

## **Jhelum Municipal Committee**

### **Energy Management Plan**

**July 2023**

## History of the Document

| Version | Date          | Description |
|---------|---------------|-------------|
| 01      | July 06, 2023 | First Draft |

|                     |   |              |                        |
|---------------------|---|--------------|------------------------|
| Client Name         | Punjab Municipal Development Fund Company (PMDFC) | Contract No. | PK-PMDFC-318212-CS-CQS |
| Assignment          | Assignment No-II: Energy Audit & Management       | Version      | 01                     |
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## ACKNOWLEDGEMENT

PITCO expresses its sincere gratitude to the World Bank & Punjab Municipal Development Fund Company (PMDFC) team for their role in guiding and steering Punjab Energy Efficient Municipal Service Delivery program. The consultant is grateful to the World Bank-Pakistan for vesting its confidence in the team for carrying out this prominent assignment for the identification of energy efficiency interventions in Municipal Committee and for their full-fledged cooperation and support throughout the study.

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

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## ABBREVIATIONS

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

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# 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 Jhelum Energy Audit Report and have been used to develop the Energy Management Plan for Jhelum 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;

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- 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 Jhelum MC Background

The city of Jhelum is located at 32.9425° N, 73.725556° E. Jhelum District has an approximate population of 1.2 million.

Jhelum city is located at right bank of river Jhelum at N-5 highway previously called G-T road (Rawalpindi – Lahore section). It has got a distance of 165 km from Lahore and 115 km from Rawalpindi. This is an ancient city and is a district head quarter. MC Jhelum comprises of city itself and Dina town (urban locality) along with the rural area of Tehsil Jhelum.

#### 1.5 Objectives

The MC’s assets such as water supply tube wells, disposal pumps, municipal vehicles, and streetlights have sub-optimal energy consumption and are thus operating inefficiently. The overall objective of the audit activity is to accurately quantify assets, identification of efficiency improvement measures and replacement of inefficient assets with efficient counterparts.

Energy management plan gives the better idea for the optimum usage of energy resources which will ultimately result in scaling down energy consumption. The goal of this activity will be monitoring efficient utilization of resources and reducing carbon emissions.

#### 1.6 Summary of Observations and Recommendations

A summary of observations and recommendations is given below.

##### 1.6.1 Water Pumping System

- Sluice valve at 18 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 7 Pumpsets had a power factor below 0.8.
- It is recommended to replace pumps at following sites:
  - Chak Abdullah Shadab Road Pump No. 25 -Unique ID: 81706206
  - Near Mehfooz CNG Pump No. 23- Unique ID: 81706212
  - Norani Masjid Pump No. 35- Unique ID: 81706215
  - Chak Bram Pump No. 35- Unique ID: 81706216
  - Sheesha Ground- Unique ID: 81706236
  - Kashmir Colony Pump No. 37 -Unique ID: 81707771
  - Municipal Stadium (Salman Parag No. 1)- Unique ID: 81806237
- 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.

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### 1.6.2 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.

### 1.6.3 Wastewater Disposal System

- Filter vanes of Disposal system require periodic cleaning.
- No record of periodic maintenance and cleaning at the disposal system.

### 1.6.4 Streetlight

- All streetlights in Jhelum are MC owned.
- 495 street lights were operational out of 960 lights.
- 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.

### 1.6.5 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.

### 1.6.6 Buildings

- CFLs, ILB, Tube Lights and Sodium Lights are being used in the building; these need to be replaced with energy efficient LED lights.
- Three 1.5-ton Window AC are installed in the municipal building. It is recommended to replace these AC with more energy efficient inverter based split AC.

