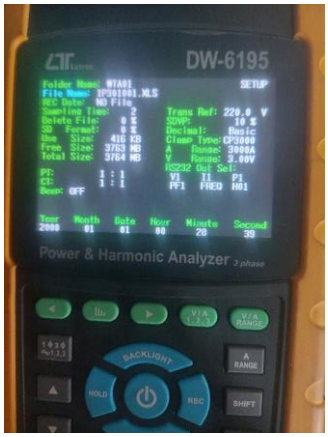

Khanewal Municipal Committee

Energy Management Plan (EMP)

July 2023

History of the Document

Version	Date	Description
01	July 06 , 2023	First Draft

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The Consultant is also grateful to entire Khanewal Municipal Committee representatives for their support extended during the field study.

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ABBREVIATIONS

CFMS	Computerized Financial Management System
CTS	Complaint Tracking System
DCS	Distributed Control System
EMP	Energy Management Plan
ESMAP	Energy Sector Management Assistance Program
EE	Energy Efficiency
MEPCO	Multan Electric Power Company
GHG	Green House Gases
GIS	Geographical Information System
GoPb	Government of Punjab
ICB	International Competitive Bidding
KPI	Key Performance Indicators
MC	Municipal Committee
PCP	Punjab Cities Program
PMDFC	Punjab Municipal Development Fund Company
PMS	Performance Management System
PMSIP	Punjab Municipal Services Improvement Project
SNGPL	Sui Northern Gas Pipelines Limited
TMA	Tehsil Municipal Authority
TOR	Terms of Reference
WBG	World Bank group

1 Summary

1.1 Project Background

The Punjab Cities Program (PCP) is a World Bank-funded hybrid of Program for Results (PforR) and Investment Project Financing (IPF) operation. It is a USD 200 million 5 years (2018 -2023) program supporting 16 cities in Punjab. The main objective of the program is to strengthen the performance of participating Municipal Committees/Corporations (MCs), focusing on urban management and improvement of municipal infrastructure for satisfactory service delivery.

Under the PforR (Window-1) the Performance Based Grants (PBGs) are being provided to the MCs of the 16 selected cities for investments in municipal infrastructure and services.

The IPF (Window-2) is supporting provincial government agencies i.e. Local Government & Community Development Department (LG&CDD), Punjab Local Government Board (PLGB), Punjab Municipal Development Fund Company (PMDFC), and PFC Unit of Finance Department (FD).

1.2 Scope of work

As per the scope of work specified in the Terms of Reference of the project, the Consultant is required to:

a) develop a detailed work program for carrying out the works immediately after mobilizing
b) prepare an inventory of relevant assets owned/operated by the MC, including municipal buildings, vehicles, streetlights, and water-supply/wastewater disposal pumps
c) collect additional information on location (where applicable), performance and energy consumption analysis, estimation of expenditure incurred
d) provide detailed information for each asset, and an overall inventory and analytical report discussing key performance indicators
e) identify energy saving opportunities, and provide saving potential (in energy and monetary terms) for each opportunity, estimated investment costs and return on investments, engineering plans, and Bill of Quantities, as needed.

The outputs of the abovementioned activities are presented in the Khanewal Energy Audit Report and have been used to develop the Energy Management Plan for Khanewal MC, which includes short-, medium-, and long-term measures to optimize energy consumption in municipal service delivery.

1.3 Introduction

Integration of energy efficient practices into the “business as usual” conduct of the organization, regular assessment of energy performance, and implementation of procedures and measures to reduce energy waste and increase efficiency are key to successful energy management. Regardless of the size of the municipality, the common element of successful energy management is the allocation of staff and resources to continually improve energy performance.

This document builds upon the energy audit report and establishes an energy management plan with precise energy efficiency goals and targets for the municipality. An Excel based monitoring and reporting tool forms an integral part of the EMP for the MC to keep itself abreast of its energy use and implementation status of various EE measures proposed under this EMP.

Adhering to EMP will allow the MC to

a) Monitor its energy performance and to minimize the energy costs of municipal services;

b) Calculate the Key Performance Indicators (KPIs) for Pumping & Disposal, Streetlights, Buildings, Vehicles; and
c) Reduce the carbon footprint associated with its energy use.

1.4 Khanewal MC Background

Khanewal is the capital of Khanewal District in the Punjab province of Pakistan. According to the 2017 Census of Pakistan, its population is 227,059. It is the 36th biggest city of Pakistan by population. The city is located at 30.3000 N, 71.9333 E. Khanewal an old subdivision of Multan district was upgraded as district w.e.f 1st July 1985 comprising 4 subdivisions namely Khanewal, Kabirwala, Mian Channu and Jahanian. It was given the status of an area committee which was upgraded as municipal committee in the year 1933.

