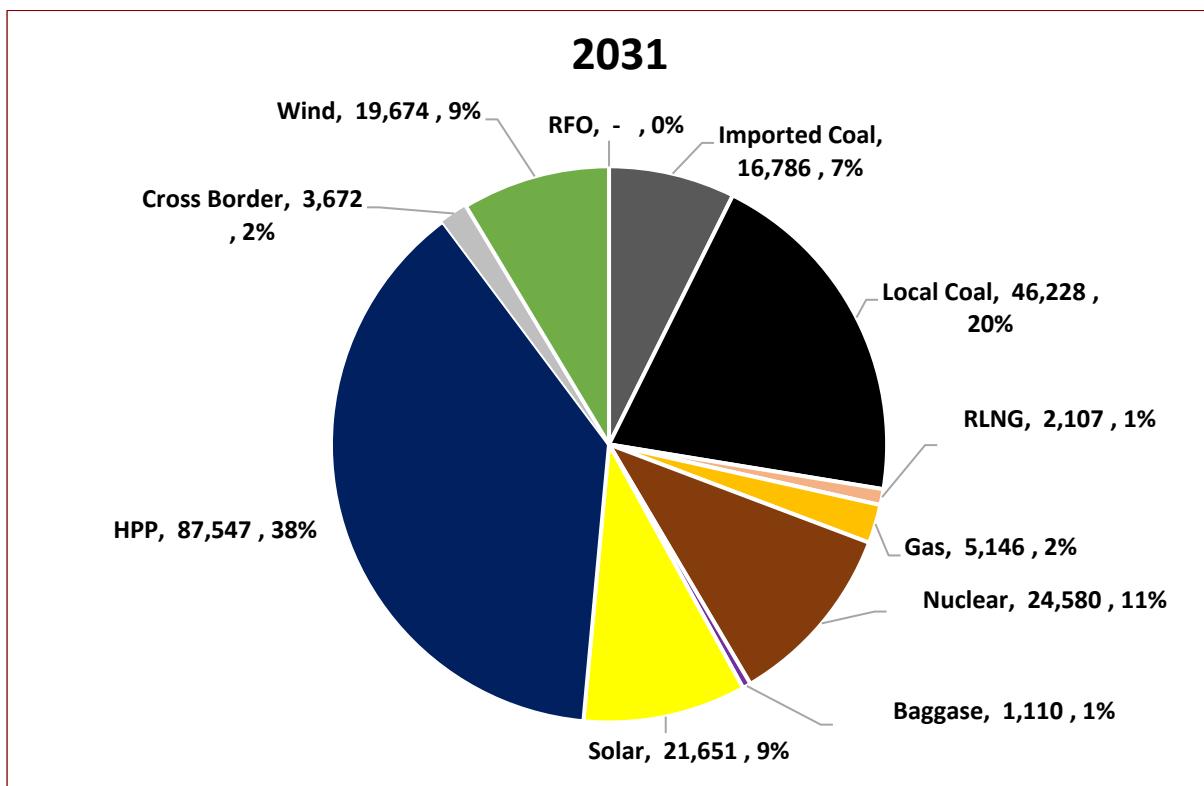


Chart G-3: IGCEP Generation Mix 2031 (GWh)

G-8. IGCEP Generation Mix 2023-31 (MW)

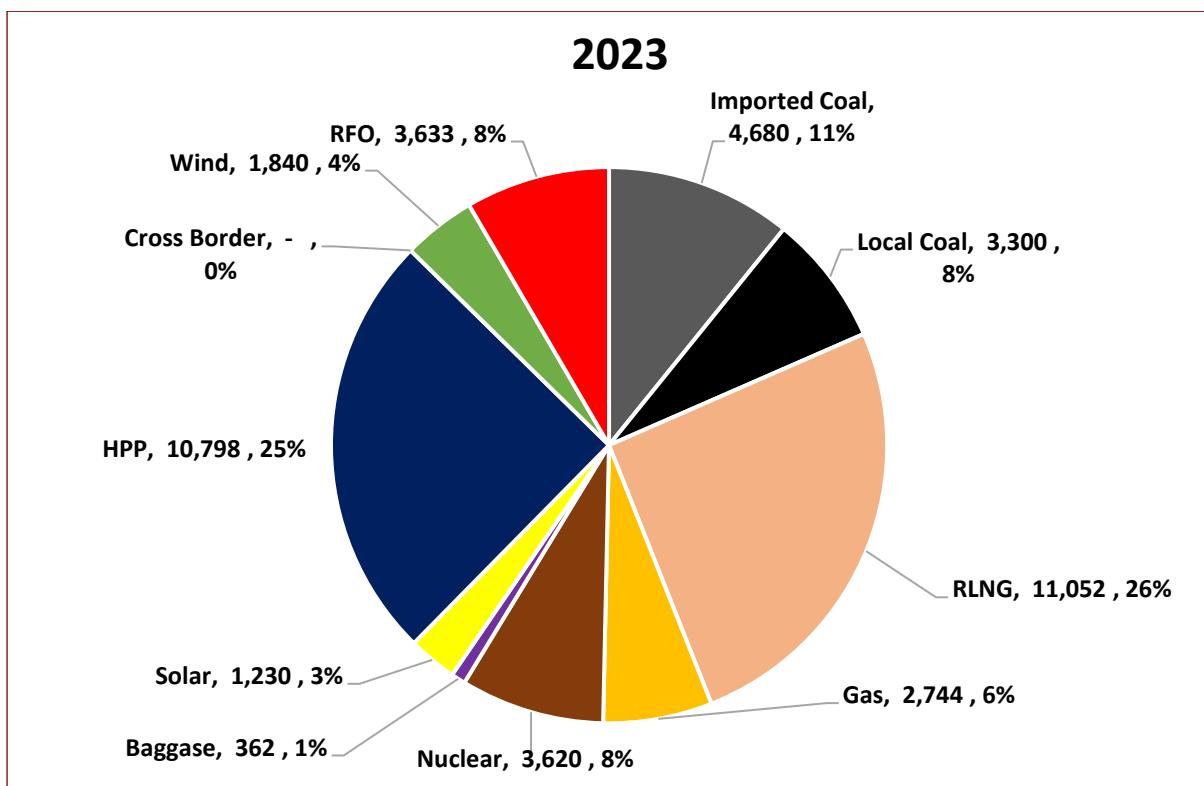


Chart G-4: IGCEP Generation Mix 2023 (MW)

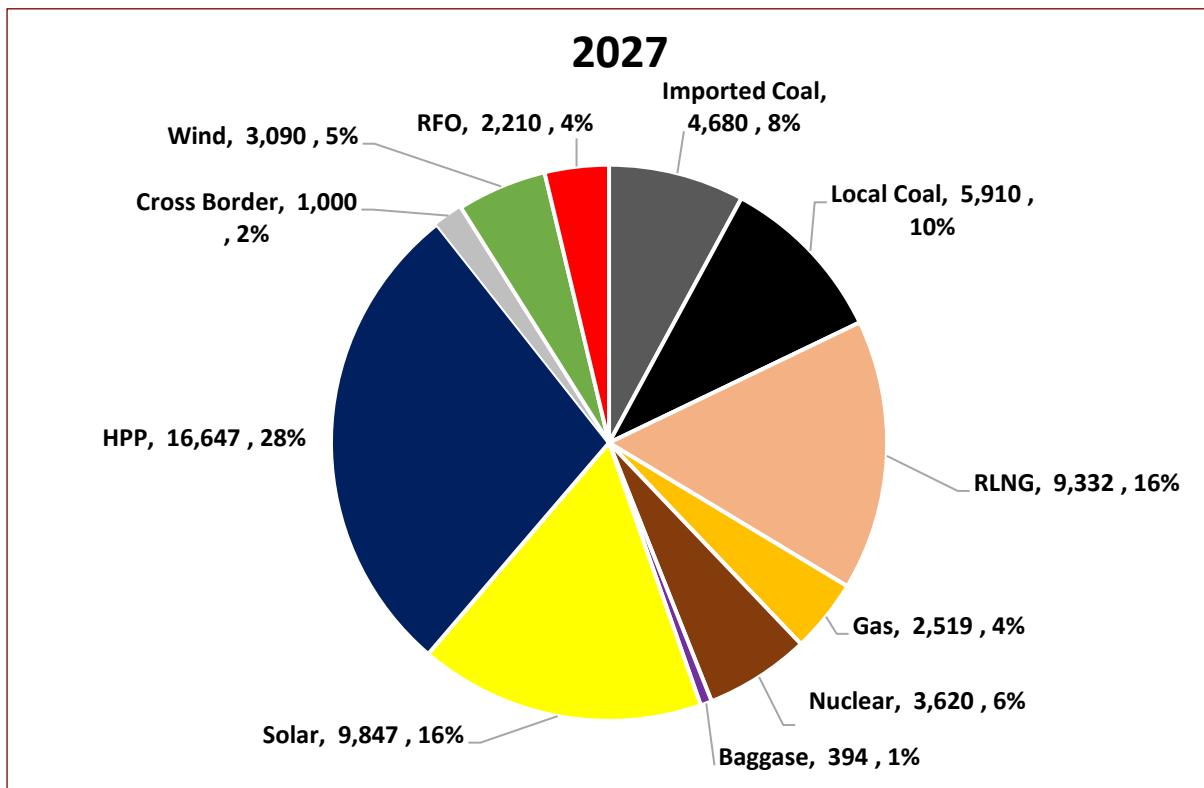


Chart G-5: IGCEP Generation Mix 2027 (MW)

