The Islamic Republic of Pakistan
National Energy Efficiency & Conservation Authority (NEECA)

Project for Developing Effective Phasing out Strategy / Program of Inefficient Appliances to Support Energy Standards and Labeling Regime in the Islamic Republic of Pakistan

Project Completion Report

March 2022

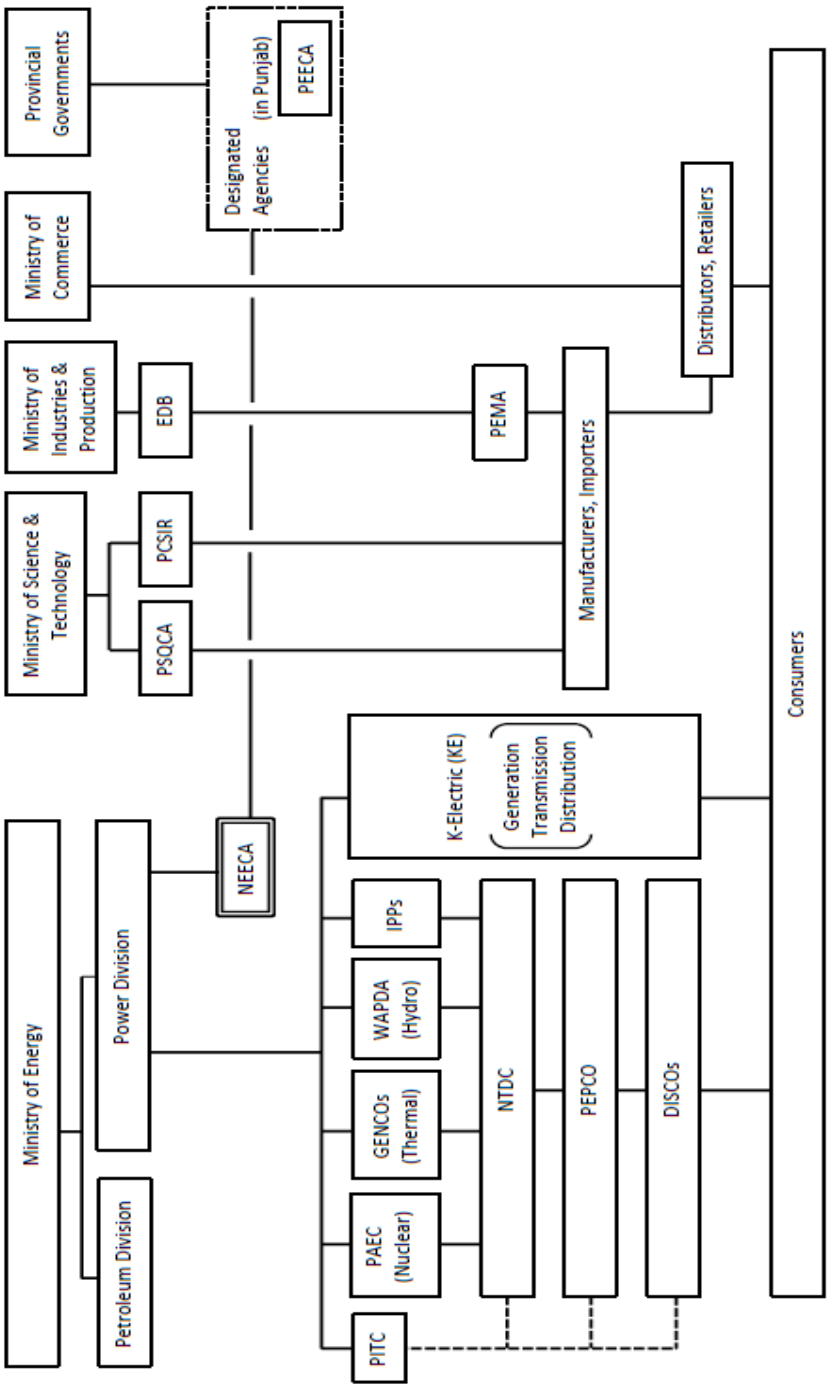
Japan International Cooperation Agency
Jizo Laboratory

IM
JR
22-024

Prefatory Figures

Map of Pakistan[5]

[5] This map, based on a UN map, modified by JICA. The depiction and use of boundaries, geographic names and related data shown on map do not necessarily imply official endorsement or acceptance by JICA.



Related organizations
Source: Jizolab

Photo Collection

Output 1

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<tr><td>Meeting with PCSIR (8 Apr. 2019)</td><td>Meeting with PEECA (8 Apr. 2019)</td></tr>
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<tr><td>Meeting with NEECA (9 Apr. 2019)</td><td>Meeting with GEPCO (11 Apr. 2019)</td></tr>
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<tr><td>Meeting with K-Electric (16 Apr. 2019)</td><td>1st JCC Meeting (19 Apr. 2019)</td></tr>
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Meeting with DISCOs (5 Jul. 2019)	NEECA Workshop (26 Sep. 2019)
	
Meeting with NEECA & CLASP (27 Sep. 2019)	Meeting with Women's Group (1 Oct. 2019)
	
1st TWG Meeting (12 Dec. 2019)	PSQCA Tech. Committee (13 Feb. 2020)

Output 2

	
JICA Tokyo (18 Nov. 2019)	JICA Tokyo (18 Nov. 2019)
	
METI (18 Nov. 2019)	Japan Air Conditioning and Refrigeration Testing Laboratory (19 Nov. 2019)
	
Panasonic Kusatsu Factory (20 Nov. 2019)	Daikin Kusatsu Factory (20 Nov. 2019)

	
Japan Quality Assurance Organization (21 Nov. 2019)	Daikin Shinjuku Showroom (22 Nov. 2019)
	
JICA Tokyo (22 Nov. 2019)	JICA Tokyo (22 Nov. 2019)

Abstract

The draft of ES&L regulations for Air Conditioners (ACs) and refrigerators has been created and approval by PEECB and promulgation of these regulations will be made shortly. After a runup period of half year to one year, enforcement will commence. In parallel to this, an awareness campaign on the ES&L scheme shall be commenced. These remaining tasks will be implemented by NEECA.

The project outputs are shown below:

(1) Output 1

1) Formulation of ISO16358 as the Pakistan Standard
2) Creation of the draft MEPS for ACs and refrigerators as the Pakistan Standard
3) Creation of the technical part of ES&L regulation with Star Rating for ACs and refrigerators
4) Capacity development of PCSIR which owns and operates a test laboratory for refrigerators
5) Power consumption survey of ACs and refrigerators (DISCO data analysis and measurement survey)
6) Proposal on vision, strategy and action plan for ES&L

(2) Output 2

1) Creation of awareness films
2) Design of awareness campaign
3) Counterpart training

(3) Others

1) JICA Newsletter on capacity development for PCSIR

Assuming a 22 PKR/kWh electricity tariff, lower thresholds of impacts of the above ES&L regulations from 2022 to 2025 are estimated as follows:

- ACs: 2,109 GWh of energy saving and approximately. 46 billion PKR economic saving
- Refrigerators: 990 GWh of energy saving and approximately. 22 billion PKR economic saving

Project for Developing Effective Phasing out Strategy/ Program of Inefficient Appliances to Support Energy Standards and Labeling Regime in the Islamic Republic of Pakistan

Project Completion Report

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4. Power Consumption Survey (DISCO Data Analysis and Measurement Survey)
5. ES&L Awareness films
6. ES&L Booklet
7. ES&L Pamphlet
8. Public Awareness Plan
9. Counterpart Training in Japan
10. JICA Newsletter on Capacity Development for PCSIR's Refrigerator Testing Laboratory (IEC62552-3 online traing)

Abbreviation

Abbreviation	English meaning
AC	Air Conditioner
ADB	Asian Development Bank
APF	Average Performance factor
CAFE	Corporate Average Fuel Economy
CERAD	Center for Energy Research and Development
CEC	Comparative Energy Consumption
CFL	Compact Fluorescent Lamps
CLASP	Collaborative Labeling and Appliance Standards Program
COVID-19	Corona Virus Disease 19
C/P	Counter Part
CPC	Consumer Protection Council
CPPA	Central Power Purchasing Agency
CSPF	Cooling Seasonal Performance Factor
DA	Designated Agency
DISCO	Distribution Company
DLC	Daily Load Curve
EAD	Economic Affairs Division
EDB	Engineering Development Board
EE	Energy Efficiency
EE&C	Energy Efficiency and Conservation
EI	Energy Intensity
EMTL	Electrical Measurement & Test Laboratory
ENERCON	National Energy Conservation Center
ESCO	Energy Service Company
ES&L	Energy Standards & Labeling
EV	Electric Vehicle
FESCO	Faisalabad Electric Supply Company
FRM	AC Full Running Month
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GENCO	Generation Company
GEPCO	Gujranwala Electric Power Company
GOP	Government of Pakistan
GW	Giga Watt
GWh	Giga Watt Hour
HH	Household
HP	Horsepower
HPC	High Pressure Cogeneration
HESCO	Hyderabad Electric Supply Company
HIES	Household Integrated Economy Survey
IEA	International Energy Agency
IEC	International Electro-technical Commission
IESCO	Islamabad Electricity Supply Company
IPP	Independent Power Producer
ISO	International Organization for Standardization
JATL	Japan Air Conditioning and Refrigeration Testing Laboratory
JCC	Joint Coordination Committee
JICA	Japan International Cooperation Agency

JIS	Japan Industry Standard
JQA	Japan Quality Assurance Organization
KE	K Electric Ltd.
kTOE	Kilo Tons of Oil Equivalent
kW	Kilo Watt
kWh	Kilo Watt Hour
L	Litter
LED	Light-Emitting Diode
LESCO	Lahore Electric Supply Company
LNG	Liquefied Natural Gas
MD	Man Day
MD	Managing Director
MEPCO	Multan Electric Power Company
MEPS	Minimum Energy Performance Standards
MIS	Management Information System
MJ	Megajoule
M/M	Minutes of Meeting
MoCC	Ministry of Climate Change
MoE	Ministry of Energy
MoEA	Minister for Economic Affairs
MoIP	Ministry of Industries and Production
MoST	Ministry of Science and Technology
MS	Microsoft
MTOE	Millions of Tons of Oil Equivalent
MVEC	Motor Vehicle Examination Center
MW	Mega Watt
MWh	Mega Watt Hour
NEECA	National Energy Efficiency & Conservation Authority
NEPRA	National Electric Power Regulatory Authority
NGO	Non-Governmental Organization
NPCC	National Power Control Center
NPHA	Naya Pakistan Housing Authority
NPHS	Naya Pakistan Housing Scheme
NTDC	National Transmission & Dispatch Company
PAEC	Pakistan Atomic Energy Commission
PBS	Pakistan Bureau of Statistics
PCRET	Pakistan Council of Renewable Energy Technology
PCSIR	Pakistan Council of Scientific and Industrial Research
PDM	Project Data Management
PEC	Pakistan Engineering Council
PEDO	Pakhtunkhwa Energy Development Organization
PEECA	Punjab Energy Efficiency and Conservation Agency
PEECB	Pakistan Energy Efficiency and Conservation Board
PEMA	Pakistan Electronics Manufacturers Association
PEPCO	Pakistan Electric Power Company Limited
PESCO	Peshawar Electric Supply Company
PITC	Power Information Technology Company
PKR	Pakistan Rupee
PNAC	Pakistan National Accreditation Council
PO	Plan of Operation
PPRA	Public Procurement Regulatory Authority

PRS	Product Registration System
PS	Pakistan Standard
PSLM	Pakistan Social & Living Standard Measurement
PSQCA	Pakistan Standards and Quality Control Authority
QESCO	Quetta Electric Supply Company
QR code	Quick Response code
R/D	Record of Discussion
RLF	Revolving Loan Fund
SEPCO	Sukkur Electric Power Company
SM	AC Stopped Month
SNS	Social Network Service
TC	Technical Committee
TESCO	Tribal Electric Supply Company
TFEC	Total Final Energy Consumption
TJ	Terajoule
TOR	Terms of Reference
TPES	Total Primary Energy Supply
TWG	Technical Working Group
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
Vadj	Adjusted Volume
VFD	Variable Frequency Drive
W	Watt
WAPDA	Water and Power Development Authority
WB	World Bank
WWF	World Wildlife Fund for Nature

1 Outline of Project

1.1 Background

Pakistan has been facing a serious energy supply-demand gap in recent years. Peak demand in 2015-16 was 24,757 MW, but operable generation capacity was limited at 18,826 MW (24% deficiency in supply capability). Because of this gap, load shedding of several hours per day in some areas has taken place.

Under these circumstances, it is recognized that an improvement in Energy Efficiency and Conservation (EE&C) at the demand side is essential to cut power consumption, in addition to enhancement of supply capability in power generation, transmission and distribution system. ADB estimated that 15.4% of energy consumption can be reduced from 2008 to 2019.

The Government of the Islamic Republic of Pakistan (GOP) requested assistance on Policy-Based Loan from the World Bank, ADB and JICA for Power Sector Reform. Following this, "Power Sector Reform (I) (II) (III)[2]" was implemented in 2012-17. In this program, policy matrix consisting of three main pillars and ten reform items were defined. The pillars are "Managing tariff and subsidies", "Improving energy sector performance" and "Increasing accountability and transparency", and in "Improving energy sector performance", improvement in EE&C on the demand side was set forth as one of the reform items.

In this situation, in order to reduce the power demand on residential and commercial sectors, the GOP implemented the Energy Standards and Labeling (hereinafter referred to as "ES&L") system for fans in 2016 with the support of JICA.

In this connection, JICA has implemented the following two projects as part of technical assistances based on above mentioned policy matrix:

- 2014-15: Institution – Building and Promotion of Energy Saving
  - (a) Formulate Minimum Energy Performance Standards (MEPS) and the ES&L scheme
  - (b) Develop a Roadmap to have a view of phase out process of non-conforming products (fan, CFL (Compact Fluorescent Lamp), motor) with ES&L
- 2015-16: Expert for Energy Conservation and Efficiency Promotion
  - (a) Formulate incentive schemes for ES&L
  - (b) Launch ES&L for (ceiling) fan

At the same time, GOP formulated the National Energy Efficiency and Conservation Act (hereinafter, EC Act) in July 2016 and the Energy National Conservation Centre (ENERCON) was reorganized as the National Energy Efficiency and Conservation Authority (hereinafter referred to as "NEECA") under the Act, for the further promotion of the EE&C. Now NEECA is the regulating authority and has the power to formulate, revise, implement and operate national EE&C policy. However, NEECA is still a small agency with limited human resources, and accordingly has urgent issues on strengthening its organizational power and enhancing its human resource development.

Finally, in order to accelerate these movements in EE&C in Pakistan, the GOP requested the Government of Japan (hereinafter referred to as "GOJ") to implement a new technical cooperation project

[2] The World Bank and JICA assisted I and II only, and ABD did all 3 phases.

with NEECA to phase out inefficient appliances in relation to promoting ES&L in 2015. This request was officially approved by the GOJ and Note Verbales were exchanged for its implementation in September 2016 between the two governments.

Thus, the Project will take over the above efforts of GOP to promote ES&L in order to phase out inefficient appliances effectively.

1.2 Goal and output

(1) Overall goal

Energy consumption is reduced by ES&L of targeted/ labeled products.

(2) Project purpose

Inefficient appliances are effectively phased out through the proper implementation of Energy saving and labelling system.

(3) Output

Output 1: Consensus among the related organizations for mandatory ES&L is formulated

Output 2: Public Awareness for ES&L is improved

1.3 Activities

Activities for Output 1 and one for Output 2 are shown in Table 1-1 and Table 1-2 respectively.

Table 1-1 Activities for Output 1
Source: Jizolab

No.	Activity
1-1	Conduct baseline survey
(1)	Primary energy
(2)	Final energy consumption
(3)	Sector wise energy conservation potential
(4)	Perspective of EE&C measures with ongoing efforts
(5)	Analysis of possible measures for EE&C in Pakistan
(6)	Power supply and demand (MW) and electricity consumption (GWh)
(7)	Electricity consumption of Target Appliance in households (Urban and Regional)
(8)	Current issues related to ES&L in Pakistan (Institutional side and technical)
(9)	Expected impact of ES&L (Referential index)
1-2	Formulate a vision for promotion of ES&L
1-3	Formulate a strategy for promotion of ES&L
(1)	ES&L monitoring framework for labeled product in market
(2)	Measures for imported appliances (Measures for inferior quality products at customs)
(3)	Measures for imported appliances (Mutual harmonization)
(4)	Revision framework of MEPS standard to reflect the latest energy performance timely
(5)	Formulation/Revision of ES&L scheme linked with the MEPS standard
(6)	Revise Roadmap for ES&L
(7)	Incentive measures
(8)	Layer wise (manufacturer, distributer/retailer and consumer) awareness and publicity activity
1-4	Formulate a specific action plan for the related organizations, such as NEECA, provincial governments, PSQCA, and PCSIR, etc.
1-5	Promote mandatory ES&L for Targeted Appliance
(1)	Identify the target appliance for mandatory ES&L scheme
(2)	Study a specific work plan and role of the related parties
(3)	Formulate related technical standard as Pakistan Standard and other necessary detailed regulations
(4)	Coordinating with related parties for the approval of regulations including PEECB
(5)	Approval of regulations by the GOP
(6)	Awareness raising of approved mandatory ES&L
(7)	Analyzing lessons learned
1-6	Conduct a counterpart training in Japan in connection with the above activities

Table 1-2 Activities for Output 2
Source: Jizolab

No.	Activity
2-1	Plan public awareness for consumers
2-2	Plan public awareness for retailers
2-3	Plan and conduct public awareness for industrial sector
2-4	Conduct a counterpart training in Japan, in connection with the above activities

1.4 Project Members

Table 1-3 Project Members
Source: Jizolab

Name	Responsibility	Affiliation	Period
Dr. Sardar Mohazzam	Project Director	NEECA	Oct. 2019 – Mar. 2022
Engr. Asad Mahmood	Project Manager	NEECA	Mar. 2019 – Mar. 2022
Engr. Muhammad Umar	Technical Staff	NEECA	Nov. 2021 – Mar. 2022
Engr. Tanzeel Khan			Nov. 2021 – Dec. 2021

Dr. Jun HAGIHARA	Chief Advisor / Policy for EE&C		Jizo Laboratory LLC	Mar. 2019 – Mar. 2022
Yoshio HIRAYAMA	Promotion for ES&L A		Jizo Laboratory LLC	Mar. 2019 – Apr. 2020
Noboru YUMOTO	Promotion for ES&L B / Awareness raising B		Energy & Environment Institute Inc.	Mar. 2019 – Mar. 2022
Koichi TANAKA	Promotion for ES&L C (Power Consumption Survey)	Predecessor	Jizo Laboratory LLC	Mar. – Oct. 2019
Hisatsugu ISHIZU		Successor	Jizo Laboratory LLC	Nov. 2019 – Jun. 2021
Takao SHIRAISHI	Awareness raising A		Jizo Laboratory LLC	Mar. 2019 – Mar. 2022
Minetoshi IZUSHI	AC Technical Standard Assistance		The Japan Refrigeration and Air Conditioning Industry Association	Nov. 2019 – Sep. 2021

1.5 Purchased Material and Equipment

Table 1-4 Procured Materials and Equipment
Source: Jizolab

Serial No.	Material and Equipment	Quantity	Purpose / Installed Place
1	Color Laser Printer	1	Office Equipment
2	Desk (w/Drawer)	4	Office Equipment
3	Chair for Desk	4	Office Equipment
4	Shelf (w/Door)	1	Office Equipment
5	Filing Cabinet (3 Drawers)	1	Office Equipment
6	Meeting Table	1	Office Equipment
7	Meeting Chair	6	Office Equipment
8	Water Server	1	Office Equipment
9	AC	3	Office Equipment
10	Data Logger (Pilot PMC770)	20	Power Measuring Instrument
11	Energy Meter (Pilot SPM91)	15	Power Measuring Instrument

1.6 JCC Meeting

A brief overview of discussed items at JCC meetings are shown in Table 1-5.

Table 1-5 Outline of JCC Meetings
Source: JICA/Jizolab

Date / Item	1	2	3
	19 Apr. 2019	9 Feb. 2021	22 Nov. 2021
General	✓	✓	✓
Progress of the project	✓	✓	✓
Confirmation of PDM	✓	✓	✓
Confirmation of PO	✓	✓	✓
Output 1	✓	✓	✓
Output 2	✓	✓	✓

(1) 1st JCC Meeting（19 April, 2019）

Overall goal, Project Purpose, PDM (ver.1) and 1st PO (Plan of Operation) were approved.

1st JCC Meeting (19 Apr. 2019)

1st JCC Meeting (19 Apr. 2019)

Figure 1-1 1st JCC Meeting (19 Apr. 2019)
Source: JICA

(2) 2nd JCC Meeting（On-line, 9 February, 2021）

NEECA and JICA agreed to the change of activities and work plan due to the COVID-19 outbreak. NEECA and PCSIR requested technical assistance to enhance operational capability of test laboratories[3]. Immediate schedule after the 2nd JCC meeting is shown in Table 1-6.

[3] Responding to this request, JICA arranged and implemented on-line training on IEC62552-3 for PCSIR's Refrigerator test laboratory. Refer to [Activity 1-5-2] (1) – 2).

Table 1-6 Schedule after February 2021
Source: JICA/Jizolab

Action to be Taken	When	Who
On-line meeting on Fee Structure	February 2021	NEECA, PEMA
On-line meeting on PRS	February 2021	NEECA, JICA Project Team
Finalize the draft of regulation for the ES&L scheme • MEPS & Star Rating • Label Design • Fee Structure • Monitoring Scheme	March 2021 (TWG-3)	NEECA, PEMA
Assignment of Counterpart Official	April 2021	NEECA
Stakeholder Workshop	April 2021	NEECA
MEPS to be Pakistan Standard	May 2021	PSQCA
Board approval on ES&L scheme	May 2021	PEECB
Round-robin Test	May to December 2021	NEECA
Launch PRS	July 2021	NEECA
Promulgate ES&L regulation	July 2021	GOP
Awareness Campaign	Soon after promulgation	NEECA
Enforcement of ES&L scheme	January 2022	GOP

(3) 3rd JCC Meeting (On-line, 22 November 2021)

NEECA and JICA agreed on the schedule toward project completion and outputs. NEECA will aim for the promulgation of ES&L regulations in January 2022. The immediate schedule following the 3rd JCC meeting is shown in Table 1-7.

Table 1-7 Schedule after December 2021
Source: JICA/Jizolab

Action to be Taken	When	Who
Board approval on the regulations for ACs and refrigerators	3rd week of December 2021	NEECA
Official Promulgation	3rd week of January 2022	NEECA
Notification on Newspaper	3rd week of January 2022	NEECA
Launching Seminar	4th week of January 2022	NEECA

After the project's completion, NEECA will implement the following tasks for enforcement.

a) Product Registration with Excel: from March 2022
b) Awareness campaign for retailers: from March 2022
c) Awareness campaign for consumers: from May or June 2022
d) Enforcement of ES&L regulations: from July 2022

Confirmed project ouputs are shown in Section 5.

2 Activities for Output 1

[Activity 1-1] Baseline Survey

[Activity 1-1-1] Primary energy

Figure 2-1 shows TPES breakdown and growth over the 6-year period from 2012 to 2018.

