EXECUTIVE SUMMARY

KUALA LUMPUR CITY HALL's Energy Management Plan 2050

Report for Feasibility Study on:

1. Improving Energy Performance (Renewable Energy and Energy Efficiency) for 27 Kuala Lumpur City Hall's Building
2. District Cooling System to Improve Energy Efficiency of 2 Kuala Lumpur City Hall's Building

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1. Improving Energy Performance (Renewable Energy and Energy Efficiency) for 27 Kuala Lumpur City Hall's Building

This plan was summarised from :

1. Business Case Report
2. Inception Report
3. Technical Feasibility Report (EE)
4. Technical Feasibility Report (RE)
5. Financial Feasibility Report (EE)
6. Financial Feasibility Report (RE)
7. Energy Audit Report for 27 Kuala Lumpur City Hall's Buliding
8. Institutional and Legal Feasibility Study
9. Environmental Impact Analysis (EIA) Report
10. Equity & Inclusion Report
11. Market Study Report
12. Procurement Documents

2. District Cooling System to Improve Energy Efficiency of 2 Kuala Lumpur City Hall's Building

This plan was summarised from :

1. Business Case Report
2. Inception Report
3. Technical Feasibility Study & Energy Audit Report
4. Financial Feasibility Report
5. Institutional and Legal Feasibility Study
6. Environmental Impact Assessment (EIA) Report
7. Equity & Inclusion Report
8. Market Study Report
9. Request for Proposal (RFP) Documents

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Abbreviations

BMS	Build Management System
BOOT	Build, Own, Operate and Transfer
CAPEX	Capital Expenditure
CFF	C40 Cities Finance Facility
CHW	Chilled Water
EE	Energy Efficiency
EIA	Environmental Impact Assessment
EMP	Environmental Monitoring Plan
EPC	Energy Performance Contracting
E&I	Equity and Inclusion
ESCO	Energy Service Companies
ESM	Energy Saving Measure
FM	Financial Model
GHG	Greenhouse Gas
GBV	Gender-Based Violence
GoMEn	Government, Ministries and Entities
IAQ	Indoor Air Quality
IRR	Internal Rate of Return
JKME	Mechanical & Electrical Engineering Department
JPPPB	Project Implementation & Maintenance Department
JRPB	City Planning Department
KLCH	Kuala Lumpur City Hall
MGTC	Malaysian Green Technology and Climate Change Corporation
NEM	Net Energy Metering
NPV	Net Present Value
OPEX	Operational Expenditure
PV	Photovoltaics
RE	Renewable Energy
RFP	Request for Proposal
RT	Refrigeration Ton
TES	Thermal Energy Storage
TNB	Tenaga Nasional Berhad
T1	DBKL Tower 1
T2	DBKL Tower 2
UNITEN	Universiti Tenaga Nasional

Foreword by
Mayor of Kuala Lumpur

Cities are the engines of growth making up 80% of global Gross Development Production (GDP). They are also responsible for 70% of carbon emissions. It is projected that cities will generate close to 4 billion tonnes of waste contributing to environmental degradation. However, if we get our cities right through plan-led development, if we green urban growth through better use of energy, we can flip the script on urbanization by making our cities the solution to the climate emergency.

In order to be resilient for future generations, the energy sector needs to rapidly transform. Greenhouse gas (GHG) emission performance will help Kuala Lumpur achieve its climate goals. We can reduce GHG intensity by lowering energy consumption.

The Kuala Lumpur City Hall's Energy Management Plan 2050, developed with the support of the C40 Cities Finance Facility (CFF), is a testament to the City Hall's commitment to reducing our carbon footprint. This project focuses began with a feasibility study of installing a District Cooling System (DCS) to improve the energy efficiency of two major public buildings including DBKL Tower 1 and Tower 2. We are working to enhance energy performance through the installation of Rooftop Solar Photovoltaic systems. We are also adopting energy-saving measures across 27 DBKL-owned buildings.

By integrating innovative technologies and environmentally sustainable practices, we aim to reduce the City Hall's carbon footprint by up to 180,000 tons CO2 emissions over the span of 25 years. The ultimate goal of this plan is to enhance climate resilience by accelerating the implementation of energy transition plans.

The Kuala Lumpur City Hall's Energy Management Plan 2050 is more than just a pathway to net-zero GHG targets; it represents a comprehensive and inclusive strategy designed to make DBKL-owned buildings more resilient. It lays out a roadmap for transformative change, ensuring that these buildings are future fit. I believe that the steps we are taking now will inspire other building-owners to embark upon the journey towards greater energy efficiency. 27 buildings under our custodianship is hardly a ripple in a city like Kuala Lumpur but if we can get 1000 buildings to follow suit, I am sure Kuala Lumpur will be a game-changer in Malaysia and our wider region.

Finally, I hope that the Kuala Lumpur City Hall's Energy Management Plan 2050 will motivate all of us to cooperate, collaborative and partner to ensure that we create a more resilient and sustainable future for all.

DATO' SERI TPr (DR.) MAIMUNAH BINTI MOHD SHARIF
Mayor of Kuala Lumpur

Foreword by
C40 Cities Finance Facilities

The C40 Cities Finance Facility (CFF) is honoured to present this foreword for the innovative and impactful energy projects with focus on Energy Efficiency, Renewable Energy, and District Cooling, in Kuala Lumpur, Malaysia. As a collaborative initiative between the C40 Cities Climate Leadership Group (C40 Cities) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, the CFF supports cities in developing sustainable urban climate infrastructure projects that address climate change and foster urban resilience.

This Kuala Lumpur City Hall's Energy Management Plan 2050 is a comprehensive initiative aimed at improving the energy performance and sustainability of 27 public buildings in Kuala Lumpur. The CFF has supported the city in the development of a customized and comprehensive procurement package for project implementation. This package consists of a request for proposal and a draft contract to improve the energy efficiency and performance of key public buildings within the city.

A key component of this project was the completion of comprehensive energy audits, conducted in all 27 buildings. These energy audits provide the critical data and insights that enabled the development of an extensive technical and financial feasibility report as well as a business case. These, in turn, build the foundation for the draft procurement documentation. The Kuala Lumpur City Hall team's diligence and efficiency in supporting the audits were instrumental in advancing the project's timelines and objectives.

The project outcomes, once implemented, will support the city to:

- Reduce more than 180,000 tons CO2 emissions over 25 years.
- Save up to 5 million RM (850.000 EUR) per year, on the back of reduced energy consumption.
- Establish a highly visible benchmark for reducing the energy intensity of governmental buildings.
- Lead on the cutting-edge of the energy transition in Malaysia and in the wider Asia region.

We extend our gratitude to all those that have contributed to this project and look forward to seeing the positive project impacts unfold, benefitting the environment and residents in Kuala Lumpur. The C40 Cities Finance Facility remains committed to partnering with climate champions such as Kuala Lumpur in their journey toward sustainability, and we are confident that this project will serve as a model for other urban centres to follow.

INGRID SIMON
Co-Director, C40 Cities Finance Facility (C40 CFF)

Fact Sheet Renewable Energy and Energy Efficiency

Improving Energy Performance (Renewable Energy and Energy Efficiency) for 27 Kuala Lumpur City Hall's Building

27 Kuala Lumpur City Hall Council assets have been identified for solar PV installation and energy audits have been done to implement low-cost energy efficiency measures and install renewable energy. The project has high upscaling potential through including further buildings in the city. The selection of buildings is based on criteria including electricity demand/energy intensity, roof space and structure, positive health impacts, contribution to resilience, potential for energy efficiency, and public visibility.