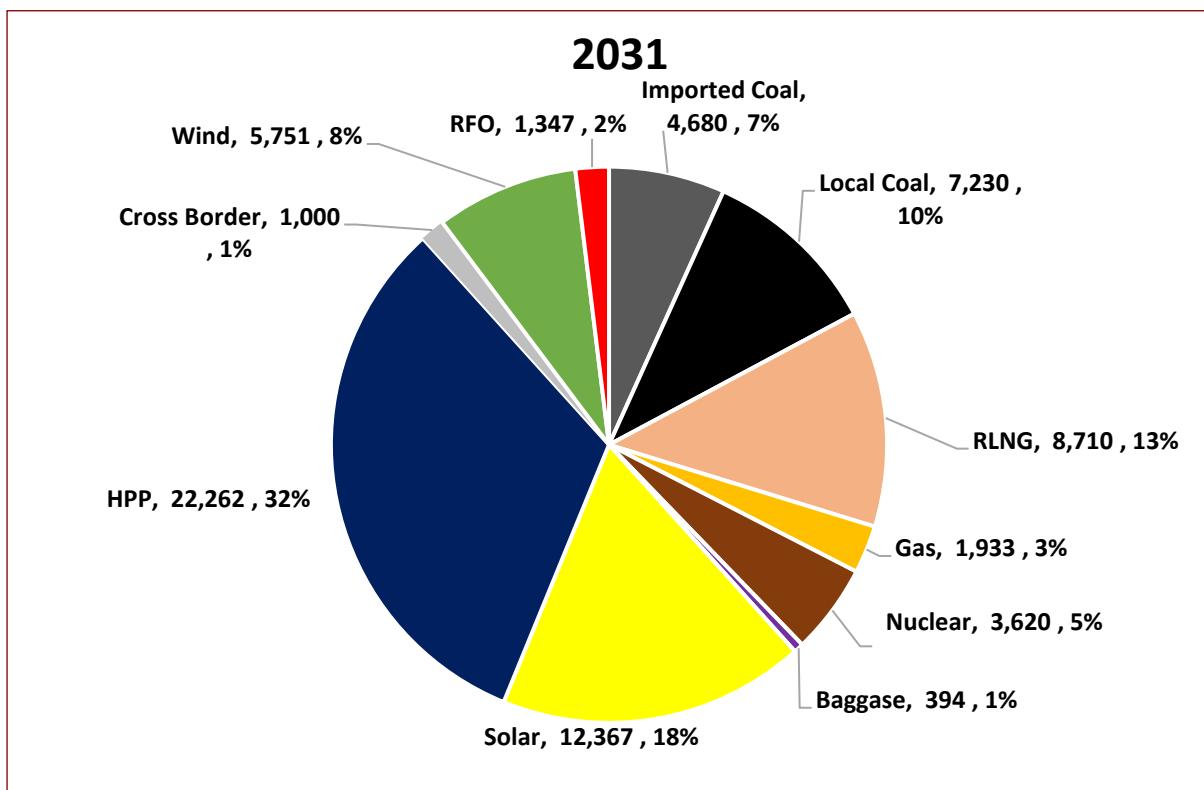
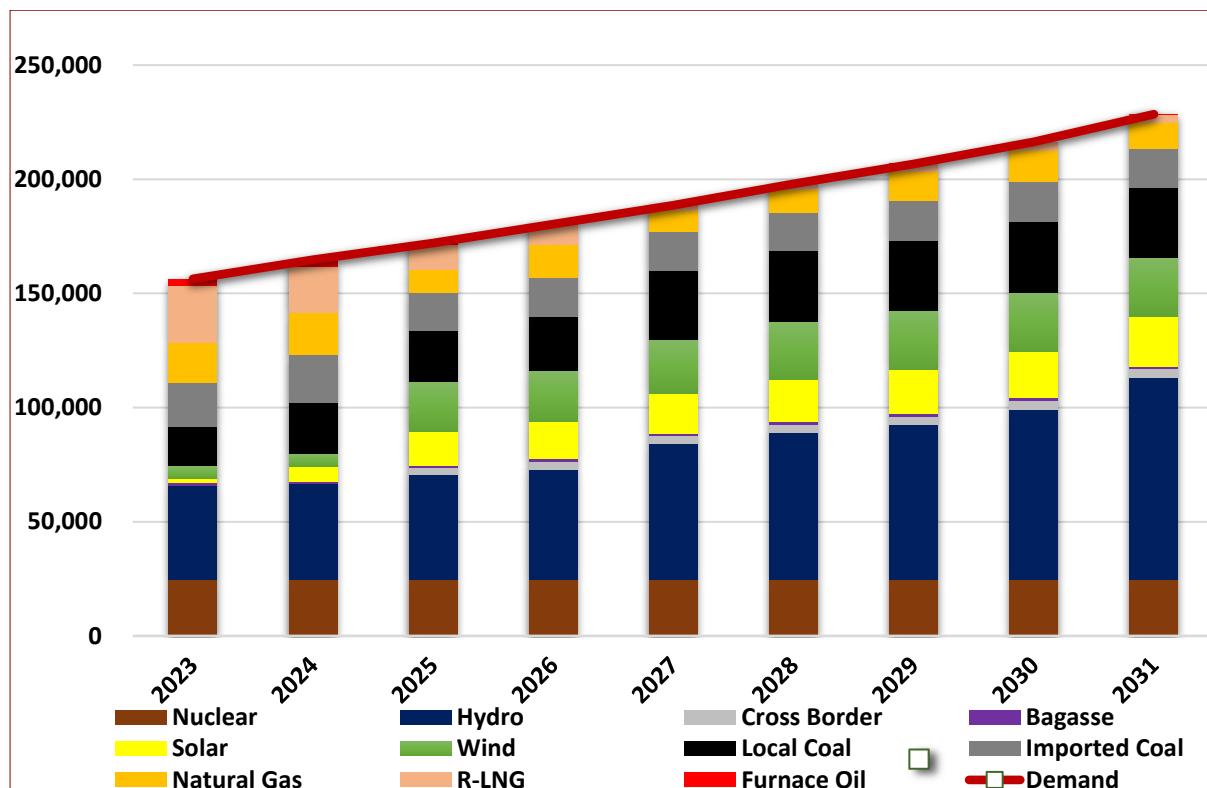