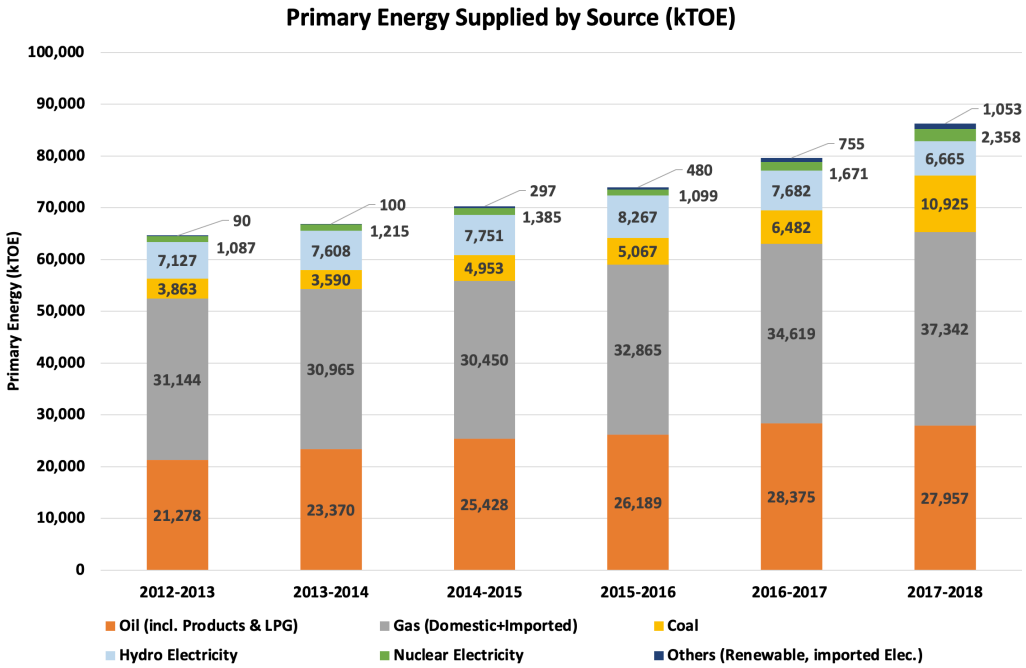


Figure 2-1 Total Primary Energy Supply (2012-2018)
Source: Jizo lab made, based on Ministry of Energy, Pakistan Energy Yearbook 2018

The characteristics of TPES is summarized as follows[4]:

- Annual growth rate of TPES was approx. 6.0% on average, and at its highest (8.4%) in 2017-18.
- Domestic production of Oil was 10% to 20% of demand in the past decade.
- Because of the increasing demand of natural gas, LNG was imported from 2015. National natural gas production is approx. 30,000 kTOE and stable, but imported LNG rose to 20.1% in 2017-18.
- Use of Coal has increased recently and was up 68.5% (10,925 kTOE) in 2017-18 compared with the previous fiscal year. Use of domestic coal is limited by the quality of coal, the difficulty in mining, and political instability.
- Water resources are large but only under 12% of its potential is utilized. The issues in development of water resources are construction costs, environmental impacts, and resident relocation.
- Amount of renewable energy is still small but steadily increasing.

4 Japan Electric Power Information Center, Electric Power Industry in Overseas Countries, Vol. 2, 2020

- Pakistan depends on non-commercialized energy, such as biofuel and energy from waste, mainly in rural areas. IEA reports it amounts to 40.2% of TPES[5], but this figure is not shown in the Energy Yearbook from the Ministry of Energy[6].

[Activity 1-1-2] Final energy consumption

Figure 2-2 shows TFEC breakdown by sector and growth over the 6 years, period from 2012 to 2018. The final figure was 54,993 kTOE in 2017-18.

Considering energy consumption by sector, Figure 2-2 shows that consumption in the industrial, transportation and domestic sectors is large, but that by the commercial and agriculture sectors is smaller. Domestic consumption in TFEC was slightly higher than 20% but has shown a small decrease.

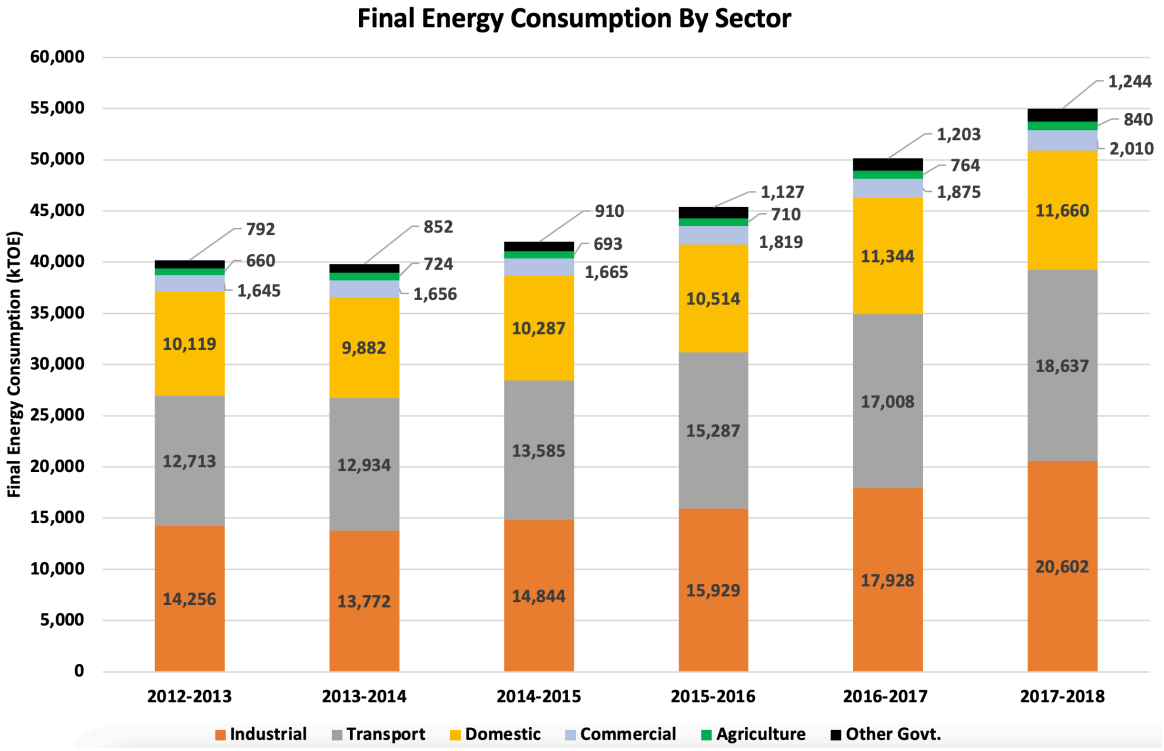


Figure 2-2 TFEC Tend and its Breakdown of Sectors (2012-2018)
Source: Jizo lab made, based on Ministry of Energy, Pakistan Energy Yearbook 2018

Since the Pakistani economy is good with a 5.8% real GDP growth rate, it follows that the TFEC of both the industrial and transportation sectors is growing. However, Pakistan is not yet a mature economy and has not attained a consumer society, and, as such, the energy consumption in the commercial sector is expected to be larger in the future.

5 IEA Pakistan Balance 2017, https://www.iea.org/sankey/#?c=Pakistan&s=Balance
6 It seems to be excluded.

[Activity 1-1-3] Sector wise energy conservation potential

According to the NEECA Strategic plan 2020-2023[7] announced on October 27, 2020, the goal of NEECA by 2023 is to save up to 3 MTOE in the primary energy supply by introducing and implementing the Energy Efficiency & Conservation Program in all major sectors of the economy, leading toward a 6.4 MT CO_2 equivalent carbon emission reduction in the economy sector. Table 2-1 shows sectoral objectives of the Plan.

According to the standards stipulated by the Energy Conservation Law, the measures shown in Table 2-1 will be promoted.

Table 2-1 Sectorwise Energy Saving Strategy
Source: NEECA Strategic Plan (2020-2023)

Sector	Primary energy saving (MTOE)	Counter measure
Building	0. 5	Improving energy efficiency in electrical systems, optimization of thermal utilities, and carrying out mandatory industrial energy audits.
Transportation	0.5	Developing vehicle examination system & regulation, the establishment of vehicle tune-up centers and fleet management mechanisms, and assisting EV dissemination with “Electric Vehicle Policy 2019”
Industry	1.3	Achieved by replacing inefficient tube wells, establishment of agricultural tractor tune-up centers, and addressing the water-energy-food nexus.
Agriculture	0.3	Replacing inefficient tube wells and establishment of agricultural tractor tune-up centers
Power	0.4	Achieved through the intervention of various EE programs which includes transformer and LT capacitor programs, carrying out heat rate assessments, and enforcement of mandatory audits in industries.

[Activity 1-1-4] Perspective of EE&C measures with ongoing efforts

Based on the NEECA Strategic Plan (2020-2023), it is aimed to achieve energy saving of 3 MTOE by 2023. This Strategic Plan will proceed in the following three stages. The first Phase is almost complete.

- The first Phase: Institutionalization
  - Establishment of a designated agency in the provinces
  - Institutionalize EE&C through the development of state and regional action plans
- The Second Phase: Creating operational measures for policies and actions
  - Formulation of MEPS
  - Formulation of ES&L scheme
  - Establishment of an energy audit system
- The Third Phase: Implementation of the Action Plan

The current situation of efforts is shown below.

[7] Strategic Plan (2020-2023), NEECA, https://neeca.gov.pk/SiteImage/Misc/files/NEECA%20Strategic%20Plan%202020-23%20Final%2028%20October%202020(1).pdf

(1) Building sector

Pakistan is a rapidly urbanizing country in Asia. By 2023, over 40 million people are expected to live in urban centers and towns[8].

NEECA in collaboration with the Pakistan Engineering Council (PEC) – the statutory body for the development and implementation of building codes, has prepared Energy Provisions-2011[9], as an addendum to the Building Codes. Currently, the NEECA and PEC are revising these codes which will be launched by the end of 2020 to achieve the 0.5 MTOE energy saving target. NEECA designated agency Punjab Energy Efficiency and Conservation Agency (PEECA) has also modified the Building Code as per their province climatic conditions, which is also under review and will be implemented in Punjab. NEECA has started various initiatives related to the building sector, such as:

- More effective regulations are mandatory MEPS and labels. Currently, PEECB is considering MEPS and label regulation proposals for fans, LEDs, ACs, refrigerators, and motors.
- For fans, a voluntary MEPS and label system has already been implemented with the cooperation of JICA[10]. 170,000 fans sold during the year 2016-2017 are labeled. Of these, 85,000 are in Punjab, a region which accounts for two-thirds of the country's electricity consumption[11].
- The draft MEPS and label regulations for LEDs (15% of total electricity generated is consumed solely by lighting) were formulated in 2020 with the cooperation of UNEP.
- MEPS for ACs and refrigerators were established as the Pakistan standard in August 2021 with the cooperation of this project. The draft label has also been outlined with the cooperation of this project.
- MEPS and draft label regulations for motors were formulated in 2020 with the cooperation of CLASP.

NEECA is in the consultation phase with the Naya Pakistan Housing Authority (NPHA) to ensure the construction of energy-efficient buildings and implementation of NEECA’s mandatory regime for home appliances in all newly constructed houses.

The adoption of labeled energy-efficient appliances has been growing. These energy efficient appliances are gradually penetrating the local market due to their cost competitiveness as their upfront costs have come down in the international market. The price point for these appliances and increased awareness for the energy efficiency gains are the two major forces, which will enable the

8 UNHABITAT, 2005. "Energy-Efficient housing in Pakistan. A case of RC Roofs in Pakistan"

9 Standards for building ventilation, heating, lighting and air conditioning energy efficiency to improve energy efficiency in the building sector

10 NEECA Strategic Plan 2020-2023

11 Keeping Cool in Pakistan, CLASP, https://www.clasp.ngo/updates/keeping-cool-in-pakistan/

market for favorable conditions for energy-efficient appliances[12]. Similarly, the new initiatives such as Naya Pakistan will provide leverage to NEECA to become a catalyst of Energy Efficiency.

(2) Transport sector

The transport sector accounted for 33.93% of the total final energy consumption in 2019[13]. With a contribution of over 13% to Pakistan's GDP, oil (liquid fuels) dominates in the transport energy consumption mix, while the share of natural gas is about 10%.

There is a pressing need to adopt an ES&L regime and establish a target for vehicle fuel efficiency standards and emissions. The vehicle fuel efficiency standards are essential to phase out inefficient and polluting vehicles.

- The fuel economy standards such as the Corporate Average Fuel Economy (CAFE)[14], as practiced in the developed world, will be formulated and adopted for the transport sector of Pakistan.
- Following that, the establishment of Motor Vehicle Examination (MVE) Centers with the inclusion of Energy Efficiency parameters would also be point of focus.
- Various other interventions would be taken in cargo and mass transportation modes such as railways, buses, etc.
- NEECA has been mandated to establish a center of research and development for electric vehicles in Pakistan for Electric Vehicle (EV) policy. NEECA will be instrumental along with other stakeholders in the implementation of the recent EV Policy in Pakistan.

(3) Industrial sector

The industrial sector has great energy saving potential. Being the largest consumer of energy, it can make Pakistani exports more competitive in global markets.

- The textile sector (accounting for 27.6% of the overall electricity consumed by industries and 40 % of the natural gas) offers the highest efficiency gains with a total energy saving potential of 2,150 GWh by improving the efficiency of compressors, heat transfer and recovery systems, lights, motors, power factor correction panels, process control, steam system optimization and Variable Frequency Drives ("VFDs").
- The cement sector (accounting for 68.9% of the total coal consumption by industries) and the steel sector are promoting significant energy savings.
- The sugar mills in Pakistan have a high specific energy consumption of over 1,250 MJ/ton which is much higher than the average value of 935 MJ/ton for the regional sugar sector. The high value in Pakistan can be attributed to the use of antiquated sugar manufacturing systems and inefficient boilers. The sugar industry has a saving potential of 138.35 GWh per year.

[12] NEECA Strategic Plan 2020-2023
[13] Ministry of Planning, Development and Reforms and UNDP- Pakistan (2019) "SE4ALL- National Action Plan"
[14] CAFE is a scheme which regulates the averaged fuel consumption of all models produced by each automobile manufacturer.

- The leather industry has a saving potential of 17 GWh per year from heat transfer and recovery systems, motors, general processes, and steam system optimization.
- Electric Motor-Driven Systems (EMDS) in the industrial sector consume almost half of total electricity. The cost-effective potential to improve the energy efficiency of electric motors is about 20 to 30%.

(4) Agriculture sector

The agriculture sector only accounts for 2% of total final energy consumption in Pakistan, Water pumps for irrigation and tractors for soil preparation are the major energy consumers in the agriculture sector. The process of irrigation through diesel and electric powered pumps is extremely inefficient in Pakistan. Additionally, the use of commercial energy is also steadily increasing with the growing number of mechanized practices to improve agricultural productivity.

Over 90% of the energy consumed in the agriculture sector is in the form of electricity, while 10% is supplied by oil in the form of High-Speed Diesel for irrigation pumps and machinery. On the contrary, the ratio of electricity versus diesel pumps installed in the country is 20:80. Electric tube wells offer high-cost advantages as their running cost is much lower than that of diesel pumps. However, electricity supply in rural areas for irrigation purposes is highly irregular which negatively affects the farmers and reduces yields. MEPS for motors will be launched to ensure energy efficiency in the irrigation sector coupled with process optimization techniques to increase yields. Training programs for farmers/tractor operators will be launched across Pakistan with the support of relevant stakeholders.

With the growing population, NEECA aims to improve energy efficiency in agri-food systems.

(5) Power sector

Transmission and distribution losses of power in Pakistan are one of the highest in the region. The average power losses in Pakistan are as high as 20%. But for some DISCOs, these losses reach over 38%[15]. There is huge potential to save energy by deploying smart metering technology for power consumers to avoid distribution losses, by expanding the electricity network to withstand pressures from demand & potential breakdowns, by upgrading and expanding the grid to minimize line losses, by operationalizing small and digital feeders for load management and replacement of old transformers with small and smart one.

Small captive power units and, demand-side management[16] should be developed and implemented.

[15] National Electric Power Regulatory Authority

[16] E.g., Time Of Day (TOD) pricing in tariff system has already been implemented. Other peak shift measures are under investigation.

[Activity 1-1-5] Analysis of possible measures for EE&C in Pakistan

The NEECA Strategic Plan is currently in its 2nd phase, and some of the 3rd phase goals are also being worked on in parallel. The targets of the second face are shown in Table 2-2. MEPS (1), ES & L (2), Monitoring (3), Test Lab (4), Energy Auditor (6,7), Awareness (9) seem to be effective measures.

Table 2-2 Objectives of the Second Phase of the Strategic Plan
Source: NEECA Strategic Plan (2020-2023)

Phase –II: Operationalization	
1	Minimum Energy Performance Standards
2	Mandatory Labelling and Standards Regime
3	Monitoring, Verification and Enforcement Systems
4	Certification and Accreditation of Appliance Testing Laboratories
5	Development of Curriculum for Energy Auditors
6	Establishment of Capacity building Program for Energy Auditors
7	Revolving Loan Fund (RLF) for Energy Efficient Appliances
8	Knowledge Management to Promote EE&C in Pakistan
9	Outreach and Awareness Plan

For reference, the goals for Phase 3 are shown in Table 2-3.

Table 2-3 Objectives of the Third Phase of the Strategic Plan
Source: NEECA Strategic Plan (2020-2023)

Phase –III: Operationalization		
Industrial Sector	1	Installation of energy meters and automatic controls in the textile industry (100) to reduce leakages of compressed air.
	2	Installation of Heat Recovery Systems (HRS) from exhaust flue gases and High-Pressure Cogeneration (HPC) in 50 Sugar mills.
	3	Installation of Variable- Frequency Drive (VFD) on pumps and motors to reduce energy losses in 50 industrial units.
	4	Thermal insulation of steam lines and valves in 100 industrial units in Pakistan.
	5	To improve the overall energy efficiency of the Cementing process in 10 cement factories.
	6	Tuning up boiler burners and adjusting air-to-fuel ratios in pulp and paper units (100).
	7	Launching energy efficiency steam reforming and Haber-Bosch synthesis in the fertilizer industry.
	8	Zig-Zag Technology for 12000-18000 brick kilns.
Building sector	1	Implementation of Building Energy Codes in Naya Pakistan Housing Scheme (NPHS) (5 million House Units).
	2	Provision of clean and energy efficient cook-stoves.
	3	Mandatory labeling scheme for electric fans at the domestic level
	4	Mandatory labeling scheme for air- conditioners and refrigerators
	5	Mandatory labeling scheme for lights.
	6	Mandatory labeling scheme for electric motors.
	7	On-bill financing mechanisms for the provision of energy-efficient home appliances
	8	Establishment of a revolving loan fund to channelize finances for energy-efficient products.
Transport sector	1	Establishment of Automotive Engine Diagnostic and & Tune-up Centers and inspection mechanisms for quality insurance
	2	Establishment of fleet management system and inspection mechanisms for quality insurance
	3	Rules and regulations for energy efficiency standards for electric vehicles instruments
Power sector	1	Deployment of smart metering technology
	2	Upgrading and expanding the Grid to minimize line losses in the electricity sector
	3	To operationalize small and digital feeders for load management.
	4	Replacement of old transformers with small smart and digital transformers
Agriculture sector	1	Replace maximum possible tube wells pumps (out of 180,000) with more efficient pumps
	2	Tune-up center for 20k Tractors having power greater than 66HP.

[Activity 1-1-6] Power supply and demand (MW) and electricity consumption (GWh)

(1) Power sector

Figure 2-3 shows the structure of the power sector in Pakistan. NEECA is an affiliated authority under the power division of the Ministry of Energy, and regulates/supervises/promotes energy conservation, both in electricity and heat.

NEECA was established under the EC Act 2016, as a successor to ENERCON. Its main activities are shown below[17].

- Formulating energy conservation programmes in all the main energy consuming sectors.
- Planning and initiating energy conservation actions nation-wide.
- Outlining policy guidelines to support energy conservation initiatives.
- Developing a comprehensive data base on opportunities for energy conservation.
- Supporting training activities on energy conservation application.
- Undertaking field research and pilot demonstration activities on specific energy conservation options and technologies; and
- Monitoring the implementation of conservation programs by other public and/or private sector entities...

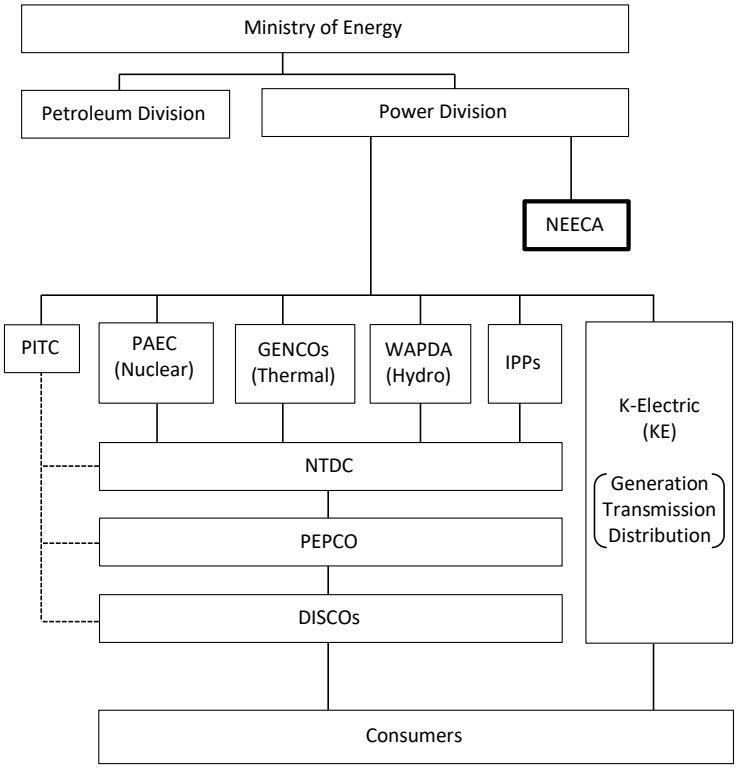


Figure 2-3 Power Sector in Pakistan
Source: Jizo lab

[17] http://www.enercon.gov.pk/enercon95f5.html?mc_id=1

NEECA also works together with the Ministry of Climate Change (MoCC) on policy making for the reduction of greenhouse gases (carbon dioxide, refrigerants such as chlorofluorocarbon, etc.).

(2) Power generation facilities

1) Structure of power generation facilities

Regarding power generation, GENCO (Generation Company) is in charge of thermal power generation, WAPDA is in charge of hydroelectric power generation, and PAEC (Pakistan Atomic Energy Commmission) is in charge of nuclear power generation. These are all government-affiliated companies and organizations. Private sector companies include IPPs that sell power generation and consignment, and KE (K-Electric), a vertically integrated power company that handles everything from power generation to distribution in the Karachi area.

Figure 2-4 shows the installed capacity of power generation facility. The power supply capacity of the country has been improving in recent years. The installed capacity of power generation facilities in 2017-2018 was 35,372 MW, an increase of about 50% from 2012-2013.

Since 2016, many thermal power IPPs have entered the market, and the ratio has reached 42.8%. The proportion of GENCO has decreased as a percentage but has slightly increased as an absolute amount. This is probably because they are promoting thermal power IPP as a measure to respond to the increase in demand.