## 1.7 Energy Supply Management

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

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

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## 1.8 Current Energy Use

The baseline energy consumption at Jhelum 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 <sup>1</sup>           | kWh/year   | 634,697 | Utility Bills    |
| Electrical energy used by Wastewater Disposal <sup>2</sup> | kWh/year   | 6,056   | Utility Bills    |
| Electrical energy used in Buildings <sup>3</sup>           | kWh/year   | 37,865  | Utility Bills    |
| Electrical energy used by Streetlights <sup>4</sup>        | kWh/year   | 86,588  | Utility Bills    |
| Diesel used by Vehicles                                    | liter/year | 86,328  | Vehicle Logbooks |

Table 2: KPIs for Potable Water & Wastewater pumps

| Sr. No. | Description                                | Unit                                  | KPI                                    |
|---------|--|---------------------------------------|--|
| 1       | Energy Density of Potable Water Production | (kWh/m <sup>3</sup> )                 | 0.18                                   |
| 2       | Energy Density of Wastewater Disposal      | (kWh/m <sup>3</sup> )                 | Disposal Pumpsets are not operational  |
| 3       | Energy Density of Wastewater Treatment     | (kWh/m <sup>3</sup> ) – if applicable | No wastewater treatment is carried out |
| 4       | Energy Cost on Potable Water Production    | (PKR/m <sup>3</sup> )                 | 8.29                                   |
| 5       | Energy Cost on Wastewater Disposal         | (PKR/m <sup>3</sup> )                 | Disposal Pumpsets are not operational  |
| 6       | Energy Cost on Wastewater Treatment        | (PKR/m <sup>3</sup> ) – 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)               | 2,635   |
| 2       | Average electricity consumed per light pole/fixture                          | (kWh/year/fixture)     | 89      |
| 3       | Average cost of purchase of (i) pole/fixture and (ii) lighting equipment     | (PKR)                  | 45,770  |
|         |  | PKR/Lighting Equipment | 37,771  |
| 4       | Average cost of installation of (i) pole/fixture and (ii) lighting equipment | (PKR)                  | 1,254   |
|         |  | PKR/Lighting Equipment | 370     |
| 5       | Average annual maintenance costs   | (PKR)                  | 182,952 |
| 6       | Average daily duration of operation  | (Hours/day)            | 12.0    |
| 7       | Average energy costs per kilometer of lit roads                              | (PKR/km)               | 118,572 |
| 8       | Average energy costs per light pole/fixture                                  | (PKR/pole)             | 4,403   |
| 9       | Number and percentage of failed public lights                                | %                      | 48      |

<sup>1</sup> Based on 12-month historical billing data

<sup>2</sup> Based on 12-month historical billing data

<sup>3</sup> Based on 12-month historical billing data

<sup>4</sup> Based on 12-month historical billing data

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Table 4: KPIs for Buildings

| Sr. No | Description                                 | Unit                  | KPI  |
|--------|---|-----------------------|------|
| 1      | Municipal Buildings Electricity Consumption | (kWh/m <sup>2</sup> ) | 6.73 |
| 2      | Municipal Buildings Heat Consumption        | (kWh/m <sup>2</sup> ) | 0.08 |
| 3      | Average Energy Cost of Heating              | (PKR/m <sup>2</sup> ) | 4    |
| 4      | Average Energy Cost of Cooling              | (PKR/m <sup>2</sup> ) | 110  |
| 5      | Average Energy Cost of Lighting             | (PKR/m <sup>2</sup> ) | 100  |

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 | 3.70                 |
| 3       | Expenditure on fuel for staff transport vehicles     | PKR/km   | Cannot be Determined |
| 4       | Expenditure on fuel for solid/liquid waste transport | PKR/km   | 79.18                |