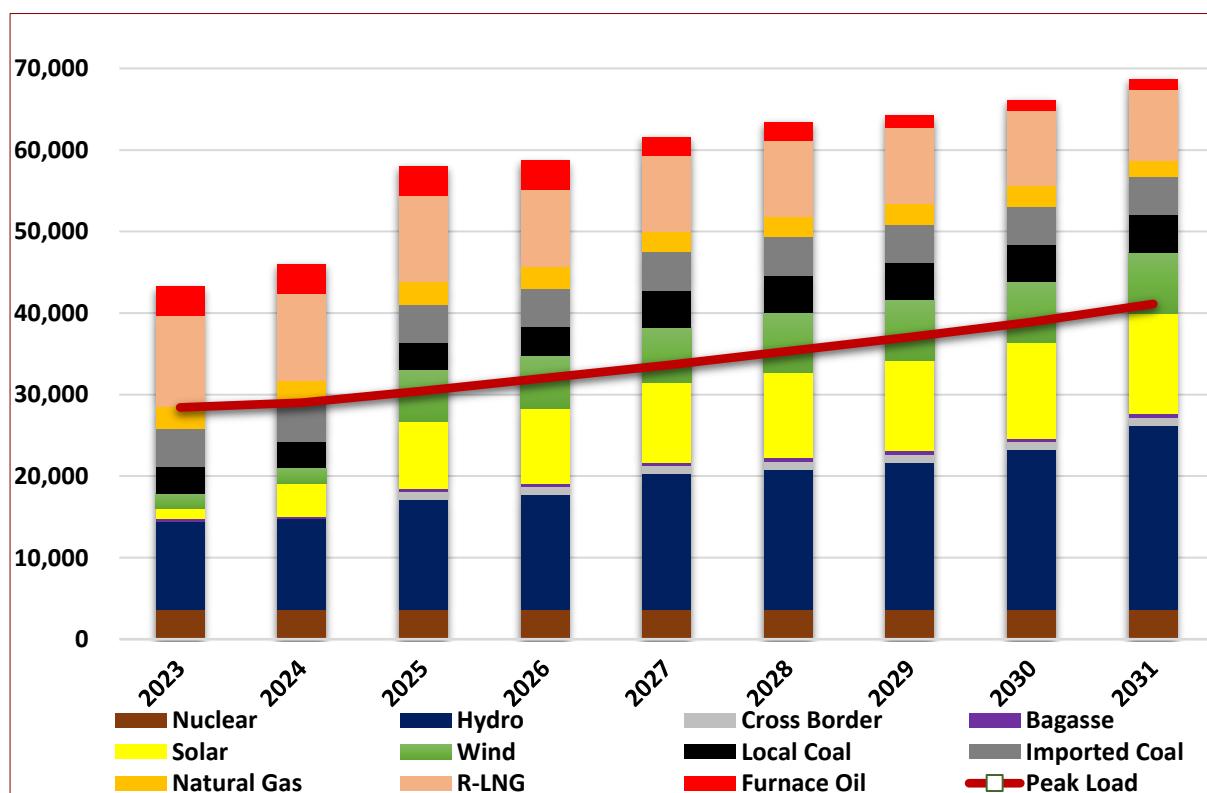
Chart G-6: IGCEP Generation Mix 2031 (MW)

Annexure H. Unconstrained VRE

H-1. Annual Energy Generation Vs Annual Energy Demand (GWh) - Country



H-2. Installed Capacity Vs Peak Demand (MW) - Country



H-3. Optimized Generation Capacity Additions (MW)

Fiscal Year	Coal Fired Steam Local Coal	Coal Fired Steam Local Coal KE	HPP	HPP KE	Solar Utility MW _p	Solar Feeder MW _p	Solar KE MW _p	Wind NTDC	Wind KE	Bagasse	Per Year Capacity Addition	Cumulative Capacity Addition
2024	-	-	-	-	-	2,000	-	-	-	-	2,000	2,000
2025	-	-	-	-	3,680	-	150	4,315	50	-	8,195	10,195
2026	-	-	-	-	325	-	150	34	50	-	559	10,754
2027	-	990	-	-	-	-	150	261	50	-	1,451	12,205
2028	-	-	-	-	-	-	150	590	50	-	790	12,995
2029	-	-	350	-	-	-	150	22	50	-	572	13,567
2030	-	-	981	82	-	-	150	-	50	-	1,263	14,831
2031	-	-	2,130	-	-	-	150	-	50	-	2,330	17,161
Total	-	990	3,461	82	4,005	2,000	1,050	5,222	350	-	17,161	

H-4. List of Projects upto 2031 (Committed + Optimized)

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2022-23							
1	Thar TEL	Local Coal	330	300	PPIB	LOS (Issued)	Commissioned
2	Net Meter	Solar	480	480	AEDB	Committed	Dec-22
3	Trimmu	CCGT_RLNG	1,263	1,243	PPIB	LOS (Issued)	Dec-22
4	Mangla (U #5-6)	Hydro	70	70	WAPDA	Mangla Refurbishment	Dec-22
5	Koto	Hydro	40.8	40.8	GoKPK	PC-1 Approved	Dec-22
6	Jamshoro Coal (U #1)	Imported Coal	660	627	GENCO	PC-1 Approved	Dec-22
7	Thal Nova	Local Coal	330	300	PPIB	LOS (Issued)	Dec-22
8	Thar-I (SSRL)	Local Coal	1,320	1,214	PPIB	LOS (Issued)	Dec-22
9	Jagran-II (U #1)	Hydro	12	12	AJK-HEB	PC-1 Approved	Apr-23
10	Helios	Solar	50	50	AEDB	Category-II Project	Apr-23
11	HNDS	Solar	50	50	AEDB	Category-II Project	Apr-23
12	Meridian	Solar	50	50	AEDB	Category-II Project	Apr-23
13	Mangla (U #3-4)	Hydro	70	70	WAPDA	Mangla Refurbishment	May-23
14	Jagran-II (U #2)	Hydro	12	12	AJK-HEB	PC-1 Approved	May-23
Generation Additions in 2022-23 (MW)			4,738	4,519			
Cumulative Addition up till 2023 (MW)			4,738	4,519			
2023-24							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-23
2	New_Solar_DG	Solar	2,000	2,000	Yet to be determined	Optimized	Jul-23
3	Jagran-II (U #3-4)	Hydro	24	24	AJK-HEB	PC-1 Approved	Jul-23
4	Siachen	Solar	100	100	GoS	Category-II Project	Sep-23
5	Manjhand	Solar	50	50	GoS	PC-1 Approved	Sep-23
6	Zorlu	Solar	100	100	PPDB	Category-II Project	Dec-23

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#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
7	Lawi	Hydro	69	69	GoKPK	PC-1 Approved	Apr-24
8	Suki Kinari (U #1)	Hydro	221	221	PPIB	LOS (Issued)	May-24
9	Trans_Atlantic	Wind	50	50	AEDB	Category-II Project	Jun-24
10	Western	Wind	50	50	AEDB	Category-II Project	Jun-24
Generation Additions in 2023-24 (MW)			3,144	3,144			
Cumulative Addition up till 2024 (MW)			7,882	7,663			
2024-25							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-24
2	Mangla (U #1-2)	Hydro	70	70	WAPDA	Mangla Refurbishment	Jul-24
3	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-24
4	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-24
5	New_Solar_Utility	Solar	3,680	3,680	Yet to be determined	Optimized	Jul-24
6	New_Wind	Wind	4,315	4,315	Yet to be determined	Optimized	Jul-24
7	Gorkin Matiltan	Hydro	84	84	GoKPK	PC-1 Approved	Jul-24
8	Tarbela Ext5 (U #1)	Hydro	510	510	WAPDA	PC-1 Approved	Jul-24
9	Suki Kinari (U #2)	Hydro	221	221	PPIB	LOS (Issued)	Jul-24
10	CASA	Cross Border Interconnection	1,000	1,000	NTDC	G2G	Aug-24
11	Tarbela Ext5 (U #2)	Hydro	510	510	WAPDA	PC-1 Approved	Aug-24
12	Shahtaj	Bagasse	32	32	AEDB	Category-I Project	Aug-24
13	Tarbela Ext5 (U #3)	Hydro	510	510	WAPDA	PC-1 Approved	Sep-24
14	Suki Kinari (U #3)	Hydro	221	221	PPIB	LOS (Issued)	Sep-24
15	Suki Kinari (U #4)	Hydro	221	221	PPIB	LOS (Issued)	Nov-24
Generation Additions in 2024-25 (MW)			12,054	12,054			
Cumulative Addition up till 2025 (MW)			19,936	19,717			
2025-26							

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-25
2	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-25
3	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-25
4	New_Solar_Utility	Solar	325	325	Yet to be determined	Optimized	Jul-25
5	New_Wind	Wind	34	34	Yet to be determined	Optimized	Jul-25
6	Gwadar	Imported Coal	300	273	PPIB	LOS (Issued)	Aug-25
7	Mangla (U #9-10)	Hydro	70	70	WAPDA	Mangla Refurbishment	Sep-25
8	Dasu (U #1)	Hydro	360	360	WAPDA	PC-1 Approved	May-26
9	Mohmand Dam (U #1)	Hydro	200	200	WAPDA	PC-1 Approved	May-26
Generation Additions in 2025-26 (MW)			1,969	1,942			
Cumulative Addition up till 2026 (MW)			21,905	21,659			

