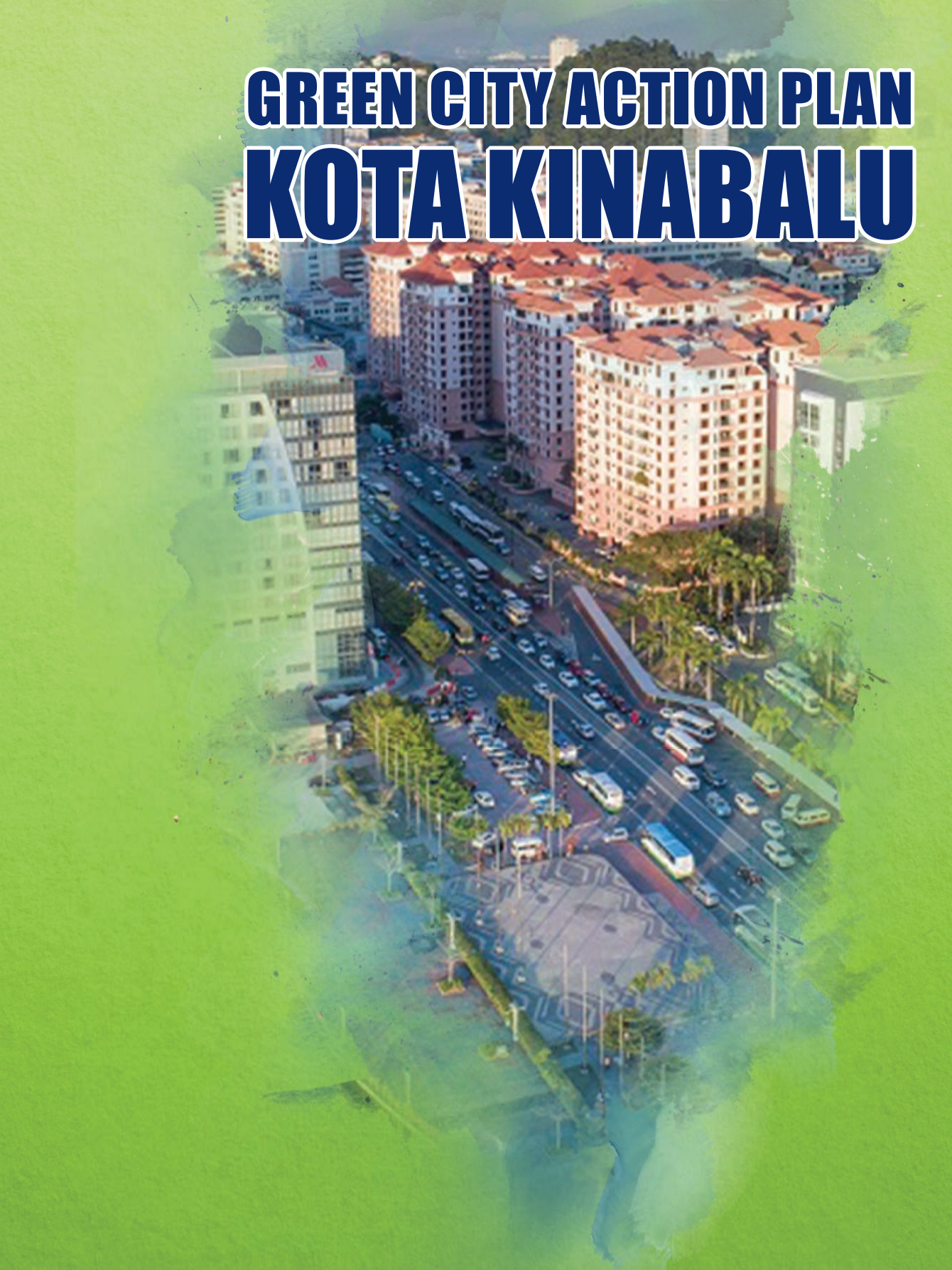
ADB

Brunei Darussalam-Indonesia-Malaysia-Philippines
East ASEAN Growth Area
(BIMP-EAGA)

GREEN CITY ACTION PLAN
KOTA KINABALU



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KOTA KINABALU

November 2019

Supported by

The Regional Cooperation and Operations Coordination Division, Southeast Asia Department of Asian Development Bank

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The Kota Kinabalu Green City Action Plan (KK GCAP) project team wishes to thank members of the Steering Committee and Technical Committees for their timely inputs and guidance. Our special gratitude to the Honorable Mayor of Kota Kinabalu City, for his visionary leadership in guiding the development of the KK GCAP. We also want to thank administrators, representatives, and stakeholders from Kota Kinabalu City and the Government of Sabah for their support and contribution to the successful compilation of this document. The team thanks the Asian Development Bank for conceptualizing the KK GCAP and providing technical and financial support.

Abbreviations

11MP	11th Malaysia Plan
ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
BIMP–EAGA	Brunei Darussalam–Indonesia–Malaysia–Philippines East ASEAN Growth Area
CAGR	compounded annual growth rate
CBD	central business district
C&D	construction and demolition
DBKK	Dewan Bandaraya Kota Kinabalu
DID	Department of Irrigation and Drainage
ESD	Education for Sustainable Development
GBI	Green Building Index
GCAP	Green City Action Plan
GDP	gross domestic product
GHG	greenhouse gas
GPC	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
HPS	high-pressure sodium lamps
IAP	ICLEI Asian Cities Climate Change Resilience network Process
IPCC	Intergovernmental Panel on Climate Change
JKR	Jabatan Kerja Raya (Public Works Department)
KK GCAP	Kota Kinabalu Green City Action Plan
KK CBD	Kota Kinabalu Central Business District
KKCH	Kota Kinabalu City Hall
KKIA	Kota Kinabalu International Airport
KKIP	Kota Kinabalu Industrial Park
LPG	liquefied petroleum gas
MRF	materials recovery facility
NRW	nonrevenue water
OTTV	overall transfer thermal value
PIN	project information note
PPP	public–private partnership
SCADA	Supervisory Control and Data Acquisition
SDGs	Sustainable Development Goals
SESB	Sabah Electricity Sdn. Bhd.
SLD	Shared Learning Dialogue
UMS	Universiti Malaysia Sabah

Weights and Measures

GJ	gigajoule
kld	kiloliters per day
km	kilometer
km^2	square kilometer
kWh	kilowatt-hour
mld	million liters per day
mm	millimeter
tCO_2e	ton of carbon dioxide equivalent
TPD	ton per day

Executive Summary

The Kota Kinabalu Green City Action Plan (KK GCAP) is a step toward attaining Kota Kinabalu's vision of becoming a "nature resort city—clean, green, and livable by 2020" using integrated and comprehensive development approaches. The Asian Development Bank (ADB) is spearheading the development of Green City Action Plans (GCAP) in the Brunei Darussalam–Indonesia–Malaysia–Philippines East ASEAN Growth Area (BIMP-EAGA) region. In line with the objectives of the BIMP-EAGA Vision 2025, Kota Kinabalu was selected as the first pilot city from Malaysia in the BIMP-EAGA region. An international consultant team from ICLEI—Local Governments for Sustainability, South Asia and Southeast Asia Secretariats was tasked with preparing the KK GCAP. The team comprises experts in urban development, climate mitigation, adaptation, and climate financing.

Kota Kinabalu City Hall (KKCH) developed a comprehensive governance structure in consultation with ADB to facilitate the preparation of the KK GCAP. At the highest level, it is envisaged that a Green Council will be constituted to ensure vertical linkages to state priorities and plans, and to secure requisite state buy-in and approvals. A steering committee was constituted at KKCH to facilitate timely development of the KK GCAP and ensure its alignment with other development plans of the city initiated by other state- and city-level agencies. Technical working groups were also constituted to secure sectoral information in a timely manner and facilitate active discussions with key officials. Two steering committee meetings took place in April and July 2018 to review project progress and approve the methodology and green interventions presented in this document.

ICLEI detailed out a methodology and time line in consultation with ADB and KKCH, to prepare the KK GCAP. A greenhouse gas (GHG) emissions inventory report was prepared for the city. Climate vulnerability assessment was conducted through community engagement and by seeking inputs from relevant departments of KKCH. It was decided that identification of priority projects for the KK GCAP would be based on the outcomes of the climate vulnerability assessment and the greenhouse gas emissions inventory; due consideration would also be given to development priorities of the city. In order to ensure practical implementation of the KK GCAP, nine project information note (PIN) documents were prepared. Each PIN document clearly defines the scope, scale, implementation mechanism, and investment required for the priority projects.

The KK GCAP provides a comprehensive assessment of urban issues, climate change vulnerability, and impacts of climate change on eight selected urban sectors, namely land use and development, water supply, sewerage and stormwater drainage, transport, solid waste, street lighting, energy, and buildings. The climate vulnerability assessment evaluated the impacts of rise in temperature, high intensity rainfall, and sea level rise on selected urban sectors and assessed related risks. Areas vulnerable to climate risks were identified for these urban sectors. Sixteen rating areas of Kota Kinabalu were demarcated as vulnerable hotspots, including Menggatal, Sepanggar, Besabak, Lokub, Kibagu, Kuala Innanam, Teluk Likas, Bukit Bendera, Kota Kinabalu CBD, Sembulan, Tanjung Aru, Pulau Gaya, Likas, Damai, Dah Yeh Villa, and Luyang. It is estimated that in 2017, economy-wide activities in Kota Kinabalu resulted in GHG emissions equivalent to 2.59 million tons of carbon dioxide. Per capita GHG emission was 4.35 tons of carbon dioxide equivalent (tCO_2e), which is below the national per capita emission of 8.03 tCO_2e (2016).

The KK GCAP identifies transport, energy, solid waste, water, sewerage and stormwater drainage, buildings, and land use and development as key focus sectors for the city. Based on the findings of the GHG emissions inventory, climate vulnerability assessment and development priorities of the city, a sector-wise long list of climate change adaptation and mitigation and other sustainable development related interventions was prepared.

Potential impacts, co-benefits, priority, indicative cost, and lead agency responsible for implementation of each measure are identified. To promote integrated and comprehensive approaches, two types of interventions are recommended. These include the following:

Soft measures:

(i) policy- or governance-oriented interventions and regulatory mechanisms for interdepartmental coordination, stakeholder engagement, and cross-disciplinary decision-making during project implementation and monitoring;

(ii) interventions which would result in a detailed assessment of a specific sector, with an aim to identify follow-up interventions (for example, coastal climate regulation plan or an energy plan); and

(iii) technical feasibility studies that require a detailed evaluation of a specific intervention within a sector before proceeding with large investments.

Hard measures:

(i) capital-intensive infrastructure projects that build the adaptive capacity of the city's urban systems;

(ii) projects that showcase good practices to raise awareness toward achieving a climate-resilient Kota Kinabalu; and

(iii) redevelopment, retrofitting, and renovation activities, apart from new development and construction.

The KK GCAP identifies transport, energy, solid waste, water, sewerage and stormwater drainage, buildings, and land use and development as key focus sectors for the city. Nine priority projects were also identified for implementation in the period between 2019 and 2023. These projects were identified based on a series of stakeholder consultations and their potential contribution to building a climate-resilient, green city. The cumulative investment required for implementing the nine priority projects is estimated to be $331.30 million. This estimated investment amount does not include land procurement costs or construction costs of housing or commercial buildings associated with identified priority projects. The KKCH, with support from financial agencies, is identifying possible financing options for effective implementation of the long list of projects and priority projects.