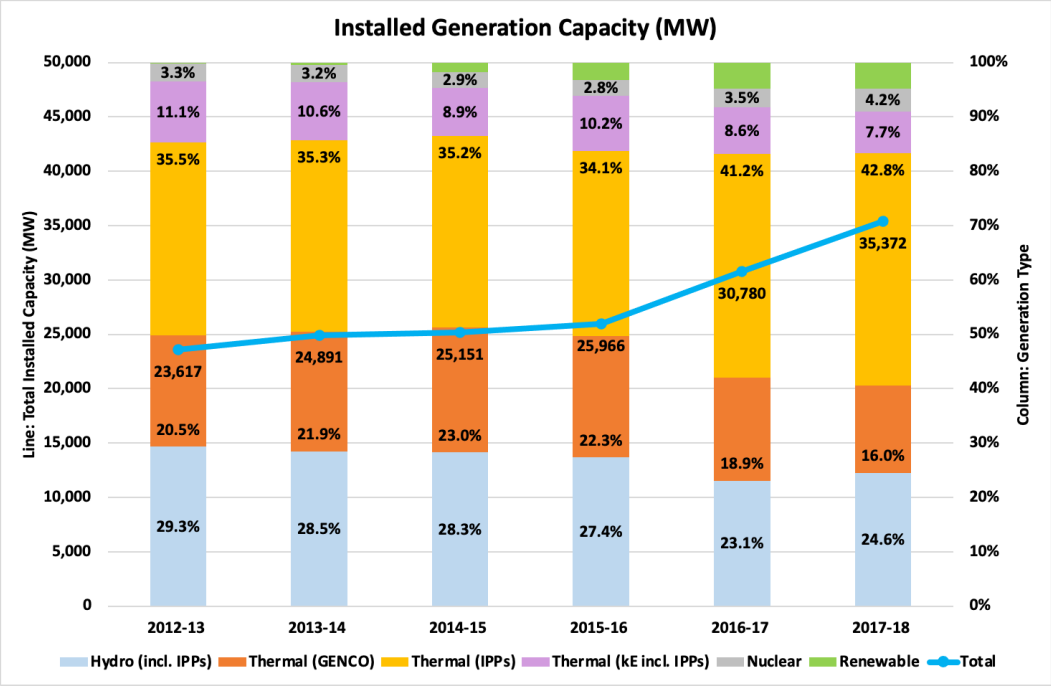


Figure 2-4 Installed Capacity of Power Generation Equipment (2012-2018)
Source: NTDC, Created by Jizolab based on Power System Statistics 2017-18

2) Electric power generated

The amount of power generated was about 100,000 GWh per year until 2014-15, but after that it started to show high growth, and in 2017-2018 it was 134,381 GWh, an increase of 11.3% from the previous year. The composition by power source is 68.7% for thermal power including IPP and KE, 21.3% for hydropower, 6.8% for nuclear power, and 3.2% for renewable energy. (See Fig. 1-3)

As shown in Fig. 1-3, the ratio of thermal power generation is increasing year by year, and in 2017-2018, it was 68.7% of the total power generation. This means that carbon dioxide emissions, which are the cause of global warming, are increasing. It is important to reduce carbon dioxide emissions through energy conservation.

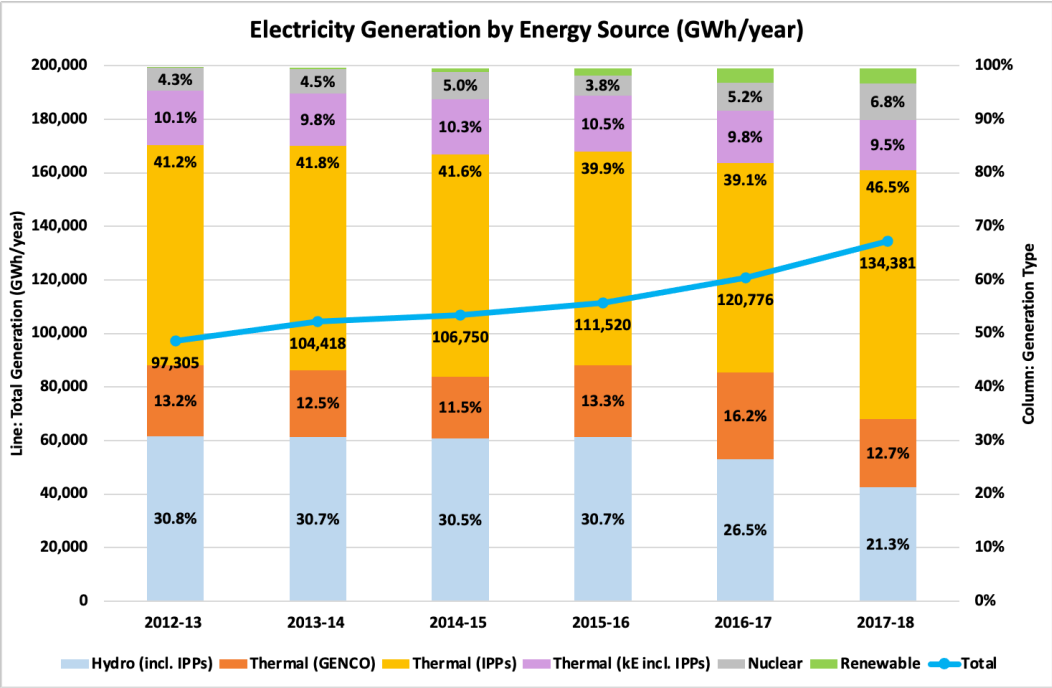


Figure 2-5 Electricity Generation (2012-2018)
Source: NTDC, Created by Jizolab based on Power System Statistics 2017-18

(3) Tansmission facilities

Transmission systems are operated by NTDC (National Transmission and Dispatch Company Ltd.) and distribution systems are operated by 10 DISCOs (Distribution Companies).

(4) Demand structure

1) Consumed electric energy by sector

Regarding demand changes over the 6 year period from 2013 to 2018, the average annual growth of consumed electric energy was 6.7%. In 2018 the increase was larger, being a 12% increase with a figure of 97,197GWh being recorded. (Refer to the line graph in Figure 2-6)

As for sector-wise consumption, domestic growth was largest with an average growth over the 5-year period from 2013 to 2018 of 8.8%. The commercial sector had similar growth but the amount itself was not so large. (Refer to column graph in Figure 2-6)

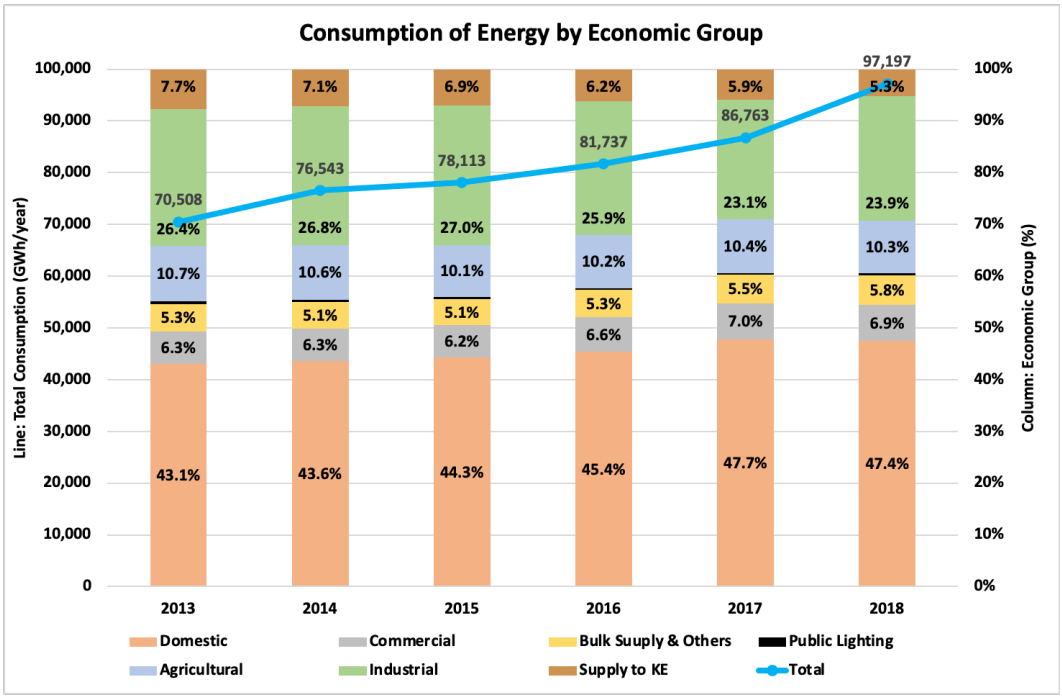


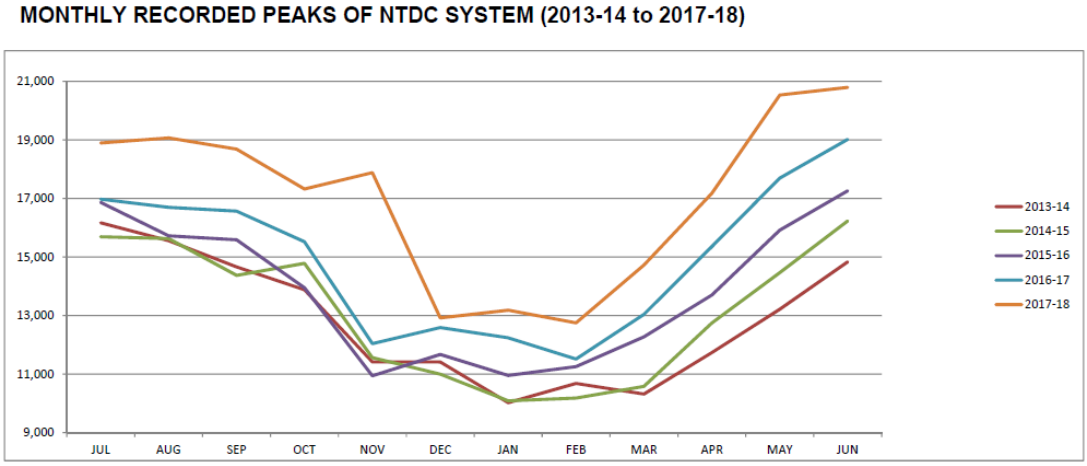
Figure 2-6 Consumed Electric Energy by Sector
Source: Jizo lab made, based on NTDC, Power System Statistics 2017-18

Recent growing consumption comes from steady economic growth, but another reason is rural electrification.[18] The increase in the ratio of consumption in both the domestic and commercial sectors is now large at 54.3% in 2018. It seems that energy conservation for ACs and refrigerators would invite more efficient use of electric energy and a reduction of carbon dioxide in Pakistan.

2) Monthly electric energy consumption

Monthly electric energy consumption is high in summer (May to August), and low in winter (December to March). In the northern area of Pakistan, especially for wealthy classes in urban areas, such as Islamabad, it seems that ACs are being used for heating in wintertime. (Refer to Figure 2-7)

[18] State of Industry Report202, NEPRA, p.176, Table 69: Category -wise Electricity Sold and p.177, Table 70 Category-wise Energy Sales in CPPA-G and K-Electric System
https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202021.pdf



	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	%Inc.
2013-14	16,170	15,560	14,662	13,885	11,417	11,416	10,025	10,683	10,320	11,738	13,217	14,835	9.58%
2014-15	15,692	15,632	14,376	14,785	11,565	11,001	10,090	10,185	10,583	12,746	14,468	16,233	0.39%
2015-16	16,866	15,725	15,589	13,953	10,943	11,674	10,955	11,256	12,274	13,705	15,920	17,261	6.34%
2016-17	16,975	16,698	16,569	15,523	12,044	12,590	12,242	11,515	13,043	15,360	17,696	19,020	10.19%
2017-18	18,897	19,070	18,686	17,326	17,882	12,923	13,185	12,753	14,727	17,180	20,535	20,795	9.33%

Figure 2-7 Monthly Electric Energy Consumption[19]
Source: NTDC, Power Data Reference Book 2017-2018

3) Consumed electric energy through DISCO

In Pakistan, power suppliers are 10 DISCOs, KE and IPPs. DISCOs' sales area map is shown in Figure 2-8.

Figure 2-8 DISCO Area of Jurisdiction
Source: Jizo lab made, based on NTDC, Electricity Demand Forecast based on Power Market Survey 2015

[19] "%Inc." at the right of the table is the growth rate as a percentage of the maximum monthly consumption (blue cell) compared with the previous fiscal year.

Sold energy by DISCOs in 2014-18 is shown in Figure 2-9. 71.7% of whole electric energy is sold by DISCOs in Punjab province, and especially, LESCO, MEPCO and FESCO sell almost half of all energy.

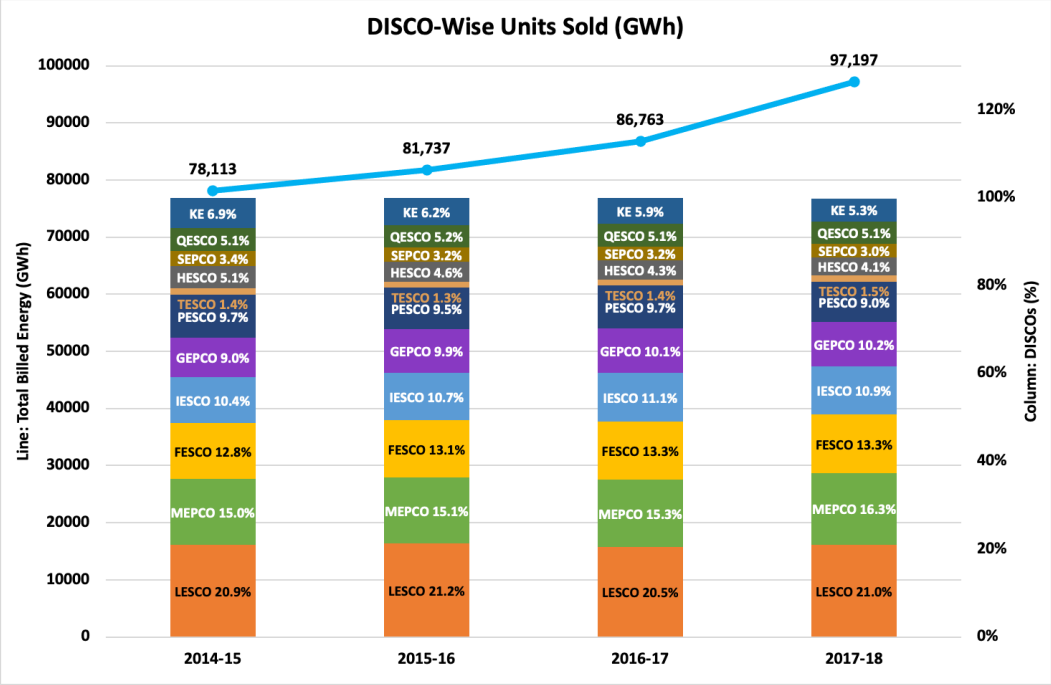


Figure 2-9 Consumed Electric Energy by DISCO (2014-2018)
Source: Jizo lab made, based on NTDC, Power Data Reference Book 2017-2018

(5) Supply and demand balance and daily load curve

According to NTDC data, at annual peak times, electric power supply (MW) is always less than demand. Therefore, rolling blackouts occur sometimes in some areas of Pakistan.

This situation is clearly shown in Figure 2-10. Each fiscal year has two column graphs, the left one shows demand and shed load in MW and the right one shows power availability (MW) at the annual peak. It is very easy to see that load management needs to be implemented to balance supply and power. E.g., it shows a 2,975 MW supply shortage at peak, 17:00 on 4th June 2018.

One way to manage load distribution is rolling blackouts. In 2013-2017, there was no margin in the power supply and load management was required to be put in effect. However, in 2018, although there is some surplus in supply (23,766MW), which mainly comes from an increase of IPPs, load management was utilized. Load management by DISCOs was very high in this year. It can be seen that this demonstrates the result of "No Payment No Power", a countermeasure for the theft of electricity. However, power availability to meet demand including shed load has not yet been allocated.

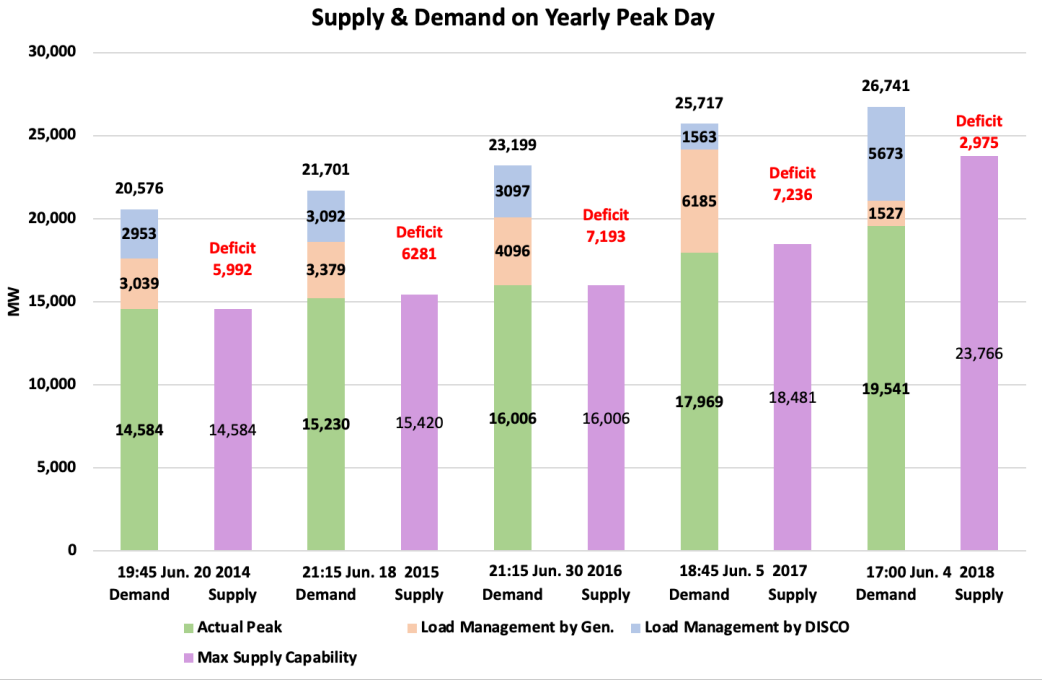


Figure 2-10 Demand and Supply at Peak
Source: Jizo lab made, based on NTDC, Power Data Reference Book 2013-14 to 2017-18

In general, power deficits come from the shutdown of power stations for maintenance, power reduction of generators and from an overload of feeders. In Japan the reserve power is approximately over 10% of expected demand, but Japan is a country which has ample power supply capability. In developing countries like Pakistan, supply is always short. To secure supply the construction of building new power stations and the enhancement of current power facilities are to be needed. However, if peak demand of electric power is suppressed by energy conservation methods, investment in new plants and/or the enhancement of facilities can be deferred.

Daily load curves of the annual peak day are shown in Figure 2-11. These curves include shed load by load management. As mentioned earlier, there are two kinds of load management, one by the NPCC (National Power Control Center) and the other by DISCOs.

The former comes from the restriction of transmission systems (shutdown of facilities for maintenance, etc.) and the latter is not only technical and operational constraints, but also deliberate suspension to impose a penalty to a feeder which has large commercial losses. (No payment, No Power).

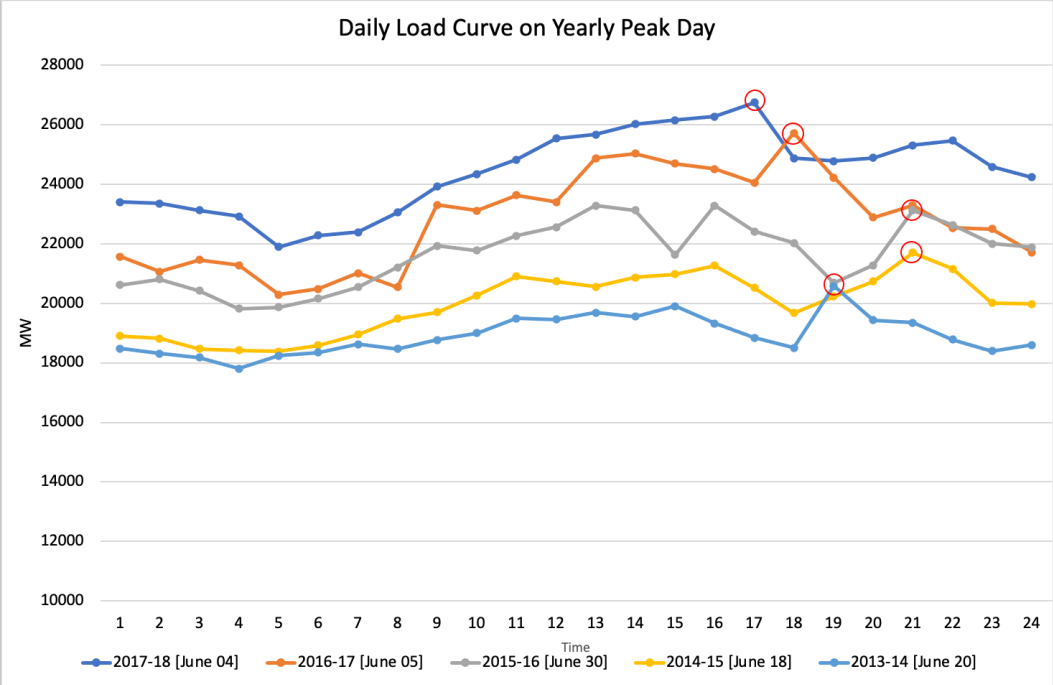


Figure 2-11 Daily Load Curve in Peak Load Day
Source: Jizo lab made, based on NTDC, Power Data Reference Book 2013-14 to 2017-18

NTDC/DISCO estimates volumes of load management by calculating the difference of MW before and after the suspension of facilities (transformers, feeders, etc.).

As shown in Figure 2-11, peak load occurrence is shifting gradually from late night to early evening in recent years. This trend may be caused by the use of many electric appliances for the preparation of dinner and the use of ACs, refrigerators, etc. and it may also mean that energy consumption (kWh) in the domestic sector is gradually increasing. Regardless, the load profile is completely different to one in a developed industrial country, which has peak demand during the daytime. As industry grows in Pakistan in the near future, peak demand may move to daytime.

We also need to understand NTDC's data fully. Load management is included in the NTDC demand curve. It is necessary to understand the load curves, taking into account of validity of the estimations of shed load and the change of life patterns by rolling blackouts.

(6) Power loss

Power loss in Pakistan is very high at about 30%, which is very large compared to that of Japanese power companies which is about 7-8%. Figure 2-12 shows the "total power supply", DISCO sales power, and loss in transmitting and distribution over the past 6 year periods. Here, the "total power supply amount" is the sum of the generated power amount (at the power generation end) and the power independently procured by DISCO without passing through the Central Power Purchasing Agency (CPPA). Therefore, the value is slightly larger than the amount of generated

power shown previously. Power plant consumption is about 10%, transmission loss is 2-3%, and distribution loss is about 15%. Distribution loss is large and caused by poor maintenance of the distribution line (feeder) and from power theft.

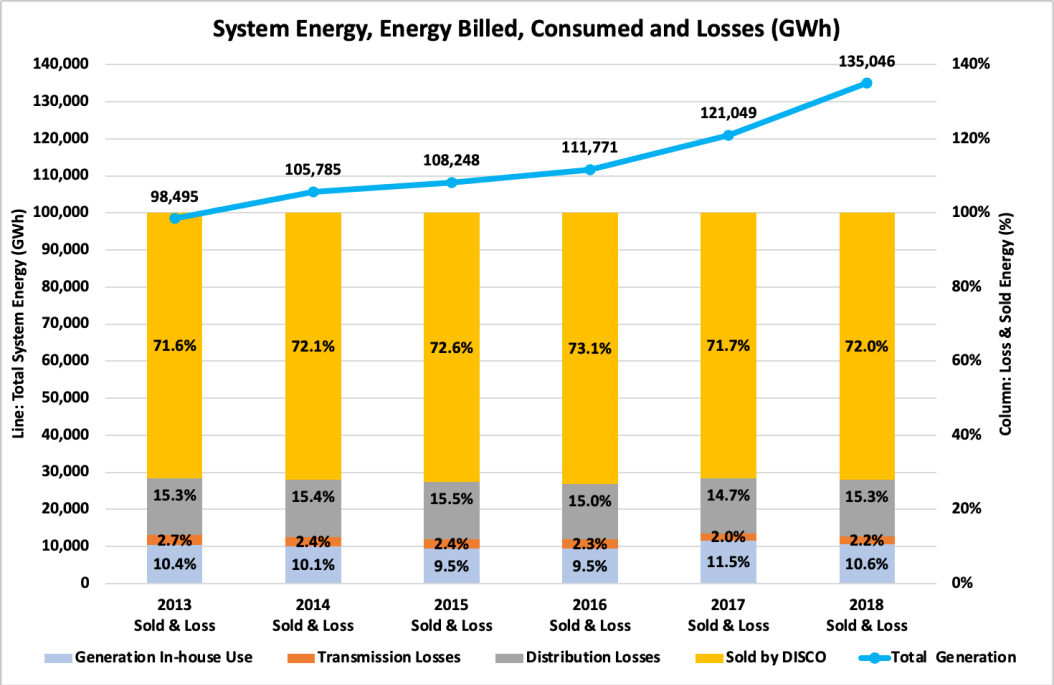


Figure 2-12 Total Power Supply, Power Consumption, and Power Loss (2013-2018)
Source: NTDC, Created by Jizolab based on Power System Statistics 2017-18

(7) Electricity Tariffs

Electricity tariffs differ slightly between DISCOs but are almost the same. As an example, the tariff of LESCO is shown in Table 2-4. As shown in the table, a time-of-use tariff is applied for domestic users exceeding 5kW.