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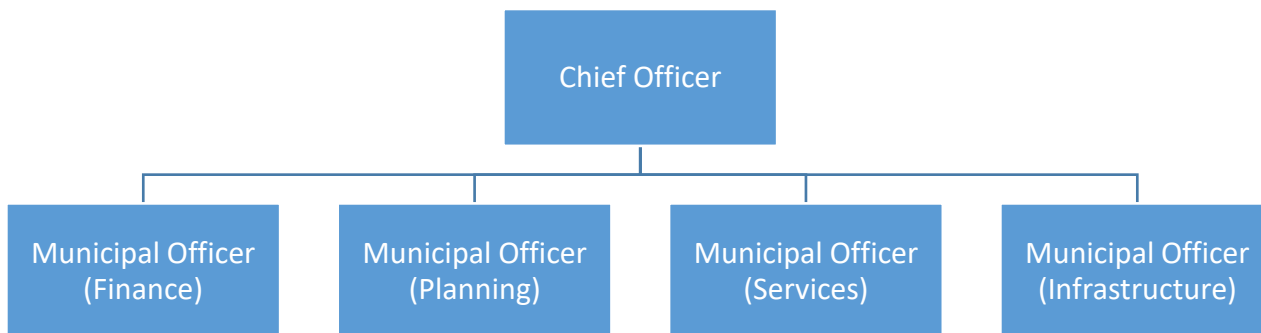
## 2 Energy Management Plan

### 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).

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## 2.4 Action List

MC Jhelum's annual energy consumption is 1,636,172 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\$ 42,520** with an estimated investment of **US\$ 170,296**
- Reduce electricity consumption by approx. **264,759 kWh**
- Reduce GHG Emissions by **141 tCO<sub>2</sub>/y**

| Sr. No. | Section              | High Priority Energy Efficiency Measure   | Electricity Saving | Investment Cost | Investment Cost | Monetary Savings | Monetary Savings | Simple Payback   | Annual Emission Reduction | Responsible Person       | Timeline       |
|---------|----------------------|---|--------------------|-----------------|-----------------|------------------|------------------|------------------|---------------------------|--------------------------|----------------|
|         |                      |   | kWh/y              | US \$           | PKR             | US \$/y          | PKR/y            | Months           | tCO <sub>2</sub> /y       |                          |                |
| 1       | Pumping and Disposal | Replacement of Pumpset at (Chak Abdullah Shadab Road Pump No. 25 - Unique ID: 81706206) | 6,598              | 4,026           | 1,128,002       | 1,060            | 296,916          | 46               | 3                         | TBA by the Energy Leader | Within 1 years |
| 2       | Pumping and Disposal | Replacement of Pumpset at (Sahil Colony Pump No. 22 - Unique ID: 81706209)              | 25,798             | 4,151           | 1,163,000       | 4,143            | 1,160,930        | 12               | 13                        | TBA by the Energy Leader | Within 1 years |
| 3       | Pumping and Disposal | Replacement of Pumpset at (Norani Masjid Pump No. 35 - Unique ID: 81706215)             | 22,017             | 4,026           | 1,128,002       | 3,536            | 990,757          | 14               | 11                        | TBA by the Energy Leader | Within 1 years |
| 4       | Pumping and Disposal | Replacement of Pumpset at (Chak Bram Pump No. 35 - Unique ID: 81706216)                 | 12,655             | 4,026           | 1,128,002       | 2,032            | 569,460          | 24               | 6                         | TBA by the Energy Leader | Within 1 years |
| 5       | Pumping and Disposal | Replacement of Pumpset at (Mandi Mor Pump No. 30 Mujahidabad - Unique ID: 81706226)     | 15,672             | 4,026           | 1,128,002       | 2,517            | 705,227          | 19               | 8                         | TBA by the Energy Leader | Within 1 years |
| 6       | Pumping and Disposal | Replacement of Pumpset at (Ramzan Bazar - Unique ID: 81706234)                          | 9,300              | 4,026           | 1,128,002       | 1,494            | 418,517          | 32               | 5                         | TBA by the Energy Leader | Within 1 years |
| 7       | Pumping and Disposal | Replacement of Pumpset at (Sheesha Ground - Unique ID: 81706236)                        | 11,016             | 4,026           | 1,128,002       | 1,769            | 495,703          | 27               | 6                         | TBA by the Energy Leader | Within 1 years |
| 8       | Pumping and Disposal | Replacement/Installation of Capacitors  | Not Quantifiable   | 1,050           | 294,210         | Not Quantifiable | Not Quantifiable | Not Quantifiable | Not Quantifiable          | TBA by the Energy Leader | Within 1 years |
| 9       | Streetlights         | Installation of LEDs at all non-functional MC operated streetlights                     | Not Quantifiable   | 84,837          | 23,771,365      | Not Quantifiable | Not Quantifiable | Not Quantifiable | Not Quantifiable          | TBA by the Energy Leader | Within 1 years |
| 10      | Buildings            | Replacement of inefficient equipment in the buildings                                   | 40,071             | 1,951           | 546,790         | 6,435            | 1,803,199        | 4                | 20                        | TBA by the Energy Leader | Within 1 years |