CHAPTER 1

Introduction

It is well recognized that within the Association of Southeast Asian nations (ASEAN), the Brunei Darussalam–Indonesia–Malaysia–Philippines East ASEAN Growth Area (BIMP-EAGA) is an important growth center witnessing significant population and economic growth. The BIMP-EAGA, with over 62% of the population of the ASEAN region (2016), is home to some of the most vulnerable populations in the ASEAN region, especially in Indonesia and the Philippines. Between 2006 and 2015 the ASEAN region witnessed a gross domestic product (GDP) growth of 5.1% compounded annual growth rate (CAGR); it is forecasted that this growth in GDP will continue over the next decade. Energy demand per GDP growth also shows an increasing trend over the last decade in the region. Indonesia and Malaysia have witnessed an increase of 32% in economy-wide greenhouse gas (GHG) emissions between 2006 and 2015.[1] In the absence of a comprehensive framework for ensuring GrEEEn[2] development, ensuring sustainable urban growth and enhancing livability in urban areas are daunting tasks in these countries.

The Asian Development Bank (ADB) is supporting the preparation and implementation of Green City Action Plans (GCAP) in the ASEAN region, in a bid to realize equitable and livable cities, wherein equal emphasis is laid on the 3Es—environment, economic competitiveness and equity. Four cities in the Indonesia–Malaysia–Thailand Growth Triangle (IMT-GT) region already received support from ADB for preparation, of their GCAPs. In March 2018, ADB mandated ICLEI—Local Governments for Sustainability, South Asia to provide technical support to Kota Kinabalu City for preparing the Kota Kinabalu Green City Action Plan (KK GCAP), through a multi-stakeholder consultative process, considering not only the 3Es, but also assessing and addressing climate change impacts. Kota Kinabalu is the capital city of the State of Sabah, in East Malaysia.

The "Green Vision" of the Mayor of Kota Kinabalu states, "The City of Kota Kinabalu will become a nature resort city—clean, green, and livable by 2020." This vision is consistent with Malaysia's sustainability objectives as stated in the 11th Malaysia Plan.[3] The vision also directly addresses a number of Sustainable Development Goals (SDGs), including Goal 11 on Sustainable Cities and Communities and Goal 13 on Climate Action. It also contributes to a number of other interlinked goals including Goal 6 on Clean Water and Sanitation, Goal 7 on Affordable and Clean Energy, and Goal 12 on Responsible Consumption and Production.[4] Kota Kinabalu City aims to realize this vision by 2020, by leveraging its physical characteristics, economic advantages, and local culture. This vision is to be achieved by focusing on four key parameters i.e., services, cleaning, enforcement, and development. The KK GCAP will facilitate the realization of this vision. Actionable plans which address all aspects of sustainability—environment, economy, and equity—and with defined implementation frameworks, are identified and included in KK GCAP.

[1] ADB. Brunei Darussalam–Indonesia–Malaysia–Philippines East ASEAN Growth Area (BIMP-EAGA). https://www.adb.org/countries/subregional-programs/bimp-eaga (accessed 2 December 2018).

[2] Green development addresses the environment, the economy, and equity.

[3] Government of Malaysia, Ministry of Economic Affairs. 2015. *Eleventh Malaysia Plan, 2016–2020*. Kuala Lumpur: Economic Planning Unit.

[4] Government of Malaysia. 2017. *Malaysia Sustainable Development Goals Voluntary National Review 2017*. https:// sustainabledevelopment.un.org/content/documents/15881Malaysia.pdf.

The KK GCAP preparation included three essential phases:

(i) Establishing a baseline for urban development in the city, including an economy-wide GHG emissions inventory and a climate vulnerability assessment

(ii) Analyzing Kota Kinabalu City's proposed development pathway and assessing the potential for integrating the concepts of resilience and sustainable development into Kota Kinabalu City's growth strategy, leading to the development of a GrEEEn strategy

(iii) Developing an action plan for the city by identifying and scoping out projects and programs for implementation, with a specific focus on identifying quick-win implementation measures.

Kota Kinabalu City view, 2018. Showing commercial development along the seafront of the city.

CHAPTER 2

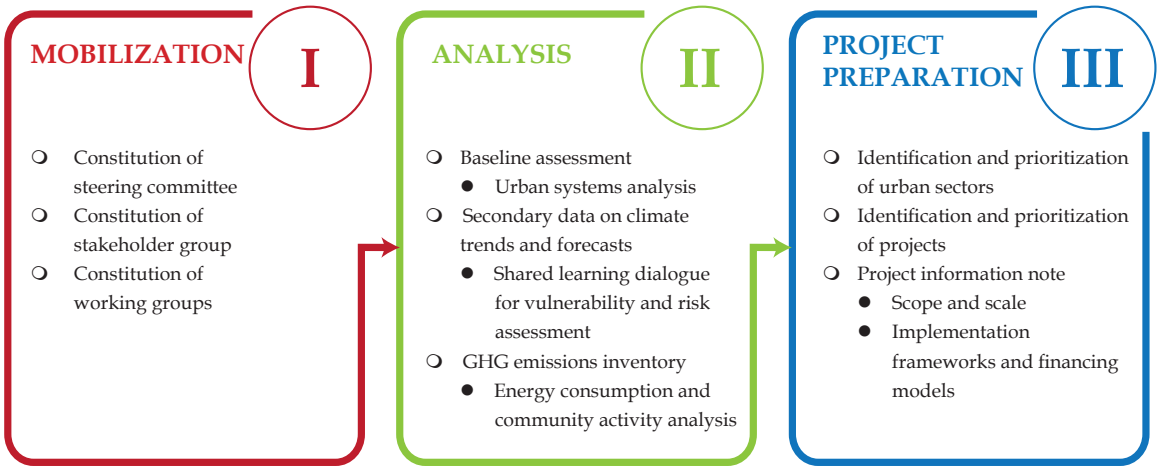
Approach and Methodology

The Mayor of Kota Kinabalu City Hall (KKCH) constituted a Steering Committee comprising representatives of the state government; ADB; Centre for Indonesia, Malaysia and Thailand Growth Triangle (CIMT); and senior officials of key departments, to guide and support the preparation of the Kota Kinabalu Green City Action Plan (KK GCAP). The Steering Committee is chaired by the State Secretary. Sector-specific working groups were also constituted, consisting of key officials from relevant departments, with an aim to expedite provision of information and to ensure an integrated multisector approach for the development of the KK GCAP.

At the highest level, it is envisaged that a Green Council, chaired by the Chief Minister of Sabah and consisting of representatives from relevant ministries, ADB, BIMP-EAGA Facilitation Centre (BIMP-EAGA FC), and CIMT, will be constituted to oversee the development, adoption, and implementation of the KK GCAP. Details of the proposed members of the Green Council and members of the Steering Committee, along with their role and functions, are given in Appendix 1.

The green vision of Kota Kinabalu Qty guided the identification of priority programs, projects, and manageable interventions. The KK GCAP is the result of an assessment of city development aspirations vis-à-vis the current development status. Development needs and priorities were analyzed through a "climate lens." Priority sectors for immediate intervention were identified through a process that considered the climate vulnerability of urban sectors and the potential for mitigation. In addition to identification of a long list of projects, this also resulted in the formulation of several priority projects, which were then discussed with stakeholders, and their scope was subsequently finalized. Project information notes (PINs) were then prepared for selected priority projects. Figure 1 shows the three phases in KK GCAP preparation.

Figure 1: Three Phases of KK GCAP Preparation



GHG = greenhouse gas, KK GCAP = Kota Kinabalu Green City Action Plan.
Source: ICLEI South Asia conceptualization.

In April 2018, through a stakeholder consultation workshop, 12 sectors were selected for conducting a baseline assessment of the service level and for identifying potential interventions that would improve the city's resilience to climate change impacts. However, based on further considerations of data availability, feasibility of implementation, including current capacity limitations, the Steering Committee decided that the KK GCAP would focus on eight service sectors which include land use and development, water supply, sewerage and stormwater drainage, transport, solid waste, street lighting, energy, and buildings. Since the KK GCAP is a live document, programs, projects, and interventions may be added and modified periodically.

Figure 2 shows the detailed process adopted for the preparation of the KK GCAP. The three phases of KK GCAP preparation are further distilled into 15 specific steps. Table 1 presents a brief description of the tools that were used in the preparation of the KK GCAP.

Figure 2: Kota Kinabalu Green City Action Plan—15-Step Preparation Process

ADB = Asian Development Bank, GHG = greenhouse gas, KKGCAP = Kota Kinabalu Green City Action Plan, KKCH = Kota Kinabalu City Hall, PIN = project information note.

Source: ICLEI South Asia conceptualization.

Table 1: Tools Used in Preparing the Kota Kinabalu Green City Action Plan

Tools	Description
Data collection questionnaire	a) 17 questionnaires (with objective and subjective questions) were prepared to identify the existing situation of service level, issues and ongoing and proposed development projects. All questionnaires were supported by guidance notes on data classification, aggregation, and disaggregation approaches. b) Each concerned department has used these questionnaires to update the KK GCAP team on current status of service provision and development priorities.
ICLEI–ACCCRN Process (IAP) toolkit	a) The IAP toolkit enables local governments to identify locations vulnerable to climate risks vis-à-vis each of the urban systems and formulate corresponding resilience strategies for identified fragile urban systems. It draws on the experiences of more than 40 ACCCRN cities and existing ICLEI planning approaches.[a] The IAP has already been applied in several cities in Indonesia, Bangladesh, the Philippines, and India.
Global Protocol for Community Scale Greenhouse Gas Emission Inventories (GPC)	a) As a global reporting standard, the GPC enables cities and communities to consistently measure and report GHG emissions and develop climate action plans and low-emission urban development strategies. For more information, please check www.iclei.org/gpc.[b]
HEAT*plus* (Malaysia Version)	a) The Harmonized Emissions Analysis Tool plus (HEAT+) is ICLEI's multilingual, online emissions inventory tool which helps local governments to estimate greenhouse gas emissions (GHGs). HEAT+ is compliant with IPCC 2006 guidelines and with the GPC. For more information, please visit http://heat.iclei.org/.[c] b) The KK GCAP team had used HEAT+—Malaysia version to account for and report greenhouse gas emissions, in accordance with the guidelines given for "BASIC" level inventories, as defined by the GPC. "BASIC" level inventories report emissions from stationary, mobile, and waste sources. They cover residential buildings, commercial/institutional facilities, industries, transport, and waste sectors. The BASIC level covers scope 1 and scope 2 emissions from stationary energy and transport, as well as scope 1 and scope 3 emissions from waste.
Shared learning dialogue (SLD)	a) Three stakeholder workshops were conducted in Kota Kinabalu City with all concerned agencies and departments at city and state level to identify development priorities and interventions. The SLD approach of the IAP guided the structure of the stakeholder workshops. b) Notes on the three SLDs are provided in Appendix 2.
Focus group discussions	a) Individual and group discussions where held in vulnerable areas of the city to review and vet the identified fragilities and impacts of climate change and potential interventions.
Assessment of priority project impacts and potential co-benefits	a) An excel-based tool which considers the vulnerability and risk scores and mitigation impact of interventions is used to prioritize and estimate potential impacts and co-benefits of identified priority projects.

KK GCAP = Kota Kinabalu Green City Action Plan, IAP = ICLEI Asian Cities Climate Change Resilience network Process.

[a] Asian Cities Climate Change Resilience Network. (2008–2018). https://www.acccrn.net/ (accessed 2 December 2018).

[b] World Resources Institute. (2014). Global Protocol for Community-Scale Greenhouse Gas Emission Inventories. http://c40-production-images.s3.amazonaws.com/other_uploads/images/101_GPC_Draft_2.0_for_public_comment.original.pdf?1406123916.

[c] HEATplus. 2011. Harmonized Emmissions Analysis Tool. http://heat.iclei.org/heatplusgpc/indexnew.aspx.

Source: ICLEI South Asia methodology for preparing the Green City Action Plan.