2026-27

1	Net Meter	Solar	480	480	AEDB	Committed	Jul-26
2	KE_New_Local Coal	Local Coal	990	912	Yet to be determined	Optimized	Jul-26
3	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-26
4	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-26
5	New_Wind	Wind	261	261	Yet to be determined	Optimized	Jul-26
6	Dasu (U #2)	Hydro	360	360	WAPDA	PC-1 Approved	Jul-26
7	Mohmand Dam (U #2)	Hydro	200	200	WAPDA	PC-1 Approved	Jul-26
8	Dasu (U #3)	Hydro	360	360	WAPDA	PC-1 Approved	Aug-26
9	Mohmand Dam (U #3)	Hydro	200	200	WAPDA	PC-1 Approved	Sep-26
10	Mangla (U #7-8)	Hydro	30	30	WAPDA	Mangla Refurbishment	Nov-26
11	Dasu (U #4)	Hydro	360	360	WAPDA	PC-1 Approved	Nov-26
12	Mohmand Dam (U #4)	Hydro	200	200	WAPDA	PC-1 Approved	Nov-26
13	Dasu (U #5)	Hydro	360	360	WAPDA	PC-1 Approved	Feb-27

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#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
14	Keyal Khwar (U #1)	Hydro	64	64	WAPDA	PC-1 Approved	Feb-27
15	Dasu (U #6)	Hydro	360	360	WAPDA	PC-1 Approved	May-27
16	Keyal Khwar (U #2)	Hydro	64	64	WAPDA	PC-1 Approved	May-27
Generation Additions in 2026-27 (MW)			4,489	4,411			
Cumulative Addition up till 2027 (MW)			26,394	26,070			
2027-28							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-27
2	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-27
3	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-27
4	New_Wind	Wind	590	590	Yet to be determined	Optimized	Jul-27
5	Gabral Kalam	Hydro	88	88	GoKPK	PC-1 Approved	Nov-27
6	Madyan	Hydro	157	157	GoKPK	PC-1 Approved	Nov-27
7	Balakot	Hydro	300	300	GoKPK	PC-1 Approved	Dec-27
Generation Additions in 2027-28 (MW)			1,815	1,815			
Cumulative Addition up till 2028 (MW)			28,209	27,885			
2028-29							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-28
2	Bata Kundti	Hydro	99	99	GoKPK	Optimized	Jul-28
3	Chowkel Khwar	Hydro	60	60	PEDO	Optimized	Jul-28
4	CJ	Hydro	25	25	PPDB	Optimized	Jul-28
5	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-28
6	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-28
7	New_Wind	Wind	22	22	Yet to be determined	Optimized	Jul-28
8	Nila Da Katha	Hydro	31.3	31.3	PEDO	Optimized	Jul-28
9	Taunsa	Hydro	135	135	PPDB	Optimized	Jul-28

#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
10	Azad Pattan (U #1)	Hydro	175	175	PPIB	LOS (Issued)	Dec-28
11	Azad Pattan (U #2)	Hydro	175	175	PPIB	LOS (Issued)	Mar-29
12	Azad Pattan (U #3)	Hydro	175	175	PPIB	LOS (Issued)	Jun-29
Generation Additions in 2028-29 (MW)			1,578	1,578			
Cumulative Addition up till 2029 (MW)			29,787	29,463			
2029-30							
1	Net Meter	Solar	480	480	AEDB	Committed	Jul-29
2	Arkari Gol	Hydro	99	99	PEDO	Optimized	Jul-29
3	Asrit Kedam	Hydro	215	215	PEDO	Optimized	Jul-29
4	Dowarian	Hydro	40	40	AJK-HEB	Optimized	Jul-29
5	Jagran-IV	Hydro	22	22	AJK-HEB	Optimized	Jul-29
6	Kalam Asrit	Hydro	238	238	PEDO	Optimized	Jul-29
7	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-29
8	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-29
9	Nagdar	Hydro	35	35	AJK-HEB	Optimized	Jul-29
10	Rajdhani	Hydro	132	132	PPIB	Optimized	Jul-29
11	Sharmai	Hydro	152.12	152.12	PEDO	Optimized	Jul-29
12	Shounter	Hydro	48	48	AJK-HEB	Optimized	Jul-29
13	Turtonas Uzghor	Hydro	82.25	82.25	KE	Optimized	Jul-29
14	Azad Pattan (U #4)	Hydro	175	175	PPIB	LOS (Issued)	Sep-29
15	Kohala (U #1)	Hydro	275	275	PPIB	LOS (Issued)	Jun-30
Generation Additions in 2029-30 (MW)			2,194	2,194			
Cumulative Addition up till 2030 (MW)			31,980	31,656			
2030-31							
1	Mahl	Hydro	640	640	PPIB	Optimized	Jul-30

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#	Name of Project	Fuel Type	Installed Capacity	Dependable Capacity	Agency	Status	Schedule of Commissioning
2	Thakot-III	Hydro	1,490	1,490	WAPDA	Optimized	Jul-30
3	Net Meter	Solar	480	480	AEDB	Committed	Jul-30
4	KE_New_Solar	Solar	150	150	Yet to be determined	Optimized	Jul-30
5	KE_New_Wind	Wind	50	50	Yet to be determined	Optimized	Jul-30
6	Kohala (U #2)	Hydro	275	275	PPIB	LOS (Issued)	Aug-30
7	Kohala (U #3)	Hydro	275	275	PPIB	LOS (Issued)	Oct-30
8	Kohala (U #4)	Hydro	275	275	PPIB	LOS (Issued)	Dec-30
9	Kohala (U #5)	Hydro	12	12	PPIB	LOS (Issued)	Feb-31
10	Kohala (U #6)	Hydro	12	12	PPIB	LOS (Issued)	Mar-31
Generation Additions in 2030-31 (MW)			3,659	3,659			
Cumulative Addition up till 2031 (MW)			35,639	35,315			

H-5. Annual Capacity Factors (%age)

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%age								
1	Almoiz	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
2	Chanar	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
3	Chiniot	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
4	Fatima	Bagasse	6.53	6.55	1.03	6.23	0.78	6.22	6.23	5.95	5.90
5	Hamza	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
6	JDW-II	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
7	JDW-III	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
8	Ryk_Mills	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
9	Shahtaj	Bagasse	0.00	0.00	45.62	45.62	45.62	45.77	45.62	45.62	45.62
10	Thal_Layyah	Bagasse	45.62	45.77	45.62	45.62	45.62	45.77	45.62	45.62	45.62
11	Appolo	PV	18.96	18.91	18.96	18.96	18.96	18.91	18.96	18.96	18.96
12	Best	PV	18.94	18.89	18.94	18.94	18.94	18.89	18.94	18.94	18.94
13	Crest	PV	19.19	19.13	19.19	19.19	19.19	19.13	19.19	19.19	19.19
14	Helios	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
15	HNDS	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
16	Manjhand	PV	0.00	23.23	23.33	23.33	23.33	23.27	23.33	23.33	23.33
17	Meridian	PV	23.51	23.27	23.33	23.33	23.33	23.27	23.33	23.33	23.33
18	Net_Meter	PV	17.08	17.03	17.08	17.08	17.08	17.03	17.08	17.08	17.08
19	New_Solar	PV	0.00	0.00	22.08	22.08	22.08	22.02	22.08	22.08	22.08
20	New_Solar_Feeder	PV	0.00	19.95	20.00	20.00	20.00	19.95	20.00	20.00	20.00
21	QA_Solar	PV	19.04	18.99	19.04	19.04	19.04	18.99	19.04	19.04	19.04
22	Siachen	PV	0.00	23.23	23.33	23.33	23.33	23.27	23.33	23.33	23.33
23	Zhenfa	PV	21.50	21.44	21.50	21.50	21.50	21.44	21.50	21.50	21.50
24	Zorlu	PV	0.00	20.17	20.17	20.17	20.17	20.11	20.17	20.17	20.17
25	Gharo	KE_PV	25.25	25.18	25.25	25.25	25.25	25.18	25.25	25.25	25.25
26	KE_New_Solar	KE_PV	0.00	0.00	22.08	22.08	22.08	22.02	22.08	22.08	22.08
27	Oursun	KE_PV	20.97	20.91	20.97	20.97	20.97	20.91	20.97	20.97	20.97
28	Act	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
29	Act_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
30	Artistic_wind	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
31	Artistic_Wind_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
32	Dawood	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
33	Din	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
34	FFC	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
35	FWEL-I	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
36	FWEL-II	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
37	Gul Ahmed	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
38	Gul_Electric	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
39	Hawa	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
40	Indus_Energy	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
41	Jhimpir	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86