Goal

Improving the Energy Performance (Renewable Energy and Energy Efficiency) of 27 Public Buildings through Energy Efficiency Saving Measures and installation of Rooftop Solar PV in Kuala Lumpur, Malaysia.

Objective

Development of a customised, comprehensive, and holistic Procurement Package, consisting of a request for proposal and draft contract.

Summary

Sector	Capacity	Investment	Mode
Renewable Energy (Rooftop Solar PV)	4.2 MWp	13 RM million	Zero Capex
Energy Efficiency (ESM Retrofits)	2.5 GWh/y	8 RM million	Zero Capex
Total		**21 RM million**	

Benefit

Sector	Production / Savings	Monetary Savings	Impact (annual reduction)
Renewable Energy (Rooftop Solar PV)	25,770 MWh	14.9 RM million (2.6 million EUR) from electricity use/ year	6,930t CO_2
Energy Efficiency (ESM Retrofits)	3,415 MWh		1,940t CO_2

Milestones

Fact Sheet District Cooling System

District Cooling System to Improve Energy Efficiency of 2 Kuala Lumpur City Hall's Building

The Kuala Lumpur District Cooling System (DCS) project aims at improving energy efficiency of two public buildings, namely KLCH Tower 1 and KLCH Tower 2. The two buildings are positioned next to the Gombak River which water will be used to cool down the buildings.

Goal

Improving the Energy Efficiency (EE) of two public buildings (DBKL Tower 1 and Tower 2) through the implementation of a District Cooling System (DCS) in Kuala Lumpur, Malaysia.

Objective

Development of a customised, comprehensive, and holistic Procurement Package, consisting of a request for proposal and draft contract.

Summary

System	Cooling Capacity	Plant Efficiency	Mode
Decentralized DCS	4,450 RT (max.)	0,8 kW/ton	BOOT with Zero CAPEX

Benefit

Sector	Savings	Monetary Savings	Impact (annual reduction)
Decentralized DCS	380 MW/year	210.991 RM / year	290t CO_2

Milestones

Dec 2022 Kick-off event with DBKL

Apr 2023 Contract award

May 2023 Inception mission

July 2023 Technical Feasibility (incl. Energy Audits)

Jan 2024 Financial Model

June 2024 Draft RfP & Contract

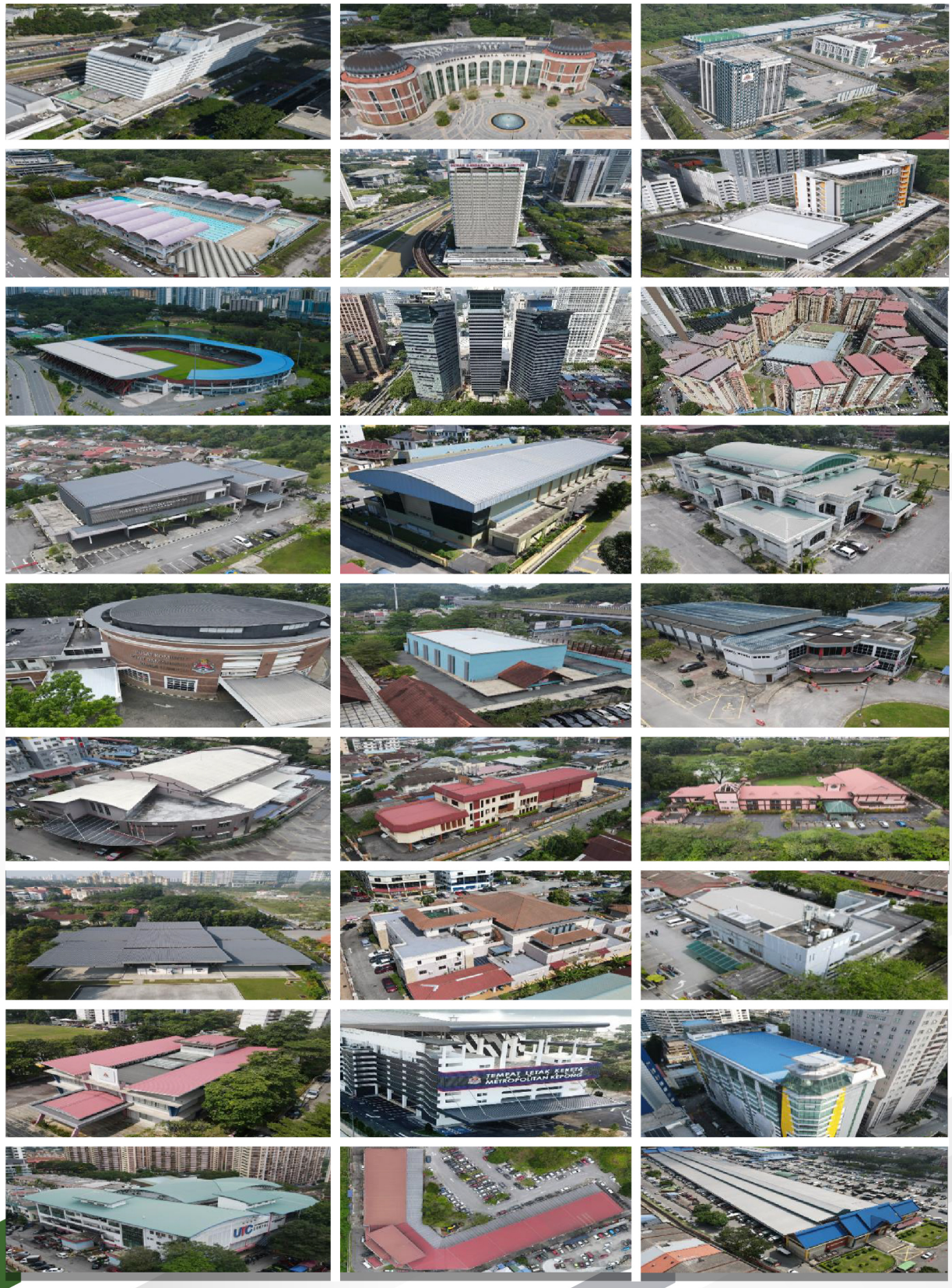
March 2025 Start of Construction

March 2026 Start of Operation

2046 end of concession

DBKL Tower 1 and Tower 2

1.0 Renewable Energy and Energy Efficiency for 27 Kuala Lumpur City Hall's Building



1.1 Introduction

This assignment was designed in support of the Kuala Lumpur City Hall (KLCH) on its mission to develop sustainable energy systems comprising renewable energy (RE) and energy efficiency (EE) solutions as a part of its efforts to mitigate climate change impacts. Based on the Kuala Lumpur Climate Change Action Plan 2050 (KLCAP2050), RE and EE penetration is to be considered in both energy supply and demand side management for the commercial, industrial and residential sectors to significantly reduce the city's Greenhouse Gas (GHG) emissions and strengthen its climate resilience.

The overall objective of this C40 City Finance Facility (CFF) assignment was to support KLCH in preparing financially ready projects for energy efficiency improvements in selected 27 public buildings in Kuala Lumpur. This is achieved via the development of a customised, comprehensive, and holistic Procurement Package. The Package shall consist of:

- **Business Case** including a financial model
- **Request for Proposal (RFP)**
- **Draft Contract**

The assignment of the Consultant started in March 2023 and ran until July 2024. The following figure provides an overview of the four work packages, tasks, and activities that facilitated the development of a comprehensive Procurement Package according to the ToR.