Table 2-4 Electric Tariff Table of LESCO (2017-2018, PKR/kWh)
(1.43PKR/Yen, end of 2019), Source: NEPRA, State of Industry Report 2018

Classification	PKR	Yen
Residential		
0-50 kWh	4.0	2.80
Less than 5kW at peak		
0-100 kWh	9.52	6.66
101-200 kWh	11.32	7.92
201-300 kWh	12.23	8.56
301-700 kWh	14.08	9.80
700 kWh 以上	16.04	11.23
Exceeding 5kW at peak		
Peak use	16.04	11.23
Off peak use	9.54	6.68
Tempolary supply	16.04	11.23
Comercial		
Less than 5kW at peak	15,73	11.01
Less than 5kW		
Regular	11.76	8.23
Peak	16.04	11,23
Off peak	9.54	6.68

Classification	PKR	Yen
Industrial		
B1	11.74	8.22
B1, Peak	16.04	11.23
B1, Off peak	9.59	6.71
B2	11.24	7.87
B2, Peak	16.04	11.23
B2, Off peak	9.36	6.55
B3, Peak	16.04	11.23
B3, Off peak	9.16	6.41
B4, Peak	16.04	11.23
B4, Off peak	9.04	6.33
Tempolary supply	11.74	8.22

Classification	PKR	Yen
Industrial （Large contractor）		
C1(a), Less than400/230V-5kW	12.24	8.57
C1(b), 400/230V-5kW to 500kW	11.74	8.22
C1(b), Peak	16.04	11.23
C1(b), Off peak	9.59	6.71
C2, 11kV,33kV-5,000kW	11.54	8.08
C2, Peak	16.04	11.23
C2, Off peak	9.36	6.55
C3, more than 66kV,5,000kW	11.44	8.01
C3, Peak	16.04	11.23
C3, Off peak	9.16	6.41
Aguricultural		
Agricaltural use	13.14	9.20
Peak	16.04	11.23
Off peak	9.14	6.40
Pump for agriculture	13.44	9.41
Peak	16.04	11.23
Off peak	9.14	6.40
Public lighting		
Public lighting	14.84	10.39
Railway traction		
Railway traction	14.84	10.39

[Activity 1-1-7] Electricity consumption of Target Appliance in households (Urban & Regional)

The purpose of the survey is to estimate present power consumption by ACs and refrigerators. Not only kWh but also kW load is estimated within the realm of possibility, because amplitude of kW load is valuable information on grid operation and for the future expansion plans of generation facilities.

As for ACs, the estimation was made with DISCO data (1), and for refrigerators it was made using a measurement survey (2).

(1) Estimation of AC consumption based on DISCO MIS data

Although the original title of this activity says the estimation of power consumption for the "average household" in "urban" and "rural" areas, the following points shall be kept in mind in the DISCO data analysis.

- Each DISCO's service area is hierarchically structured, from the top: Circle, Division and Sub-Division, divided geographically. Analysis is made in Circle wise, but generally Circle consists of urban and rural areas. We can say it is "urban major" or "rural major", but it is difficult to define "urban" or "rural" clearly.

- The target of our analysis is domestic (residential) customers and is 17,508,435 households in 6 DISCOs and KE. Accordingly, the analysis is not based on an "average household" but by estimating macro indicators (e.g., averages) from micro data. Since DISCO MIS Data is in the order of millions and covers all customers, high reliabity on estimation would be expected.

1) Methodology

The methodology of the estimation is derived from the following assumption on cooling appliances such as ACs and fans.

a) The consumtion difference between SM (AC Stopped Month) and FRM (AC Full Running Month) is large.
b) Almost all the difference is because of cooling appliances

2) Objective

Objectives are to estimate the following 3 indicators of ACs.

a) Ownership (%)
b) Power consumption (MWh)
c) Daily Load Curve (MW)

3) Target of kWh analysis

The target is domestic customers in FESCO, HESCO, IESCO, LESCO, MEPCO and SEPCO (6 DISCOs) under PEPCO and KE, for a total of 7 DISCOs. The analyzed number of Circles (Regions in KE) and customers are 39 and 17,508,435 respectively. Billed data of 2 months (SM and FRM) is used. (Refer to Table 2-5)

Table 2-5 Number of Domestic Data
Source: Jizo Lab

DISCO		6 DISCOs							KE	7 DISCOs
		LESCO	IESCO	MEPCO	FESCO	HESCO	SEPCO	Total		
# of Circles		8 (9)	5	9	2 (5)	4	3	34	5	39
# of Data	Original	4,058,701	2,509,299	5,890,514	1,601,324	716,565	481,046	15,257,449	2,322,986	17,580,435
	Effective	3,423,701	2,227,663	4,950,137	1,508,107	487,288	307,421	12,904,317	1,877,047	14,781,364
	Effective /Original	84.4%	88.8%	84.0%	94.2%	68.0%	63.9%	84.6%	80.8%	84.1%

In billed consumption data of SM and FRM, there are some blanks, zero and negative numbers. Such data seem to come from moving-in, moving-out, balance for previous sales data and use of multiple contracts to reduce electricity charges in FRM. Such data have been removed as ineffective data in the analysis.

4) Condition of AC ownership

Based on the discussions with the 7 DISCOs, it is assumed that a household with more than a 340kWh change in FRM – SM has an AC. This condition is the minimum, or lower limit, of 1 AC and fans owner. Condition for fan owner is assumed as 25 kWh change in FRM – SM.

5) Estimation of AC ownership ratio and consumption (kWh)

Estimated AC ownership ratios of each Circle/Region are shown in Figure 2-13. The highest percentage is S. E. 2nd Circle in LESCO, at 28.9%. There are some Circles with over 20% ownership, which contain urban areas. On the other hand, the ratio in rural major Circles is around 2 – 3%. In FESCO, since the data of 3 Circles was not provided, just only an estimation for Circles with data are shown in Figure 2-13.

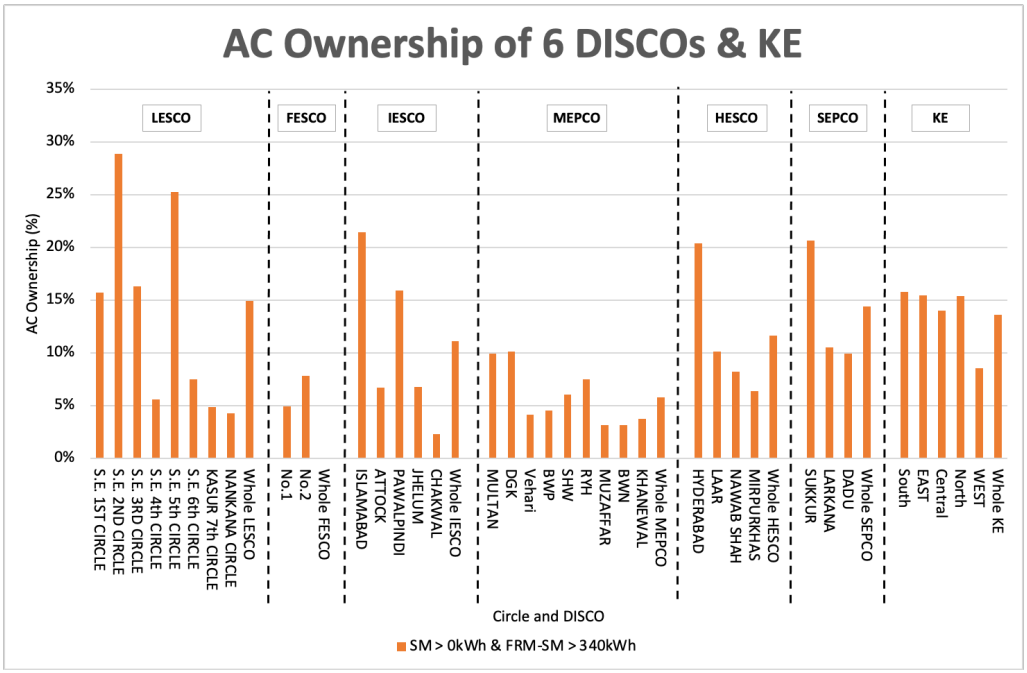


Figure 2-13 Estimated AC Ownership of 6 DISCOs and KE
Source: Jizo Lab

By extrapolating ratios of no-data Circles with estimated percentages of Circle with data in FESCO, the AC ownership ratio of 6 DISCOs under PEPCO is 9.6%, and that of 7 DISCOs including KE is 10.1%.

Table 2-6 shows estimated AC power consumption (GWh). Domestic ACs consume 3 – 7% of total power consumption, and 6 – 13% of domestic sector power consumption.

Table 2-6 Estimated AC Power Consumption (GWh)
Source: Jizolab, NTDC, KE

	Estimated Domestic AC Annual Consumption (GWh)	Annual Consumption (GWh) [NTDC, Power Market Survey 2019] [KE Data provided in 2020 in JICA Project]			
		Total	AC Ratio	Domestic	AC Ratio
LESCO	1,325	20,448	6.5%	9,029	14.7%
IESCO	517	10,606	4.9%	5,092	10.2%
MEPCO	589	15,853	3.7%	8,896	6.6%
FESCO	402	12,925	3.1%	6,512	6.2%
HESCO	246	4,027	6.1%	2,438	10.1%
SEPCO	230	2,963	7.8%	1,828	12.6%
6 DISCOs total	3,309	66,822	5.0%	33,795	9.8%
KE	842	13,285	6.3%	7,226	11.6%
7 DISCOs total	4,150	80,107	5.2%	41,021	10.1%

6) Estimation of AC Daily Load Curve (DLC, MW)

Due to data deficits in provided Feeder data, which may come from supply failure (planned and/or unplanned outage), we could not estimate the DLC of many Feeders. As such, we can show only those in LESCO, IESCO, MEPCO and KE, as shown in Figure 2-14 - Figure 2-17.

Due to this, we have just 3 DISCO DLCs within the 10 DISCOs under PEPCO, we could not compare domestic AC DLC with NTDC DLC on the peak day. However, by estimating it from 3 DLCs, it is supposed to be less than 10% of the NTDC grid load.

The common remarkable feature is a large load at middle of the night. The second peak exists around 16 – 17 o'clock. Because of the TOU tariff, which has a high unit rate during 19 – 23 o'clock in the summertime, AC load may be depressed untill middle of the night after the 2nd peak.

Current peak of NTDC exists around 15 – 18 o'clock and is out of alignment with the first peak of AC DLC. Over the next 10 years, with people wanting more comfortable living with additional ACs, the second peak may become higher.

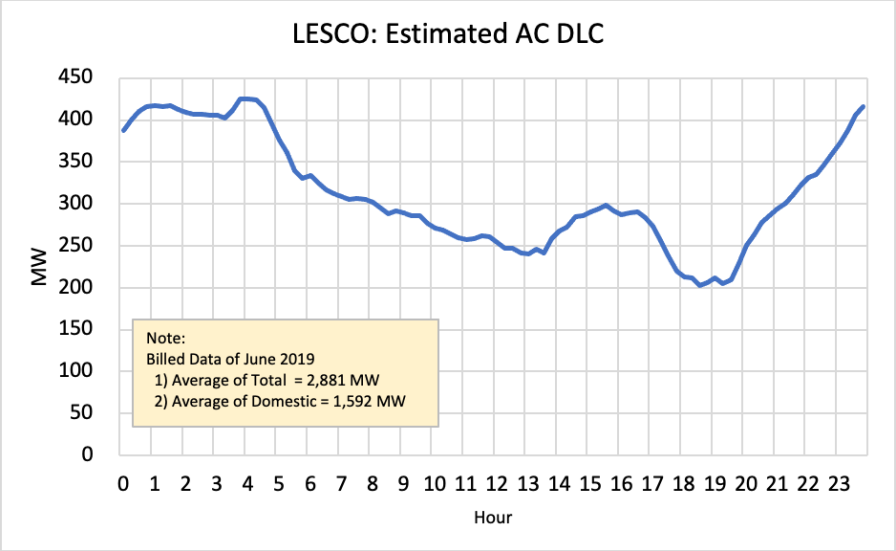


Figure 2-14 Estimated AC Daily Load Curve in LESCO
Source: Jizolab

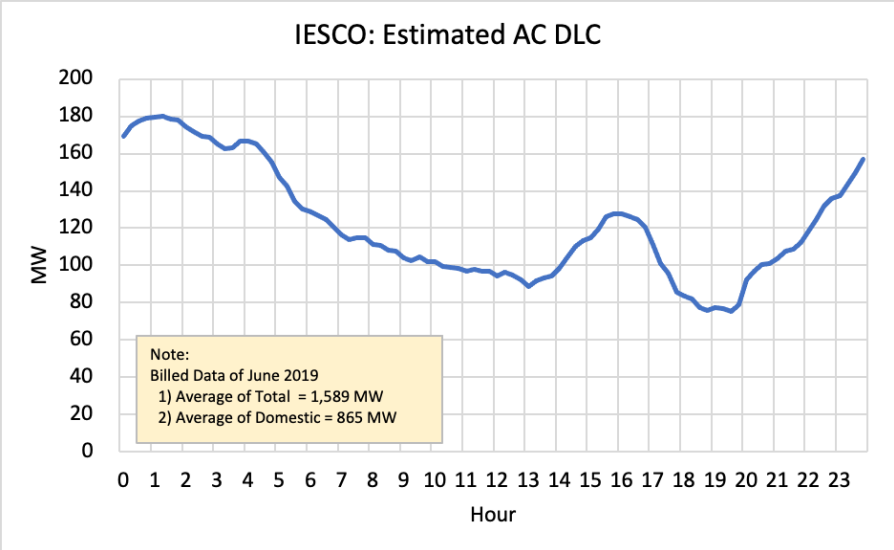


Figure 2-15 Estimated AC Daily Load Curve in IESCO
Source: Jizolab

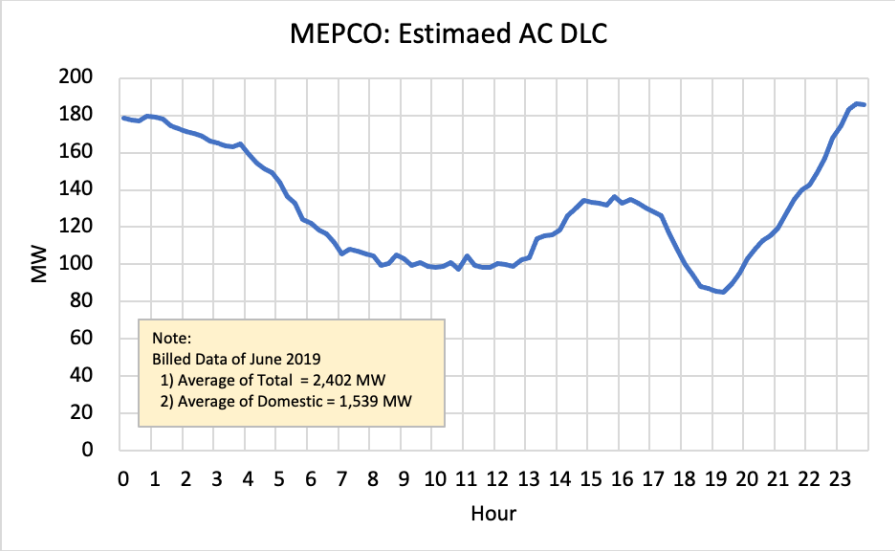


Figure 2-16 Estimated AC Daily Load Curve in MEPCO
Source: Jizolab

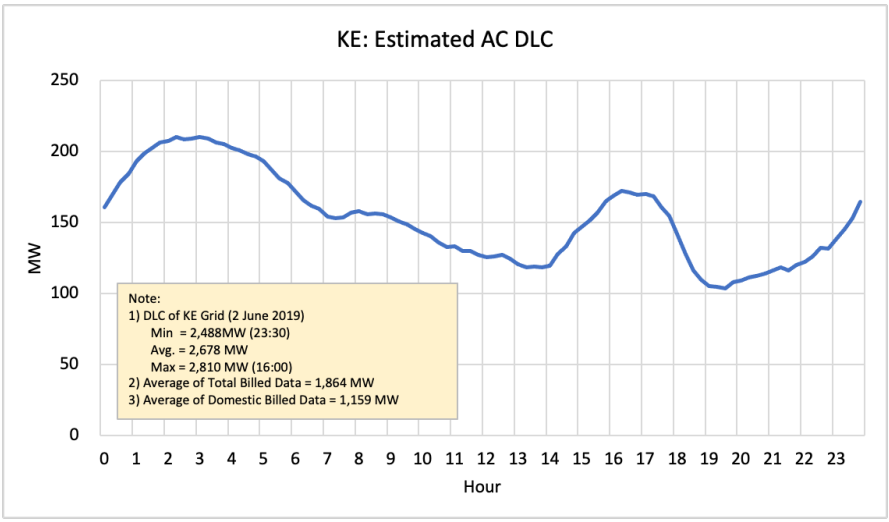


Figure 2-17 Estimated AC Daily Load Curve in KE
Source: Jizolab

Although KE has a tie line with the NTDC grid, domestic AC load is 4.1 – 7.6% of the KE grid peak DLC (26 June 2019) and is not so large currently.

For details of DISCO data analysis, refer to Appendix 9-1.

(2) Measurement Survey

In July to August 2021, a measurement survey was implemented. A data logger with memory was used for AC having large load fluctuation and an energy meter was used for refrigerator/freezer, which can be deemed to have an almost flat load.

1) Target household

Profiles of target households are shown in Table 2-7.

Due to constraints on unwelcome instrument installations inside houses by strangers and the COVID-19 pandemic, we focused the survey on 9 households around Islamabad rather than on the entire country. These target households were identified through the influence of a local Project member.

2) Refrigerator/Freezer

Table 2-8 shows the measurement outcome of 7 refrigerators and 5 freezers. Average annual power consumption is approx. 850kWh[20].

Households in Pakistan numbered 32,205,111 in the 2017 census and the ownership ratio of refrigerator estimated by PBS PSLM2018-19 was 47.6%. Assuming the average unit per household as 1.06, power consumption of refrigerators in Pakistan is estimated to be around 13,800GWh.

[20] Annual power consumtion was estimated by multiplying factor 0.8 to measured outcome, since survey was imolemented in summer.

HH No.	Location	Area	Family Size	Residence form			Appliances Measured			How to use AC and Fan?			Load shedding (in a day)	Generator	UPS or Stabilizer	Solar Panel
				Structure	Area (Sq. feet Sq. meter)	No. of Rooms	AC	Fridge	Freezer	AC only	AC + Ceiling fun (always)	AC + Ceiling fun (sometime)				
HH01	Fizaya Colony, Rawalpindi	Urban	3	2 story	6,800 632	5	4		1	✓			< 1 hour		UPS: 2 kVA×1	5 kVA
HH02	G-11/1, Islamabad	Urban	4	2 story	3,400 316	4	2		1		✓		< 1 hour		UPS: 2 kVA×1	
HH04	Falcon Colony, Rawalpindi	Urban	5	2 story	4,500 418	6	3	1	1	✓			< 1 hour		UPS: 2 kVA×1	
HH05	G-10/4, Islamabad	Urban	4	1 story	3,600 334	4	2	2		✓			< 1 hour		UPS: 2 kVA×1	
HH21	F-6/2, Islamabad	Urban	5	2 story	6,500 604	8	2		1		✓		none		UPS: 0.6 kVA×1	
HH22	G-9/3, Islamabad	Urban	3	2 story	2,200 204	5	1	1			✓		< 1 hour		UPS: 1 kVA×1 Stabilizer: 1 kVA× 1	
HH23	F-6/2, Islamabad	Urban	4	2 story	6,800 632	8	2	1	1		✓		none	5 kVA×1	UPS: 1 kVA×3 Stabilizer: 1.2 kVA×5	
HH24	I-8/4, Islamabad	Urban	2	2 story	3,500 325	8	2	2			✓		1 - 2 hours	5 kVA×1	UPS: 2 kVA×1 Stabilizer: 1 kVA×4	
HH25	Fizaya Colony, Rawalpindi	Urban	3	2 story	7,400 687	4	2	1	1, but failed		✓		< 1 hour			
					Total Measured		20	8	5							

Note) HH stands for Household.

Table 2-7 Profile of target Household of Measurement Survey
Source: Jizolab

	House No.	Manufacuturer	Model No.	Volume (L)	Purchased year	Approx. Price (PKR)	Measuring Instrument	Start	End	Hour	Consumption (kWh)	Wh/Hour	kWh/Year	Annual Average (kWh)
								Date & Time	Date & Time					
Refrigerator	HH04	Orient	6047PF	316	2008	35,000	EM06	2021/07/12 12:47	2021/08/11 12:49	720.0	94.7	131.5	1152.2	829.1
	HH05	Dawlance	9178LFVS	353	2012	40,000	EM03	2021/07/08 11:48	2021/07/16 12:09	192.4	24.4	126.9	1111.2	
		Haier	HRF-380H	370	2010	38,000	EM02	2021/07/08 11:53	2021/07/17 12:06	216.2	14.7	68.0	595.6	
	HH22	Dawlance	-----	350	2006	30,500	EM07	2021/07/29 12:10	2021/08/21 11:13	575.0	80.1	139.3	1220.2	
	HH23	Haier	HRF-398EB/EP	368	2014	50,500	EM13	2021/07/25 13:00	2021/08/21 11:42	670.7	50.3	75.0	657.0	
	HH24	National	-----	320	1998	18,500	EM14	2021/07/27 12:11	2021/08/21 10:36	622.4	43	69.1	605.2	
		Haier	HRF-380M	383	2012	32,000	EM15	2021/07/27 11:58	2021/08/21 10:32	622.6	136	218.5	1913.6	
Freezer	HH01	Haier	HDF-285SD	285	2014	40,000	EM04	2021/07/09 11:05	2021/08/10 13:08	770.0	55.3	71.8	629.1	902.3
	HH02	Waves	WF210	301	2003	25,000	EM08	2021/07/13 12:32	2021/08/16 13:57	817.4	133.6	163.4	1431.7	
	HH04	Waves	-----	301	2006	33,000	EM05	2021/07/12 12:48	2021/08/11 12:52	720.1	102.7	142.6	1249.4	
	HH21	Dawlance	-----	350	2007	35,500	EM11	2021/07/31 14:38	2021/08/21 12:13	525.6	102.7	195.4	1711.8	
	HH23	Haier	-----	325	2017	40,000	EM09	2021/07/25 12:40	2021/08/21 11:47	671.1	47.3	70.5	617.4	

Note) Refrigerator at HH25 was out of order, not measured.

Table 2-8 Measurement Outcome (Refrigerator/Freezer)
Source: Jizolab

3) Specifications of measured ACs

Table 2-9 shows specifications of measured ACs. We measured 20 ACs in 9 households.