1.5 Objectives

Water supply tube wells, disposal pumps, municipal vehicles, and street lights has trivial energy consumption. The MC's assets are working inefficiently giving less benefits with maximum usage of utilities. The overall objective of this audit activity is to make sure the exact count of assets, identify efficient resources & replacement of inefficient ones with new competent resources.

Energy management plan gives the better idea for the optimum usage of energy resources which will ultimately result in scaling down energy consumption. EMP gives the fruitful result by monitoring the operations in more organized way. Prime goal of this activity will be managing efficient utilization of resources maintaining the environmental standards reducing carbon emissions.

1.6 Energy Supply Management

Energy is supplied to the Khanewal MC via a number of providers as outlined below:

- Electricity for pumps and buildings is supplied by MEPCO.
- Electricity for streetlights is supplied by MEPCO as per Public Lighting tariff.
- Natural gas is supplied to the municipality by SNGPL.
- Khanewal MC has a purchasing agreement with fuel/pump stations wherein all municipal vehicles get their fuel refills from specified pumping stations.

1.7 Summary of Observations and Recommendations

A summary of observations and recommendations is given below:

1.7.1 Water Pumping System

- Sluice valve at 5 pump sites were either jammed or broken and need to be replaced.
- Air release valves installed on the network should be properly maintained.
- Installation and replacement of capacitors have been recommended where Power Factor was found to be below 0.8 since a penalty is being charged by DISCO for PF lower than 0.9. A total of 4 Pumpsets had a power factor below 0.8.
- It is recommended to replace pumps at following sites:
    - Colony No. 2 water supply - Unique ID: 31206462
- Reschedule operational hours of the pumps to avoid peak charges.
- Smart Metering integrated with DCS system is recommended at all tubewells. It is necessary to develop water balance, demand forecast, monitoring of energy efficiency and line leakages. Furthermore, this will act as a precursor to water metering and billing for consumers.

1.7.2 Dewatering Sets

- Operational logs were not available with the MC. It is recommended to maintain operational log of dewatering sets, containing details of fuel consumption, location of activity and operational hours.

1.7.3 Wastewater Disposal System

- Filter Wanes of Disposal system require periodic cleaning.
- No record of periodic maintenance and cleaning at the disposal system.
- Installation and replacement of capacitors have been recommended where Power Factor was found to be below 0.8 since a penalty is being charged by DISCO for PF lower than 0.9. A total of 8 disposal Pumpsets had a power factor below 0.8.

1.7.4 Streetlight

- Out of the total 1,778 streetlights in the MC, only 608streetlights are operational.
- All the lights are MC operated
- The MC has no record and database of streetlights. It is recommended to develop GIS based database for all streetlights within the MC to record all operation and maintenance related activities of the streetlights.
- Asset tagging should be carried out for every streetlight pole and other fixtures related to Streetlight.
- It is recommended to install photo-electric switches for energy conservation.
- Periodic maintenance regime should be implemented for efficient resource utilization and operational cost savings.
- The consultant has not proposed solar powered streetlights as an alternative to conventional grid powered streetlights because the pilot projects carried out by NHA related to the former have not been successful due to their extensive O&M requirements. Secondly, roads/pathways inside the city do not receive sufficient amount of solar irradiation, hence not optimal for installation of solar powered lights.

1.7.5 Vehicles

- All non-registered vehicles must get registered immediately to avoid any misuse.
- O&M cost of all the vehicles should be properly logged to calculate the efficiency of the vehicles
- Tracking devices should be installed on the MC's existing fleet.
- All old and non-functional vehicles (10 years or more) should be sold in the open market through transparent auction scheme.

1.7.6 Buildings

- Old conventional tube-lights, Incandescent light bulbs, and CFLs are being used in the building; these need to be replaced with energy efficient LED lights
- Four Window ACs are installed in the municipal building. It is recommended to replace these AC with more energy efficient inverter based split AC.

1.8 Current Energy Use

The baseline energy consumption at Khanewal as well as the KPIs for pumping, lighting, buildings, and vehicles are given below.