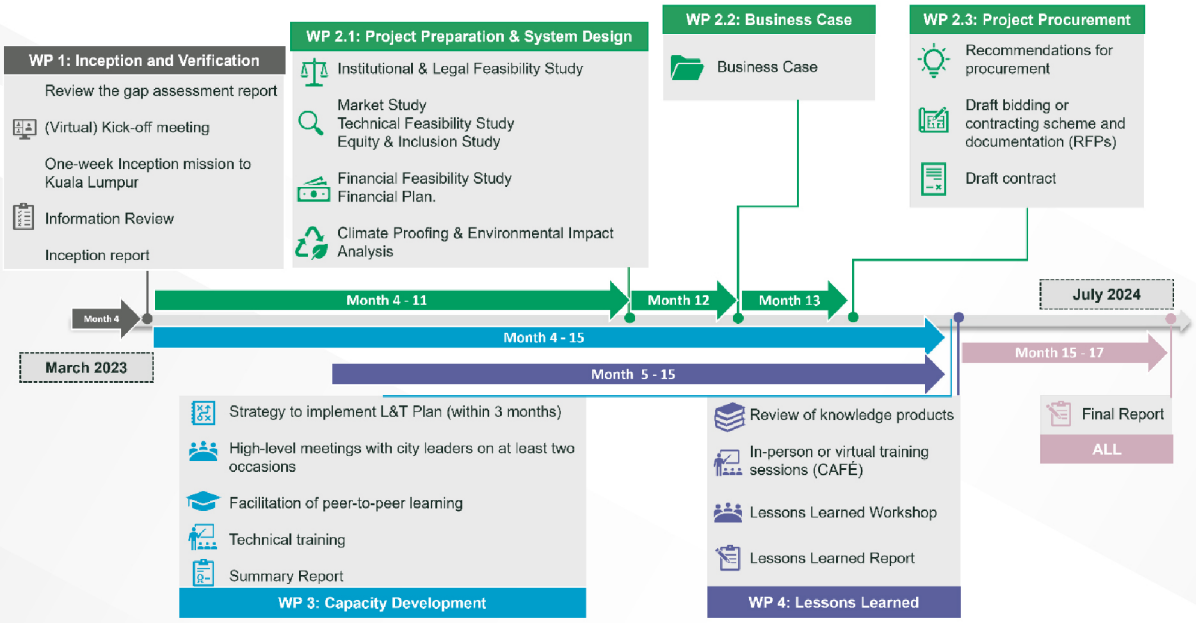


Figure 1: Overview of work packages and tasks according to the ToR

Based on the above works, the study identified several potential business cases for possible implementation within the KLCH framework. The summary of recommended projects and implementation approached is presented in this report. The comprehensive deliberations of competing business cases can be examined in the associated detailed reports.
The 27 public buildings of concern under this assignment are as follows :

Cluster Type		Buildings Asset	No
	Community Centre	• Setiawangsa Community Centre • Dewan Serbaguna Kampung Bharu • Manjalara Community Centre, Kepong • Bukit Cheras Community Centre • Koperasi Polis Phase 2 Community Centre • Gombak Community Centre • Sri Petaling Community Centre • Sentul Perdana Community Centre (UTC Sentul) • Taman Ibu Kota Community Centre, Gombak • Bukit Damansara Community Centre • Bukit Damansara Community Centre	11
	Government Office	• Kuala Lumpur City Hall Training Centre (IDB) • KLCH Tower 1 • KLCH Tower 2 • KLCH Tower 3 • Enforcement Department Building, Bandar Tun Razak	5
	Sports/ Recreational Complex	• Footbal Stadium KL • Pudu Ulu Recreational Park • Stadium Badminton Bandar Tun Razak (Kompleks Sukan Bandar Tun Razak) • Kompleks Renang Kuala Lumpur	4
	Library	• Kuala Lumpur Public Library • Library 1 Wilayah, Lembah Pantai	2
	Commercial Centre	• Pusat Penjaja Bandar Seri Permaisuri • Kuala Lumpur Wholesale Market • PT80 Commercialization Centre	3
	Public housing	• PPR Desa Tun Razak	1
	Car park	• Multi-Story Parking Building (Kepong)	1

Figure 2: Overview of the 27 public buildings

1.2 Key Findings

This chapter provides the key findings of the different deliverables under this assignment.

1.2.1 Technical Feasibility

A detailed explanation on this matter can be found in the report "**CFF – RE EE; Technical Feasibility Report (EE)**, **CFF – RE EE; Technical Feasibility Report (RE)**"

The technical feasibility study assessed energy efficiency and rooftop solar PV potential in 25 public buildings through energy audits. The annual energy savings from the implementation of the Energy Saving Measures (ESM) (less the chiller replacement) is estimated to be **2.5 GWh**. The ESM to be undertaken in the various buildings is summarised in the following figure.

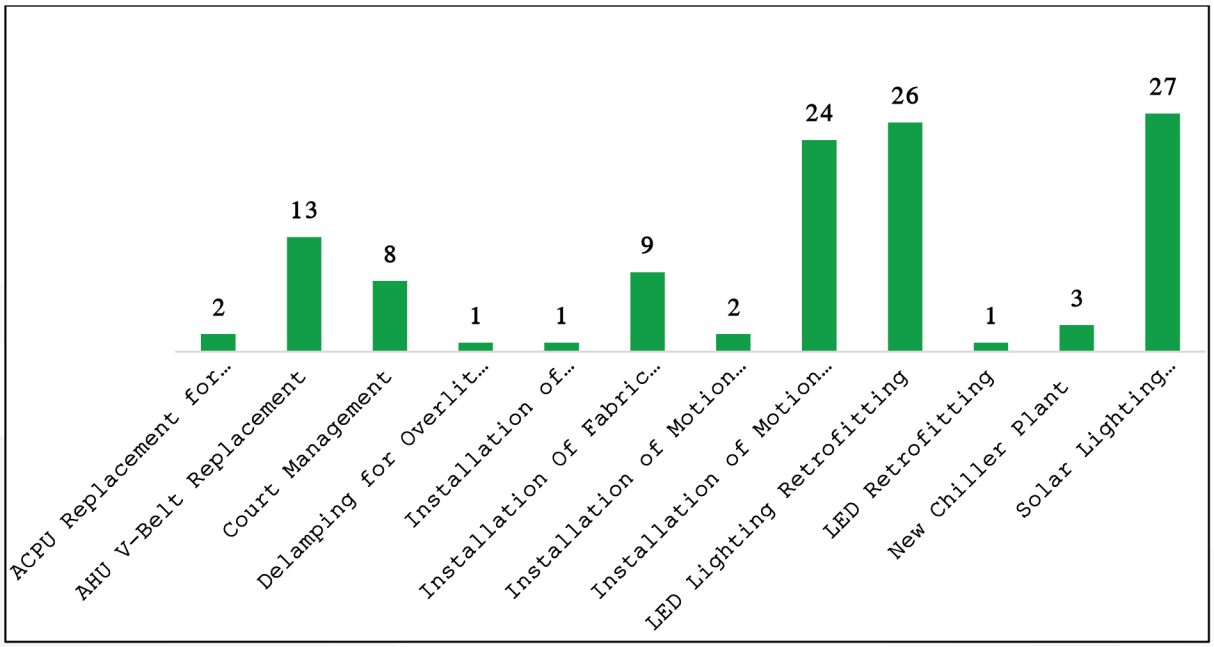


Figure 3: ESM measures to be undertaken in the 27 public buildings

The following figure provided an overview of the power consumption reduction of each building after the ESM implementation (between 2.17% and 79.45%).