Table 2-9 Specification of Measured AC
Source: Jizolab

House No.	AC No.	Manufacturer	Model Number	Type	Control	Cooling Capacity		Purchased year	Approx. Price (PKR)	Data Logger	Location
						Ton	kW				
HH01	AC-1	ACSON	AWM20J-APLBB	Split	Non-inverter	1.5	5.3	2016	105,100	DL01	Bed Room #1
	AC-2	GENERAL	Window AC	Window	Non-inverter	1.5	5.3	1990	20,000	DL04	Drawing Room
	AC-3	GREE	GS-24CITH2W	Split	Inverter	2.0	7.0	2018	125,100	DL05	Bed Room #2
	AC-4	GREE	GS-18CITH11S	Split	Inverter	1.5	5.3	2019	85,000	DL06	Bed Room #3
HH02	AC-1	GREE	GS-18FITH1W	Split	Inverter	1.5	5.3	2019	110,000	DL10	Bed Room #1
	AC-2	KENWOOD	CON18S	Split	Non-inverter	1.5	5.3	2005	60,000	DL11	Bed Room #2
HH04	AC-1	PEL	OS-19MXX	Split	Non-inverter	1.0	3.5	2008	65,000	DL07	Drawing Room
	AC-2	Orient	-------	Split	Non-inverter	1.0	3.5	2010	45,000	DL08	Bed Room #1
	AC-3	Orient	-------	Split	Non-inverter	1.0	3.5	2009	50,000	DL09	Bed Room #2
HH05	AC-1	Dawlance	LVS30	Split	Non-inverter	1.5	5.3	2013	45,500	DL03	Drawing Room
	AC-2	Dawlance	DAC-180CT3K	Split	Non-inverter	1.5	5.3	2007	40,000	DL02	Bed Room
HH21	AC-1	LG	Window AC	Window	Non-inverter	1.5	5.3	1992	17,000	DL13	Bed Room #1
	AC-2	National	Window AC	Window	Non-inverter	1.5	5.3	1989	15,000	DL14	Bed Room #2
HH22	AC-1	Orient	OU-19K7	Split	Non-inverter	1.5	5.3	2015	60,500	DL12	Bed Room
HH23	AC-1	National	Window AC	Window	Non-inverter	1.5	5.3	1991	15,500	DL17	Bed Room #1
	AC-2	PEL	------	Split	Non-inverter	1.5	5.3	2019	75,000	DL18	Bed Room #2
HH24	AC-1	PEL	PINVC-18K	Split	Non-inverter	1.5	5.3	2016	60,000	DL19	Bed Room #1
	AC-2	Haier	HSU-18NH/012DC(W)	Split	Non-inverter	1.5	5.3	2017	73,500	DL20	Bed Room #2
HH25	AC-1	GREE	GS-24CITH2G	Split	Non-inverter	2.0	7.0	2019	109,000	DL15	Drawing Room
	AC-2	GENERAL	-------	Split	Non-Inverter	1.0	3.5	-------	------	DL16	Bed Room

4) ACs

a) Power Consumption (kWh)

Table 2-10 shows outcomes on ACs power consumption per day at 9 households. It doesn't correlate well with family size, house largeness, number of rooms, or number of ACs.

Table 2-10 Refrigerator Power Consumption (kWh)
Source: Jizolab

HH No.	Location	No. of Rooms	Family Size	How to use AC and Fan		AC No.	Type	Control	Cooling Capacity	Room	No. of AC Operation Day	per Unit		per HH	
				AC only	AC + Ceiling fun (always)							Consumed Energy (kWh)	kWh/d	Consumed Energy (kWh)	kWh/d
HH01	Fizaya Colony, Rawalpindi	5	3	✓		AC-1	Split	Non-inverter	5.3	Bed Room #1	27	230.5	8.54	405.0	13.06
						AC-2	Window	Non-inverter	5.3	Drawing Room	3	10.7	3.55		
						AC-3	Split	Inverter	7.0	Bed Room #2	28	105.5	3.77		
						AC-4	Split	Inverter	5.3	Bed Room #3	31	58.3	1.88		
HH02	G-11/1, Islamabad	4	4		✓	AC-1	Split	Inverter	5.3	Bed Room #1	33	248.3	7.52	257.7	7.81
						AC-2	Split	Non-inverter	5.3	Bed Room #2	4	9.4	2.36		
HH04	Falcon Colony, Rawalpindi	6	5	✓		AC-1	Split	Non-inverter	3.5	Drawing Room	29	14.1	0.48	684.6	23.61
						AC-2	Split	Non-inverter	3.5	Bed Room #1	29	461.3	15.91		
						AC-3	Split	Non-inverter	3.5	Bed Room #2	28	209.2	7.47		
HH05	G-10/4, Islamabad	4	4	✓		AC-1	Split	Non-inverter	5.3	Drawing Room	8	24.6	3.07	62.3	7.78
						AC-2	Split	Non-inverter	5.3	Bed Room	8	37.7	4.71		
HH21	F-6/2, Islamabad	8	5		✓	AC-1	Window	Non-inverter	5.3	Bed Room #1	19	104.7	5.51	292.4	15.39
						AC-2	Window	Non-inverter	5.3	Bed Room #2	18	187.8	10.43		
HH22	G-9/3, Islamabad	5	3		✓	AC-1	Split	Non-inverter	5.3	Bed Room	21	119.762	5.70	119.8	5.70
HH23	F-6/2, Islamabad	8	4		✓	AC-1	Window	Non-inverter	5.3	Bed Room #1	26	96.5	3.71	229.8	8.84
						AC-2	Split	Non-inverter	5.3	Bed Room #2	26	133.3	5.13		
HH24	I-8/4, Islamabad	8	2		✓	AC-1	Split	Non-inverter	5.3	Bed Room #1	23	175.6	7.64	358.1	14.92
						AC-2	Split	Non-inverter	5.3	Bed Room #2	24	182.4	7.60		
HH25	Fizaya Colony, Rawalpindi	4	3		✓	AC-1	Split	Non-inverter	7.0	Drawing Room	26	378.8	14.57	581.4	22.36
						AC-2	Split	Non-Inverter	3.5	Bed Room	26	202.6	7.79		

b) Daily Load Curve (DLC, kW)

Figure 2-18 to Figure 2-26 show AC DLCs on the measured peak day at each household. Definition of the chart is shown below:

i. Bar chart: Real DLC on the measured peak load day is shown as a stacked area chart with breakdown of each AC. The vertical axis is kW on the left side. Houses contain 1 to 4 ACs. Consumption of each AC is shown in a different color. If an AC wasn't in operation, it is not shown on the graph chart. The top line shows AC DLC of the whole household. A zero of top line means that no AC was in operation in the household.

ii. Red dotted line chart: Maximum load recorded at the specified time on the horizontal axis during the measured period[21]. As such, every DLC exists under this line. The vertical axis is kW on the left side.

iii. Green line chart: Ratio of operating ACs at the specified time on the horizontal axis during the measurement period. The vertical axis is a percentage at the right side. 0% shows that all ACs were switched off and 100% is 1 or more ACs were on, at the time on every day during the measured period.

Even at a single household, AC DLCs varied a lot on different days. Operation of ACs depends on the ambient temp, time away from home, power outage, etc. Although we could have averaged the DLC with measured outcomes, it would have become a dull curve and wouldn't show any actual peak load.[22] and wouldn't show any actual peak load. As such, to avoid a misunderstanding by averaging the DLCs, only DLC on the peak day is shown here.

The green line chart (iii) shows very clearly how a household operates its ACs. However, please note that this chart is not DLC.

The estimated AC DLC is very similar to one derived by the DISCO data analysis shown in the previous section.

[21] E.g., on 30 days measurement by the data logger, 30 DLCs were recorded. On one specific time in a day, we get 30 values. The red dotted line chart is drawn by connecting the maximum of 30 values over 24 hours.

[22] Using the example in the previous footnote, supplementation may be given as follows: 30 values at one specific time are very staggered. The average of 30 values is less than maximum of them. Since average of 30 DLCs is the curve drawn with these averaged and depressed values over a 24 hour periods, it fails to show any information about peak load.