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#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
42	Lakeside	Wind	38.93	38.07	38.17	38.17	38.17	38.07	38.17	38.17	38.17
43	Liberty_Wind_1	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
44	Liberty_Wind_2	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
45	Master	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
46	Master_Green	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
47	Metro_Power	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
48	Metro_Wind	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
49	NASDA	Wind	38.93	38.07	38.17	38.17	38.17	38.07	38.17	38.17	38.17
50	New_Wind	Wind	0.00	0.00	41.28	41.28	41.28	41.17	41.28	41.28	41.28
51	Sachal	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
52	Sapphire_Wind	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
53	Tenaga	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
54	Three_Gorges_I	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
55	Three_Gorges_II	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
56	Three_Gorges_III	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
57	Trans_Atlantic	Wind	0.00	41.28	41.28	41.28	41.28	41.17	41.28	41.28	41.28
58	Tricom	Wind	37.94	37.09	37.19	37.19	37.19	37.09	37.19	37.19	37.19
59	Tricon_A	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
60	Tricon_B	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
61	Tricon_C	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
62	UEP	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
63	Western	Wind	0.00	37.19	37.19	37.19	37.19	37.09	37.19	37.19	37.19
64	Yunus	Wind	30.99	30.91	30.99	30.99	30.99	30.91	30.99	30.99	30.99
65	Zephyr	Wind	34.86	34.82	34.86	34.86	34.86	34.82	34.86	34.86	34.86
66	Zorlu_Wind	Wind	31.99	31.91	31.99	31.99	31.99	31.91	31.99	31.99	31.99
67	KE_New_Wind	KE_Wind	0.00	0.00	41.28	41.28	41.28	41.17	41.28	41.28	41.28
68	CASA	Interconnection	0.00	0.00	41.80	41.92	41.92	41.80	41.92	41.92	41.92
69	Arkari Gol	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.22	42.22
70	Asrit Kedam	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.72	49.72
71	Bata Kundu	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	54.76	54.79	54.79
72	Chowkel Khwar	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	44.57	44.57	44.57
73	CJ	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	50.50	50.50	50.50
74	Dowarian	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.85	48.85
75	Jagran-IV	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.09	49.09
76	Kalam Asrit	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.41	44.41
77	Mahl	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.53
78	Nagdar	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.87	48.87
79	Nila Da Katha	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	51.31	51.31	51.31
80	Rajdhani	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.46	58.46
81	Sharmai	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.94	50.94
82	Shounter	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.86	48.86
83	Taunsa	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	55.02	55.02	55.02

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
84	Thakot-III	HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.30
85	Turtonas Uzghor	KE_HPP Candidate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.89	51.90
86	Azad Pattan	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	52.77	52.77	52.77
87	Balakot	HPP Committed	0.00	0.00	0.00	0.00	0.00	41.21	41.21	41.21	41.21
88	Dasu	HPP Committed	0.00	0.00	0.00	64.47	64.47	64.29	64.47	64.47	64.47
89	Diamer Bhasha	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	Gabral Kalam	HPP Committed	0.00	0.00	0.00	0.00	0.00	33.77	33.77	33.77	33.77
91	Gorkin Matiltan	HPP Committed	0.00	0.00	42.71	42.80	42.83	42.71	42.83	42.83	42.83
92	Jagran-II	HPP Committed	50.39	50.39	50.53	50.53	50.53	50.39	50.53	50.53	50.53
93	Karot	HPP Committed	44.39	44.29	44.38	44.37	44.38	44.29	44.38	44.39	44.39
94	Keyal Khwar	HPP Committed	0.00	0.00	0.00	0.00	52.07	51.92	52.07	52.07	52.07
95	Kohala	HPP Committed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.14	56.14
96	Koto	HPP Committed	57.15	57.15	56.98	56.98	57.12	56.96	57.12	57.15	57.15
97	Lawi	HPP Committed	0.00	47.99	47.88	47.84	47.99	47.90	47.99	48.02	48.08
98	Madyan	HPP Committed	0.00	0.00	0.00	0.00	0.00	47.43	47.43	47.43	47.43
99	Mohmand Dam	HPP Committed	0.00	0.00	0.00	42.71	42.71	42.60	42.71	42.71	42.71
100	Suki Kinari	HPP Committed	0.00	49.07	49.07	49.07	49.07	48.93	49.07	49.07	49.07
101	Tarbela_Ext_5	HPP Committed	0.00	0.00	10.05	10.05	10.05	10.02	10.05	10.05	10.05
102	Allai Khwar	HPP Existing	44.28	44.20	44.28	44.28	44.28	44.20	44.32	44.32	44.32
103	Chashma	HPP Existing	48.58	48.45	48.58	48.58	48.58	48.45	48.58	48.58	48.58
104	Daral Khwar	HPP Existing	38.58	38.48	38.58	38.58	38.58	38.48	38.58	38.58	38.58
105	Dubair Khwar	HPP Existing	53.09	52.95	53.09	53.09	53.09	52.95	53.09	53.09	53.09
106	Ghazi Brotha	HPP Existing	52.78	52.63	52.78	52.78	52.78	52.63	52.78	52.78	52.78
107	Golen Gol	HPP Existing	9.15	9.12	9.15	9.15	9.15	9.12	9.15	9.15	9.15
108	Gulpur	HPP Existing	28.92	28.84	28.92	28.92	28.92	28.84	28.92	28.92	28.92
109	Jagran-I	HPP Existing	48.95	48.82	48.95	48.95	48.95	48.82	48.95	48.95	48.95
110	Jinnah	HPP Existing	25.74	25.67	25.74	25.74	25.74	25.67	25.74	25.74	25.74
111	Khan Khwar	HPP Existing	40.22	40.11	40.22	40.22	40.22	40.11	40.22	40.22	40.22
112	Malakand-III	HPP Existing	53.86	53.71	53.86	53.86	53.86	53.71	53.86	53.86	53.86
113	Mangla	HPP Existing	64.95	60.97	58.32	56.00	54.77	54.20	54.35	54.35	54.35
114	Neelum Jehlum	HPP Existing	51.68	51.54	51.68	51.65	51.68	51.54	51.69	51.69	51.69
115	New Bong	HPP Existing	55.49	55.34	55.49	55.49	55.49	55.34	55.49	55.49	55.49
116	Patrind	HPP Existing	43.76	43.64	43.76	43.76	43.76	43.64	43.76	43.76	43.76
117	Small Hydel	HPP Existing	45.02	44.90	45.02	45.02	45.02	44.90	45.02	45.02	45.02
118	Tarbela 1-14	HPP Existing	37.99	37.89	37.99	37.99	37.99	37.89	37.99	37.99	37.99
119	Tarbela_Ext_4	HPP Existing	30.12	30.04	30.12	30.12	30.12	30.04	30.12	30.12	30.12
120	Warsak	HPP Existing	50.64	50.50	50.64	50.64	50.64	50.50	50.64	50.64	50.64
121	Engro 90MW	CCGT_Gas	90.23	74.96	33.64	30.22	40.49	35.86	32.28	31.23	26.29
122	Foundation	CCGT_Gas	89.97	90.25	57.94	88.08	57.94	57.94	78.25	81.84	74.60
123	Guddu-I	CCGT_Gas	36.90	74.63	13.55	73.13	17.61	17.20	69.39	68.69	67.80
124	Guddu-II	CCGT_Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
125	Guddu-V (747)	CCGT_Gas	75.56	75.77	60.72	74.01	51.07	70.10	73.07	70.61	69.90