Table 1: Baseline Energy Data

Particulars	Unit	Value	Source
Electrical energy used by Tubewells[1]	kWh/year	401,521	Utility bills
Electrical energy used by Wastewater Disposal[2]	kWh/year	345,815	Utility bills
Electrical energy used in Buildings[3]	kWh/year	108,930	Utility bills
Electrical energy used by Streetlights[4]	kWh/year	159,951	Utility bills
Diesel used by Vehicles	liter/year	75,132	Vehicle logbooks

Table 2: KPIs for Potable Water & Wastewater pumps

Sr. No.	Description	Unit	KPI
1	Energy Density of Potable Water Production	(kWh/m^3)	0.24
2	Energy Density of Wastewater Disposal	(kWh/m^3)	0.10
3	Energy Density of Wastewater Treatment	(kWh/m^3) – if applicable	No wastewater treatment is carried out.
4	Energy Cost on Potable Water Production	(PKR/m^3)	10.94
5	Energy Cost on Wastewater Disposal	(PKR/m^3)	4.34
6	Energy Cost on Wastewater Treatment	(PKR/m^3) – if applicable	No wastewater treatment is carried out.

Table 3: KPIs for Streetlights

Sr. No.	Description	Unit	KPI
1	Average electricity consumed per kilometer of lit roads	(kWh/km)	2,258
2	Average electricity consumed per light pole/fixture	(kWh/year/ fixture)	99
3	Average cost of purchase of (i) pole/fixture and (ii) lighting equipment	PKR/Pole	45,282
		PKR/Lighting Equipment	38,283
4	Average cost of installation of (i) pole/fixture and (ii) lighting equipment	PKR/Pole	1,254
		PKR/Lighting Equipment	370
5	Average annual maintenance costs	(PKR)	224,717
6	Average daily duration of operation	(Hour)	10.3
7	Average energy costs per kilometer of lit roads	(PKR/km)	101,615
8	Average energy costs per light pole/fixture	(PKR/ fixture)	4,449
9	Number and percentage of failed public lights		66%

Table 4: KPIs for Buildings

Sr. No	Description	Unit	KPI
1	Municipal Buildings Electricity Consumption	(kWh/m^2)	29.51
2	Municipal Buildings Heat Consumption	(kWh/m^2)	0.93
3	Average Energy Cost of Heating	(PKR/m^2)	42
4	Average Energy Cost of Cooling	(PKR/m^2)	545
5	Average Energy Cost of Lighting	(PKR/m^2)	280

[1] Based on 12-month historical billing data.
[2] Based on 12-month historical billing data.
[3] Based on 12-month historical billing data.
[4] Based on 12-month historical billing data.

Table 5: KPIs for Vehicles

Sr. No.	Description	Unit	KPI
1	Fuel consumption for staff transport vehicles	km/Liter	Cannot be Determined
2	Fuel consumption for solid/liquid waste transport	km/Liter	3.73
3	Expenditure on fuel for staff transport vehicles	PKR/km	Cannot be Determined
4	Expenditure on fuel for solid/liquid waste transport	PKR/km	79

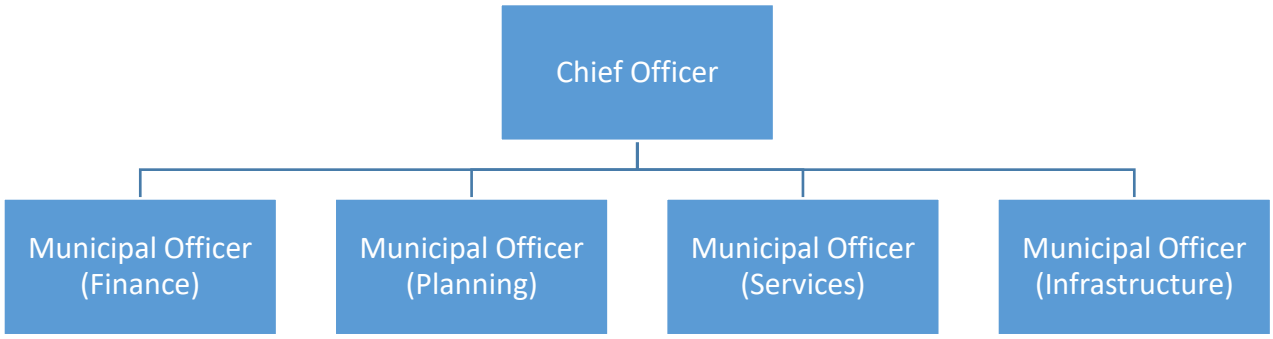
2 Energy Management Plan

2.1 Energy Use Management

The overall management of energy is primarily the responsibility of the Chief Officer. To aid in the efforts to track and reduce energy consumption in the MC, the Chief Officer will ensure effective monitoring and reporting, using the Excel based template, by the respective departments.