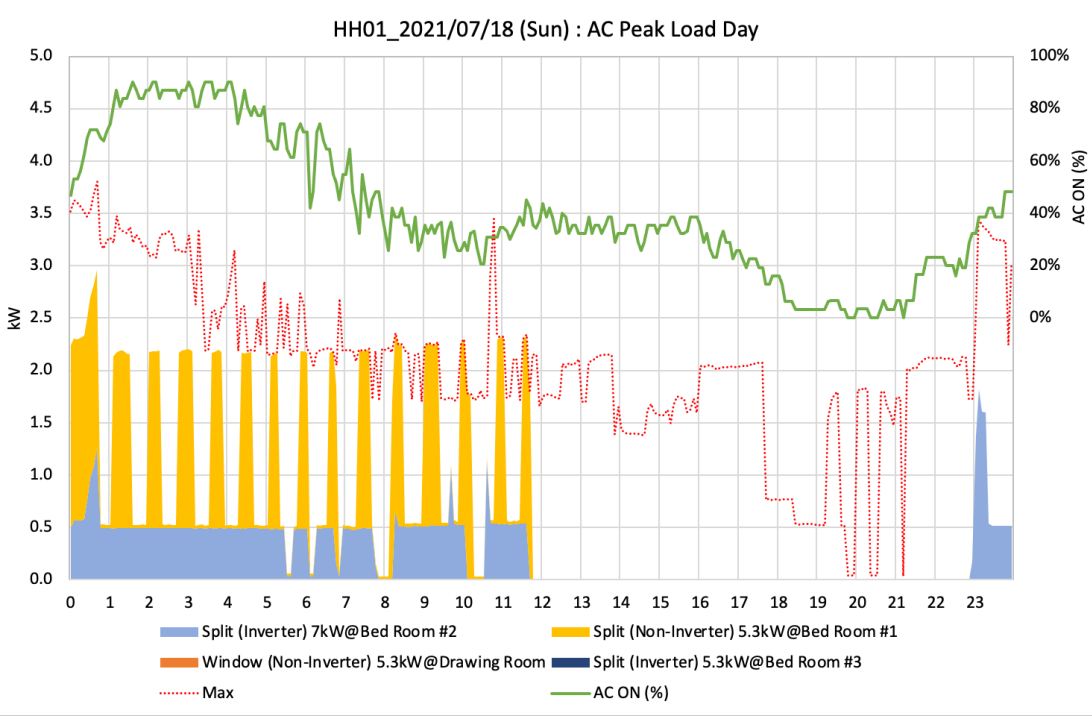


Figure 2-18 HH01 AC DLC
Source: Jizolab

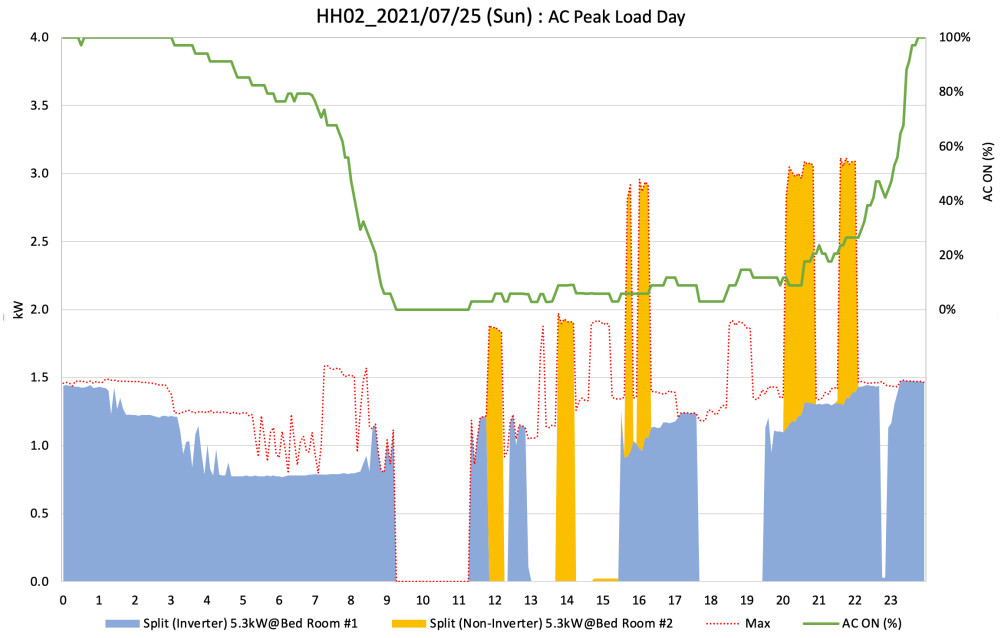


Figure 2-19 HH02 AC DLC
Source: Jizolab

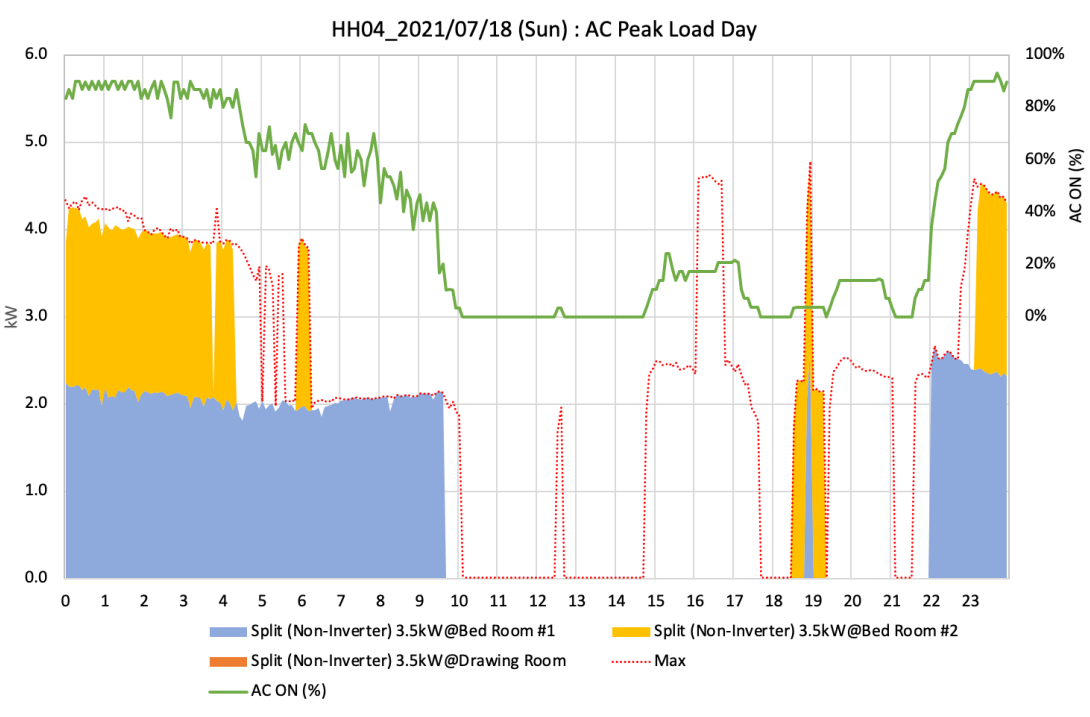


Figure 2-20 HH04 AC DLC
Source: Jizolab

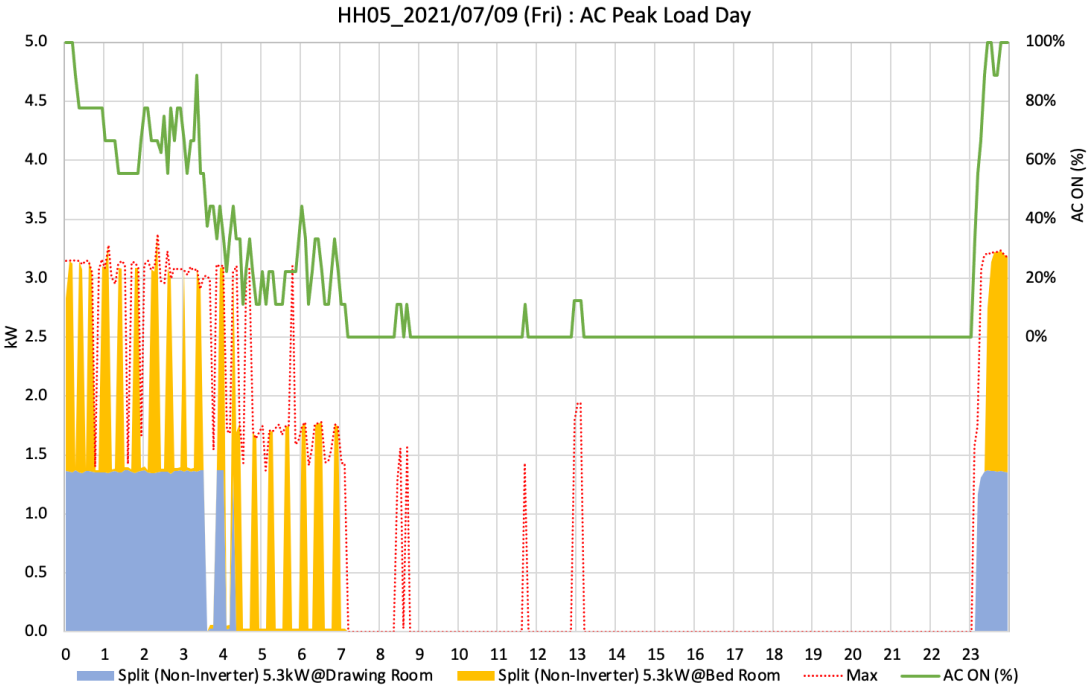


Figure 2-21 HH05 AC DLC
Source: Jizolab

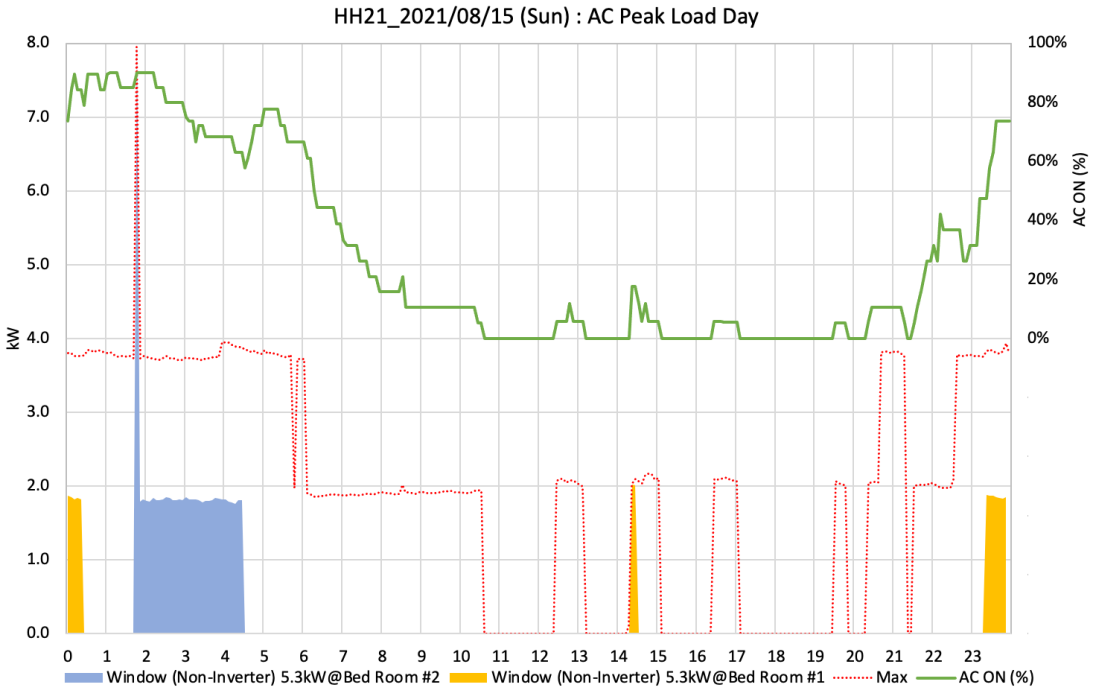


Figure 2-22 HH21 AC DLC
Source: Jizolab

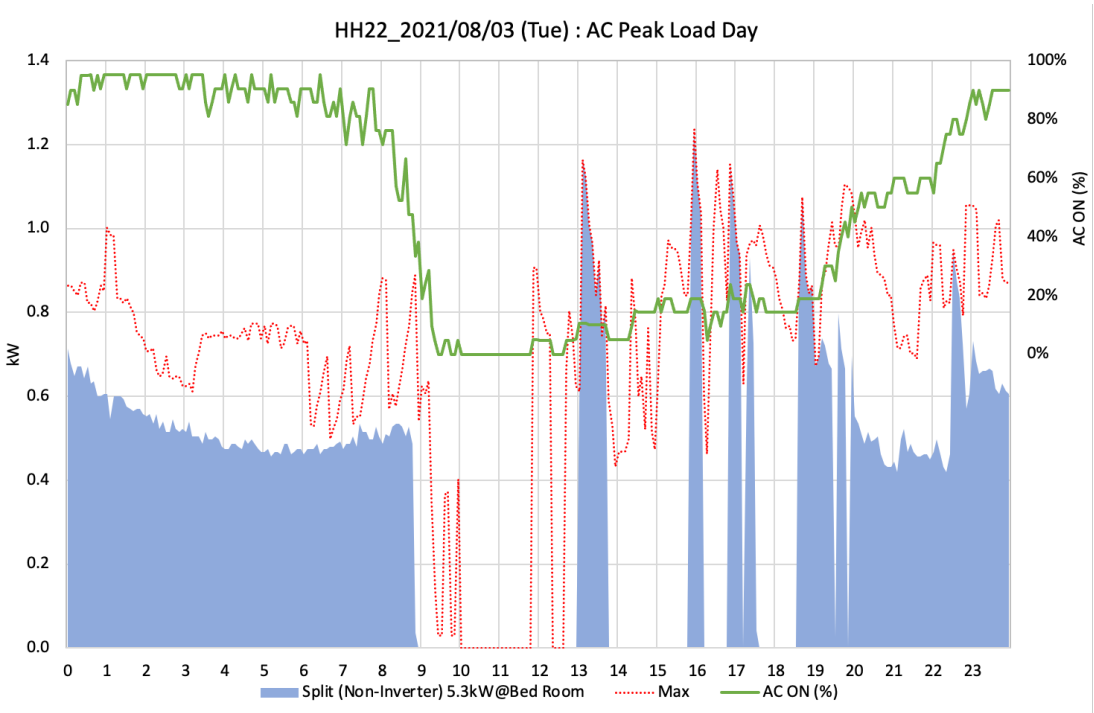


Figure 2-23 HH22 AC DLC
Source: Jizolab

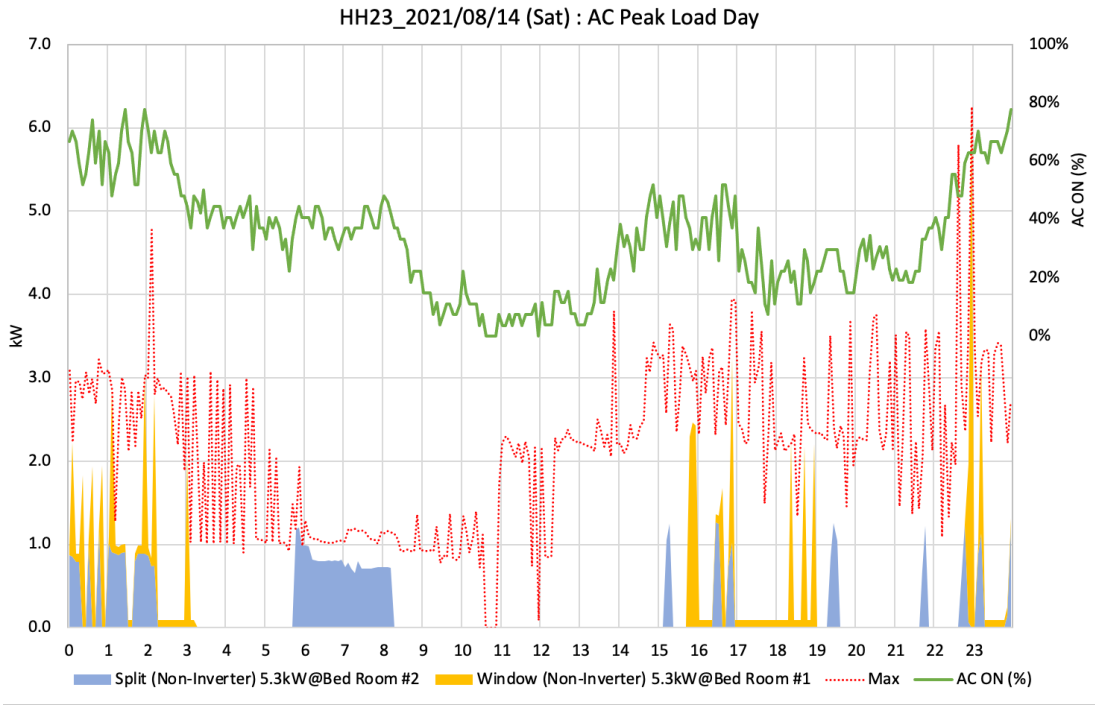


Figure 2-24 HH23 AC DLC
Source: Jizolab

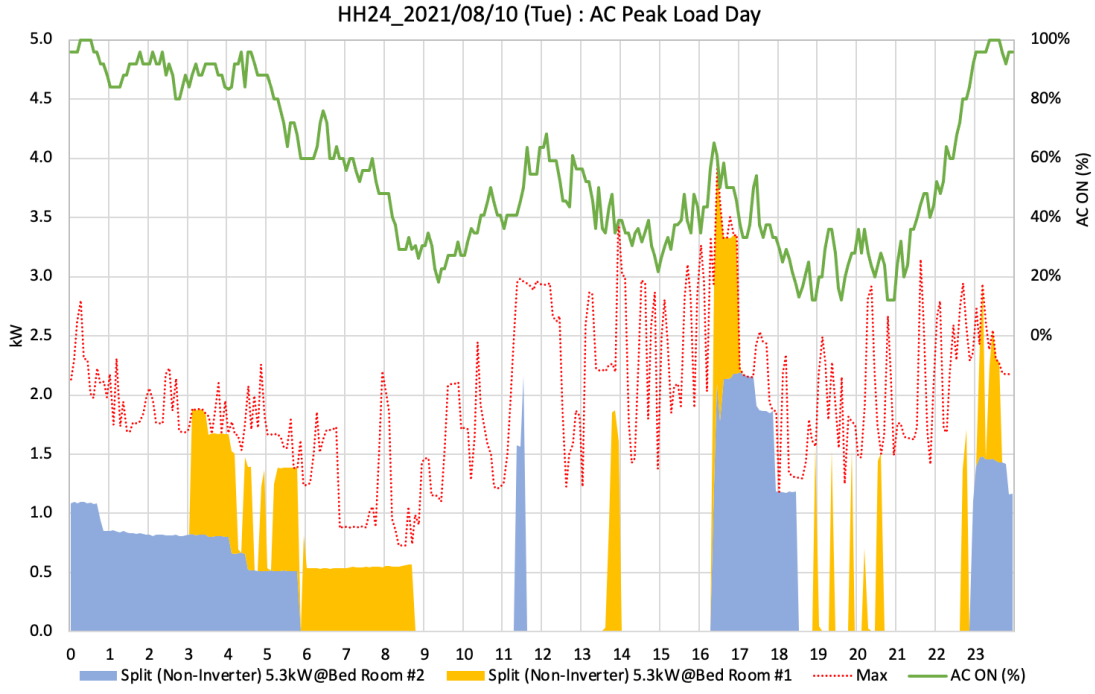


Figure 2-25 HH24 AC DLC
Source: Jizolab

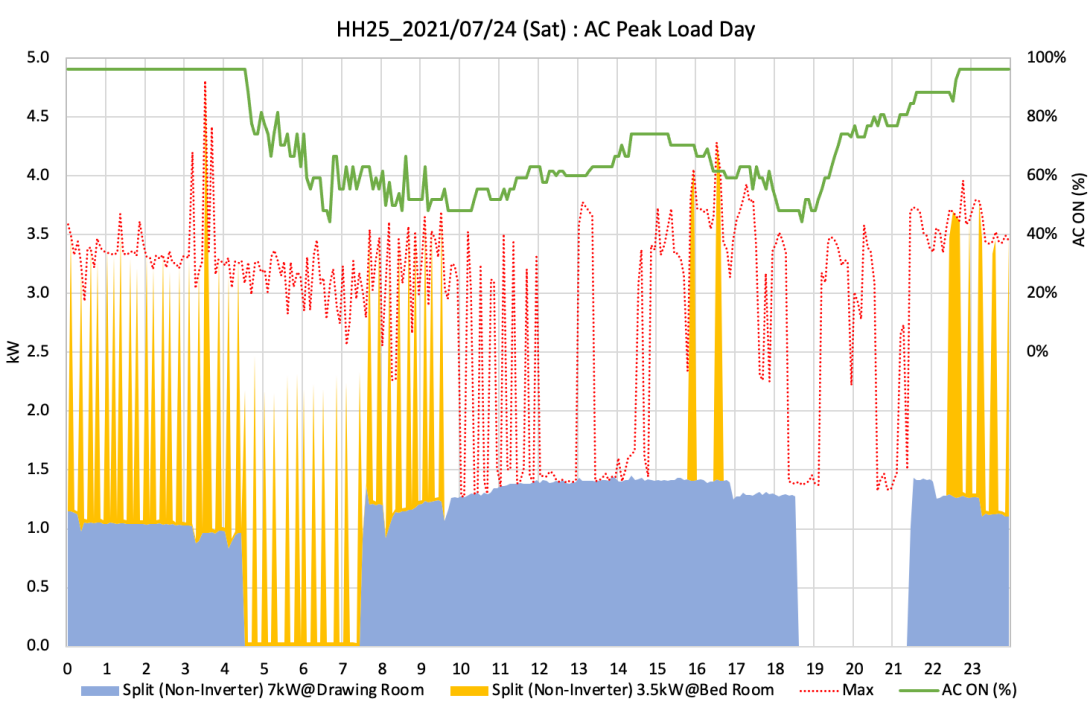


Figure 2-26 HH25 AC DLC
Source: Jizolab

[Activity 1-1-8] Current issues related to ES&L in Pakistan (Institutional & technical)

The energy efficiency of room air conditioners and household refrigerating appliances is increasing year by year, due to the efficiency improvement of Chinese appliances, especially room air conditioners, the increase of per capita income of Pakistan's consumers and the increase of electricity tariffs etc. MEPS and labeling regulations intend to enhance dissemination of these high efficiency appliances. To achieve this purpose, NEECA shall enhance institutional capacity (mainly personnel capacity) and frameworks to monitor the trend of the market in Pakistan and the technological development of appliances to improve energy efficiency in the world.

Consumers's trust to the ES&L regulations, especially labeling regulations, is the most critical issue for the success of the regulations. NEECA needs to enhance institutional capacity to carry out market surveillance on compliance of the regulations effectively.

[Activity 1-1-9] Expected Impact of mandatory ES&L scheme (Referential index)

(1) AC

An impact estimation was made under the following assumtions:

1) According to Figure 2-29, the increase of sold units from 2018 to 2019 was 119,000. The growth may continue in the coming years.
2) Averaged AC efficiency sold now may be 1★[23].

[23] Here, a typical product with an n Star Rating is refered to as n★. That is, 3★ is a typical product with ★★★.

3) Without mandatory ES&L regulation, average AC efficiency sold over the next 3 years from the second half of 2022 may continue to be 1★.
4) With mandatory ES&L regulation, from the second half 2022, it may be 2★ in the first year, 3★ in the second year, 4★ in the third year on average. Sold units may be as shown in Table 2-11.

Table 2-11 Assumed AC Sold Units with Mandatory ES&L Regulation
Source: Jizolab

Units Sold (Thousand)	2022-2023	1,544.5 (2★)
	2023-2024	1,663.5 (3★)
	2024-2025	1,782.5 (4★)

5) According to Figure 2-32, major cooling capacity is 5.0 - 5.5kW (1.42-1.56 ton). Assuming a 5.28kW (1.50 ton) AC with a mid-valued energy efficiency in each star rating is sold in the next 3 years, their annual power consumption may be as shown Table 2-12.

Table 2-12 Assumed AC CSPF and Power Consumption per Year
Source: Jizolab

4.5 ≤ kW ≤10.5		1★		2★		3★		4★		5★	
CSPF	Band Width	3.0	3.3	3.3	3.7	3.7	4.0	4.0	4.5	4.5	
	Mid-value	3.15		3.50		3.85		4.25		4.50	
kWh/y	Mid-value	2,296		2,067		1,879		1,702		1,607	

Based on the above assumptions, total power consumption is calculated as shown in Table 2-13. Saved energy is 2,109 GWh over 3 years and economic outcomes are savings of 46 billion PKR, under the unit rate of 22 PKR/kWh.

Table 2-13 Energy Saving Impact by Mandatory ES&L Regulation for AC
Source: Jizolab

		Without Regulation (Business As Usual)			With Regulation		
Year	Units Sold (Thousands)	Rating Sold	kWh/y	Total GWh/y	Rating Sold	kWh/y	Total GWh/y
2022-2023	1,544.5	1★	2,296	3,547	2★	2,067	3,192
2023-2024	1,663.5	1★	2,296	3,820	3★	1,879	3,125
2024-2025	1,782.5	1★	2,296	4,093	4★	1,702	3,034
			Total	11,460		Total	9,351
						Saved Eneregy	2,109

(2) Refrigerator

An impact estimation was made under the following assumtions:

1) According to Figure 2-33, the increase of sold units from 2018 to 2019 was 27,000. This growth may continue in the coming years.
2) Averaged refrigerator efficiency sold now may be 1★.

3) Without mandatory ES&L regulation, averaged refrigerator efficiency sold over the next 3 years from the second half 2022 may continue to be 1★.
4) With mandatory ES&L regulation, from the second half 2022, it may be 2★ in the first year, 3★ in the second year, 4★ in the third year on average. Sold units may be as shown in Table 2-14.

Table 2-14 Assumed Refrigerator Sold Units with Mandatory ES&L Regulation
Source: Jizolab

Units Sold (Thousand)	2022-2023	2061.5 (2★)
	2023-2024	2088.5 (3★)
	2024-2025	2115.5 (4★)

5) According to Figure 2-36, the most common size is 200 - 400L. Assuming a 350L (Vadj = 400L) refrigerator with a mid-valued energy efficiency in each star rating is sold in the next 3 years, their annual power consumption may be as shown Table 2-15.

Table 2-15 Assumed Refrigerator Power Consumption per Year
Source: Jizolab

Vadj=400		1★		2★		3★		4★		5★	
CEC	Band Width	650	570	570	488	488	423	423	325	325	
	Mid-value	610		529		455		374		325	

Based on the above assumptions, total power consumption is calculated as shown in Table 2-16. Saved energy is 990 GWh over 3 years and economic outcomes are savings of 22 billion PKR, under the unit rate of 22 PKR/kWh.

Table 2-16 Energy Saving Impact by Mandatory ES&L Regulation for Refrigerator
Source: Jizolab

		Without Regulation (Business As Usual)			With Regulation		
Year	Units Sold (Thousands)	Rating Sold	kWh/y	Total GWh/y	Rating Sold	kWh/y	Total GWh/y
2022-2023	2,061.5	1★	610	1,258	2★	529	1,090
2023-2024	2,088.5	1★	610	1,274	3★	455	951
2024-2025	2,115.5	1★	610	1,290	4★	374	791
			Total	3,822		Total	2,832
						Saved Eneregy	990

[Activity 1-2] Vision for promotion of ES&L

"**Save Energy, Mottainai!"** was proposed as a vision. The followings are other options. NEECA shall discuss these at a later date.

- Mottainai! Think Conservation
- Smart Choice, Mottainai!
- Mottainai! Wisely Use Energy

Figure 2-27 Mottainai!! in Awareness Film
Source: Jizolab

"Mottainai" is a Japanese concept and word. Kōjien, widely considered the most authoritative Japanese dictionary, lists three definitions for the word "mottainai":

1) inexpedient or reprehensible attitude towards a god, buddha, noble or the like
2) awe-inspiring and unmerited/undeserved, used to express thanks
3) an expression of regret at the full value of something not being put to good use

In contemporary Japanese, mottainai is most commonly used in the sense of 3) or 2). "mottainai" is commonly interpreted as wasteful or excessive spending. However, it contains respect to everything in its intrinsic nuance, as shown in 3), that is, to be regrettable to lose without making full use of the original ability and its potential usage." It's not an economical word, and a sense of esteem and respect for the importance, value, and dignity of everything. When this dignity is damaged or is likely to be damaged, a Japanese feels "mottainai" with sorry, regret, remorse, apology, and thanks. It is a desire to let it (and energy) exert its value and ability to the fullest.

This word became famous by the Kenyan activist, government minister and Nobel laureate Dr. Wangari Maathai. In her speech at the UN[24], she said that "even at personal level, we can all reduce, re-use and recycle, what is embraced as Mottainai in Japan, a concept that also calls us to express gratitude, to respect and to avoid wastage". We find she understands the meaning truly, since she included the words "gratitude" and "respect".

Much primary energy used to generate power is not sustainable now. We need to use it with a feeling of "mottainai". Such a life and way to live will bring us to a society which cherishes limited natural resources and uses them much more rationally. This coincides with the SDGs proposed by the UN.

[24] https://web.archive.org/web/20110601034605/http:/www.un.org/wcm/webdav/site/climatechange/shared/Documents/SpeechMaathai.pdf

[Activity 1-3] Strategy for promotion of ES&L

"Vision, Strategy and Action Plan on ES&L (Appendix 9-1)" was proposed to NEECA. It specifies an effective strategy for NEECA to follow by implementing an ES&L regulation scheme. Its contents are show below.

[Activity 1-3-1] ES&L monitoring framework for labeled product in market

NEECA shall establish registered product databases, which are linked to PRS, quarterly sales reports of registered products submitted by manufactures/importers, and market surveillance scheme such as verification tests.

(1) Verification test

NEECA carries out verification tests on registered models based on risk-based sampling such as complaints from consumers, manufactures etc., market surveillance and quality management of manufactures etc. All verification tests are carried out in accordance with the applicable test standards and parameters. NEECA requests the verification test to a PNAC accredited third party testing laboratories.

(2) Conformance of verification test

A registered model is deemed to have passed the verification test if the energy performance obtained through the test falls within the conformance limits. Examples of conformance limits for room air conditioners and household refrigerating appliances is specified in Appendix 7-4.

(3) Procedure of verification test

NEECA carries out risk-based sampling in the market and buys models from the market for verification tests.

Manufactures and importers of labeled appliances, whose model is to be tested, shall provide information on the test mode which is required by the testing laboratory.

If the model fails to pass the verification test, the registered company of the model is notified and given an opportunity to decide either to cancel the registration of the model or to request NEECA to carry out a second check testing of the model at the registered companies' expense.

In the case of a second verification test, NEECA buys three (3) samples of the same model from the market and test the samples. NEECA informs the registered company of the models about the date of the second check test, so they are able to witness the test.

The model shall be considered to comply with the MEPS and labeling requirements, if the average of the three samples is within the conformance limits shown. NEECA notifies the registered company, and no further action is taken.

NEECA shall cancel the model's registration if the model fails to pass the second verification test. NEECA may also consider additional enforcement requirements. The registered company shall withdraw all stock of the failed models from the market immediately.

Registered companies are allowed to apply the model registration after correcting the label level.

To implement reliable verification tests, NEECA shall request the following to testing laboratories.

- Develop common agreement on practice of measurement of energy consumption between accredited testing laboratory and inhouse testing laboratories of manufactures and importers through continuous round robin tests and analysis of differences of testing results between them.
- Expand capacity of accredited testing laboratories for verification tests.
  The market of appliances in Pakistan is growing year by year. It is necessary to expand capacity of accredited testing laboratories to be able to carry out a high enough number of samples to be tested.

[Activity 1-3-2] Measures for imported appliances (At customs)

NEECA should communicate with Customs and the Federal Bureau of Revenue, on the import of appliances and ask Customs to prohibit the import of products without product registration under Section 10 (c) of the Act.

[Activity 1-3-3] Measures for importing appliances (Mutual recognition)

To reduce the need for verification tests in Pakistan and to encourage the export of labeled appliances to other Asian and African countries etc., NEECA should work to have mutual accreditation agreement with major trading countries under collaboration with the MoFA, MoST and PNAC.

[Activity 1-3-4] Revision framework of MEPS standard

Refer to [Activity 1-3-5].

[Activity 1-3-5] Formulation/Revision of ES&L scheme linked with MEPS standards

(1) Expand scope of target appliances

Target appliances to be covered by the Mandatory ES&L Scheme shall be expanded. Based on the market survey, penetration rate and energy efficiency, added appliances shall be carefully selected.

Even for existing target appliances, expansion of the scope shall be investigated. E.g., as for household refrigerating appliances, there are various types of refrigerating appliances. The current scope of the MEPS and Labeling regulation covers only two (2) door refrigerators/freezers. To increase coverage of the regulation, NEECA needs to develop MEPS and Labeling regulations of one (1) door refrigerators, freezers, and other refrigerating appliances to maximize the effect of the regulation.

(2) Change target appliances

Technological innovation is recently very rapid. An appliance may be obsolete because of technological innovation. For example, Compact Fluorescent Light bulbs (CFL) have been replaced by LED lamps. It is necessary to take note of technology trends and revise the list of target appliances.

(3) Maintain integrity of the ES&L scheme

Trust for the energy label is of the utmost importance. To keep the integrity of the scheme, market surveillance should be made continuously. The initial step is to establish a surveillance team within NEECA.

[Activity 1-3-6] Revise roadmap for ES&L

(1) Enhance accredited testing laboratory and its capability

The most urgent necessary action is to establish an accredited AC testing laboratory. Testing laboratories at PCSIR should be enhanced. To have the capability to conform the verification tests, existing test facility should also be expanded. E.g., the capability of PCSIR's test facility for refrigerator may be around 15 - 20 units/year.

(2) Partnership with private sector

Success of the energy conservation scheme depends on the harmonization between NEECA and the private sector, including manufacturers, importers, and retailers. Keeping communication with them is essential to improve/modify/enhance the scheme.

(3) Cooperation with Designated Agencies

Pakistan is wide and NEECA has limited personel resources. It is necessary to cooperate with provincial governments, i.e., Designated Agencies. Since, especially, PEECA is going to have an AC testing laboratory, work in closer cooperation with it will be very important. Expansion of similar networks in other provinces is also highly expected.

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(4) Training and capacity development of NEECA and Designated Agencies

Implementing establishment of an institutional system concerning energy conservation through strengthening of support for the development of personnel resources including the dispatch of

Japanese long-term experts to Pakistan and the reception of trainees to training courses in Japan, etc.

[Activity 1-3-7] Incentive measures

(1) Financial incentives

According to NEECA's Strategic Plan (2020-2023), as an incentive for consumers to purchase energy-efficient products with many stars, a distribution company to lend the purchase cost of the appliance with a low-interest loan and then collect the repayment with the electricity bill (On-bill Financing) is planned. (Budget total 100 million rupees)

In future, Export Promotion (incentive) Programs for highly efficient appliances shall be investigated. Tight cooperation with MoI&P shall be established.

(1) Public procurement in federal and provincial governments

In Japan, it is widely acknowledged that whoever suggests something should be the first to start (先ず隗より始めよ). This word comes from China (启动比隗). When a government promotes something, it should be the first to do it. That is, public procurement of labeled product by federal and provincial governments is very important to enlarge/promote the ES&L scheme.

[Activity 1-3-8] Layer wise awareness and publicity activity

Refer to [Activity 2-1], [Activity 2-2] and [Activity 2-3].

[Activity 1-4] Specific action plan for the related organizations

"Vision, Strategy and Action Plan on ES&L (Appendix 9-1)" was proposed to NEECA. It specifies the necessary action plan to be executed by NEECA, on implementing the ES&L regulation scheme. Its contents are show below.

(1) Administrative procedures of MEPS and Labeling regulations

NEECA proposes over-all procedures of ES&L application and approval as shown at Figure 2-28.

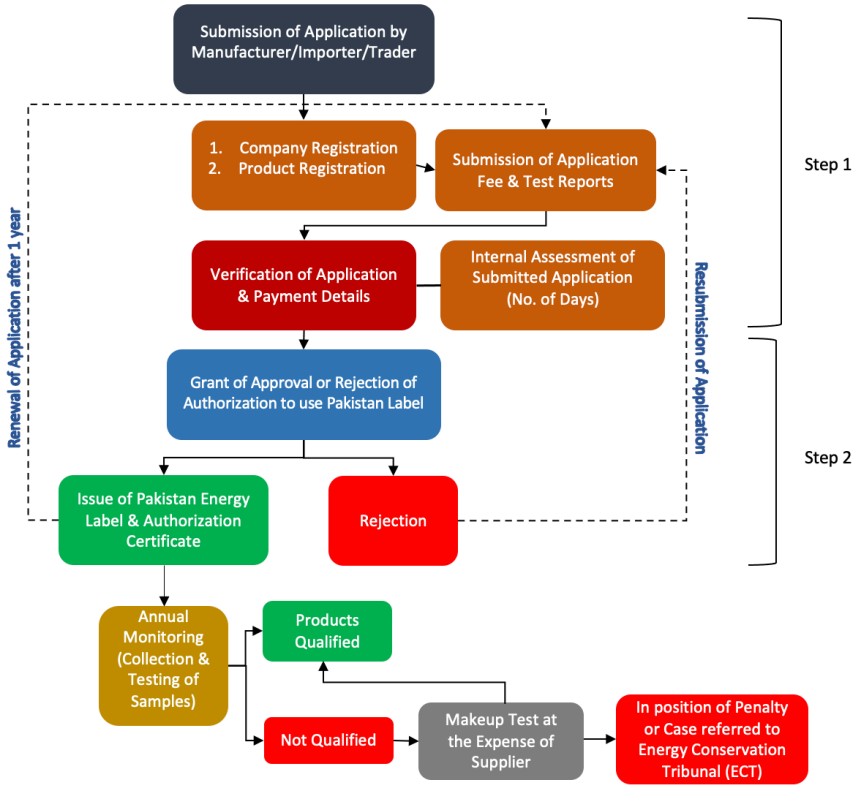


Figure 2-28 Procedures of ES&L Application and Approval
Source: NEECA & Jizolab

(2) Develop online product registration system

NEECA is developing an online product registration system (PRS) only for LED lighting products. Product registration of other appliances, such as, room air conditioners and household refrigerating appliances may be started by an Excel based manual registration system. Taking into consideration the reduction of required personnel resources of NEECA and applicants, NEECA needs to transfer the product registration system from a manual to an online system as soon as possible.

However, NEECA needs to consider institutional and financial scheme to maintain and update the online system continuously when NEECA develops the online system for another appliance. In particular, continuous updating of hacking blocking system is critically important for an online system. Additionally, NEECA shall have a common online system which can be used by all appliances under MEPS and Labeling regulations. Therefore, applicability of the system to various type of appliances is required.

(3) Establish registered product database

NEECA should establish a registered product database to confirm compliance of the MEPS and Labeling regulations efficiently. The database shall be linked to the PRS, which includes specifications of each product. To maintain up-to-date data, NEECA requests the registered

companies to submit quarterly reports (every three (3) months) on production, import and sales of the registered product. This indicates the number of the registered product of a particular model sold in the market. This also indicates availability of a particular model in the market for verification tests.

NEECA examines the consistency of these data with provision of security tags for each model.

(4) Enhance monitoring, verification, and enforcement system

Consumer's trust in 5-star labels of appliances is the key to success of MEPS and Labeling regulations. NEECA needs to establish reliable enforcement scheme of the MEPS and Labeling regulations from product registration, monitoring, market surveillance including verification test and enforcement measures such as penalties for non-compliant companies.

NEECA should carry out market surveillance periodically, under collaboration with provincial governments, to confirm the registered products in shops, brochures, or internet sites, which carry the labels that are compliant with the requirement of the MEPS and Labeling regulations.

NEECA shall cancel the model's registration, if the model does not display the label directed by the MEPS and Labelling regulations properly. NEECA may also consider additional enforcement requirements. The registered companies shall withdraw all stock from the market immediately.

NEECA may impose fines under section 18, National Energy Efficiency and Conservation Act, 2016 (the Act) to a manufacture, importer etc., if the model does not display the correct label. The manufacture, importer etc. shall withdraw all stock from the market immediately.

(5) Enforcement

The NEECA act provides the measures to enforce the MEPS and Labeling regulations as follows. NEECA shall use these measures to enforce the MEPS and Labelling regulations effectively.

Article 15. Powers of inspection

(1) The designated agency may appoint, after the date of commencement of this Act, as many inspecting officers as may be necessary for the purpose of ensuring compliance with energy consumption standards specified under section 10 or ensure display of particulars on label on equipment or appliance specified under clause (b) of section 10 or for the purpose of performing such other functions as may be assigned to them.

(2) Subject to any rules made under this act, an inspecting officer shall have power to –
(a) inspect any operation carried on or in connection with equipment or appliance specified under clause (b) of section 10 or in respect of which energy standards under clause (a) of section 10 have been specified.

Remaining paragraphs of this section are omitted.