Site Name	Total annual consumption (kWh/year)	Total annual consumption after ESM implementation (kWh/year)	Total consumption difference (kWh/year)	Total consumption reduction (%)
Pusat Komuniti Setiawangsa	224,715	212,549	12,166	5.41%
Dewan Serbaguna Kg. Bharu	99,514	89,806	9,708	9.76%
Pusat Komuniti Bukit Cheras	100,782	66,848	33,934	33.67%
Pusat Komuniti Koperasi Polis Fasa 2	67,432	33,433	33,999	50.42%
Pusat Komuniti Gombak	94,524	46,467	48,057	50.84%
Pusat Komuniti Sri Petaling	281,267	239,416	41,851	14.88%
Pusat Komuniti Taman Ibu Kota	137,599	82,776	54,823	39.84%
Pusat Komuniti Bukit Damansara	125,599	28,017	97,582	77.69%
Pusat Komuniti Bukit Bandaraya	176,306	78,178	98,128	55.66%

Site Name	Total annual consumption (kWh/year)	Total annual consumption after ESM implementation (kWh/year)	Total consumption difference (kWh/year)	Total consumption reduction (%)
Kompleks Sukan Bandar Tun Razak	161,932	91,309	70,623	43.61%
DBKL Menara 1	101,196	88,091	13,105	12.95%
DBKL Menara 2	6,709,222	5,605,349	1,103,873	16.45%
DBKL Menara 3	3,313,684	2,785,352	528,332	15.94%
DBKL Jabatan Penguatkuasaan	4,207,312	3,062,316	1,144,996	27.21%
Stadium Bolasepak KL	2,500,821	2,446,532	54,289	**2.17%**
Taman Pudu Ulu	799,188	746,483	52,705	6.59%
Kompleks Renang KL	202,867	41,688	161,179	**79.45%**
Perpustakaan KL	306,205	273,210	32,995	10.78%
Perpustakaan KL @ Lembah Pantai	1,087,930	1,049,841	38,089	3.50%
Pusat Penjaja Bandar Seri Permaisuri	174,529	163,169	11,360	6.51%
Pasar Borong KL	75,625	45,701	29,924	39.57%
PPR Desa Tun Razak	356,295	178,560	177,735	49.88%
Tempat Letak Kereta (TLK) Taman Tasik Metropolitan Kepong	307,536	194,523	113,013	36.75%
Institut Latihan DBKL (IDB)	189,520	95,894	93,626	49.40%
UTC Sentul	1,700,074	1,435,887	264,187	15.54%
Grand Total	**26,185,612**	**21,413,114**	**4,772,498**	
Grand Total (Without Chiller)	**26,185,612**	**23,656,909**	**2,528,703**	

Figure 4: Power consumption reduction of each building after the ESM implementation

The rooftop solar PV component is estimated at **4.2MWp.** The assessment took place at 25 of the 27 sites, since two sites already have solar PV installations. All the parameters of assessments are shown below.

Items	Solar rooftop analysis components
Electricity Tariff	Tariff classification
	Energy Consumption
	Maximum Demand
Site Data	Aerial Picture
	Roof Dimensions
	Electrical Systems
Capacity Considerations	Consumptions
	CT Ratio and Fuse Ratings
	Roof Available Area
	Maximum Demand
Simulation Software	System Sizing
	3D Design
	Shade Analysis
	Solar Irradiance Data

Figure 5: Solar rooftop analysis components

1.2.2 Financial Analysis

A detailed explanation on this matter can be found in the "**CFF-RE EE ; Financial Feasibility Report (EE)** and **CFF-RE EE ; Business Case Report**" and the " **CFF-RE EE ; Financial Feasibility Report (RE)**"reports.

Renewable Energy (Rooftop Solar PV)

The estimated capital investment required for rooftop solar PV for 25 public buildings is about **RM 13 million**. The proposed implementation scheme is via **Zero Capex** where a third party is to undertake the investment under a power purchase agreement. This investment model is recommended to be implemented in the Net Energy Metering (NEM) Government, Ministries and Entities (GoMEn) scheme. It should be noted that the NEM GoMEn scheme has a dateline of 31st December 2024 to apply for the quota.

Energy Saving Measures (EE Retrofits)

The EE retrofits identified require an investment of about **RM 8 million.** The implementation mode after a detailed discussion with KLCH's team is to deploy the **EPC route**. Energy Service Companies (ESCO) can be invited to participate in the request for proposal (RFP) for the EE components. Using the EPC model, guaranteed shared savings will benefit KLCH.

The summary of investment and implementation modes are as follows:

Sector	Capacity	Investment (RM Million)	Implementation Mode
Renewable Energy	4.2 MWp	13	Zero Capex
Energy Efficiency (ESM retrofits)	2.4 GWh/y	8	Zero Capex
Total		**21**	**Zero Capex**

Figure 6: Financial analysis

1.2.3 Legal Feasibility

A detailed explanation on this matter can be found in the report **"CFF-RE EE ; Institutional & Legal Feasibility Study (RE-EE-DCS)**".

From a legal perspective, as a local authority equipped with statutory authority, DBKL has the power and means to conduct and deliver the respective projects based on the identified business models, the existing legal as well as institutional framework of DBKL subject to the following:

1. Compliance with applicable laws such as energy-related laws (e.g. licensing/registration with the Energy Commission in the case of RE).
2. The decision to embark on each project and the details for each project must be designed and crafted based on commercial, social and technical considerations.
3. In implementing the Project, DBKL needs to assess and determine how it plans to finance the respective projects considering its internal and external constraints (e.g. the need to seek permission from the Federal Government for projects requiring funds from the Federal Government).
4. About the adoption of business models, if there exist financial constraints to incur CAPEX upfront, a non-CAPEX-based model can be considered (e.g. BOOT model in the case of DCS Project or Solar Leasing/PPA in the case of RE Project).
5. Contracts to be entered into by DBKL should also be structured in a manner that rewards efficiency and discourages wastage (e.g. Energy Performance Contracting to ESCO).
6. DBKL will also have to ensure that it has adequate and organised manpower resources (backed by experienced consultants) to monitor and manage the development as well as the implementation of the respective projects (including the operations, maintenance and upgrading). In this regard, there needs to be an effective project management team to amongst others (a) ensure that the risks of change and variation to contracts are mitigated if not eliminated; (b) compliance with applicable laws (including health and safety, energy as well as environmental laws); and (c) strive to achieve efficiency in managing resources.

1.2.4 Environmental Impact Assessment

A detailed explanation on this matter can be found in the report **"CFF-RE EE ; EIA Report"**.
The proposed RE and EE interventions at all 27 public buildings can be viewed as a positive contribution to the overall environment which reduces the carbon footprint due to the move from conventional energy sources to renewable energy and retrofitting of inefficient electrical equipment. Adding a renewable source of energy to the existing transmission lines would support federal and state initiatives to encourage renewable energy. Based on the environmental impact assessment of both the identified positive and negative impacts undertaken for the proposed project, the positive effects of this project significantly outweigh the negative ones. Most of the negative impacts are localized especially in terms of biodiversity loss (minor), and dust and noise pollution, mitigation measures as detailed in the Environment Monitoring Plan should be adhered to, to minimize these effects as much as possible.

The implementation of rooftop solar PV for 25 buildings is expected to reduce carbon emissions by **6,930t CO_2 annually**.

The implementation of energy efficiency measures for the buildings is expected to reduce carbon emissions by **1,940t CO_2 annually**.