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#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			% 								
126	Liberty	CCGT_Gas	75.26	75.02	40.17	40.17	0.00	0.00	0.00	0.00	0.00
127	Uch	CCGT_Gas	86.08	86.32	39.91	44.16	43.09	43.59	46.45	48.14	0.00
128	Uch-II	CCGT_Gas	87.77	88.05	51.31	73.35	51.32	51.33	51.33	75.75	51.32
129	SNPC-I	KE_CCGT_Gas	91.98	92.25	66.44	90.08	35.30	34.46	46.47	83.97	40.38
130	SNPC-II	KE_CCGT_Gas	91.98	92.25	68.62	90.37	36.73	35.93	80.23	84.22	41.67
131	AES Lalpir	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
132	AES Pakgen	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
133	HUBCO	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
134	Jamshoro-I U1	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
135	Jamshoro-II U4	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
136	Muzaffargarh-I U1	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
137	Muzaffargarh-I U2	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
138	Muzaffargarh-I U3	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
139	Muzaffargarh-II U4	ST_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
140	Saba	ST_RFO	14.38	21.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00
141	AGL	DG_RFO	36.12	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00
142	Atlas	DG_RFO	14.40	21.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
143	Engro 127MW	DG_RFO	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
144	HuB N	DG_RFO	36.12	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00
145	Kohinoor	DG_RFO	14.39	21.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
146	Liberty Tech	DG_RFO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
147	Nishat C	DG_RFO	36.12	21.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
148	Nishat P	DG_RFO	36.81	22.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
149	C-1	Nuclear	80.43	80.65	80.43	80.43	80.43	80.65	80.43	80.43	80.43
150	C-2	Nuclear	79.61	79.83	79.61	79.61	79.61	79.83	79.61	79.61	79.61
151	C-3	Nuclear	81.01	81.23	81.01	81.01	81.01	81.23	81.01	81.01	81.01
152	C-4	Nuclear	81.01	81.23	81.01	81.01	81.01	81.23	81.01	81.01	81.01
153	K-2	Nuclear	85.06	85.30	85.03	85.03	85.05	85.28	85.05	85.06	85.05
154	K-3	Nuclear	85.66	85.90	85.63	85.63	85.65	85.89	85.65	85.65	85.65
155	Engro Thar	Local Coal	82.51	82.74	81.41	81.63	80.45	81.05	81.01	81.27	77.85
156	Gwadar	Local Coal	0.00	0.00	0.00	67.93	77.70	81.02	81.61	81.02	78.17
157	Lucky	Local Coal	85.08	85.31	85.05	85.06	84.95	84.95	85.01	85.07	85.07
158	Thal Nova	Local Coal	49.35	85.21	84.06	84.07	83.49	83.74	83.60	84.08	82.81
159	Thar TEL	Local Coal	84.98	85.21	84.06	84.07	83.50	83.74	83.81	83.93	82.65
160	Thar-I (SSRL)	Local Coal	42.14	85.21	84.40	84.64	84.02	84.21	84.09	84.18	84.20
161	K.E_NEW_L.Coal	KE_Local Coal	0.00	0.00	0.00	0.00	82.85	82.92	82.81	83.16	83.16
162	China HUBCO	Imported Coal	51.57	51.57	51.57	51.57	51.57	51.57	51.57	51.57	51.57
163	Jamshoro Coal	Imported Coal	49.36	80.64	10.10	12.75	16.36	14.92	18.90	23.53	21.39
164	Port Qasim	Imported Coal	48.72	48.72	48.72	48.72	48.72	48.72	48.72	48.72	48.72
165	Sahiwal Coal	Imported Coal	48.02	48.02	48.01	48.01	48.01	48.01	48.01	48.01	48.01
166	FPCL	KE_Imported Coal	82.15	52.10	7.12	11.30	5.95	9.20	13.39	17.38	14.75
167	Davis	DG_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

#	Plant Name	Fuel	23	24	25	26	27	28	29	30	31
			%								
168	Balloki	CCGT_RLNG	4.23	1.01	0.06	0.82	0.53	0.55	1.36	1.34	1.12
169	Bhikki	CCGT_RLNG	1.21	0.46	0.00	0.25	0.29	0.28	0.43	0.51	0.48
170	FKPCL	CCGT_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
171	Halmore	CCGT_RLNG	37.73	37.73	37.73	22.68	0.00	0.00	0.30	0.30	0.30
172	Haveli	CCGT_RLNG	11.09	4.52	0.46	1.67	1.29	1.58	1.87	1.78	2.22
173	KAPCO 1	CCGT_RLNG	35.31	35.29	35.29	0.00	0.00	0.00	0.00	0.00	0.00
174	KAPCO 2	CCGT_RLNG	11.86	11.87	11.87	0.00	0.00	0.00	0.00	0.00	0.00
175	KAPCO 3	CCGT_RLNG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
176	Nandipur	CCGT_RLNG	36.38	36.38	36.38	21.87	0.00	0.00	0.00	0.21	0.23
177	Orient	CCGT_RLNG	37.73	22.68	0.00	0.00	0.00	0.00	0.30	0.30	0.30
178	Rousch	CCGT_RLNG	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
179	Saif	CCGT_RLNG	37.73	37.73	37.73	22.68	0.00	0.00	0.00	0.30	0.30
180	Saphire	CCGT_RLNG	37.73	37.73	37.73	22.68	0.00	0.00	0.19	0.30	0.30
181	Trimmu	CCGT_RLNG	26.53	11.54	3.11	4.37	3.01	2.62	4.90	6.28	6.53
182	BQPS2	KE_CCGT_RLNG	85.24	73.12	18.74	19.08	8.16	7.59	12.99	13.94	13.84
183	BQPS3	KE_CCGT_RLNG	89.85	89.80	49.58	48.04	17.22	18.00	21.71	24.08	23.61
184	KCCPP	KE_CCGT_RLNG	85.17	52.08	9.16	9.34	6.19	6.10	10.16	12.36	10.33
185	KTGTPS	KE_CCGT_RLNG	45.16	40.01	3.39	5.80	2.32	2.64	3.74	5.02	7.05
186	SGTPS	KE_CCGT_RLNG	48.00	43.72	3.97	6.20	2.79	3.16	3.81	5.44	7.57
187	BQPS1-U1	KE_ST_RLNG	10.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
188	BQPS1-U5	KE_ST_RLNG	29.34	29.97	1.68	1.71	0.39	0.45	1.00	1.05	1.39
189	BQPS1-U6	KE_ST_RLNG	16.15	15.55	1.41	1.54	0.00	0.01	0.63	0.75	0.96
190	BQPS1-U2	KE_GT_RLNG	22.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(All numbers in yellow color, in this table, represent retirement of the corresponding project.)

H-6. Year-wise Installed Capacity Addition (MW)

FY	Local Coal	Hydro	RLNG	Nuclear	Imported Coal	RE	Local Gas	Furnace Oil	Cross Border	Net Yearly Addition	Cumulative Total
2022	1,320	10,593	9,789	3,620	4,020	2,802	2,744	3,633	-	-	38,521
2023	1,980	205	1,263	-	660	630	-	-	-	4,738	43,259
2024	-	314	-420	-	-	2,830	-	-	-	2,724	45,983
2025	-	2,347	-	-	-	8,707	-	-	1,000	12,054	58,037
2026	300	630	-1,300	-	-	1,039	-	-	-	669	58,706
2027	990	2,558	-	-	-	941	-225	-1,292	-	2,972	61,678
2028	-	545	-	-	-	1,270	-	-131	-	1,684	63,362
2029	-	876	-	-	-	702	-	-727	-	851	64,212
2030	-	1,514	-172	-	-	680	-	-136	-	1,886	66,098
2031	-	2,979	-450	-	-	680	-586	-	-	2,623	68,721
Total	4,590	22,560	8,710	3,620	4,680	20,281	1,933	1,347	1,000	30,201	68,721

H-7. IGCEP Generation Mix 2023-2031 (GWh)

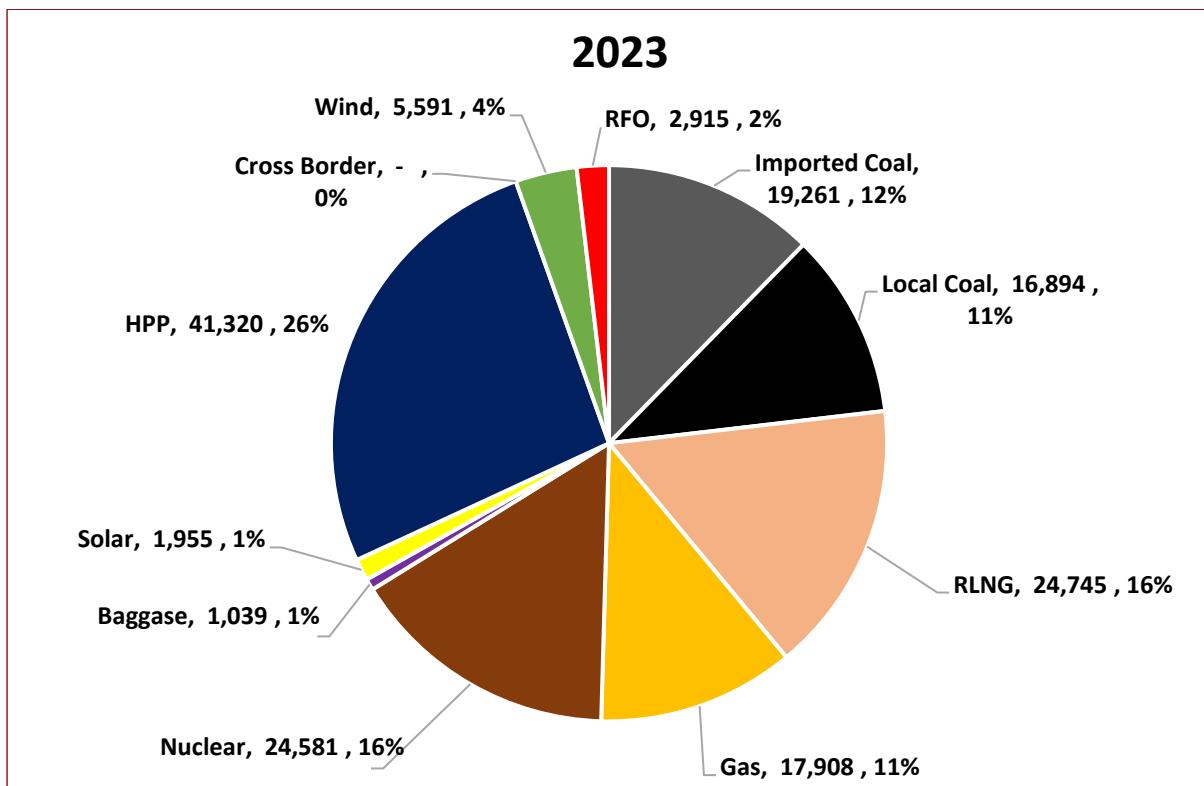


Chart H-1: IGCEP Generation Mix 2023 (GWh)