The KK GCAP team (KKCH, local and international consultant team) developed a "city profile" and "urban system analysis" with an intent to establish and define the baseline for each of the selected priority sectors. This exercise identified gaps in existing and planned infrastructure development vis-à-vis achievement of stated green objectives. The urban system analysis includes information on existing urban service performance and emerging issues, gleaned from discussions held with concerned departments and agencies, both in one-on conversations and during the three shared learning dialogues (SLDs). The GHG emissions inventory was prepared to identify sectors with significant GHG reduction potential that could be incorporated into the plan. A vulnerability assessment was conducted for the five identified fragile urban systems, to incorporate climate adaptive measures in the plan. The vulnerability assessment included an assessment of the risks of climate change impacts on urban systems and identified potential hazards of continuing in the "business as usual" scenario. An assessment of the climate change exposure, sensitivity, and adaptive capacity of each urban system is also included in the vulnerability assessment. Thematic geographical information system maps were used to represent vulnerable areas/ locations (rating areas) vis-à-vis each of the selected urban systems. The key actors for each sector were identified, including both, those who are vulnerable and those who can support planning and implementation of resilience interventions.

A long list of green interventions in each of the considered urban systems was identified through stakeholder consultations. These interventions can broadly be classified into two categories—soft measures (consisting primarily of policy interventions, awareness-raising activities, assessments or studies, among others) and hard measures (consisting of infrastructure measures, including redevelopment, retrofitting, renovation as well as new development). The resilience, feasibility, and impact scores for each of these interventions were identified. Based on this cumulative score, the action plan classified the priority of individual interventions as very high, high, medium, and low. The action plan also provides an indicative cost for each action, identifies the sustainable development goal addressed by the action, and also identifies the lead agency responsible for implementation.

Further, the KK GCAP team, in line with guidance provided by the Steering Committee and inputs from the stakeholder discussions, identified nine priority projects for fast track implementation. The KK GCAP includes a preliminary assessment of the size, feasibility, impact, and costing of these nine priority projects. This information is provided in individual project information note documents. It is intended that the project information note documents will be submitted to various financing agencies by KKCH, with support from CIMT and ADB, to ensure implementation.

KK GCAP Stakeholder consultation workshop, July 2018. Stakeholders during the working group exercise on the Vulnerability assessment.

CHAPTER 3

Kota Kinabalu—City and Climate Profile

3.1 City Profile

Kota Kinabalu is the fastest growing coastal city in East Malaysia. It is the capital city of Sabah state, and is home to major commercial and industrial activities in the region. The city is also a popular national and international tourist destination. Kota Kinabalu is the sixth largest city in Malaysia after Kuala Lumpur, Greater Penang, Johor Bahru, Ipoh, and Kuching. It covers an area of approximately 366 square kilometers (km^2). Kota Kinabalu City is very well known regionally and internationally for its natural landscape, mythological, historical, social, and cultural features. The location of Kota Kinabalu City on the Sabah state map is shown in Map 1.

Recent economic growth has resulted in rapid urbanization of the city. The city now extends up to adjacent districts of Penampang and Putatan in the south and Tuaran in the north. The city is witnessing significant growth owing to its strategic importance; it is an administrative capital, a major transport hub, growing port, manufacturing hub, emerging tourist center as well as a major gateway into Sabah and East Malaysia.

Map 1: Location of Kota Kinabalu City

Source: Adapted from map found at https://d-maps.com (accessed on 20 November 2018).

The city is the tourism gateway to Sabah and is popular among international tourists for its numerous ecotourism destinations including Mount Kinabalu (a World Heritage Site), Sipadan, Sukau, Maliau Basin, Danum Valley, Sepilok Orangutan Sanctuary, and Selingan (Turtle) Islands. The city itself features a number of tourist attractions such as the Tunku Abdul Rahman Park, Tanjung Aru, Likas Bay beaches, and museums and buildings with impressive architecture, particularly in mosques, churches, and temples.

3.2 Connectivity

Kota Kinabalu City is well connected by air, rail, and road transport systems. The Kota Kinabalu International Airport (KKIA) is located about 8.4 km southwest of the city center, and serves direct flights to and from a majority of Malaysian and Asian cities. The Tanjung Aru Railway Station of the Sabah State Railway is located approximately 10 km away from the city center and connects Kota Kinabalu to Tenom and some other towns in between. National and state highways connect the city to other cities in Sabah and Sarawak.

3.3 Demography

The population of Kota Kinabalu City is 452,058 as per census 2010. The annual population growth rate between 1991 and 2010 was 4.06%. This rise was mainly influenced by migration from adjoining states. The population density of Kota Kinabalu City is 1,315 persons/km^2 as per census 2010.

The population of Kota Kinabalu is expected to grow to 637,845 and 779,576 persons by 2020 and 2030, respectively (Table 2 and Figure 3). The average annual growth rate is estimated to be around 2.43% between 2018 and 2030. Considering the projected increase in population, provision of enhanced urban services and other social amenities is a challenge that KKCH and related agencies will have to address. Figure 3 depicts population growth projections for Kota Kinabalu City.[5]

Table 2: Population by Age in Kota Kinabalu District

Year	2020		2030	
Category	Total	%	Total	%
Preschool	76,104	12	82,731	11
Primary school	73,656	12	78,094	10
Secondary school	128,568	20	149,668	19
Tertiary school	41,948	7	68,394	9
Economically active	232,616	36	272,882	35
Seniors	84,953	13	127,807	16
Total	**637,845**	**100**	**779,576**	**100**

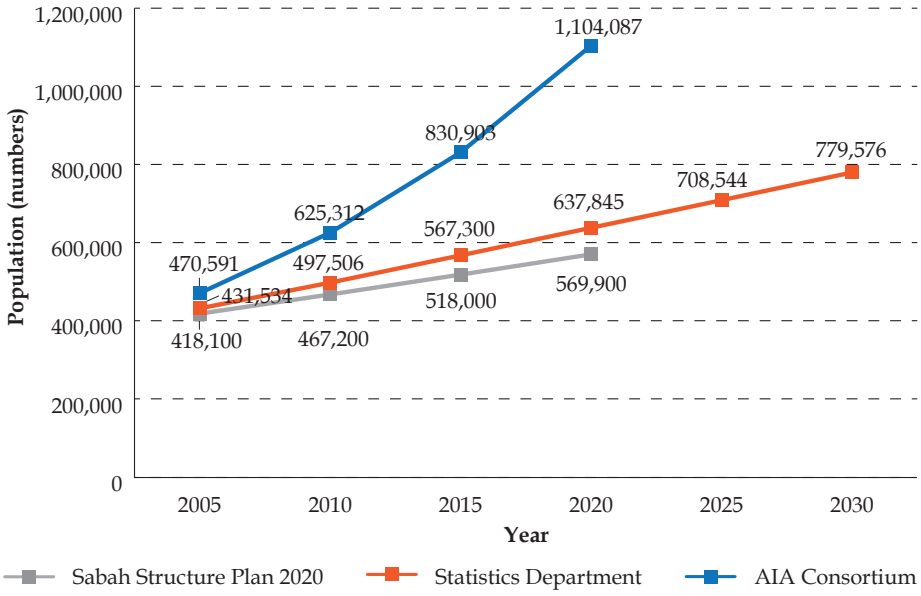
Source: Kota Kinabalu City Hall. 2010. Kota Kinabalu Structure Plan 2030. https://web.archive.org/ web/20150205090002/; and http://www.statistics.gov.my/portal/download_Population/files/population/03ringkasan_kawasan_PBT_ Jadual1.pdf (accessed 15 June 2018).

3.4 Land Use

Kota Kinabalu City started expanding its territory from Gaya Island, the first settlement area of the British Empire, to Tanjung Aru, Kepayan, Luyang, Inanam, Menggatal, Telipok, and Sepangar. The city covers a total area of 366 km^2 and constitutes the Kota Kinabalu district which is the smallest, yet highly dense and populous

[5] Kota Kinabalu City Hall. 2015. *Kota Kinabalu Local Plan 2020.*

Figure 3: Kota Kinabalu Population Projection, 2005–2030



Source: Kota Kinabalu Structure Plan 2030.

district of the Sabah state. Industrial development and increasing commercial activity are key driving forces for growth. A booming tourism sector also adds to the continued growth of the city.

Low density development across the central business district has contributed to urban sprawl. Commercial and residential land-use has been increasing over the past 2 decades. The city has witnessed the development of new residential colonies at 1 Borneo, Alamesra, Inanam, Bukit Sepangar, and 1 Sulaman, in the northern areas along Sulaman road. The sustained pressure of increasing population has led to the growth of adjoining suburbs toward the south as well. Significant changes in land use are evident in the southern part of the city.

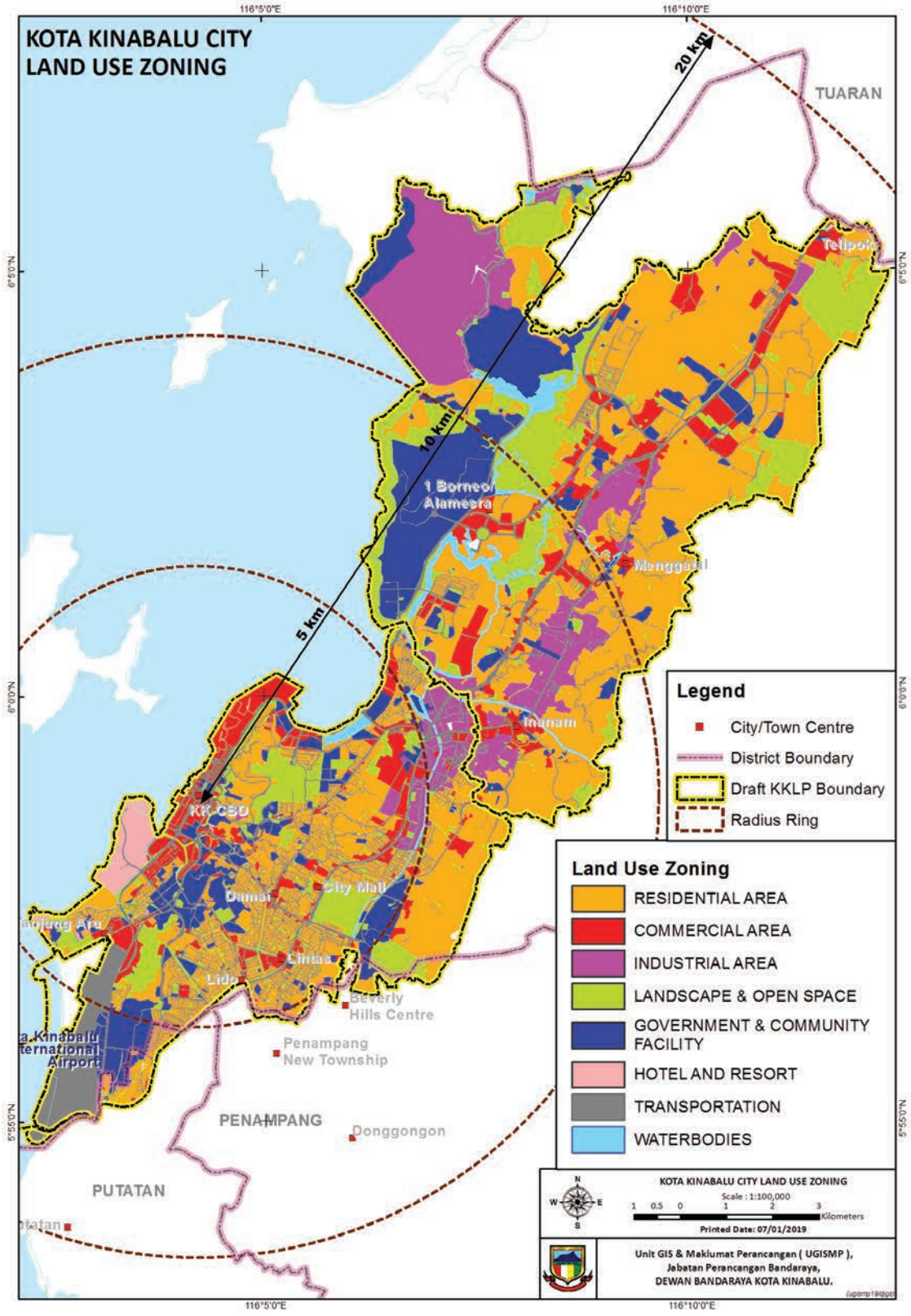
The Kota Kinabalu Local Plan 2020 is a statutory document under the Sabah Town and Country Planning Ordinance 1950 which contains planning and development guidelines for different land use zones. As per the plan, green/open spaces cover approximately half of the city area. Commercial areas are concentrated within a kilometer from the city center. Commercial land use constitutes 11% of the total area. Institutional areas cover 18% of the city.[6] Two universities located approximately 10 km to the north of the city center, are the largest institutions in Kota Kinabalu. Map 2 depicts the different land uses across the city.