Article 16. Powers to issue directions. The Federal Government or a Provincial Government may, in exercise of its powers and performance of its functions under this Act and for efficient use of energy and its conservation, issue such directions in writing as it deems fit for the purpose of this Act to any person, officer, authority or any designated consumer shall be bound to comply with such directions. Explanation. - For the avoidance of doubts, it is hereby declared that the power to issue directions under this section includes the power to direct- (a) regulation of norms for process and energy consumption standards in any industry or building complex, or (b) regulation of energy consumption standards for equipment and appliances.
Article 18. Imposition of fine. (1) Failure on part of any person to comply with the provisions of this Act shall constitute an offence, which shall entail a fine commensurate with the gravity of offence, as determined by the Board from time to time. (2) The amount of fine imposed, in case of default, shall be recovered as arrears of land revenue.

(6) Periodic review and update of the standards

NEECA should review MEPS and Labeling standards every 2 years in terms of technology, market trends and amendment of testing standards.

1) Technology

Energy efficiency of appliances is improving continuously via technological development. Taking into consideration the strong needs for energy saving to mitigate climate change in the world, manufactures are competing to improve energy efficiency of these appliances. Therefore, NEECA should always watche the latest energy efficiency technology and make updates to MEPS and Labeling regulations when required.

2) Market trends

Consumer choice of appliances may change via the willingness of payment and provision of more attractive appliances. E.g., the market share of inverter driven room air conditioners is sharply growing in recent years. Additionally, the market share of frost-free refrigerators is growing gradually year by year. MEPS and Labeling regulations should be updated considering these market trends.

3) Amendment of ISO/IEC standards

Testing standards of ISO/IEC are frequently amended or updated to improve the accuracy of energy efficiency tests. PSQCA should apply these international standards to Pakistan standards immediately and NEECA should use the latest testing standards for MEPS and Labeling regulations.

[Activity 1-5] Promote mandatory ES&L for Targeted Appliance

[Activity 1-5-1] Identify the target appliance for mandatory ES&L scheme

At 1st JCC meeting in April 2019, the Target Appliances are defined as ACs and refrigerators.

According to a market survey in Pakistan, recent market trend of room air conditioners and household refrigerators is follows.

(1) AC

Sales of room air conditioners are increasing year by year in Pakistan and sales in 2019 reached more than 1 million units. Market share of inverter air conditioners is rapidly increasing and reached 78% in 2019. More than 99 % of air conditioners are wall mounted sprit types, and the market of window type air conditioners have disappeared. More than 90 % of air conditioners have a cooling capacity between 3.5kW and 5.5kW.

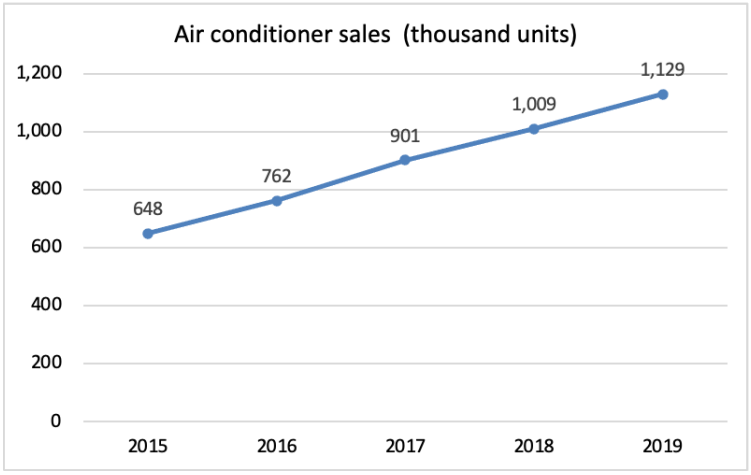


Figure 2-29 Sales of AC
Source: Jizo Lab

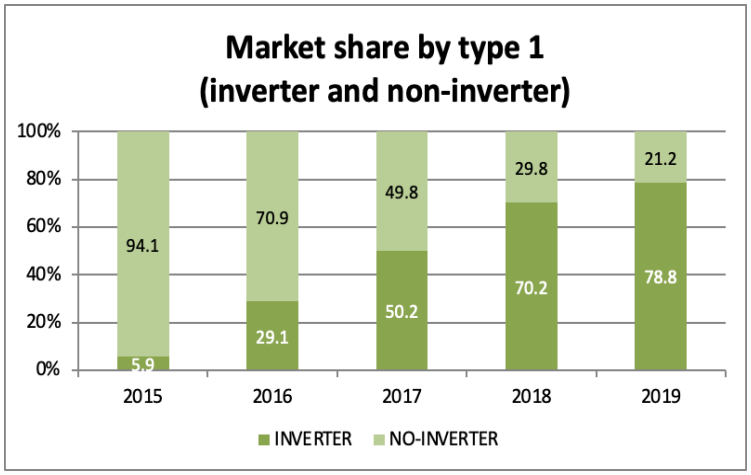


Figure 2-30 Market Share by Type -1 (Inverter vs Non-inverter)
Source: Jizo Lab

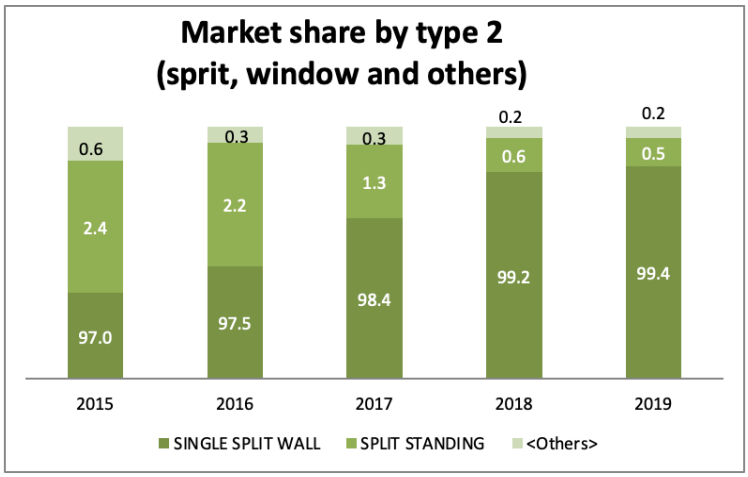


Figure 2-31 Market Share by Type -2 (Sprit, Window and Others)
Source: Jizo Lab

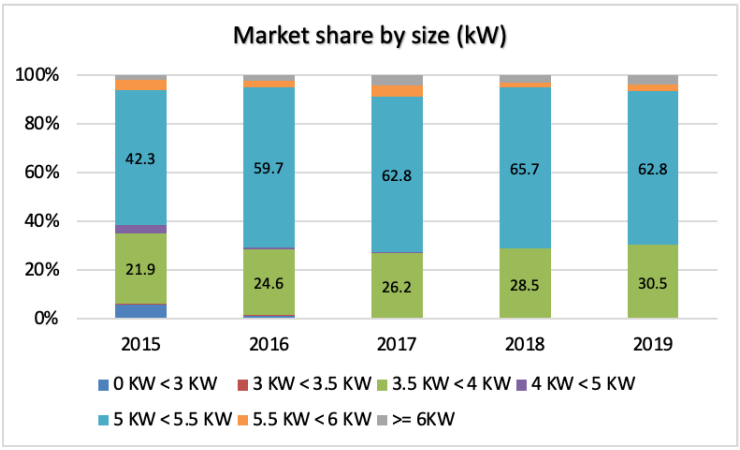


Figure 2-32 Market Share by Cooling Capacity
Source: Jizo Lab

(2) Refrigerator

Sales of household refrigerating appliances in Pakistan is increasing year by year and reached more than1.96 million units in 2019. The market share of direct cool refrigerators (units that directly cool the air circulation inside its compartments with the natural process of convection) was more than 93 % in 2019. However, market share of frost-free refrigerators (units that cool the air circulation inside its compartments with forced air circulation by a fan) is increasing gradually and reached about 7 % in 2019. More than 97 % of refrigerators are the 2-door type and the capacity of most refrigerators is between 100 – 500 L.

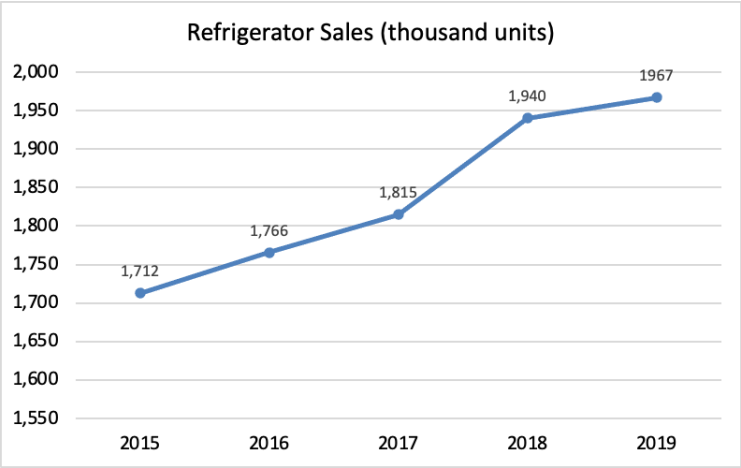


Figure 2-33 Sales of Refrigerator
Source: Jizo Lab

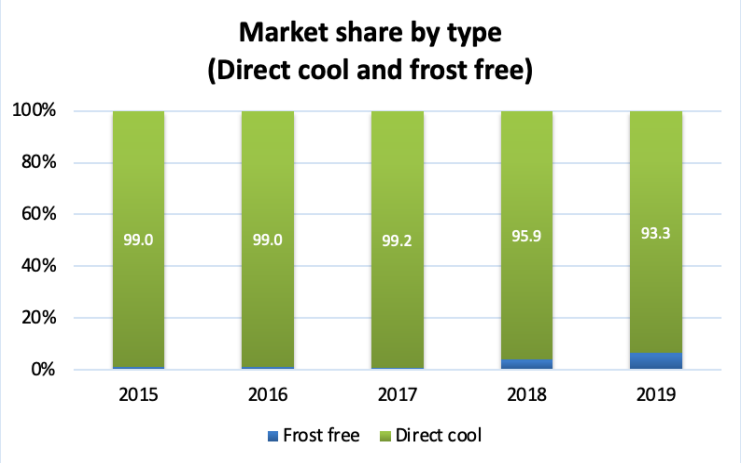


Figure 2-34 Market Share by Type
Source: Jizo Lab

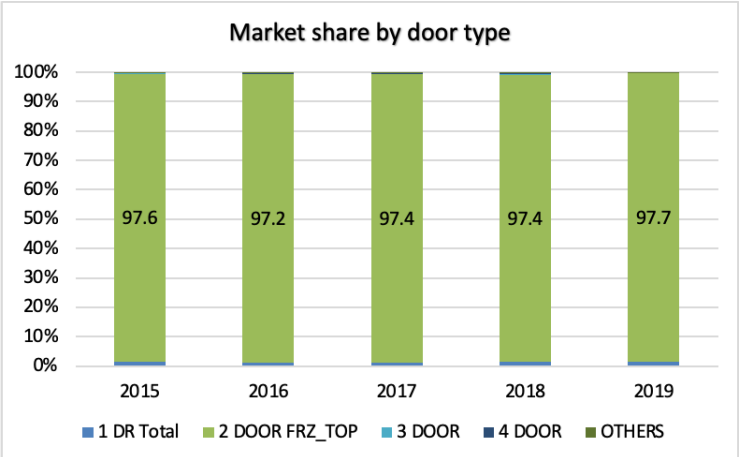


Figure 2-35 Market Share by Door Type
Source: Jizo Lab

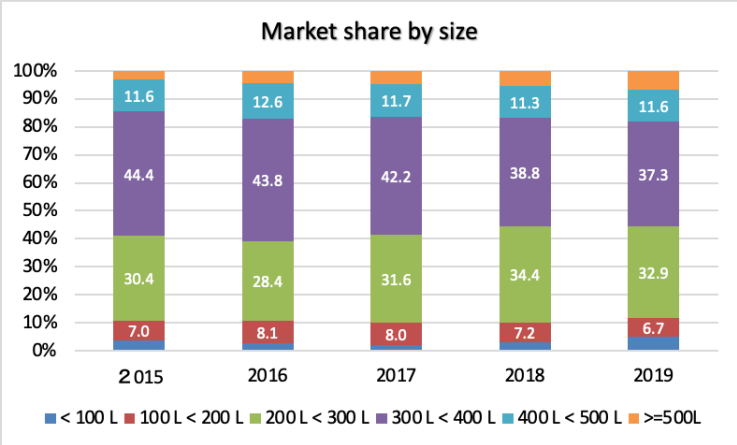


Figure 2-36 Market Share by Capacity
Source: Jizo Lab

[Activity 1-5-2] Study a specific work plan and role of the related parties

It is necessary to establish third-party accredited testing labolatory

(1) AC

PEECA is building an AC testing laboratory. The laboratory is built at the Center for Energy Research and Development (CERAD which is supervised by the Punjab provincial government) in the University of Engineering and Technology, Lahore. American Electronics (a Pakistani company) has contracted with PEECA to build the laboratory. The testing equipment is enthalpy type meter made by ODIN Systems in China. American Electronics is in charge of training of operators and accreditation as PS: IEC62552 testing laboratory by PNAC after installation of the equipment. The testing laboratory will be operated by CERAD. The 10 operators will be provided by CERAD (3-4 operators), PCSIR (3 operators) and PEECA (3 operators).

(2) Refrigerator

PCSIR built a refrigerator testing laboratory that was accreditated by PNAC as a PS: IEC62552 testing laboratory in April 2018. 2 operators have been trained by the Chinese manufacture of testing equipment. However, there are few requests for refrigerator testing since commissioning and additional training of operators are thought to be necessary as a third-party testing laboratory. Taking into consideration of this situation, JICA Expert Team and NEECA provided an online training on IEC62552-3 (Household refrigerating appliances – Characteristics and methods- Part 3: Energy consumption and volume) to PCSIR, which is the PNAC accredited testing labolatory and implements verification tests of labeled household refrigerating appliances, manufactures and importers in Pakistan based on request by NEECA. JQA provided the training in October 2021. The details of the training are shown in Appendix 7-5.

Additionally, NEECA provided financial assistance to PCSIR to implement round robin testings of household refrigerating appliances between PCSIR and testing laboratories of manufactures/importers to improve accuracy of energy consumption measurements.

These efforts will assist to carry out reliable verification tests to confirm compliance of labeling regulations.

[Activity 1-5-3] Technical standard as PS and detailed regulations

(1) Study technical standards for ES&L regulations

1) Pakistan Standards

PSQCA is in charge of Pakistan standards. The headquarter of PSQCA in Karachi is in charge of technical standards on home appliances including room air conditioners and household refrigerators and PSQCA in Islamabad is in charge of conformity standards of ISO/IEC17000. PSQCA basically adopts international standards such as ISO and IEC standards, which are necessary in Pakistan.

Technical committees which are organized by experts and stakeholders of each specific field, provide advice and suggestions to PSQCA when PSQCA develops Pakistan standards. The technical committee on Electrical Appliances and Accessories (TC-3) is in charge of Pakistan standards on home appliances. Table 2-17 shows the current member of TC-3.

Table 2-17 TC-3 Member List (December 2019)
Source: PSQCA

CHAIRMAN		
1.	Engr. Shafqat Husain Mangan	M/s. XEN (KWSB), Karachi
PUBLIC SECTOR		
1.	The Managing Director	National Energy Conservation Authority (ENERCON), Govt. of Pakistan Ministry of Energy, Islamabad.
2.	Mr. Mansoor Iqbal Khan Director H.R.	Siemens Pakistan Engg Co. Ltd., Karachi
3.	Engr Irfan Rabbani Chief Engineer	Head Engineering Research Centre PCSIR Laboratory Complex Ferozepur Road, Lahore
4.	Director General	Director General Pakistan Council of Renewable Energy Technologies (PCRET), Islamabad
5.	Managing Director	H N R Company (Pvt) Ltd, Lahore.
INDUSTRIES		
1.	Managing Director	M/s Philips Electrical Ind. of Pak (Pvt) Ltd., Karachi
2.	Mr. Amir Butt Managing Director	Cool Industries (Pvt) Ltd (Waves), Lahore.
3.	Engr. Sarfrazuddin & Chairman (PEEMA), Director	New Applied Electric Industries (Pvt) Ltd, Karachi.
4.	Managing Director	Digital World Pak. (Pvt) Ltd (Samsung), Lahore.
5.	Managing Director	Cool Industry (Pvt) Ltd (Wave), Lahore.

GOVERNMENT		
1.	The Director	Directorate of Industries & Mineral Development, Govt. of Punjab, Lahore-
2.	The Director	Directorate of Industries & Mineral Development, Govt. of Sindh, Karachi.
3.	The Director	Directorate of Industries & Mineral Development, Govt. of NWFP, Peshawar
4.	The Director	Directorate of Industries & Mineral Development, Govt. of Baluchistan
CONSULTANCY		
1.	Engr. Roland D' Souza	M/s. Fahim, Nanji & D'Souza (FND) Consulting Engineers, Karachi
ACADEMIA		
1.	The Chairman,	Electrical Department University of Engineering & Technology, Lahore.
2.	The Chairman,	Electrical Department, NED University of Engineering & Technology, Karachi.

MANUFACTURER ASSOCIATION		
1.	The General Manager (Appliance Manufacturing)	M/s. Pak Electron, Lahore
2.	Engr. Asif Mirza, Technical Manager,	M/s Clipsal Pakistan (Pvt) Ltd, Karachi
3.	Engr. Ameeruddin, Director	M/s Dawlance (Pvt) Ltd, Karachi Fax #. 5674643
CONSUMERs		
1.	Engr. Waqar Ali, 4948525	Representative, Consumer Protection Council (CPC) C/o M/s Eurotech (Pvt.) Ltd, Karachi.
2.	Mr. Mohammad Abbas Sajid President	Ashre Pakistan Chapter American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Engineering Service, Karachi.
3.	Mr. Shakil Ahmed Khan Lead E & I Engineer	Zishan Engineers (Pvt) Ltd. Consultants, Designers & Engineers, Karachi.
SECRETARIAT		
Engr. Muhammad Ashraf Palari Deputy Director / Secretary to Technical Committee		Standards Development centre, Karachi

2) Pakistan standards on room air conditioner

ISO5151 (Non-ducted air conditioners and heat pumps – testing and rating for performance) which defines the testing method of energy efficiency of room air conditioners, has been published as PS: ISO5151/2013. ISO16358 (Air-cooled air conditioners and air-to-air heat pumps-Testing and calculating methods for seasonal performance factors: Part1: Cooling seasonal performance factor, Part2: Heating seasonal performance factor, Part3: Annual performance factor), which defines calculation methods of seasonal performance factors to estimate cooling and heating efficiency based on local temperature bin distribution has not yet been published as a Pakistan standard.

Therefore, JICA added an Expert for "AC Technical Standard Assistance" to the JICA Expert Team as the expert on ISO16358. He made a presentation on ISO16358 during the training in Japan in November 2019 and explained this to PSQCA in Karachi in December 2019. PSQCA adopted ISO16358-1, 2, 3 and ISO16358-2 Amenndment1/2019 (Addition of

temperature bin distribution table in hot region and calculation software of cooling seasonal performance factor) as the Pakistan standard (PS: ISO16358-1, 2, 3 and ISO16358-2 Amenndment1/2019) in January 2020.

3) Pakistan standard on household refrigerating appliances

IEC 62552 (Household refrigerating appliances−Characteristics and test methods：
Part1: General requirements,
Part2: Performance requirements,
Part3: Energy consumption and volume)
are published as the PS: IEC62552.

4) Conformity standards (ISO/IEC 17000)

ISO/IEC17000 has not yet been published as Pakistan standards. PSQCA is planning to publish these standards gradually. However, PNAC already provides accreditation of ISO/IEC17025 (General requirements for the competence of testing and calibration laboratories) to local laboratories in Pakistan. The Haier air conditioner testing laboratory has been accredited by PNAC and the PCSIR testing laboratory of refrigerators also has been accredited under ISO/IEC17025. PEECA is building an air conditioner testing laboratory and will apply for accreditation to PNAC soon.

(2) Preparation of MEPS and Labeling Regime of room air conditioner and household refrigerating appliances

Testing methods and parameters have been identified in order to carry out common testing conditions among manufacturers, suppliers and importers.

1) Room air conditioner

The Expert “AC Technical Standard Assistance” explained the result of calculating CSPS (cooling seasonal performance factor), APF (Annual performance factor) etc. at the PSQCA technical committee (TC-3) in February 2020, based on the temperature bin distribution in 2018 in Karachi, Lahore and Islamabad, which was provided by the PSQCA. The committee agreed that CSPF shall be used for MEPS and labeling regulation, temperature bin distribution shall be calculated from a 3 year average population weighted temperature bin distribution in Karachi, Lahore and Islamabad and active hours shall be 8 hours per day.

Following the TC-3 committee, the PSQCA provided temperature data for 2016, 2017 and 2018 in 3 cities. Based on the data, the 3 year (2016-2018) average population weighted temperature bin distribution in Karachi, Lahore and Islamabad has been prepared for calculation of CSPF.

Table 2-18 Temperature bin Distribution
（Population weighted of Karachi, Lahore, Islamabad, Rawalpindi）
Source: Jizolab

Bin number j	1	2	3	4	5	6	7	8	9
Outdoor temperature tj ℃	21	22	23	24	25	26	27	28	29
Fractional bin hours n_j	0.034	0.038	0.038	0.042	0.051	0.055	0.072	0.088	0.103
Bin hours n_j	n_1	n_2	n_3	n_4	n_5	n_6	n_7	n_8	n_9
Bin hours (nj) h	78	87	87	96	116	126	164	201	234
Bin number j	10	11	12	13	14	15	16	17	18
Outdoor temperature tj ℃	30	31	32	33	34	35	36	37	38
Fractional bin hours n_j	0.109	0.084	0.071	0.058	0.048	0.039	0.023	0.016	0.01
Bin hours n_j	n_{10}	n_{11}	n_{12}	n_{13}	n_{14}	n_{15}	n_{16}	n_{17}	n_{18}
Bin hours (nj) h	248	192	162	132	110	89	53	37	23
Bin number j	19	20	21	22	23	24	Total		
Outdoor temperature t_j ℃	39	40	41	42	43	44	-		
Fractional bin hours nj	0.007	0.006	0.004	0.002	0.001	0.001			
Bin hours n_j	n_{19}	n_{20}	n_{21}	n_{22}	n_{23}	n_{24}	-		
Bin hours (n_j) h	16	14	9	5	2	2	2283		

2) Household refrigerating appliances

PS: IEC62552 does not specify regional parameters such as ambient temperatures. Therefore, to carry out energy efficiency tests under a common parameter among manufactures, suppliers and importers, local parameters need to be identified. The first technical working group meeting in Lahore, December 2019, agreed that the ambient temperature shall be 32℃ and the regional function to calculate energy consumption shall be 365 days at 32℃. To calculate energy consumption of ambient controlled anti-condensation heaters, a probability for temperature and humidity data has been prepared, based on the weather data provided by the PSQCA.

Table 2-19 Population-weighted Probability for Temperature and Humidity Data
- Ambient Controlled Anti-condensation Hheater -
Source: Jizolab

Relative humidity	RH band mid-point	Probability at 16℃	Probability at 22℃	Probability at 32℃
0 to 10 %	5 %	0.00 %	0.05 %	0.15 %
10 to 20 %	15 %	0.06 %	0.41 %	1.39 %
20 to 30 %	25 %	0.16 %	2.23 %	3.18 %
30 to 40 %	35 %	0.60 %	3.41 %	4.48 %
40 to 50 %	45 %	2.09 %	4.41 %	5.62 %
50 to 60 %	55 %	2.81 %	4.04 %	8.15 %
60 to 70 %	65 %	4.55 %	5.23 %	21.09 %
70 to 80 %	75 %	4.48 %	4.01 %	8.74 %
80 to 90 %	85 %	2.98 %	3.04 %	0.23 %
90 to 100 %	95 %	0.97 %	1.47 %	0.00 %
Total	-	19 %	28 %	53 %

MEPS and Labeling regulations were planned to be drafted based on the submitted testing data from Pakistan manufactures and importers. However, the survey of tested data in Pakistan was not able to be done as planned, because of the spread of COVID 19 and the lockdown order by the government of Pakistan. To avoid a delay in preparation of the introduction of MEPS and Labeling regulations, NEECA agreed to prepare the first draft regulations based on foreign experiences. The first draft was provided to NEECA by the end of June 2020 and provided to PEMA members and other manufactures by webinar in August 2020. Following this, a 2nd technical working group online meeting with PEMA members and other manufactures was held in November 2020. At the meeting, manufactures and importers agreed to submit replies to the survey sheets which were distributed before the lockdown.