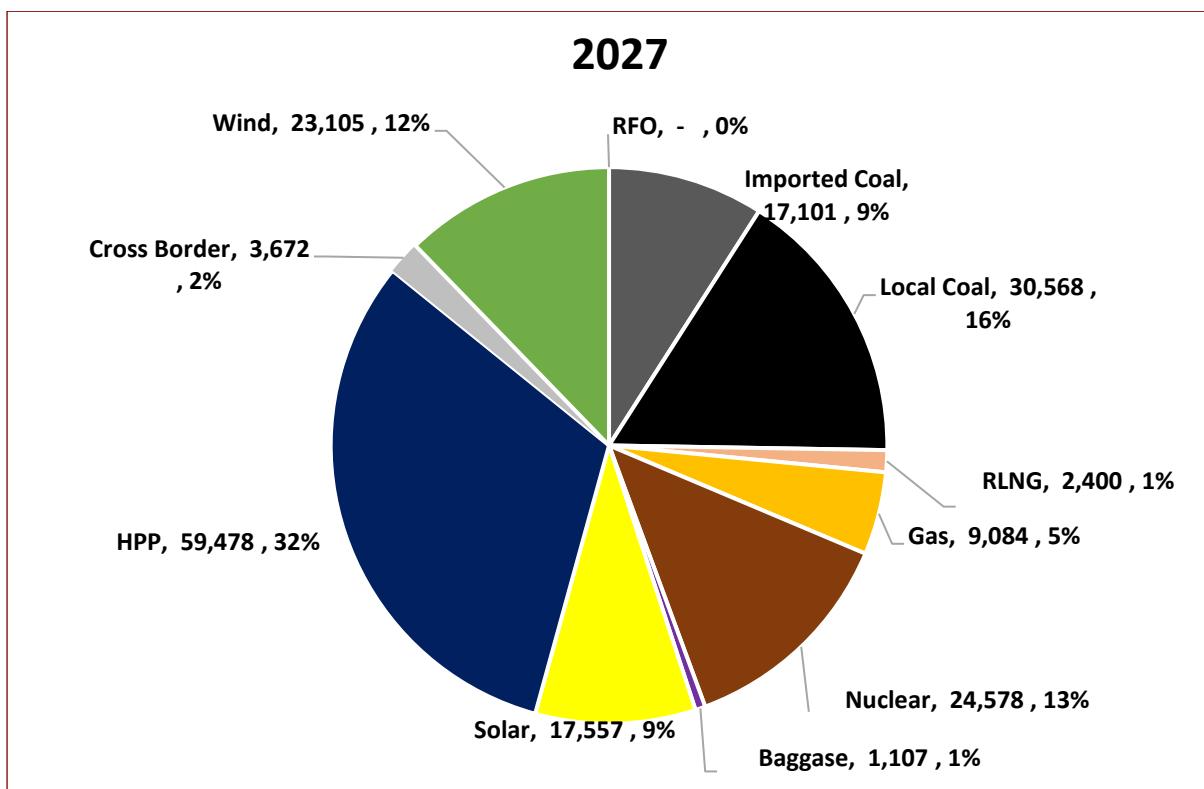


Chart H-2: IGCEP Generation Mix 2027 (GWh)

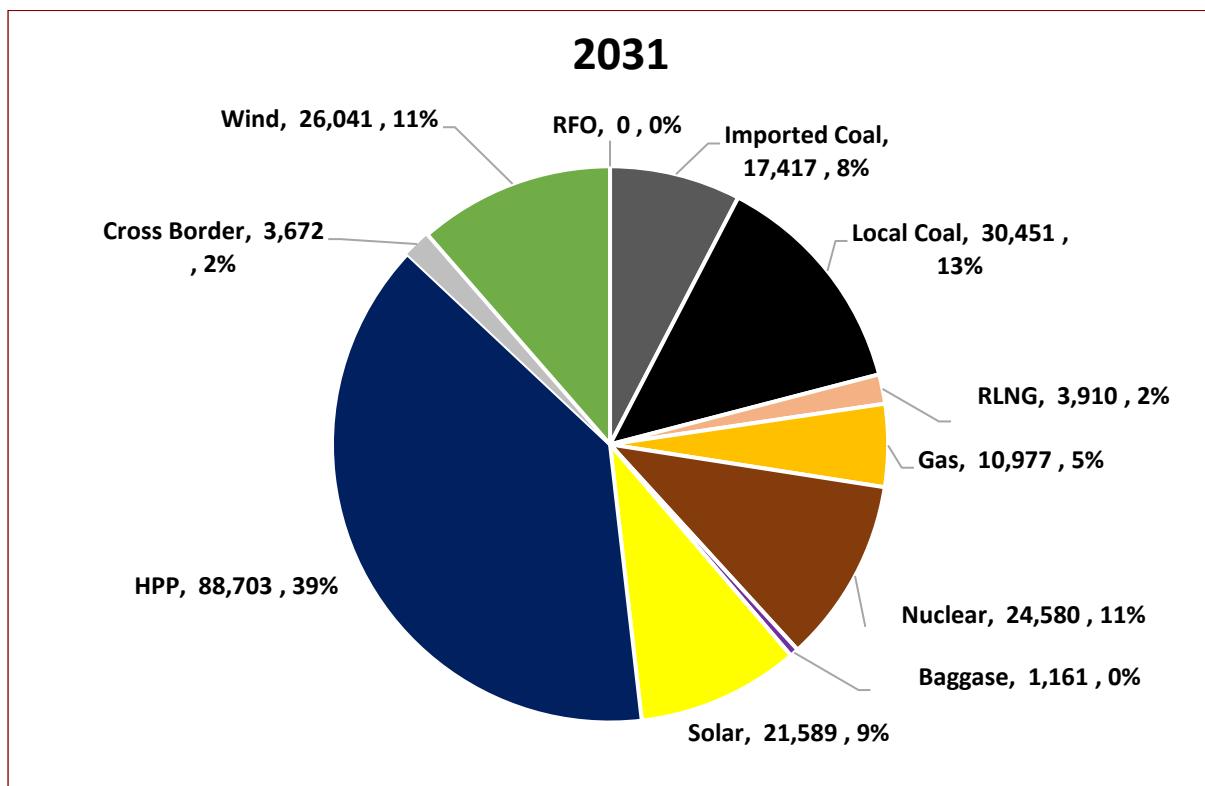


Chart H-3: IGCEP Generation Mix 2031 (GWh)

H-8. IGCEP Generation Mix 2023-31 (MW)