3.5 Economic Activities

The Kota Kinabalu Structure Plan 2030 and Kota Kinabalu Local Plan 2020 focus on developing the tourism sector in order to boost the city's economy. Improving services is also integral to ensuring economic growth. The structure plan emphasizes the need for developing housing and improving infrastructure and utilities, while also encouraging commercial sector development. The five main objectives of the plan are to promote Kota Kinabalu as a world class tourism destination; ensure good and efficient infrastructure facilities; encourage

[6] Footnote 5.

Map 2: Kota Kinabalu City Land Use, 2010



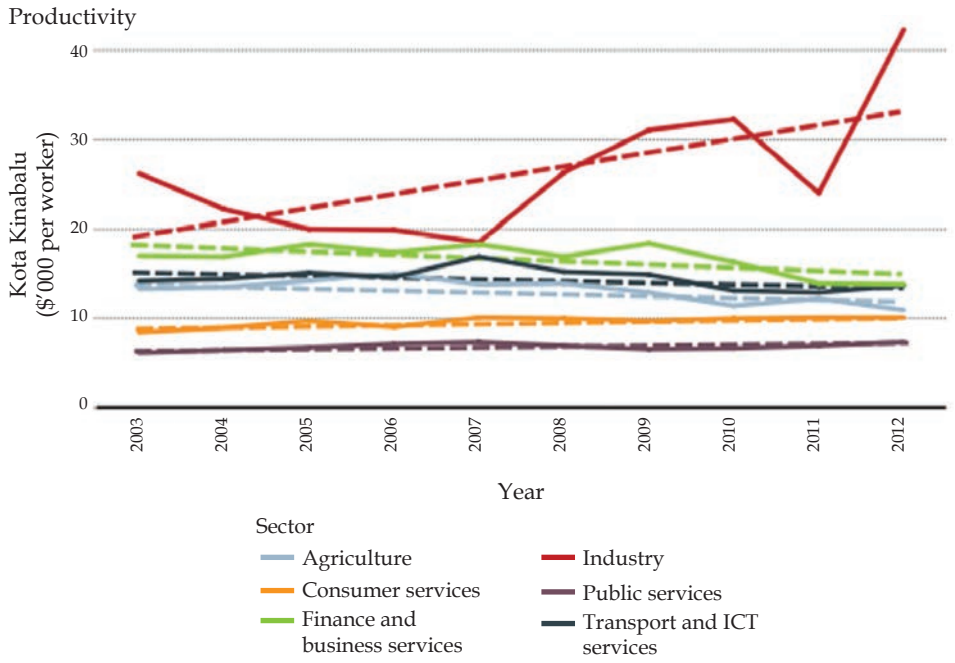
Source: Kota Kinabalu City Hall.

environmentally sustainable design; promote maritime-related business and industries; and upgrade local living standards.

Kota Kinabalu's economy appears to have experienced more volatility than other cities in Malaysia. The employment share of consumer services sector was 38% while the industrial services sector contributed to 23% of all employment in 2012. Labor productivity in Kota Kinabalu stagnated or even decreased in most sectors, except in the industry sector, where it rose from $26,200 per worker to almost $43,000 per worker from the year 2003 to 2012. Labor productivity in the consumer services remained stagnant at around $10,000 per worker, while in financial and business services, productivity declined from $17,000 to $13,000 per worker during the same period.[7]

Figure 4 presents the labor productivity, GDP share, and employment share by sector in Kota Kinabalu from 2003 to 2012.

Figure 4: Economic Productivity Scenario of Kota Kinabalu, 2003–2012



ICT = information and communication technology.

Source: World Bank. 2015. Achieving a System of Competitive Cities in Malaysia. http://documents.worldbank.org/curated/en/709061475743434007/pdf/102222-v1-REVISED-PUBLIC-Malaysia-Competitive-Cities-Main-Report-lowres-final.pdf (accessed 2 June 2018).

3.6 Local Government Body

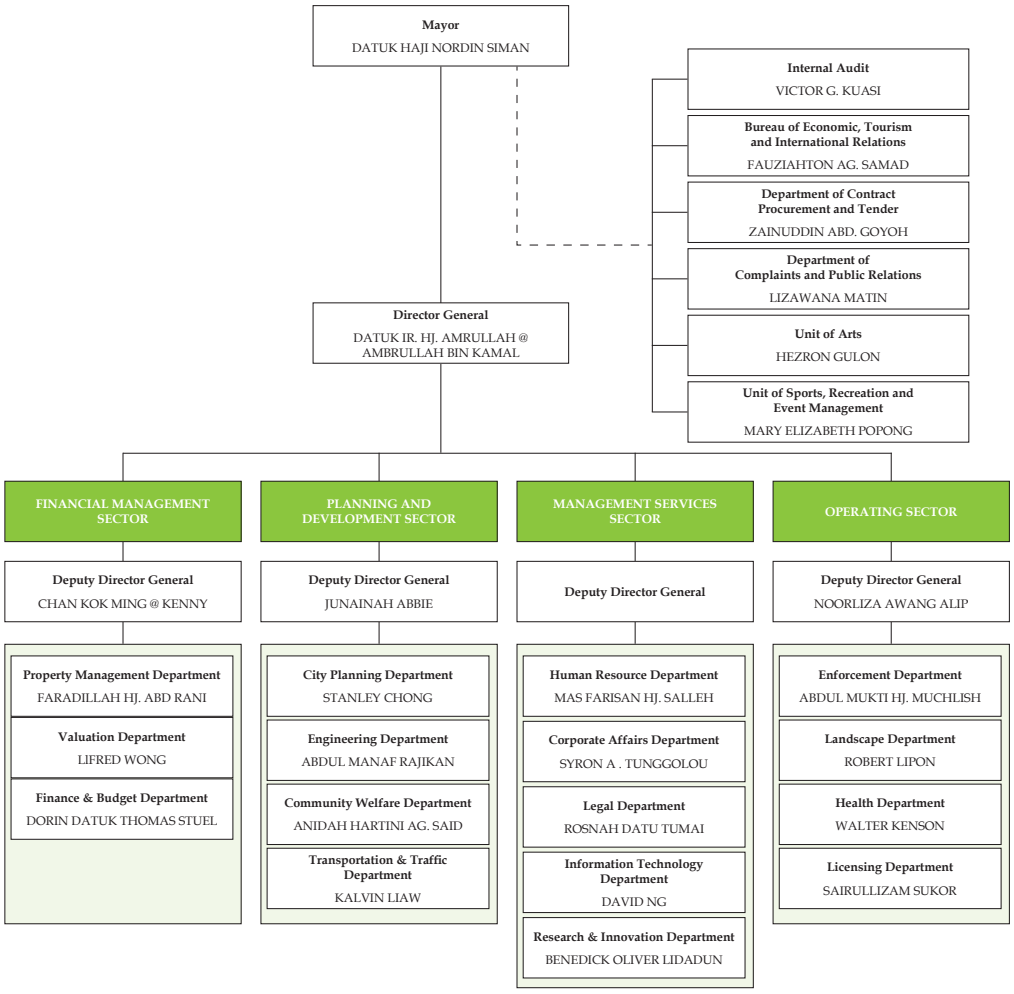
The Kota Kinabalu City Hall was formed on 3 February 2000 by the Sabah state government, and is responsible for administering the city of Kota Kinabalu. KKCH is responsible for urban planning, heritage conservation, public health, sanitation, waste management, traffic management, environmental protection, street lighting,

[7] World Bank. 2015. *Achieving a System of Competitive Cities in Malaysia*. http://documents.worldbank.org/curated/en/709061475743434007/pdf/102222-v1-REVISED-PUBLIC-Malaysia-Competitive-Cities-Main-Report-low-res-final.pdf.

registering of births and deaths, administration of public municipal schools, and generic maintenance of urban infrastructure. The Kota Kinabalu City is divided into 61 rating zones as per the Kota Kinabalu Local Plan 2020, for administrative management.[8] The rating zones consist of four types: urban, suburban, new rating areas, and country divisions. The city is governed by the mayor and 24 councilors, appointed by the Sabah State Government to serve a 1-year term. The KKCH is governed by the DBKK Enactment, 1996; the Local Government Ordinance, 1961; Local Government Act, 1976; and Town and Country Planning Act, 1976. The administrative structure of KKCH is presented in Figure 5.

KKCH offices are located mainly within the City Hall of Kota Kinabalu City. The solid waste management department of KKCH is located away from the City Hall, adjacent to the Centre Point mall.

Figure 5: Administrative Structure of Kota Kinabalu City Hall



Source: Laman Web Rasmi Dewan Bandaraya Kota Kinabalu. Carta Organisasi Dewan Bandaraya Kota Kinabalu. http://www.dbkk.sabah.gov.my/index.php/en/info-dbkk/info-korporat/carta-organisasi (accessed 25 November 2018).

[8] Rating zones are the areas in which the relevant local authority has imposed a property tax on property owners. Rating zones are administrative ward boundaries within Kota Kinabalu City that help facilitate development and infrastructure planning.

3.7 Climate Profile of Kota Kinabalu

The climate of Kota Kinabalu City is hot and humid. The monthly average climate data of Kota Kinabalu City were analyzed for the period of 1971 to 2000 to understand the overall trend of temperature and rainfall (Figure 6). During 1971–2000, Kota Kinabalu's average temperature was 28°C and the average annual rainfall was 212 millimeters (mm). Climate data from this period is summarized in Table 3.

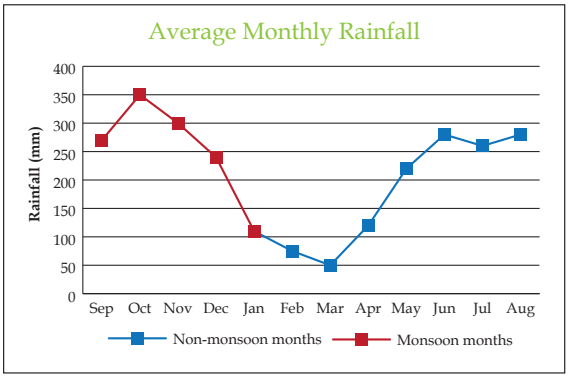
Table 3: Kota Kinabalu Climate Data, 1971–2000

Season	Months	Average Rainfall (mm)	Average Rainy Days	Average Humidity (%)	Maximum Temperature (°C)	Minimum Temperature (°C)	Mean Monthly Sunshine Hours
Monsoon	September	285.2	14	81	34.0	23.7	180.7
	October	345.8	16	82	33.3	23.6	191.9
	November	302.4	17	83	33.5	23.5	192.5
	December	242.3	13	83	32.7	23.3	197.5
	January	104.8	8	83	35.0	18.0	187.7
Non monsoon	February	73.4	7	82	34.2	17.0	194.8
	March	50.5	6	81	35.7	18.0	233.4
	April	114.2	8	80	35.6	24.1	245.3
	May	216.2	12	81	35.3	24.3	228.8
	June	279.4	13	80	35.6	24.0	197.6
	July	262.7	13	79	34.1	23.7	204.9
	August	270.3	13	78	35.0	23.7	196.7

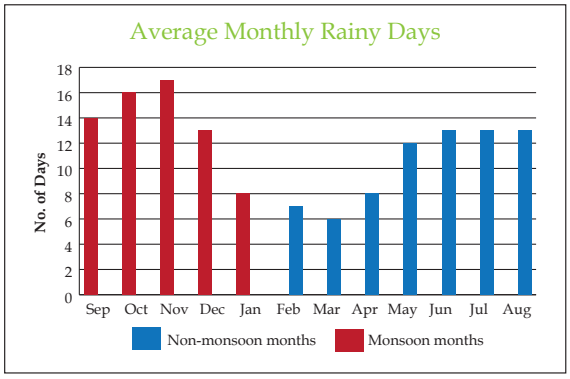
mm = millimeter.