2.2 Baseline Energy Consumption Trend

The figure below shows the proposed structure of the MC energy management team:



Based on the above, the following roles have been assigned to the relevant officers:

- Energy Leader: The Chief Officer has been designated as energy leader with overall responsibility for energy management.
- Energy Team: The Energy Leader in consultation with the Municipal Officers shall identify staff members and personnel who will oversee implementation of energy efficiency measures and review their performance.

2.3 Types of Measures

Recommended EE measures are categorized into high, medium and low priority measures. High priority EE measures are those which shall be implemented immediately (within 1 year) to meet the baseline demand, medium term measures may be implemented in the near future (within 2-3 years' time) and low priority measures may be implemented in the remote future (within 3-5 years' time).

2.4 Action List

MC Khanewal's annual energy consumption is 1,774,226 kWh which is mainly in the form of electricity (water supply, buildings & streetlights) and fuel for vehicles. The study has helped in successfully identifying resource and energy efficiency improvement measures which will help:

- Yield annual savings of **US$ 10,587** with an estimated investment of **US$ 266,966**
- Reduce electricity consumption by approx**. 65,922 kWh**
- Reduce GHG Emissions by **35 tCO2/y**

Sr. No.	Section	High Priority Energy Efficiency Measure	Electricity Saving kWh/y	Investment Cost US $	Investment Cost PKR	Monetary Savings US $/y	Monetary Savings PKR/y	Simple Payback Months	Annual Emission Reduction tCO2/y	Responsible Person	Timeline
1	Pumping and Disposal	Replacement of Pumpset at (Colony No. 2 water supply - Unique ID: 31206462)	18,742	4,026	1,128,002	3,010	843,378	16	9	TBA by the Energy Leader	Within 1year
2	Pumping and Disposal	Replacement/Installation of Capacitors	Not Quantifiable	1,350	378,270	Not Quantifiable	Not Quantifiable	Not Quantifiable	Not Quantifiable	TBA by the Energy Leader	Within 1year
3	Streetlights	Installation of LEDs at all non-functional MC operated streetlights	Not Quantifiable	215,477	60,376,702	Not Quantifiable	Not Quantifiable	Not Quantifiable	Not Quantifiable	TBA by the Energy Leader	Within 1year
4	Buildings	Replacement of inefficient equipment in the buildings	14,633	3,499	980,540	2,350	658,495	18	7	TBA by the Energy Leader	Within 1year
		Total:	**33,375**	**224,352**	**62,863,514**	**5,360**	**1,501,872**		**16**		

Sr. No.	Section	Medium Priority Energy Efficiency Measure	Electricity Saving kWh/y	Investment Cost US $	Investment Cost PKR	Monetary Savings US $/y	Monetary Savings PKR/y	Simple Payback Months	Annual Emission Reduction tCO2/y	Responsible Person	Timeline
1	Streetlights	Replacement of existing MC operated inefficient streetlights with LEDs	32,547	12,614	3,534,457	5,227	1,464,609	29	19	TBA by the Energy Leader	Within 2-3 years
		Total:	**32,547**	**12,614**	**3,534,457**	**5,227**	**1,464,609**	**29**	**19**		

Sr. No.	Section	Low Priority Energy Efficiency Measure	Water Savings m^3/y	Investment Cost US $	Investment Cost PKR	Monetary Savings US $/y	Monetary Savings PKR/y	Simple Payback Months	Annual Emission Reduction tCO_2/y	Responsible Person	Timeline
1	Pumping and Disposal	Installation of Flow meters integrated with a centralized DCS system	24,868	30,000	8,406,000	0	0	0	Not Quantifiable	TBA by the Energy Leader	Within 3-5 years
		Total:	**24,868**	**30,000**	**8,406,000**	**0**	**0**	**0**	**0**		

2.5 Monitoring Progress and Reporting

An Excel based monitoring and reporting tool, provided along with the EMP, shall be used for monitoring on monthly basis the following:

- Status of implementation of energy efficiency measures
- Energy consumption for tubewells & disposal works, vehicles, streetlights and buildings.
- Impacts of energy efficiency projects

The Energy Leader (under section 2.4) will assign focal persons responsible for implementation of each EE measure. They will also be responsible for filling out information in the excel based reporting and monitoring tool on a monthly basis and submitting the report to the Energy leader who, in turn, will be responsible for submitting the same to PMDFC on monthly basis.