1.2.5 Equity and Inclusion

A detailed explanation on this matter can be found in the report **"CFF-RE EE DCS ; E&I Report (RE EE DCS)".**

In principle, it can be assumed that implementing EE measures and Solar PV rooftop installations through the CFF RE/EE project benefits both the workforce and the community. Employees enjoy reduced energy costs, increased comfort and productivity, improved health, and better workplace morale. The community benefits from a **reduced carbon footprint**, **job creation**, **enhanced energy resilience**, and **educational opportunities**. Concrete benefits for vulnerable groups, however, will emerge later in the project cycle.

Recommendations for the way forward target critical aspects concerning urban planning policies, employment practices, and green initiatives. The standardization of the E&I framework is crucial; therefore, it is advised that DBKL form an **E&I committee** to establish standardized, equitable, and inclusive urban planning frameworks.

Collaboration with government bodies, academic institutions and industry leaders in sustainability, such as Malaysian Green Technology and Climate Change Corporation (MGTC), Universiti Tenaga Nasional (UNITEN) and Tenaga Nasional Berhad (TNB), offers opportunities for developing training programs and enhancing green job initiatives.

Additionally, it is recommended that DBKL enhance awareness and engagement regarding its green initiatives. Internal awareness campaigns, community outreach programs, and promotional materials can effectively educate employees, community members and especially vulnerable groups about the purpose, benefits, and progress of green projects.

1.3 Next Steps

To implement the findings of this study, it is recommended that the following actions are taken into consideration by DBKL. The next steps are categorised in three circumstances as enumerated below.

Immediate Next Step

The immediate next step for consideration is as follows:

1. Application of NEM GoMen to meet the dateline of 31st December 2024

   The application of the NEM GoMen is to be undertaken by an approved consultant. The market practice is that the application is done by the investor. However, this mode was deliberated and the practical approach is to appoint a consultant to assist DBKL. Since the RE expert in the study has the credentials as well as intimate knowledge of the project, it may be a good choice for KLCH to appoint him. The legal advisor is also needed to support KLCH in terms of the documentation required with the third-party investor.

Subsequent Actions

The subsequent actions include:

2. Issuance of Request for Proposal (RFP) for the following: -
   - Implementation of NEM GoMen using the Zero Capex model
     - The Zero Capex model for the NEM GoMen must start with the appointment of the consultant as early as August 2024. The documentation will take time. The consultant will have a submission target of 24th December or earlier.
     - The execution of the contract with the Investor is estimated to be in **February 2025**.
   - Implementation of Energy Performance Contract (EPC) for Energy Saving Measures
     - The Energy Performance Contract can start anytime in the year. As this is a pioneering project in KLCH, it is recommended that the technical and legal consultants be deployed.
     - The implementation is expected to commence after the execution of the EPC contract scheduled around middle of **June 2025**.

Timeline

The timeline of RE and EE implementation is further elaborated in the table below as a guide on the activities and duration required. The hard date is **31st December 2024** being the last day of the submission to apply for Solar PV quota for NEM GoMen.

No	Item	Start date	End date	Note
1	**Application for NEM Gomen**	15-Jul-24	25-Jul-24	
1.1	Appoint Approved Consultant	1-Aug-24		Dr. Kamil can provide this service
1.2	Prepare Application Document	7-Aug-24		
1.3	Submit Application to SEDA		24-Dec-24	Target Submission Date
2	**Solar PV**			
2.1	Customise the RFP to the Solar Implementation Scheme			
	a) Appoint Consultant for KLCH	1-Aug-24		The same consultant can undertake advisory roles
	b) Prepare the RFP Document to meet KLCH requirements	15-Aug-24		Preparation of the RFP can be done while the NEM GoMen application is being prepared

No	Item	Start date	End date	Note
	c) Select and Integrate the Technical Guides and Minimum Requirements for Solar PV into the RFP	24-Sep-24		
	d) Float the RFP	1-Oct-24	15-Oct-24	
	e) Adjudicate the Submissions and Select the Top 3 Proposals	18-Oct-24	28-Oct-24	
2.2	Negotiate the Contract Terms with Investors			
	a) Prepare Baseline Position and Preferred Terms	2-Nov-24	23-Nov-24	Based on the submissions, the baseline positions of KLCH are prepared
	b) Negotiate with the Top 3 Proposers	28-Nov-24	19-Dec-24	Legal Consultant support is recommended
	c) Select the Final Winner	9-Jan-25	30-Jan-25	
	d) Finalise Solar PV Zero Capex Contract	1-Feb-25	22-Feb-25	
2.3	Execute Zero Capex Contract with Investor	27-Feb-25	27-Feb-25	
3	**Energy Efficiency**			
3.1	Customise the RFP to the Solar Implementation Scheme			
	a) Appoint Consultant for KLCH	29-Nov-24		The same consultant can undertake advisory roles to facilitate the project
	b) Prepare the RFP Document to meet KLCH requirements	29-Nov-24		
	c) Select and Integrate the Technical Guides and Minimum Requirements for EE to the RFP	8-Jan-25		
	d) Float the RFP	15-Jan-25	29-Jan-25	
	e) Adjudicate the Submissions and Select the Top 3 Proposals	1-Feb-25	11-Feb-25	
3.2	Negotiate the Contract Terms with Investors			
	a) Prepare Baseline Position and Preferred Terms	16-Feb-25	9-Mar-25	Based on the submissions, the baseline positions of KLCH are prepared.
	b) Negotiate with the Top 3 Proposers	14-Mar-25	4-Apr-25	Legal Consultant support is recommended
	c) Select the Final Winner	25-Apr-25	16-May-25	
	d) Finalise EE Zero Capex Contract	18-May-25	8-Jun-25	
3.3	Execute Zero Capex Contract with Investor	13-Jun-25	13-Jun-25	

Figure 7: Timeline for next steps

Concluding Action

3. Negotiate and Execute Solar PV and Energy Efficiency respective Agreements.
   Based on the timeline, the project's target implementation is the end of **February 2025** for Solar PV and middle of **June 2025** for EE.

2.0 District Cooling System to Improve Energy Efficiency of 2 Kuala Lumpur City Hall's Buildings




1.1 Introduction

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- **Request for Proposal (RFP)**
- **Draft Contract**

The assignment of the Consultant started in March 2023 and ran until July 2024. The following figure provides an overview of the four work packages, tasks, and activities that facilitated the development of a comprehensive Procurement Package according to the ToR.