Replies to the survey sheet from major manufactures of PEMA members etc. were collected by the end of February 2021. After analyzing the data submitted by them, draft final regulations (Appendix 6-3) were prepared in March 2021 and presented at the 3rd technical working group meeting (online) in March 2021. At the meeting, the participants accepted the draft final regulations (Scope, testing standard and parameters, MEPS, and labeling classifications).

In June 2021, JICA Expert Team and NEECA organized an online seminar to explain methods to calculate CSPF of room air conditioners to PEMA members and other manufacturers. The number of the participants was 30. Experts of Pakistan manufactures provided questions such as frequency settings of inverters based on their experiences. (Appendix 7-5)

(3) Label design

The draft of the five-star label design is shown in Figure 2-37. The technical committee of NEECA suggested to integrate a security tag with the five-star label. Following the suggestion, the five-star label design has been changed to include security tag information, which is to avoid forgery of the label. NEECA is finalizing the label design taking into consideration further additional suggestions from the technical committee.

Figure 2-37 Draft NEECA Energy Label
Source: NEECA/Jizolab

[Activity 1-5-4] Coordinating with related parties for the approval of regulations

JICA, JICA Expert Team and NEECA had several online meetings to discuss the timeline of promulgation of MEPS and Labeling regulations of room air conditioners and household refrigerating appliances.

The technical working group, which is organized by PEMA members and other manufactures, agreed the draft final MEPS and Labeling regulations (Scope, testing standard and parameters, MEPS, and labeling classification) in March 2021. The technical committee of PSQCA adopted these regulations as the Pakistan standard (PS: 5294/2021 (R) Minimum Energy Performance Standard and labeling requirements for Room Air Condioner (MEPS), PS: 5531/2021 Minimum Energy Performance Standard and Labeling requirements for Household refrigerating Appliances (MEPS)) in August 2021.

The technical committee of NEECA and PEECB are continuing discussion on the MEPS and Labeling regulations including label design and general regulation for all ES&L appliances such as fee structure, monitoring and enforcement etc. Final draft regulations were provided to PEMA members and other manufactures for comment in December 2021. MoST also organized a stakeholder meeting on the regulations.

[Activity 1-5-5] Approval of regulations by the GOP

The NEECA act requests NEECA to issue ES&L regulations under direction provided by PEECB. The regulation shall provide six months (further additional six months, if necessary) from promulgation to execution of the regulations to regulated manufactures and importers. NEECA expects one year from promulgation to execution of the ES&L regulation. Therefore, execution of the regulations is estimated after Februaly 2023.

[Activity 1-5-6] Awareness raising of approved mandatory ES&L

Refer to [Activity 2-1], [Activity 2-2] and [Activity 2-3].

[Activity 1-5-7] Analyzing lessons learned

Refer to 4.3.

[Activity 1-6] Counterpart training in Japan in connection with the above activities

Refer to [Activity 2-4].

3 Activities for Output 2

The purpose of public awareness activity is to gain an understanding of consumers and stakeholders such as retailers, manufacturers and governmental organizations, on the importance and significance of energy saving and the ES&L scheme.

The basic policy is as follows:

- Focus on public awareness in time for ES&L enforcement
- Widely publicize by utilizing social media
- Comprehensive public awarenes for consumers, involving home appliance manufacturers and retailers
- Focus on popularizing energy labels
- Cost effectiveness

Due to the delay of PEECB's approval on ES&L regulations, the awareness activity for consumers and retailers could not be implemented during the project period, and only the design of the awareness campaign was made. Refer to Attachment 8-4 for design details.

[Activity 2-1] Public awareness for the consumers

(1) Time and period of implementation

From 1 month before the enforcement of ES&L regulations for ACs and refrigerators, 3-month period for implementation.

(2) Medium used for awareness

Social media shall be used for targeting consumers, especially young people, women, and schools (refer to Table 3-1)

Table 3-1 Targets and Media Used
Source: Jizolab

Target	Public Awareness Medium	Explanation
Consumer	YouTube	• Social media spreads messages widely and efficiently • Cost effective
	Facebook	
	Twitter	
	Pamphlet	• The easiest way to publicize • To be widely known, insert pamphlet into the package of appliances
	Booklet	• Utilize booklet for school education and NEECA events
	Newspaper ad	• Public awareness for non-social media users
Retailer	Online seminar Pamphlet	• Public awareness for retailers in the whole of Pakistan

The reasons for choosing social media as the main medium are shown below.

- Social media can send messages to many age groups at low cost.
- YouTube, Facebook, and Twitter have many users in Pakistan.

For non-social media users, newspaper ads will be used, and a booklet is prepared as a teaching material for school education.

(3) Contents

1) Movie

The following short-films were created. The scripts are shown in Attachment 8-1.

a) Importance of Energy Conservation: Mottainai
b) Energy Saving on Air Conditioner 1: Energy Label
c) Energy Saving on Refrigerator 1: Energy Label
d) Energy Saving on Air Conditioner 2: Smart Use
e) Energy Saving on Refrigerator 2: Smart Use
f) CSPF Presentation

These films are both ① 2 - 3 minute films, with a ② 1 minute shortened version. ① may be used for YouTube, and ② for Facebook and Twitter. In addition, an integrated version of the film ① of a) - e) above was also created in Japan. It can be used for screenings on long-distance buses.

The narration of the above films is in English only. NEECA shall produce an Urdu version before the campaign.

2) Still Image

Booklets and pamphlets were created by using still images extracted from the film.

3) Others

The electronic files of the above contents were provided to NEECA. Editing, integration, and extraction of still images may be done easily to create posters.

(4) Contents for each medium

1) Social media

a) YouTube

- The long version of the film ① in (3)- 1) shall be run on YouTube.
- Commencement from one month before the enforcement of ES&L regulations

b) Facebook / Twitter

- The short version of the film ② in (3)-1) shall be run on Facebook and Twitter. Additionally, still images extracted from the films shall be shown.
- Delivering of paid advertisements to social media users who would be interested
- Study and implement the following measures to increase publicity
  - Voice-over in Urdu on the films
  - Utilization of influencers
  - Utilization of hashtags
  - Utilization of keywords that guide potential users to Facebook sites
  - Guidance to the NEECA homepage and Facebook using QR code
- Commenced one month before the enforcement of ES&L regulations

2) Newspaper ad

Ad shall be placed in English newspapers (The News, Jang, Dawn), Urdu newspapers (Daily Jang, Daily Nawa e Waqt), etc, based on the following schedule and contents.

Table 3-2 Newspaper Ad Schedule and Contents
Source: Jizolab

Period	1 month before enforcement	1 month after enforcement	2 months after enforcement
Morning or Evening	Morning		
Page	Front page	Back page	Inside page
Size	A4	A5	A6
Frequency	Once a week (Total 4)	Twice a week (Total 8)	3 times a week (Total 12)
Contents	• Importance of Energy Saving • Pre-announcement of ES＆L regulation • Contents of short-film a)	• Notification of ES＆L regulation • What is Energy Label • Contents of short-films b) and c)	• Notification of ES＆L regulation • What is Energy Label • Contents of short-films a) to e)

Media interviews shall be utilized as well as newspaper advertisements. Also (paid) editorial advertising shall be considered.

3) Booklet and pamphlet

The following three types of booklets and pamphlets have been produced in Japan.

- Importance of Energy Conservation: Based on film a)
- Energy Saving on Air Conditioner: Based on film b) and d)
- Energy Saving on Refrigerator: Based on film c) and e)

The booklet is mainly used for school education. Lectures shall be held about 6 times over 3 months.

[Activity 2-2] Public awareness for retailers

Seminars for retailers, who carry ACs and refrigerators, shall be held to put them on make them aware of Energy Labels and to promote higher efficiency appliances. Awareness for retailers is very important because they meet with consumers directly.

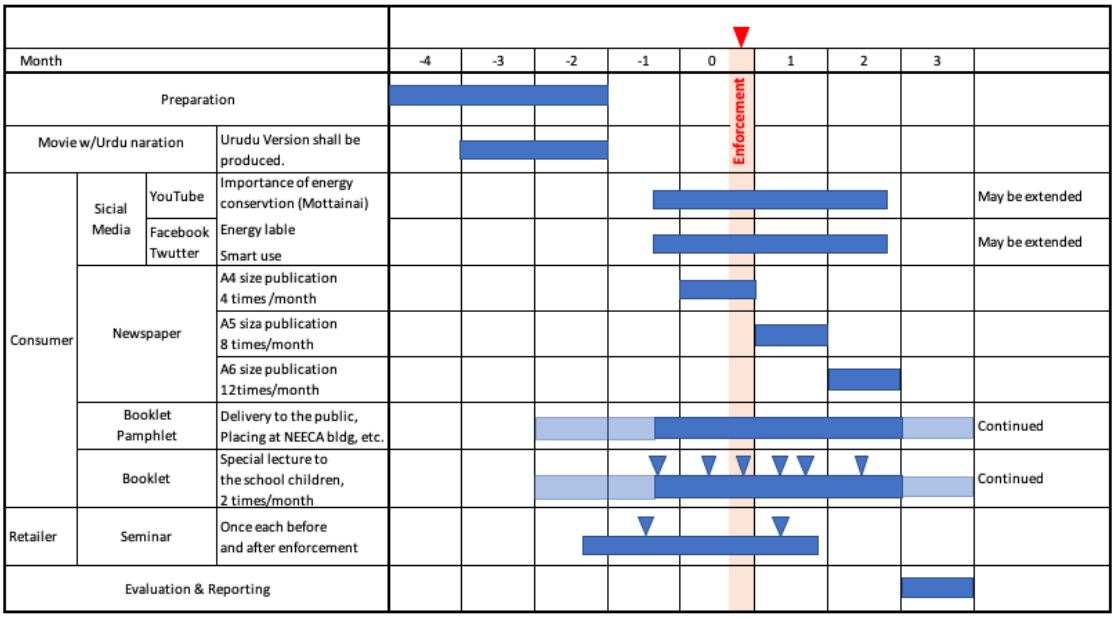
- To invite retailers, the cooperation of manufacturers, Chamber of Commerce and PEMA shall be necessary, since NEECA does not have a diect connection to them,
- Seminars shall be held twice, once before and once after enforcement.
- To let retailers understand CSPF, by using film f).

[Activity 2-1 & 2-2] Implementation plan of awareness campagin

(1) Implementation schedule

Implementation schedule of [Activity 2-1] and [Activity 2-2] is shown in Table 3-3.

Table 3-3 Public Awareness Implementation Schedule
Source: Jizolab



(2) Evaluation of the effect of public awareness campaigns

The effects of the implemented awareness campaigns shall be evaluated with the following indicators. The evaluation shall be utilized to review awareness strategies and to study improvements.

- YouTube: Number of views, Number of registered channels, Number of clicks
- Facebook: Number of followers, Number of likes it! Number of shares
- Twitter: Number of followers, Number of likes it! No. of retweets

- Newspaper: Number of accesses through QR code
- Seminars: Number of participants, questionnaires

(3) Implementation of Public Awareness Campaign

NEECA shall select and contract with a local ad agency to carry out the awareness campaign, based on the above-mentioned design. Attachment 8-4 shows a tentative TOR on implementation and candidates for reference.

[Activity 2-3] Public Awareness for industrial sector

The manufacturers, importers and rerated organizations with PEMA discussed the following points and established a consensus on ES&L Regulations.

- Establishment of new energy efficiency standards which utilize worldwide standards.
- Manufacturing ACs and refrigerators which conform to the new energy efficiency standard in Pakistan.
- Enforcement of production inspection and testing which conform to the new standards.
- To establish a product registration system which follows new standards and use of the Energy Label.

The technical Working Group (TWG) was established under NEECA with PEMA, to have harmonization among manufacturers and the government (PCSIR, PSQCA) on technical standards for AC and refrigerators. TWG meetings are shown inTable 3-4. At the third TWG held on June 2021, the final draft of the MEPS and Regulations were finalized.

Table 3-4 Awareness for Industry
Source: Jizo Lab

	Seminar/Workshop	Date	Agenda
1	Seminar at 1st TWG	Dec. 2019	• Testing method of AC and refrigerator • Parameters for refrigerator testing
2	Seminar at 2ndTWG	Feb. 2020 (on-line)	• Draft of MEPS and Labeling sheme for AC and refrigerator
3	Workshop at 3rd TWG	Jun. 2020 (on-line)	• Revised MEPS and ES&L Regulations based on the discussion at second TWG meeting and manufacurers' test data on energy consumption of appliances and CSPF

[Activity 2-4] Counterpart Training in Japan

A brief overview of Counterpart Training is shown below. Refer to Attachment 5 for details.

(1) Outline

1) Training period: 11 - 18 November 2019, 5 days
2) Training location: Japan

3) Purpose of Training

When formulating the MEPS and Star rating system which shows energy efficiency, it is important to gain consumer reliance of the label, and to establish a framework to disseminate efficient appliances using the label.

Therefore, the purpose is to study the following:

- Introduction (including inspections) of related equipment and test contents in Japan's energy conservation policy/system design (including energy label)
- Role and consensus building process among related organizations
- Energy conservation awareness/dissemination
- Cutting-edge energy conservation technology and system
- Administrative efforts related to technology dissemination
- Labeling certification testing

4) Trainees

Ten (10) members from the manager class in federal and provincial governments (Designated Agency: DA), the business sector and from third-party laboratory participated. Refer to Table 3-5 for the list.

Table 3-5 Name List of Trainees
Source: Jizo Lab

Mr. Asad Mahmood, Manager Technical,	National Energy Efficiency & Conservation Authority (NEECA), Ministry of Energy
Mr. Muhammad Umar, Research Associate、	NEECA, Ministry of Energy
Mr. Mohib Zaman, Assistant Technical Adviser	Ministry of Science & Technology (MOST)
Mr. Muhammad Ashraf Palari, Deputy Director (Electrical),	Pakistan Standards & Quality Control Authority (PSQCA)
Mr. Khushal Das, Assistant Director, Import & Export,	Pakistan Standards & Quality Control Authority (PSQCA)
Mr. Muhammad Azhar, Quality Manager / Head, EMTL	Pakistan Council of Science & Industrial Research (PCSIR)
Mr. Agha Hassan Raza, Director General (South)	Energy Department, Baluchistan
Mr. Syed Aziz Ahmad, Project Director	Pakhtunkhwa Energy Development Organization (PEDO)
Mr. Javed Iqbal Janjua, Assistant Manager, Tariff,	Engineering Development Board, Ministry of Industries & Production (MOIP)
Mr. Iftikhar Ahmad, Additional Secretary	Energy & Power Department, Khyber Pakhtunkhwa

5) Contents of Training

a) Introduction of Japanese scheme and regulation

- Top runner scheme to raise efficiency target value continuously.
- Display of annual electricity charges by retailers

b) Introduction of the framework of performance testing.

Test laboratories purchase appliances and apply testing by themselves. The role of each related party, such as regulatory organizations (business groups in Japan, NEECA in Pakistan), third party test laboratories and manufacturers

- Responsibility of manufacturers and credibility of third-party test laboratories
- Particularity of Japanese schemes
    - Business groups are the main and responsible actors in Japanese implementation scheme

c) Introduction of the Japanese label

- Point of view of energy efficiency on appliance selection
- How to show efficiency on label (comparison of appliance cost vs saving in utility charge)

6) Schedule of training course

Training program is shown in Table 3-6.

(2) Evaluation of Trainees

A comprehensive evaluation result would be the best, but due to a tight schedule, the training schedule shall be improved.

Table 3-6 Schedule of Counterpart Training in Japan
Source: Jizo Lab

Date	time	visit	Purpose / target
11/16 Sat		Islamabad - Bangkok	
11/17 Sun		Bangkok - Narita	
11/18 Mon	9:00 -12:00	Briefing session	JICA
	13:00 -14:30	Presentation (Country report)	Trainees' presentation regarding Pakistani energy conservation
	15:30 -17:00	Ministry of Trade and Industry	Top-runner system of energy efficiency
11/19 Tue	13:00 -15:30	The Japan Air Conditioning and Refrigeration Testing Laboratory	(Site visit) Third-party testing lab of AC
11/20 Wed	09:00 -12:00	Moving from Tokyo to Kusatsu by train	
	13:00 -15:30	Panasonic, Kusatsu factory	(Site visit) AC & refrigerator Manufacturer
	15:30 - 17:30	Daikin Industries, Shiga Factory	(Site visit) AC Manufacturer
		Kusatsu - Kyoto	
11/21 Thu		Kyoto - Yokohama - Minamiosawa	
	14:00 -16:00	Safety & EMC Center, Japan Quality Assurance Organization (JQA)	(Site visit) Third-party testing lab of refrigerator
	16:30 -17:30	Moving from Minamiosawa to JICA Tokyo center	
11/22 Fri	09:00 -12:00	Daikin Showroom in Shinjuku	(Site visit) Advertising/explaining of AC energy saving performance
	14:00 -17:00	JICA Tokyo center	(Presentation) Action Plan
11/23 Sat		Narita – Bangkok - Islamabad	

4 Issues and Measures in Implementation

4.1 Project Implementing Scheme

4.1.1 Change of methodology for Power Consumption Survey

JICA requested to implement random sampling on questionnaire and measurement surveys for Power Consumption Survey, to have quantifiable reliability. However, this was quite irrational and unfeasible in Pakistan because of the limited resources (budget, human resource, period). Finaly. the survey for AC was implemented by analyzing DISCO data. A measurement survey was done on a limited scale around Islamabad due to COVID-19. The survey outcome was only a reference for AC units but was used to estimate the power consumption of refrigerator units.

4.1.2 Project implementation under COVID-19 pandemic

Due to the COVID-19 pandemic, we have been obliged to provide technical assistance by email, phone, and on-line meetings. However, without JICA experts' presence, NEECA wa not able to proceed in undertaking tasks on schedule, and we had a number of communication troubles with NEECA which led to an inability adhere to the timeline. It is clear that remote assistance is ineffective, causing progress to be slow and creating low quality output against large amount of input and effort.

4.1.3 Change of task for awareness

Although awareness activity should be implemented in Pakistan, the following changes were made under constraints of COVID-19 and a delay of PEECB approval.

- Awareness activities for industry were implemented by on-line meetings
- Sub-contacting of content creation for awareness, such as film, pamphlet and booklet creation, was implemented in Japan.
- NEECA shall implement the following awareness activities, on enforcement of the Regulations after the Project completion,
    - On-line seminars for retailers utilizing created content
    - Awareness campaigns for consumers with social media (YouTube, Facebook, Twitter) and newspaper ads, utilizing cretated contents.

4.2 Project Operation Structure

4.2.1 Addition and change of project members

- JICA Expert "ES&L Promotion A", Mr Yoshio Hirayama left in April 2020.
- JICA Expert "ES&L Promotion C (Power Consumption Survey)" switched from Mr. Koichi TANAKA to Mr. Hisatsugu ISHIZU in November 2019.
- Mr. Minetoshi IZUSHI was assigned to the JICA Expert "AC Technical Standard Assistance" position from November 2019 to September 2021.
- Dr. Sardar Mohazzam was assigned as full-time Managing Director (MD) of NEECA, in November 2019 for a three-year period.

4.2.2 Sub-contacting to Japanese experts

At the 2nd JCC meeting held on 9 February 2021, technical assistance for capacity development of PCISR's refrigerator testing facility was requested to JICA. Due to COVID-19, dispatching JICA experts to Pakistan was difficult and on-line training from Japan was provided by sub-contracting to JQA.

4.3 Lessons Learned

(1) It is very difficult to undertake Power Consumption Survey without strong support from DISCOs. It is essential to include the power sector, not only DISCOs but also NTDC and PITC, as counterparts of the Project.

(2) Effectiveness of remote assistance by email, phone, on-line meeting drops to less than 50% compared to normal operations in the field, as well as creating delays in the schedule. If on-schedule implementation without reduced scope and deteriorated quality is required, experts must work in the field at any cost. Maybe this is unfeasible. However, it is very important to redefine the goals of the project, what we cut from the project, and what we shall (can) achieve with additional resources.

(3) Strong support from the MoE is essential to implement EE&C projects, because NEECA is a fragile and young organization, and not good at formulating regulations, which require coordination capabilities with other organizations.

(4) Counterpart training was short at just 5 days and ended up becoming cram sessions. With two weeks, the program could spare more time for discussions with Japanese experts and visits to energy efficient factories/buildings/companies.

5 Achievement of Project Goal

The draft of ES&L regulations for ACs and refrigerators has been created, and approval by PEECB and promulgation of these regulations will be made shortly. After a runup period of half year to one year, enforcement will commence. In parallel to this, an awareness campaign on the ES&L scheme shall be started. All these remaining tasks will be implemented by NEECA.

The project outputs are shown below:

(1) Output 1

1) Formulation of ISO16358 as the Pakistan Standard
2) Creation of the draft MEPS for AC and refrigerator as the Pakistan Standard
3) Creation of the technical part of ES&L regulation with Star Rating for ACs and refrigerators
4) Capacity development of PCSIR which owns and operates a testing laboratory for refrigerators
5) Power consumption survey of ACs and refrigerators (DISCO data analysis and measurement survey)
6) Proposal on vision, strategy, and action plan for ES&L

(2) Output 2

1) Creation of awareness films
2) Design of awareness campaign
3) Counterpart training

(3) Others

1) JICA Newsletter on capacity development for PCSIR

Assuming a 22 PKR/kWh electricity tariff, minimum impacts of the above ES&L regulations from 2022 to 2025 are estimated as follows:

- ACs: 2,109 GWh of energy saving and approximately. 46 billion PKR economic saving
- Refrigerators: 990 GWh of energy saving and approximately. 22 billion PKR economic saving

Refer to Attachment 1 for details. Only “Outputs and Indicators” and “Project Purpose and indicators” are shown below.

Table 5-1 Outputs and Indicators
Source: Jizolab

Outputs and indicators			
Narrative Summary	Objectively Verifiable Indicators	Target values	Actual Values Achieved at Completion
1. Consensus between the related organizations for mandatory ES&L is formulated	1.1. Utilization of vision, strategy, and action plans for the promotion of ES&L	2 (AC, refrigerator)	2
	1.2. Progress of consensus formulation of the related organizations for mandatory ES&L of the targeted appliances	3	3
	1.3. Progress of addition of targeted appliances of ES&L	2 (AC, refrigerator)	• MEPS formulated. • Draft of Star Rating Regulations for AC & refrigerator were developed.
2. Public Awareness for ES&L is improved	2.1. Number of seminars /workshops and number of participants	4 for industry & stakeholder	3

Table 5-2 Project Purpose and Indicators
Source: Jizolab

Project Purpose and indicators			
Narrative Summary	Objectively Verifiable Indicators	Target values	Actual Values Achieved at Completion
Inefficient appliances are effectively phased out through the proper implementation of Energy saving and labelling system.	Number of mandatory ES&L	2	2
	Number of targeted appliances of ES&L	2 (AC, refrigerator)	2 (AC, refrigerator)
	Number of security tags with labeled products		

6 Proposal to Achieve Overall Goal

(1) Efforts and supports on Energy Efficiency and Conservation by the MoE Power Division is highly expected.

(2) It is necessary to implement, review and improve/revise Energy Conservation Schemes steadily and frequently in the long term, based on changes of technology and society. Maintenance and development of the strong collaborative alliance between MoE, NEECA, MoST, PSQCA and PCSIR is expected.

(3) Collaborative alliance with the power sector is essential to promote energy saving in power. Strong cooperation between NTDC, DISCO and KE is expected.

(4) Continued efforts and expansion of awareness is necessary. The first issue is to let people know what energy conservation is and why it’s necessary. The initial step is to establish a responsible department in NEECA and to assign an experienced public relations officer.