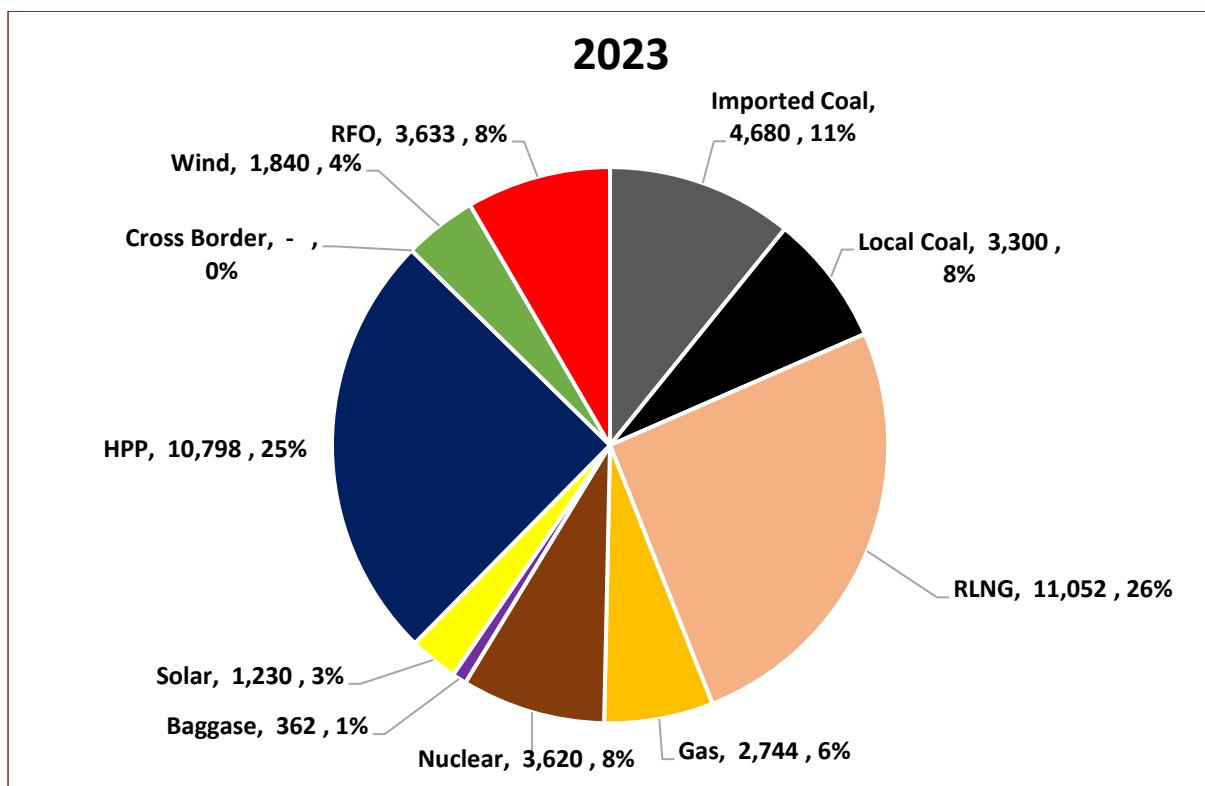


Chart H-4: IGCEP Generation Mix 2023 (MW)

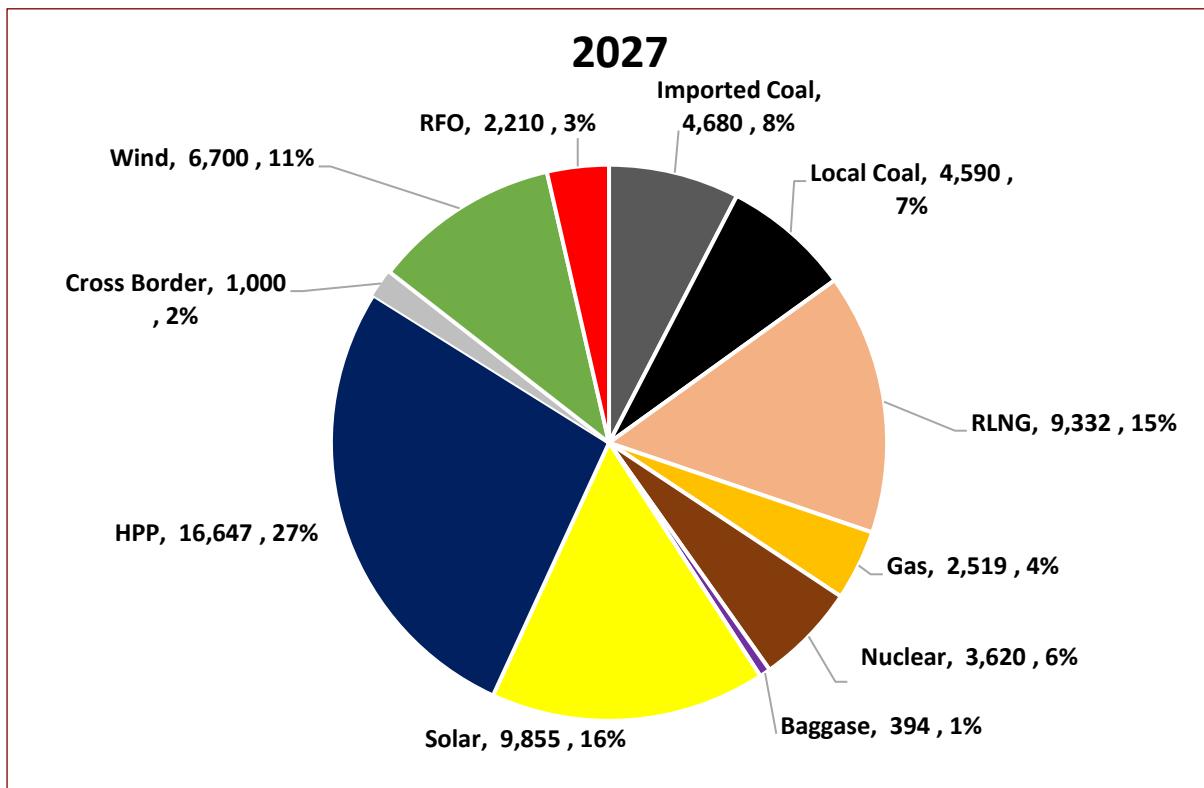


Chart H-5: IGCEP Generation Mix 2027 (MW)

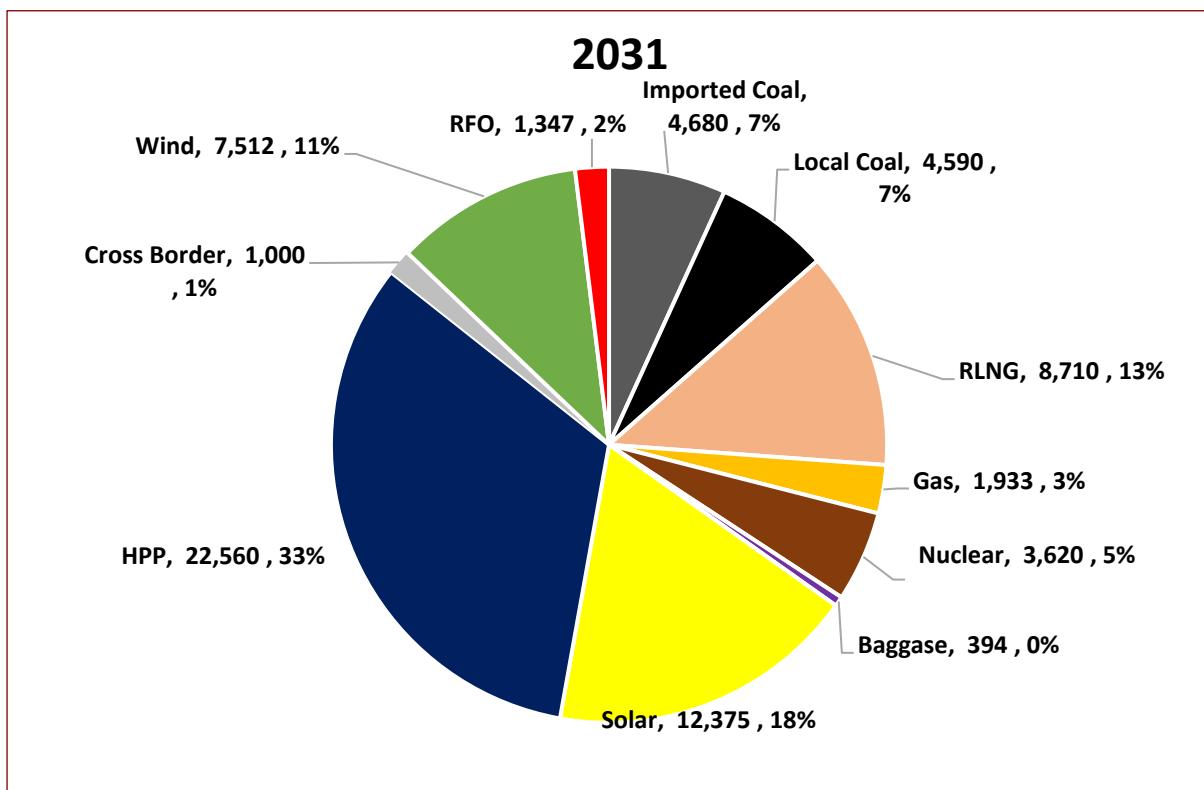


Chart H-6: IGCEP Generation Mix 2031 (MW)



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