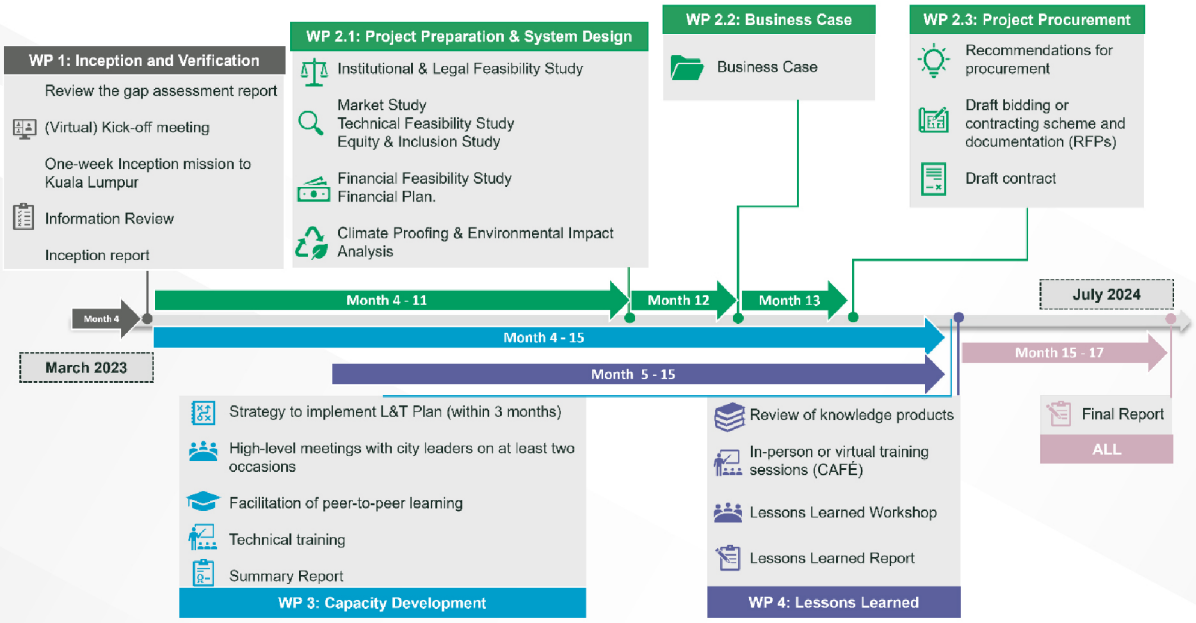


Figure 1: Overview of work packages and tasks according to the ToR

Based on the above works, the study identified several potential business cases for possible implementation within the KLCH framework. The summary of recommended projects and implementation approached is presented in this report. The comprehensive deliberations of competing business cases can be examined in the associated detailed reports.
The 27 public buildings of concern under this assignment are as follows :

2.2 Key Findings

This chapter provides the key findings of the different deliverables under this assignment.

2.2.1 Technical Feasibility

A detailed explanation on this matter can be found in the report **"CFF – DCS; Technical Feasibility & Energy Audit Report**"

The District Cooling System (DCS) assignment offers a smart solution to manage cooling capacity and energy consumption efficiently in the city. Overall, there are three main reasons that justify the need for DBKL to install a DCS system in Tower 1 and Tower 2:

1. **Energy efficiency**: The DCS will improve the energy efficiency of the buildings.
2. **Chilled Water (CHW) temperature improvement:** It can be concluded that the DCS will improve some of the CHW temperature issues encountered, including improving overall efficiency of the air-conditioning system and indoor air quality (IAQ).
3. **Incorporating other non-CHW air-conditioning system capacity**: There are other non-chilled water systems air-conditioning in the building. Implementation of the DCS system should include potentially future capacity from conversion of these systems to CHW systems.

A technical feasibility study was conducted as cornerstone of this project, assessing energy efficiency, cooling systems performance, and IAQ at DBKL Tower 1 and Tower 2. Two main DCS options were analysed:

- **Centralized System**: Very efficient system but requires a lot of new space and is the most disruptive.
- **Decentralized System**: Reuses existing equipment, is less disruptive, requires less new space, and is still very efficient.

The study recommends a **decentralized DCS** option due to space constraints, existing equipment conditions and its cost-effectiveness. A decentralized DCS system will also reuse existing cooling equipment near Tower 1 and Tower 2, minimizing new infrastructure, reducing costs, and limiting disruption. The new system will have a capacity of **4,450 refrigeration ton (RT)**, including extra capacity for future buildings, with Towers 1 and 2 using 1,600 RT after derating.

The following figure illustrates the comparison between different plant efficiencies, specifically for IAQ adjustments to the building, both before and after the implementation of DCS.

Description	Based Total	After Adjusted for IAQ	After Implementation of DCS
Improvement Efficiency kW/Ton	0.87	0.99	0.8
Annual Consumption Baseline (kWh)	11,584,284	-	-
Annual Consumption Baseline, monthly (kWh)	965,357.00	-	-
AC Plant portioning based on report, monthly (kWh)	397,205.25	452,813.99	365,246.21
kWh Saving			
Monthly kWh Usage	397,205.25	452,813.99	365,246.21
Monthly RM Charges	144,979.92	165,277.10	133,314.87
kWh Charges /year	1,739,759.00	1,983,325.25	1,599,778.39
After implementation of DCS			
Monthly kWh saving /addition with NEW DCS, RM		-20,297.19	11,665.05
Yearly kWh saving with NEW DCS (RM)		-243,566.26	139,980.61
Yearly ICPT Saving (RM)		-9,008.62	6,434.73
Yearly MD saving (RM)		-74,076.01	52,911.44
Total Yearly Saving (RM)		-346,948.07	210,991.82
Overall % Saving / Addition		14%	-8%
Estimated Investment Cost (RM)		-	14.6M
Estimated Carbon addition/reduction, Ton/mWh		495.07	-284.52
Estimated Co2e addition/ reduction (%)		Addition 5.8%	3.3%
Building Energy Index for AC plant (kWh/m2/year)	79.53	90.67	73.13
Costing for AC Plant (RM/m2/Year)	29.03	33.09	26.69

Figure 9: Efficiency comparison in savings

2.2.2 Financial Analysis

A detailed explanation on this matter can be found in the report "**CFF-DCS ; Financial Feasibility Report**"

Build Own Operate Transfer (BOOT)

DBKL has chosen the Commercial Agreement via **Build Own Operate Transfer (BOOT)** for implementing the proposed DCS plant, with the following benefits for DBKL:

1. Zero-Capex solution for DBKL but intended goal and objective of providing staff comfort and optimum level of energy efficiency for both DBKL Towers.
2. DBKL to rely on the DCS Investor's experience in operating the DCS plant.
3. Performance guarantee provided by the DCS Investor will ensure full energy efficiency realization and long-term effectiveness of the DCS Plant.
4. DBKL to focus on its core business rather than having to manage the operation of a DCS Plant.
5. DBKL to eliminate the risk of having to bear potentially higher operating costs of an inefficient plant by securing the pre-agreed tariff upfront via the concession agreement.
6. After the expiry of the concession, DBKL will obtain full ownership of the DCS Plant.
7. Please note: The excess capacity of the Proposed DCS Plant needs to be sold to a third party to ensure the financial viability of the DCS Plant.

The following figure provides a summary of the BOOT financial model

	BOOT to DCS Investor
Asset Ownership	DCS Investor will own the DCS Plant and transfer the full ownership of the plant to DBKL upon expiry of BOOT contract.
Upfront Capital Investment by DBKL	No
Project Internal Rate of Return (IRR)	12.5%
Equity IRR	17.50%
Project Net Present Value (NPV)	RM5,362,519
Equity NPV	RM3,165,279
Base CHW Tariff (RM/ RTh)	RM0.767
Adjusted IRR	19.20%
Adjusted Tariff (RM/RTh)	RM0.774
Cooling cost to DBKL for 21 years – based on adjusted CHW Tariff (RM'mn)	-RM122.9 million
Proceeds from selling CHW to third parties	n.a
Net cooling cost to DBKL for 21 years (RM'mn)	-RM122.9 million
Performance & Availability Guarantee	Yes
Impact of plant efficiency to DBKL	No
Future higher than expected cost escalation impact on DBKL Operation	No

Figure 10: BOOT financial model summary

Capital Expenditure Investment ("CAPEX")

The total CAPEX investment is estimated to be **RM14.6 million** which include the following:

No.	CAPEX Investment	Estimated Cost (RM)
1	Preliminaries work which include: a) *Project Management of c.RM685.1k (est 1.5%Equipment+ Local Facility Cost)* b) *Design & Engineering of RM685.1k (est 1.5%Equipment+ Local Facility Cost)*	1,370,200
2	Main Equipment & System cost (as per following table 2)	12,340,000
3	Local facility cost (civil works)	500,000
4	Other contingency cost (*2.5% of Prelim works + equipment + local facility cost*)	355,300
	Total	**14,565,000**

Figure 11: CAPEX investment

The breakdown of estimated cost for the main equipment and DCS system includes the following:

No.	Main Equipment & System Cost	RM/ Capacity	Estimated Cost (RM)
1	1,790 RT Plant (T1 & T2 Ground Floor Plant)	500 per RT	895,000
2	1,510 RT Plant (T2- L12 plant & Auditorium)	4,500 per RT	6,795,00
3	6,000 m^3 DCS Tank	500 per m^3	3,000,000
4	CHW Piping 3,300 RT	500 per RT	1,650,00
	Total		**12,340,000**

Figure 12: Cost of main equipment and DCS system

The drawdown of financial funding for the CAPEX investment will be completed in stages, aligning with the development phases of the DCS Project. The financial model incorporates the assumption that the plant will be available up to 75% upon completion of Year 1 of construction. It is projected that the plant will reach full operational capacity by Year 4 of operation.