Source: World Meteorological Organisation. World Weather Information Service—Kota Kinabalu. https://web.archive.org/ web/20131023025934/http:/ worldweather.wmo.int/020/c00081.htm (accessed 25 November 2018).

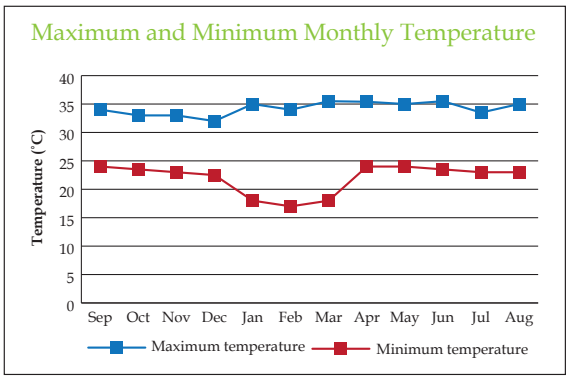
Figure 6: Kota Kinabalu City Rainfall and Temperature Data



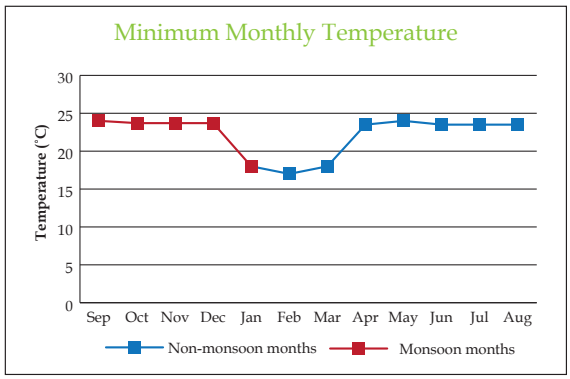
The average rainfall in the Kota Kinabalu City for the monsoon and non-monsoon period is 256 mm and 181 mm, respectively.



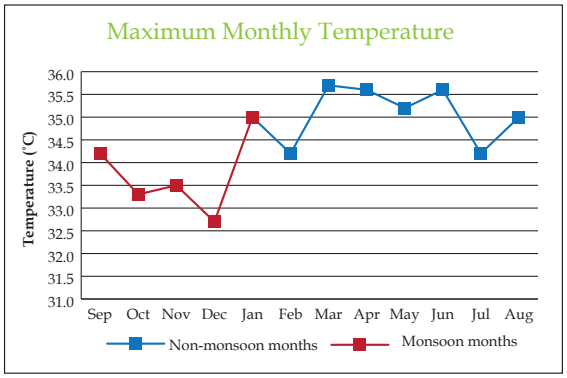
The average number of rainy days in monsoon and non-monsoon period is 13 and 10 days, respectively.



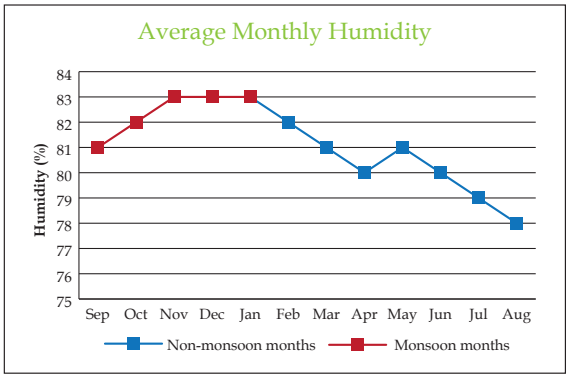
The average minimum and maximum monthly temperature in Kota Kinabalu City is 22.24°C and 34.5°C, respectively.



The average minimum temperature for monsoon and non-monsoon period in Kota Kinabalu City is 22.42°C and 22.11°C, respectively.



The average maximum temperature for monsoon and non-monsoon period in Kota Kinabalu is 33.7°C and 35.07°C, respectively.



The average annual humidity in Kota Kinabalu City is 81%. The average humidity for monsoon and non-monsoon period in Kota Kinabalu City is 82.4% and 80.14%.

Source: ICLEI South Asia analysis, 2018.

CHAPTER 4

Policies and Plans Relevant to Kota Kinabalu

4.1 National Policies and Plans

This section outlines key legislation and policies at federal, state, and local levels that contribute to and impact the development of Kota Kinabalu City.

4.1.1 National Policy on Climate Change

The National Policy on Climate Change 2009 aimed to advance climate change action through efficient management of resources, enhanced environmental conservation, and mainstreaming climate change responses into national policies, plans, and programs. The policy also aims to strengthen institutional and implementation capacity to address climate change and provides a framework for multi-stakeholder collaborative action to address the challenges of climate change.

4.1.2 National Policy on the Environment

The National Policy on the Environment 2002 focuses on ensuring environmentally sound, sustainable development, which would ultimately result in improving the quality of life. It recognizes that sustainable development is key to ensuring economic, social, and cultural development. It promotes the development of conservation areas through appropriate land use planning, sustainable management of natural resources including water and forests, and sustainable energy production and conservation, as measures that would ensure effective management and conservation of natural resources, which is one of the strategic focus areas of the policy. These measures have a strong bearing on reducing the carbon footprint of development in Malaysia.

4.1.3 National Green Technology Policy

In 2009, the National Green Technology Policy was released with an overarching goal to stimulate national economy by using green technology. The policy defines green technology as the development and application of products, equipment, and systems used to conserve the natural environment and resources, which minimize and reduce the negative impacts of human activities. The policy recommends achieving national objectives by using innovative and proven green technologies across sectors. The policy encourages the use of renewable energy and energy efficiency technologies as well as other green technologies, the implementation of which would result in zero or low GHG emissions.

4.1.4 National Renewable Energy Policy and Action Plan

The National Renewable Energy Policy and Action Plan was introduced in 2009 with an objective to increase the share of renewable energy in the national power mix by promoting renewable energy technologies and systems across the country. The plan focuses on a convergence of energy, industrial, and environmental policies to bolster

clean energy technology deployment. It is expected to bring about effective reductions in GHG emissions and environmental pollution.

4.1.5 Renewable Energy Act 2011

The primary objective of the Renewable Energy Act 2011 is to encourage the renewable energy industry by providing appropriate economic incentives, with an aim to garner climate change mitigation benefits. The feed-in tariff system was designed to incentivize renewable energy producers with an aim to ensure long-term contracts, thereby increasing the financial viability of renewable energy investments. The Renewable Energy Act is expected to drive the renewable energy industry through the deployment of innovative market-based instruments.

4.1.6 Malaysia Vision 2020 or "Wawasan 2020"

Malaysia had launched its vision, the "Malaysia Dream 2020," also called the "Wawasan 2020. The vision calls for transforming Malaysia into a developed country by 2020. It envisages holistic development of the country in all aspects including economic, political, and social. The current government has extended the time line for achieving "Wawasan 2020" to 2025. It is believed that with a right set of conducive policies and their implementations, the vision could be realized by 2025.

4.1.7 The Eleventh Malaysia Plan 2016–2020

The Eleventh Malaysia Plan (11Mp) 2016–2020 is Malaysia's 5-year development plan toward realizing the goal of Vision 2025. The 11th Plan is based on the national Development Strategy of Malaysia (MynDS) which centers around the advancement of a citizen-centric and capital-based economy, to be achieved with the execution of development program and projects. The 11MP has six important pillars:

(i) strengthening inclusivity,

(ii) increasing people's prosperity,

(iii) enhancing human capital development,

(iv) sustainability and resilience development through green growth,

(v) strengthening infrastructure to support economic growth, and

(vi) engineered economic growth for increasing prosperity.

4.1.8 Malaysian Urban Indicator Network

The Federal Town and Country Planning Department of the Government of Malaysia created the Malaysian urban indicator network for urban territories in 2002. The network establishes a new set of indicators covering 11 areas to evaluate progress toward urban sustainability. These 11 areas include land use, population, households, economic and socioeconomic development, infrastructure, transport, environmental management, local government, affordable housing, and housing provision. This assessment framework was the first of its kind in Malaysia, where indicators are linked to benchmarks.

4.1.9 Green Building Index

Malaysia's Green Building Index (GBI) is a green building rating tool that intends to promote sustainability in the buildings sector, while sensitizing industry stakeholders to adopt environment-friendly strategies and technologies. The overall objective of the GBI is to reduce electricity demand of buildings while adopting clean,

green, and efficient technologies and at the same time preserving national resources. Malaysia's GBI focuses on six elements—energy efficiency, indoor environmental quality, sustainable site planning and management, materials and resources, water efficiency, and innovation.

4.2 State and Local Government Plans

There are several urban sector development policies and plans promulgated by the state of Sabah and the city of Kota Kinabalu. These are summarized in Table 4.

Table 4: Sector Plans and Strategies for Sustainable Development

Policy, Strategy, or Regulation	Target Sectors	Description
Kota Kinabalu Structure Plan 2030 (KKSP 2030)	Urban design, land use, roads and transport, infrastructure and utilities, tourism	KKSP 2030 establishes the vision and broad strategies of the Kota Kinabalu City Hall (KKCH) for the development of Kota Kinabalu City until 2030. KKSP 2030 lays out the future land use and zoning regulation. It provides a comprehensive framework to guide development of Kota Kinabalu with an aim to achieve stated economic, social, and environmental development priorities. KKSP also lists out potential policies with regard to the land use, investment opportunities, and other issues related to physical development, which would ensure equitable and sustainable development of the city.
Kota Kinabalu Local Plan 2020 (KKLP 2020)	Urban design, land use, roads and transport, infrastructure and utilities, tourism, heritage, open space and recreation	The Local Plan was prepared in accordance with the requirements set forth in the Town and Country Planning Ordinance. It provides details on the population and demographic profile of the city and information on urban design, land use, roads and transport, infrastructure and utilities, tourism, heritage, and open space.
Kota Kinabalu Public Transport Master Plan 2014–2020 (KKPTMP 2014–2020)	Sustainable public transport	The KKPTMP includes action plans to improve and enhance its public transport system in two phases, i.e., short-term planning from 2014 to 2017 and long-term planning for beyond 2017. The Master Plan is aimed at upgrading and enhancing the city's public transport system to ensure a systematic, efficient, and sustainable transport system.
Sabah LEAP—Long-Term Strategic Action Plan (2016–2035)	Natural resources, tourism, sustainable economy	The Sabah LEAP focuses on the long-term development of the state. The vision of LEAP is that by 2035, the citizens of Sabah will live in harmony with nature; preserve it for future eras, while also improving the quality of life by developing a sustainable economy. The overall objective is to promote new and sustainable green technologies and advance sustainable development with due consideration given to efficient use of national resources and environment conservation.
Sabah Development Corridor (SDC) Blueprint, 2008–2025	Economy, natural resources, environment	The SDC was formulated in 2008, in joint collaboration, by the Government of Malaysia and Government of Sabah. The overall objective of the SDC is to propel the region into becoming an international tourist destination and create new job opportunities. It also focuses on creating more liveable spaces by using new and transformative technologies.
Sabah Forestry Policy (2005)	Forest	The Sabah Forestry Policy was released in 2005 to provide guidelines and a framework for sustainable management of forest resources. The policy strengthens mechanisms to manage permanent forest reserves while also enhancing resource utilization and create employment opportunities.
Sabah Shoreline Management Plan (2007)	Natural resources and coastal protection	The SMP was formulated in 2007 by the Government of Sabah, during the 8th Malaysia Plan period. It forms a basis for the management of the shoreline in the State of Sabah. The SMP provides a comprehensive baseline assessment of local priorities and available resources. The plan focuses on natural conservations strategies for coastline protection, while also ensuring that sustainable local economic development is promoted.
Kota Kinabalu City Competitiveness Master Plan (CCMP)	Skilled and knowledge-based employment, livability	3

Source: Kota Kinabalu City Hall (2018).