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| Sr. No. | Section | High Priority Energy Efficiency Measure | Electricity Saving | Investment Cost | Investment Cost   | Monetary Savings | Monetary Savings | Simple Payback | Annual Emission Reduction | Responsible Person | Timeline |
|---------|---------|---|--------------------|-----------------|-------------------|------------------|------------------|----------------|---------------------------|--------------------|----------|
|         |         |   | kWh/y              | US \$           | PKR               | US \$/y          | PKR/y            | Months         | tCO2/y                    |                    |          |
|         |         | <b>Total:</b>                           | <b>143,127</b>     | <b>116,145</b>  | <b>32,543,377</b> | <b>22,986</b>    | <b>6,440,709</b> |                | <b>72</b>                 |                    |          |

| Sr. No. | Section      | Medium Priority Energy Efficiency Measure                                | Electricity Savings | Investment Cost | Investment Cost  | Monetary Savings | Monetary Savings | Simple Payback | Annual Emission Reduction | Responsible Person       | Timeline         |
|---------|--------------|--|---------------------|-----------------|------------------|------------------|------------------|----------------|---------------------------|--------------------------|------------------|
|         |              |  | kWh/y               | US \$           | PKR              | US \$/y          | PKR/y            | Months         | tCO2/y                    |                          |                  |
| 1       | Streetlights | Replacement of existing MC operated non efficient streetlights with LEDs | 117,717             | 27,152          | 7,608,089        | 18,905           | 5,473,467        | 17             | 69                        | TBA by the Energy Leader | Within 2-3 years |
|         |              | <b>Total:</b>  | <b>117,717</b>      | <b>27,152</b>   | <b>7,608,089</b> | <b>18,905</b>    | <b>5,473,467</b> | <b>17</b>      | <b>69</b>                 |                          |                  |

| Sr. No. | Section                   | Low Priority Energy Efficiency Measure                               | Water Savings | Investment Cost | Investment Cost  | Monetary Savings | Monetary Savings | Simple Payback | Annual Emission Reduction | Responsible Person       | Timeline         |
|---------|---------------------------|--|---------------|-----------------|------------------|------------------|------------------|----------------|---------------------------|--------------------------|------------------|
|         |                           |  | m³/y          | US \$           | PKR              | US \$/y          | PKR/y            | Months         | tCO2/y                    |                          |                  |
| 1       | Water Pumps and Disposals | Installation of Flow meters integrated with a centralized DCS system | 38,036        | 27,000          | 7,565,400        | 0                | 0                | 0              | Not Quantifiable          | TBA by the Energy Leader | Within 3-5 years |
|         |                           | <b>Total:</b>  | <b>38,036</b> | <b>27,000</b>   | <b>7,565,400</b> | <b>0</b>         | <b>0</b>         | <b>0</b>       | <b>0</b>                  |                          |                  |

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## 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.

|                     |   |               |                        |
|---------------------|---|---------------|------------------------|
| Client Name         | Punjab Municipal Development Fund Company (PMDFC) | Contract No.  | PK-PMDFC-318212-CS-CQS |
| Assignment          | Assignment No-II: Energy Audit & Management       | Version       | 01                     |
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