Operational Expenditure (OPEX)

The total estimated OPEX cost over the 21-year lifespan of the DCS plant amounts to **RM194.6 million**, including :

1. Average annual utility cost of **RM7.6 million** over 21 years, covering electricity and water consumption.
2. Average annual maintenance cost of **RM1.6 million** over 21 years for routine maintenance activities.
3. Periodic overhaul charges of RM500,000 every 5 years to maintain plant efficiency.

Despite the relatively low initial CAPEX investment of RM14.6 million, prioritizing ongoing maintenance and efficient operation is crucial for maximizing long-term benefits and sustainability.

2.2.3 Legal Feasibility

A detailed explanation on this matter can be found in the report "**CFF – DCS; Institutional and Legal Feasibility Report**"

From a legal perspective, as a local authority equipped with statutory authority, DBKL has the power and means to conduct and deliver the respective projects based on the identified business models, the existing legal as well as institutional framework of DBKL subject to the following:

1. Compliance with applicable laws such as energy-related laws (e.g. licensing/registration with the Energy Commission in the case of RE).
2. The decision to embark on each project and the details for each project must be designed and crafted based on commercial, social and technical considerations.
3. In implementing the Project, DBKL needs to assess and determine how it plans to finance the respective projects considering its internal and external constraints (e.g. the need to seek permission from the Federal Government for projects requiring funds from the Federal Government).
4. About the adoption of business models, if there exist financial constraints to incur CAPEX upfront, a non-CAPEX-based model can be considered (e.g. BOOT model in the case of DCS Project or Solar Leasing/PPA in the case of RE Project).
5. Contracts to be entered into by DBKL should also be structured in a manner that rewards efficiency and discourages wastage (e.g. Energy Performance Contracting to ESCO).

6. DBKL will also have to ensure that it has adequate and organised manpower resources (backed by experienced consultants) to monitor and manage the development as well as the implementation of the respective projects (including the operations, maintenance and upgrading). In this regard, there needs to be an effective project management team to amongst others (a) ensure that the risks of change and variation to contracts are mitigated if not eliminated; (b) compliance with applicable laws (including health and safety, energy as well as environmental laws); and (c) strive to achieve efficiency in managing resources.

2.2.4 Environmental Impact Assessment

A detailed explanation on this matter can be found in the report "**CFF-DCS ; EIA Report**" The proposed DCS project shall have the following components:

- New DCS Chiller Plant
- Underground Chilled Water Distribution Network
- Building End-users/Consumers which include heat exchangers/ Energy Transfer Station (ETS)

Although it is no requirement under the regulation, an Environmental Impact Assessment (EIA) was carried out to understand the impact of the proposed DCS project. All impacts identified were considered minor or negligible. The most significant impact of the proposed project would be the **temporary deterioration of local freshwater quality** during underground piping installation and new DCS chiller plant room construction installation at the proposed site. However, the impact is only during construction stage and can be overcome as per a proposed mitigation plan.

The water source for the DCS shall be from the utility water and not from the river. This is due to the: a) poor water quality of Gombak River contributed by urban runoff, industrial discharge, untreated sewage; b) inconsistent water supply and the river volume fluctuate subject to weather patterns and upstream activities; c) extracting large volume of water from the river may affect the river ecosystem.

Consideration needs to be made in the event maintenance work is carried out for the DCS plant and the stored water of 6000 m^3 needs to be discharged to the drainage system before river which is situated about 50 m from the discharging point. This is to avoid shock loading in terms of quantity and the low temperature which may affect the aquatic organisms. Considering that the quantity and temperature of the water will be unusual for the river, some mitigation measures need to be addressed when the event occurs.

Since there were no significant environmental impacts identified for the proposed project, mitigation measures were general construction phase guidelines such as dust control measures and appropriate waste management. The proposed **Environmental Monitoring Plan (EMP)** in the detailed EIA report also provides mitigation & monitoring measures for these items to ensure that the project will be implemented sustainably during construction and operation phase.

The proposed DCS is expected to reduce carbon emission by **290t CO_2e annually**.

2.2.5 Equity and Inclusion

A detailed explanation on this matter can be found in the report "**CFF-DCS ; E&I Report**" District Cooling Systems (DCS) offer efficient and reliable cooling, improving workplace comfort, air quality, and energy cost savings for employees. For the community, DCS reduces the carbon footprint, lessens electrical grid strain, and lowers urban temperatures. It also promotes **job creation**, **community resilience**, and **urban sustainability**. Concrete benefits for vulnerable groups, however, will emerge later in the project cycle.

Identified potential risks concern i) **Gender-Based Violence (GBV)**, ii) **economic displacement / exclusion**, iii) **occupational health & safety** and iv) **social inclusion**. Developed mitigation strategies are as follows:

Potential Risks		Mitigation Strategies
Gender-Based Violence (GBV) and Harassment	• Construction sites may become hotspots for GBV and harassment, particularly in urban settings where anonymity and transient populations can exacerbate these issues. • Women working on or near construction sites may face verbal, physical, or sexual harassment from male workers.	• **Develop and Enforce a Code of Conduct**: Implement strict policies against GBV and harassment, including a zero-tolerance policy, and ensure all workers understand and adhere to it. Ensure the policy is well-publicized within the community. • **Training and Awareness Programs**: Conduct regular training sessions on gender sensitivity and respectful workplace behaviour, including sessions in local languages and tailored to the urban context. • **Complaint Mechanisms**: Establish clear, confidential, and easily accessible reporting mechanisms for victims of harassment or violence, ensuring prompt and appropriate responses. Use mobile apps or hotlines to facilitate easy reporting.
Economic Displacement / Exclusion	• Vulnerable groups, particularly those in low-income urban areas, might be economically displaced due to construction activities. • People, mainly women, who engage in informal sector activities, such as street vending, may be disproportionately affected. • Women and people with disabilities in particular tend to have less technical background in the RE/EE sector and therefore benefit less from new jobs in this field.	• **Inclusive Compensation Plans:** Ensure fair compensation programs are inclusive and specifically consider the needs of women and marginalized groups. Engage with local women's associations to understand their specific needs. • **Participatory Planning:** Engage with local communities, including women and marginalized groups, in the planning process to identify potential impacts and mitigation strategies. • **RE/EE-related Job Training:** conduct (technical) job-trainings with a focus on RE/EE for women and people with disabilities.
Occupational Health & Safety	• Construction sites can pose significant safety risks, and people with disabilities might be particularly vulnerable to accidents and injuries. • Women may not be provided with personal protective equipment (PPE) that fits them properly (e.g. gloves and helmets that are too large), increasing their risk of injury.	• **Accessible Infrastructure:** Design construction sites to be easily accessible, ensuring safe and easy movement. • **Tailored PPE:** Provide appropriately sized PPE for all workers, including women. • **Health and Safety Training:** Conduct regular health and safety training that includes specific modules for the needs of women and people with disabilities.
Social Exclusion	• Vulnerable groups might be excluded from decision-making processes related to RE/EE projects. • Projects might not consider the specific (energy) needs of these groups, leading to inequitable benefits.	• **Inclusive Consultation Processes:** Ensure that vulnerable groups are further actively included in all stages of project planning and implementation. Utilize local (women's) organizations for better outreach.