CHAPTER 5

Kota Kinabalu City Urban Sector Profile

The sustainability and quality of life in any urban center are closely linked to the adequacy and quality of basic infrastructure facilities that support it. This chapter provides information on the existing status of services and physical infrastructure in Kota Kinabalu City. The service sectors covered include land use and development, water supply, sewerage and stormwater drainage, transport, solid waste, street lighting, energy, and buildings.

5.1 Land Use and Development

Land use and development planning in Kota Kinabalu are governed by two planning documents namely, Kota Kinabalu Structure Plan 2030 and the Kota Kinabalu Local Plan 2020. These were prepared in accordance with the requirements of the Town and Country Planning Ordinance of the Government of Sabah. Both documents guide the development control and land use zoning within the administrative jurisdiction of KKCH. The Kota Kinabalu Structure Plan 2030 provides a macro long-term strategic land use plan, centered on development strategies and policies for Kota Kinabalu City up to the year 2030. The land use profile of Kota Kinabalu City 2010 is given in Table 5.

Table 5: Kota Kinabalu—Facts and Figures on Land Use

Item	Unit (km^2)
Total land area	366
Total KKCH operational area	145.44
Residential area	54.71
Commercial area	13.28
Industrial area	14.88
Government and community facility	19.36
Landscape and open space	19.51
Infrastructure and utilities	1.7
Transport	16.83
Hotel and resort	1.62
Water bodies	3.55

KKCH = Kota Kinabalu City Hall, km^2 = square kilometer.
Source: Draft Kota Kinabalu Local Plan 2020.

Other relevant statutory planning documents relevant to KKCH include the Sabah Structure Plan 2033 and the Sabah Development Corridor Blueprint for development up to 2025 (Sabah Development Corridor Blueprint 2008–2025). Kota Kinabalu City extends across several townships, without any clear buffer to distinguish one township from the next. Kota Kinabalu expanded to Likas, Inanam, One Borneo, Mengattal, Telipok, and Tamparuli—creating one long stretch of sporadic development of housing, industrial, and commercial development.[9] Traditional community dwellings are taken over by new development. Urban and suburban

[9] DBKK. 2018. Kota Kinabalu City Competitiveness Master Plan.

Box 1: Challenges in Land Use and Development Planning

i) Aligning planning strategies, vision, funding, regulation, and planning approvals.
ii) Duplication of administrative processes among different departments.
iii) Land use policies do not address climate change impacts explicitly.
iv) Absence of coastal zoning regulation that addresses climate change impacts.
v) Project approvals do not strongly and explicitly consider environment, equity, and social inclusion.
vi) Funding constraints and limited expertise to carry out open and green space conservation programs.

Source: ICLEI South Asia's findings during meetings with the Kota Kinabalu City Hall and other stakeholders.

development should ideally be governed by zoning and land-use regulation; this is critical to protect social interests and ensure availability of adequate open spaces for community use and conservation of natural resources.

Given climate change projections, Kota Kinabalu can expect a rise in mean temperature and more frequent events of high precipitation, which are likely to disrupt economic activity and infrastructure. From a long-term perspective, toward the end of this century, it is predicted that sea-level rise would significantly increase the risk of flooding and consequent infrastructure damage. This would impact all inhabitants of the city. Therefore it is critical for the government to integrate considerations of climate change impacts in conventional development approaches and revisit development priorities and strategies, especially for the central business district adjoining the shoreline. The challenges related to the land use and development sector are given in Box 1.

Climate-related risks have not been considered and integrated into urban planning, as is evident from the various sectoral plans of the city. It is imperative that the green city interventions proposed in KK GCAP be well-integrated into urban, sectoral, and flood protection plans, in order to ensure sustainable development. Further, implementation of these plans should be well coordinated across concerned departments and with the State of Sabah.

5.2 Water Supply

The Sabah State Water Department (Jabatan Air negeri Sabah—JAnS) is responsible for ensuring provision of safe and clean drinking water to Kota Kinabalu City. The primary sources of water in Kota Kinabalu City are Babagon Dam and Moyog River. Raw water is made potable, to meet the standards of safe drinking water, by a process that includes pre-chlorination, primary treatment, and filtration. The city has four water treatment plants: Kasigui (50 million liters per day [mld]), Moyog (160 mld), Telibong 1 (55 mld) and Telibong 2 (80 mld), which ensure potable water supply. A brief profile of the water supply sector (2016) is given in Table 6.[10]

The water supply distribution system is divided into 35 zones on the basis of topography and reservoir location. Approximately 30 reservoirs, each with 8 mld capacity, have been developed by JAnS to cater to the city. These water tanks, with a total capacity of approximately 240 mld, are considered adequate to serve the current domestic demand and cater to existing commercial, institutional, and industrial demand as well. As per the latest records of Sabah Water Department, there are 62 water pumping stations in the city of Kota Kinabalu (2018). The location of gravity feed system in Sungai Inanam/Likas catchment is shown in Map 3.

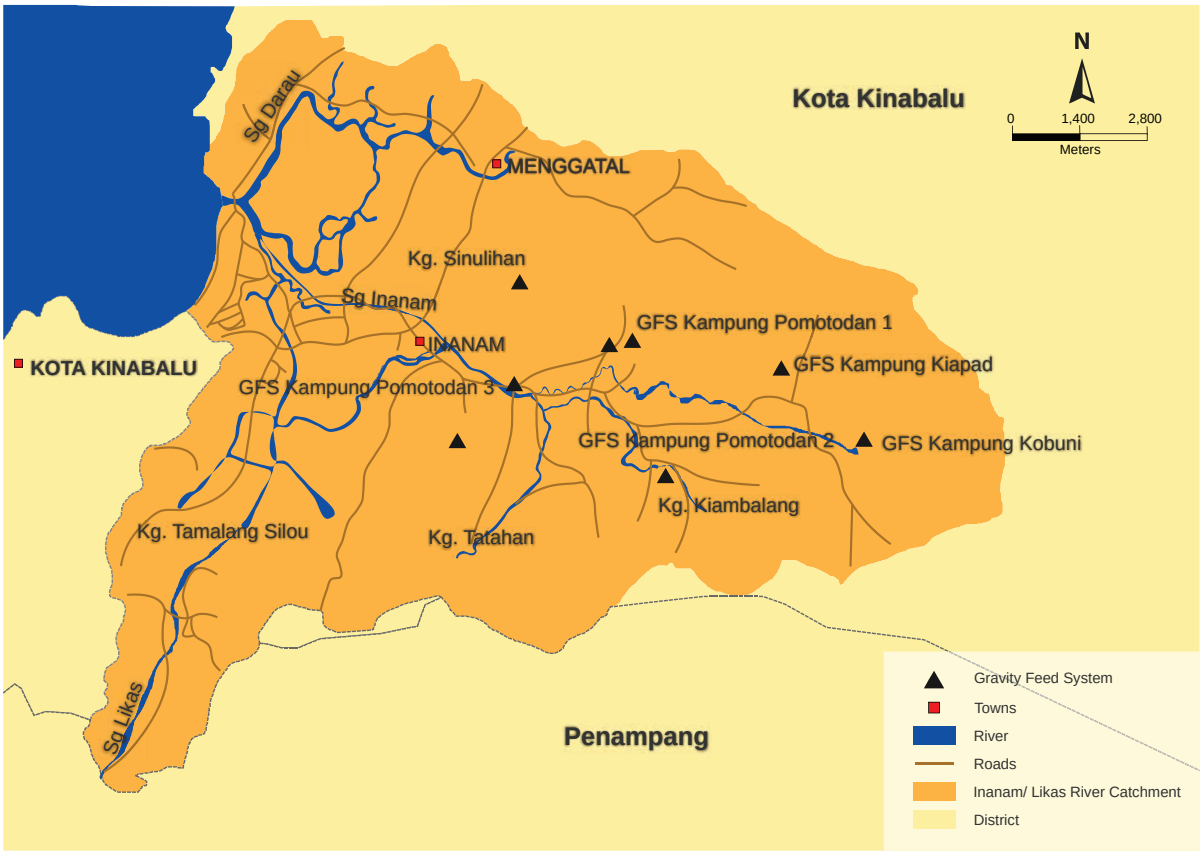
[10] All data in this subsection are from 2016, unless otherwise indicated.

Table 6: Kota Kinabalu—Facts and Figures on Water Supply

Item	Unit
Daily supply	336.90 MLD
Water supply coverage	95%
Number of water connections	92,631
Water supply zones	35
Total length of network	1,500 km approximately
Annual electricity consumption in water pumping stations	5 million kWh
Water demand	470 MLD (2017)
Nonrevenue water	29% (2017)

km = kilometer, kWh = kilowatt-hour, mld = million liters per day.
Note: All data are from 2016, unless otherwise indicated.
Source: Sabah Water Department. Statistical Yearbook 2016.

Map 3: Location of Gravity Feed Systems in Sungai Inanam Likas Catchment



It is estimated that by the year 2022, current raw water sources will be insufficient to cater to the ever increasing demand, primarily driven by population rise, urbanization, and economic growth; therefore, it is important for the government to undertake long-term sustainable water management interventions.[11] Further, Kota Kinabalu has a risk of damage from urban flooding, to its water infrastructure such as water intake facilities, pumping stations, water treatment plants, main lines to storage tanks, storage tanks, and distribution networks. The challenges related to the water supply sector are given in Box 2.

Box 2: Kota Kinabalu—Challenges in the Water Supply Sector

- Northern part of the city faces water scarcity.
- Certain parts of Kota Kinabalu City still experience low water pressure.
- Only 84% of Kota Kinabalu consumers are paying for their water supply, either because of dysfunctional meters or because meters are not provided.
- Leakage of main and distribution pipes.
- Illegal connections or water theft.
- Tap water does not meet the standards of direct drinkable water in some of the areas.

Source: ICLEI South Asia's findings during meetings with the Kota Kinabalu City Hall and other stakeholders.

It is estimated that the water supply system will become dysfunctional if flood waters reach 2 meters above mean sea level, causing deleterious social and health impacts and resulting in revenue losses to utilities.

The rising water demand as a result of population growth, coupled with climate-related risks to water infrastructure, warrant serious consideration. It is apparent that both climate and nonclimate factors are important and need to be considered in future efforts to secure safe water supply.

5.3 Sewerage and Stormwater Drainage

The Kota Kinabalu sewerage system is managed by KKCH Sewerage Department, Public Works Department (Jabatan Kerja Raya or JKR), and private developers. The KKCH has a memorandum of understanding with JKR, wherein JKR develops regional sewage treatment plants (STPs), while KKCH operates and maintains the small STPs. The city has 137 STPs, mainly using technologies like activated sludge process, sequential batch reactors, and extended aeration activated sludge process. Kota Kinabalu district is divided into three zones by JKR for sewerage management purposes: northern, central, and southern catchment zones. The Penampang Regional STP caters to Kota Kinabalu southern catchment, treating up to 34 mld. The Inanam lagoons cater to Kota Kinabalu central catchment, treating up to 27 MLD, while the northern catchment is served by smaller STPs. Key facts and figures on wastewater management in the city are given in Table 7.