Figure 13: Potential risks and mitigation strategies

It is recommended that DBKL applies the mitigation strategies for the identified potential risks to ensure that women and vulnerable groups also benefit equally from green infrastructure projects.

In addition, recommendations for the way forward target critical aspects concerning urban planning policies, employment practices, and green initiatives. The standardization of the E&I framework is crucial; therefore, it is advised that DBKL form an **E&I committee** to establish standardized, equitable, and inclusive urban planning frameworks.

2.3 Next Steps

A comprehensive Request for Proposal (RFP) for the development of a DCS using the BOOT model has been prepared. This RFP will solicit proposals from qualified vendors to design, construct, operate, and eventually transfer the DCS. The documents can be found in the report " **CFF-DCS ; RFP Documents**,**RFP Documents Section I**,**Section II**,**Market Study**"

DBKL should initiate the tendering process promptly to select qualified Concessionaire contractors for designing, constructing, and operating the district cooling infrastructure. Delays in this process can prolong the project timeline and may result in increased costs. The following negative consequences may arise:

1. Delays in the tendering process can lead to inflation in project costs due to factors such as rising material prices, labour costs, and contractual disputes.
2. Delayed tendering prolongs the overall project timeline, delaying the realization of benefits such as energy savings and environmental improvements.
3. Delaying the project could result in missed opportunities to address pressing energy and sustainability challenges, as well as potential incentives or funding opportunities available for timely implementation.

To mitigate these risks, DBKL should prioritize the tendering process, streamline administrative procedures, and ensure transparent communication with all stakeholders to facilitate timely project execution.

Careful consideration should be given to selecting appropriate technology for the district cooling infrastructure. This includes choosing efficient chillers, distribution systems, and control mechanisms to optimize energy performance and reliability.

By following these steps diligently, DBKL can effectively prepare for the successful implementation of the DCS project, ensuring efficient operation, reliability, and compliance with safety and regulatory standards.

To successfully implement the DCS and Thermal Energy Storage (TES) Plant, DBKL should concurrently invest in a new Building Management System (BMS) for DBKL Tower 1 and Tower 2. This investment involves assessing the current BMS, selecting an advanced technology that integrates with the new cooling systems, and overseeing its installation and integration.

> Roles and Responsibilities

Mechanical & Electrical Engineering Department (JKME) - Spearhead the project implementation in the mechanical and electrical engineering aspects.

Responsibilities:

1. Oversee the design and installation of mechanical and electrical systems.
2. Ensure compliance with relevant standards and regulations.
3. Coordinate with other departments to integrate mechanical and electrical components.
4. Conduct regular inspections and maintenance of installed systems.

Project Implementation & Maintenance Department (JPPPB) - Lead the overall project execution and maintenance activities.

Responsibilities:

1. Manage project timelines, resources, and budgets.
2. Coordinate with contractors and suppliers to ensure timely delivery of materials and services.
3. Monitor project progress and address any issues or delays.
4. Ensure all maintenance activities are planned and executed efficiently.
5. Report progress and any challenges to the project steering committee.

City Planning Department (JPRB) - Provide support and strategic guidance as the main secretariat of the CFF program with DBKL.

Responsibilities:

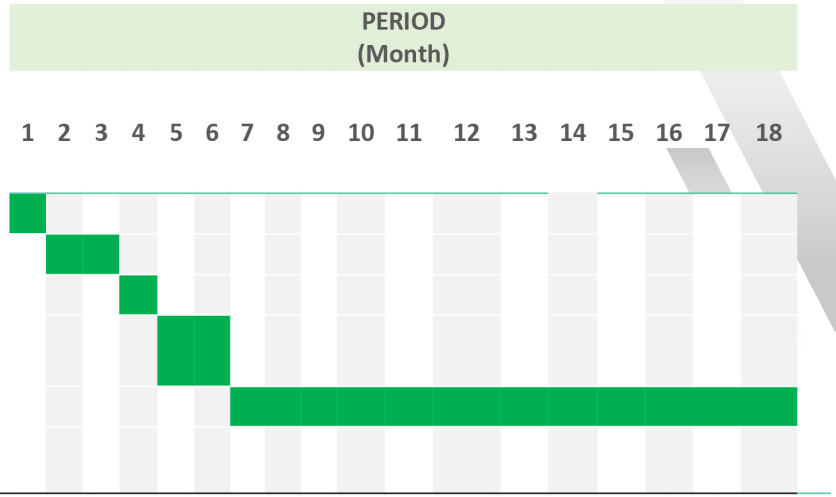
1. Assist in urban planning and ensuring the project aligns with city development goals.
2. Facilitate necessary approvals and permits from city authorities.
3. Coordinate with other departments and stakeholders to ensure project alignment with broader city initiatives.
4. Support community engagement and communication efforts related to the project.

This structure ensures a comprehensive and coordinated approach to the project, leveraging the expertise and resources of each department to achieve successful implementation and long-term sustainability.

No.	Event/Works	Timeline	Roles and responsibility
1.	Preparation of RFP	1 month from the date of approval of the framework	CFF DCS
2.	Issuance of RFP	Upon approval from the respective person(s) in charge in DBKL	DBKL
3.	Submission of Proposals	Within two (2) months from the date of the issuance of the RFP	DBKL
4.	Proposal Evaluation	Within one (1) month from the last date for submission of proposal	DBKL
5.	Negotiation/Clarification on Proposals and Award	Within two (2) month from the last date for submission of proposal	DBKL
6.	Construction Period	Not more than twelve (12) months from award	Success Bidder / Concessionaire
7.	Operation Period	Between 15 to 21 years from expiry of Construction Period	Concessionaire

Figure 14: Provides the proposed timeline of the next steps

ACTIVITY	PLAN START (Month)	PLAN DURATION (Month)	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Preparation of RFP	1	1	1	1	100%
Issuance of RFP	2	2	2	2	100%
Proposal Evaluation	4	1	4	1	100%
Negotiation/Clarification on Proposals and Award	5	2	5	2	100%
Construction Period	7	12	7	12	100%
Operation Period (in Years)	19	252	19	252	100%



ACTIVITY	PLAN START (Month)	PLAN DURATION (Month)	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Operation Period (in Years)	19	252	19	252	100%

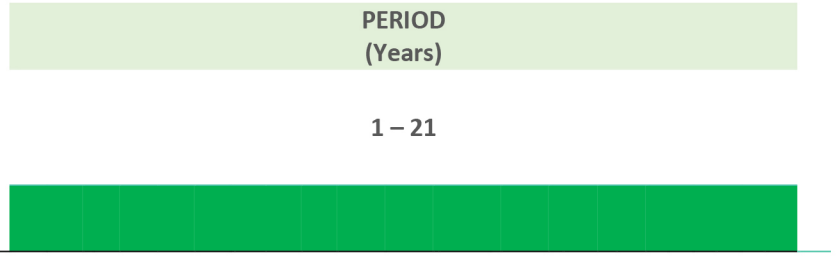


Figure 15: Proposed timeline for the DCS

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