The sewage treatment infrastructure in the Kota Kinabalu district has a nominal capacity of approximately 555,000 population equivalent (2013). Some of the STPs in Kota Kinabalu district are either partially functional or are not functioning and abandoned. As a result, urban drains act as secondary sewers, carrying sewage and septic tank overflows, while also conveying stormwater during wet weather. Owing to funding constraints, the provision of regional, centralized sewerage infrastructure has lagged behind, and as such there has been a proliferation of small STPs servicing individual developments, mostly built by the private sector. There are 61 small STPs in operation but not handed over to KKCH. These are located in apartment and/or condominium

[11] *Daily Express*. 2015. Meeting Sabah's Water Needs. 21 March. http://www.dailyexpress.com.my/news.cfm?newsID=98182.

blocks and are maintained by their respective building management agencies. These systems have a total capacity of 170,000 population equivalent and contribute to 31% of the district's sewage treatment capacity. These are less efficient than centralized, regional systems. A large network of smaller plants is more difficult to monitor compared with fewer centralized systems. Details of the existing sewage treatment systems in Kota Kinabalu City are given in Table 8.

Table 7: Kota Kinabalu—Facts and Figures on Sewerage Management

Item	Unit
Total sewage generation	125 MLD
Sewerage network coverage	60%
Number of STPs	137
Collection efficiency of sewerage network	90%
Electricity consumption for sewage conveyance and treatment	2.44 million kWh

kWh = kilowatt-hour, mld = million liters per day, STP = sewage treatment plant.

Sources: ICLEI South Asia's findings during meetings with the officials of Public Works Department and Kota Kinabalu City Hall.

Table 8: Sewage Treatment System of Kota Kinabalu City (mld)

Type	Design Capacity	Current Treated Volume
STP	101	111
Central septic tanks	2.73	2.73
Individual septic tanks	1.33	1.29
Pour flush—open defecation/ unconnected	8.52	8.53
Total	**114**	**124**

mld = million liters per day, STP = sewage treatment plant.

Source: Sewerage Department, Kota Kinabalu City Hall.

Other factors contributing to the low performance of the sewerage infrastructure are septic tanks and pour flush latrines which together account for 10% of the sewerage infrastructure capacity. Septic tanks and pour flush latrines discharge poor quality effluent, and in practice, septic tanks are rarely de-sludged, unless until completely blocked.

Water quality in the catchment area is also affected by nonsewered areas across Kota Kinabalu City. In the absence of appropriate treatment facilities, untreated sewage from these areas is discharged directly to the storm drainage system or to nearby water bodies (Map 4).

In nonsewered areas such as Pulau Gaya and Telipok, decentralized wastewater treatment systems can be established to ensure adequate treatment and prevent contamination of water bodies. These decentralized systems can be implemented in all peri-urban areas which are not connected to STPs. The city can adopt economic and regulatory instruments to minimize the discharge of untreated sewage into water bodies. These steps will help reduce water pollution and will improve the deteriorating water quality in water bodies.

JKR has established projects to increase the capacity of sewage treatment infrastructure. The capacity of the Penampang Regional Sewage Treatment Plant is being enhanced to 34 mld, with an ultimate aim of reaching 67 MLD capacity. The Inanam lagoons will be replaced with mechanized and efficient STPs with a final capacity

Map 4: Nonsewered Areas across Kota Kinabalu City

Source: ICLEI South Asia analysis.

of 79 mld. Locations or areas where sewage management infrastructure is vulnerable to climate change impacts are identified in Map 5.

Kota Kinabalu is home to the Moyog, Inanam, and Darau rivers. The Moyog river, to the south of Kota Kinabalu Central Business District (CBD), drains into the South China Sea, just south of KKIA. The Inanam and Darau rivers, to the north of Kota Kinabalu CBD and Likas Bay, also drain into the South China Sea.

The drainage network in Kota Kinabalu City comprises small road-side drains within housing estates and the main drains that collect runoff from these housing estates. These either drain directly to the South China Sea, as in the case of the main drains along Jalan Penampang and at the Likas Sports Complex, or drain into the abovementioned rivers. The Department of Irrigation and Drainage (DID) is in the process of finalizing the Kota Kinabalu Drainage Master Plan, which includes solutions to various drainage issues in the city, mentioned in Box 3. In terms of regulations, DID Penampang is in charge of managing drainage and irrigation in both Kota Kinabalu and Penampang districts.

The risk of rise in high intensity rainfall events, compounded by risks posed by nonclimate factors (such as land subsidence, poor drainage, and deforestation in upper watersheds), increases the likelihood of urban flooding. The city needs to adopt an integrated water management approach, considering the prevailing conditions and addressing infrastructure requirement. The main challenges in the sewerage and stormwater drainage sector are given in Box 3. Rating zones and/or locations where the sewage and stormwater drainage system is vulnerable to climate change impacts, are indicated on Maps 5 and 6.

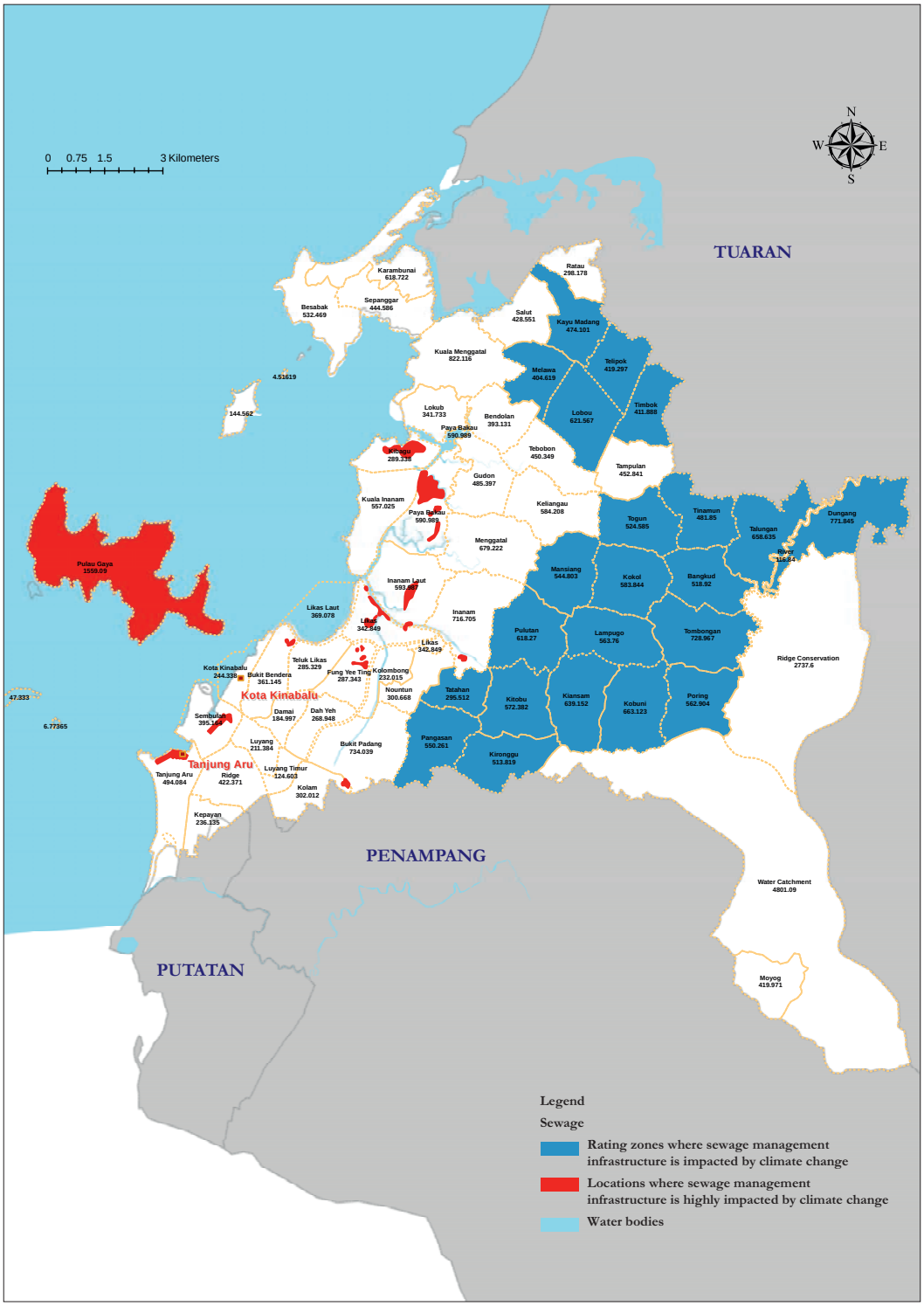
Box 3: Challenges in the Sewage and Stormwater Drainage Sector

- Urban areas in Kota Kinabalu experience localized flooding. This occurs during high intensity storm events at the sub-catchment level, often coinciding with high sea water levels due to tides and/or storm surges.
- Some of Kota Kinabalu areas are flat and in low-lying coastal locations; with flat gradients and ground levels approximately 1–2 meters above high tide levels. Backwater from tides can heavily influence drainage conditions in these areas.
- Secondary drains in these areas are unable to discharge into main drains because of the high-water levels in major drains/river systems.
- Local drainage conveyance systems are undersized.
- Undersized culverts or hydraulic structures at roadside crossings cause localized flooding.
- Overgrown drains which are poorly maintained, lead to reduced hydraulic efficiency and design capacity.
- Drain blockage due to siltation, vegetation, or debris accumulation.
- Upstream and/or infill development have increased flows to a level exceeding the drainage system capacity.

Source: ICLEI South Asia's findings during meetings with the Kota Kinabalu City Hall and other stakeholders.

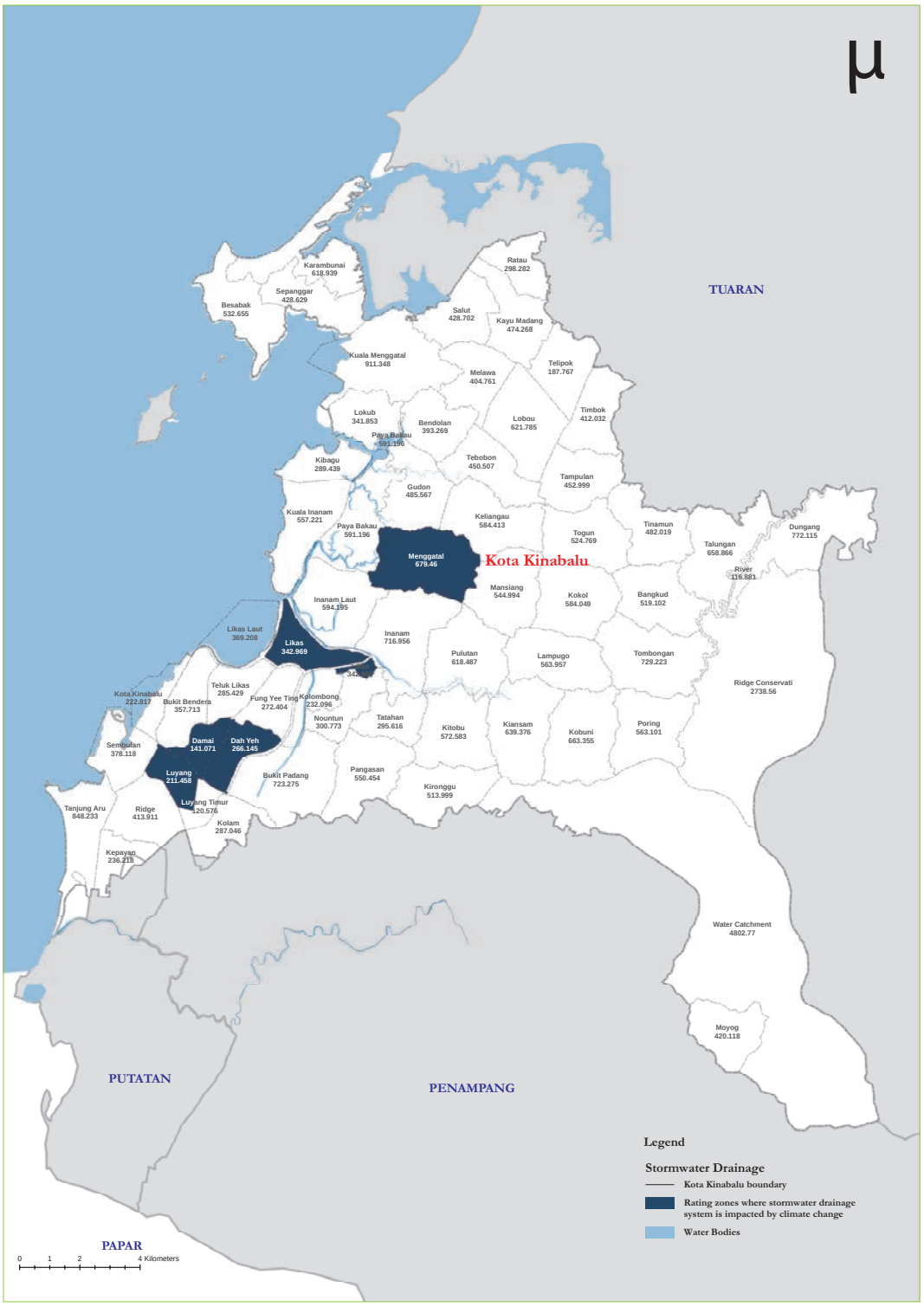
KK GCAP Focused group discussion, 2018. Discussion between consultants and engineers of Kota Kinabalu City Hall on Solid Waste Management and Sewerage of Kota Kinabalu city.

Map 5: Nonsewered Areas across Kota Kinabalu City



Source: ICLEI South Asia analysis.

Map 6: Stormwater Drainage—Vulnerable Areas



Source: ICLEI South Asia analysis.

5.4 Transport

Kota Kinabalu City is well connected to state highways which enable easy access to neighboring cities and states. Vehicle movement within the city is mainly through arterial and link roads. The KKCH has adopted a four-level road hierarchy comprising arterial, sub-arterial, local distributor, and local access roads. JKR and KKCH are involved in the process of repairing, widening, and constructing new roads. Key facts and figures of the transport sector are given in Table 9.

Table 9: Transport Facts and Figures

Item	Details	
Road length	Total road length in the city: 700 km 400 km (KKCH-owned roads, housing roads, and roads in CBD area) 300 km (JKR-owned)	
Modal share	Public transport	8%
	Motorcycle	7%
	Four-wheeler	75%
	Cycling	5%
	Walking	5%

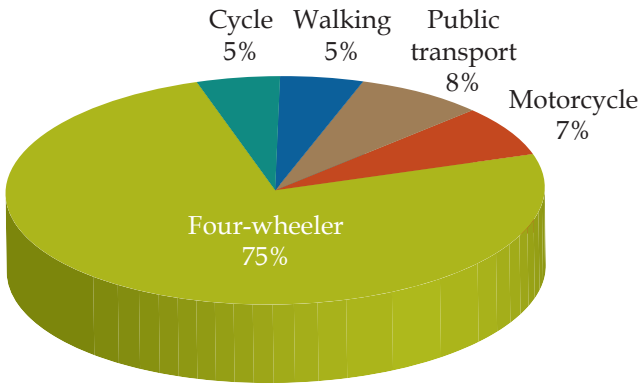
CBD = central and business district, JKR = Jabatan Kerja Raya (Public Works Department), KKCH = Kota Kinabalu City Hall, km = kilometer.

Sources: Road Transport Department and Kota Kinabalu City Hall.

Interior roads connecting different parts of the city are maintained by the JKR. One of the major roads in the city is the Lintas-Tuaran Bypass Road, which serves as a ring road, circling the city and connecting the districts and suburbs surrounding the city. Areas such as Putatan, Penampang, Luyang, Likas, Inanam, Menggatal, Sepanggar, and Tuaran are connected to Kota Kinabalu CBD area via this road.

The public bus system in Kota Kinabalu is inefficient and ineffective and accounts for only 8% of the total mode share in the city (Figure 7). Privately operated minibuses or vans are used as an alternate mode of public transport. There are two principal public bus transport terminals in the downtown area. The terminal along Tun

Figure 7: Transport Mode Share in Kota Kinabalu City (%)



Source: Kota Kinabalu City Hall (2018).

Razak Road serves buses plying various parts of the city and its periphery, while the terminal close to Bandaran Berjaya serves intercity buses that ply toward the south of the city (to areas such as Papar, Tenom, Beaufort and further). The third transport terminal, the north Kota Kinabalu Bus Terminal in Inanam area, services commuters going toward north and northeast of the city.

The Sabah Development Corridor Blueprint 2008–2025 advocates the development of an integrated public transport system. In order to achieve that target, it is imperative to encourage modal shifts from private to public transport use through improvement in public transport infrastructure, policy changes, and fiscal incentives. The main challenges in achieving this objective are issues around accessibility, reliability, physical condition, convenience, comfort, and safety of the existing public bus system. All such issues can be resolved through regularization and improvement of the bus service. It is very important to come up with a robust self-sustaining business model for the benefit of the community, while also ensuring profitability of service providers. Overall, there is a strong need to prioritize public transport and traffic management.

The Kota Kinabalu Public Transport Master Plan 2014–2020 has been prepared with an objective to provide a conceptual master plan for public transport for the greater Kota Kinabalu area. However, it is because of funding constraints and other administrative challenges, that the recommendations of the master plan have not been implemented thus far. Challenges faced by the city in the transport sector are given in Box 4.

Box 4: Challenges in the Transport Sector

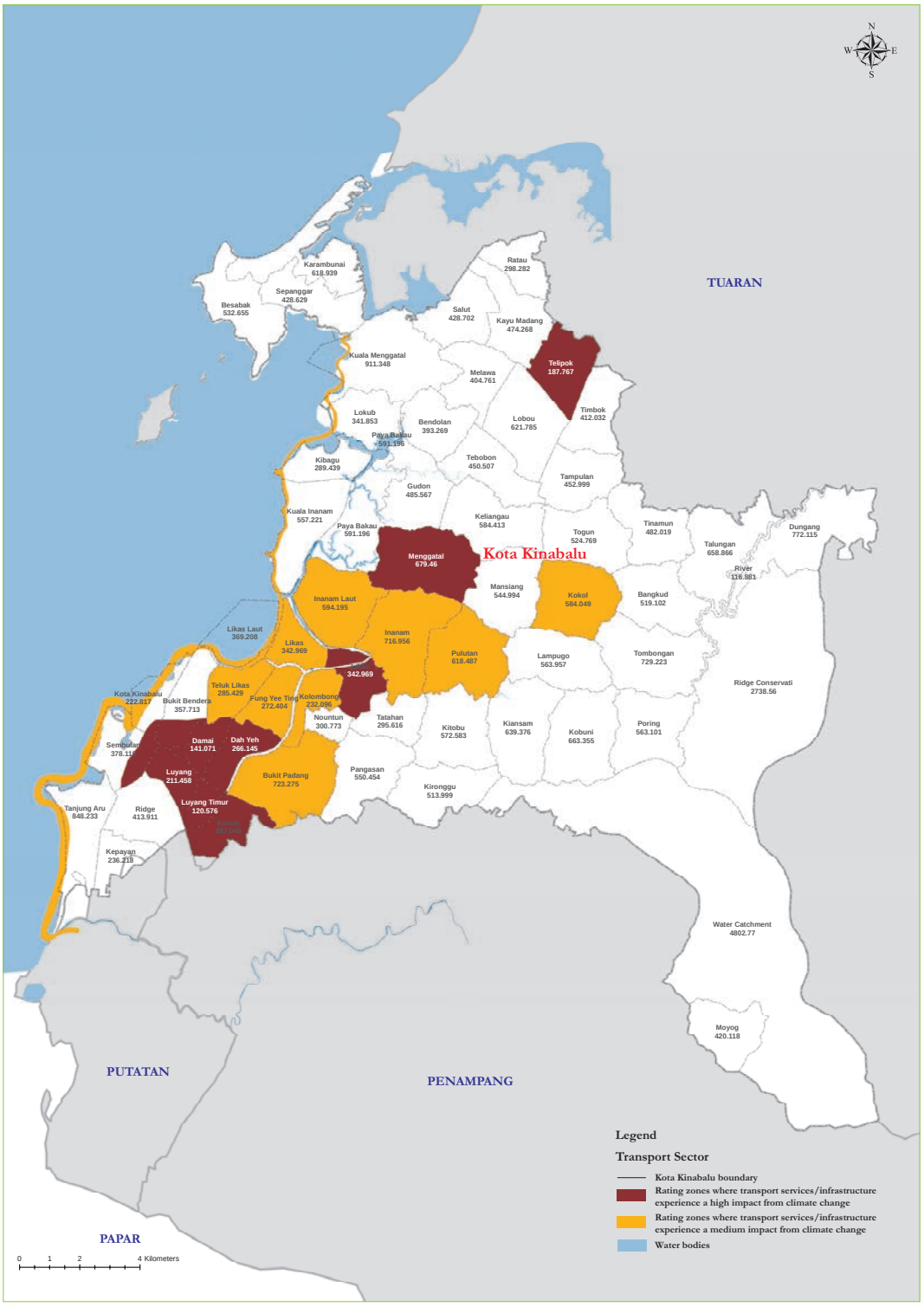
i) Limited use of public transport.
ii) Private vehicle usage is high.
iii) Bus permit issue: several private operators ply the same route.
iv) Inconsistent public service: frequency, duration, route, and punctuality are not defined.
v) Parking space is limited and in high demand in the city.
vi) Road widths, particularly of arterial roads, are too narrow, with limited scope for future expansion.
vii) Majority of intersections are at grade leading to severe conflicts between intertown and commuter traffic.
viii) Pedestrian access to public transport on arterial roads is made impossible because of poor subdivision planning in the past; man-made barriers such as floodways and continuous rows of housing act as barriers.

Source: ICLEI South Asia's findings during meetings with the Kota Kinabalu City Hall and other stakeholders.

Kota Kinabalu City traffic comprises a blend of passenger, moderate, and quick-moving vehicles. On account of insufficient width of carriageway and low conveying limit of streets, development of vehicles is hampered, causing incessant clog at a portion of the zones particularly in the CBD.

Kota Kinabalu is a developing ecotourism destination. The success of Kota Kinabalu as a tourist destination will depend on the ease of mobility within the city. A robust public transport system, well integrated with intermediate public transport modes, is thus imperative. This will also result in promoting sustainable transport and in lowering GHG emissions from the transport sector, which currently accounts for approximately 50% of total GHG emissions. An enhanced public transport system will also improve air quality and has multiple other economic and social benefits. For ensuring sustainable transport in Kota Kinabalu City, the public bus system needs to be immediately improved, by regulating bus routes, operators, types of buses, and ensuring efficient and timely service. Rating zones where transport services and related infrastructure are vulnerable to climate change impacts are shown in Map 7.

Map 7: Transport—Vulnerable Areas



Source: ICLEI South Asia analysis.

5.5 Municipal Solid Waste Management

Municipal solid waste mainly consists of residential and commercial waste generated within the jurisdiction of Kota Kinabalu and does not include industrial hazardous and biomedical wastes. KKCH is responsible for collection, transport, processing, and disposal of municipal solid waste generated within its jurisdiction. KKCH is also responsible for estimation and analysis of waste, waste minimization, public awareness and enforcement and resource management. Residential waste is collected at the doorstep and commercial waste from community bins and containers. There are 58 compactors, 12 open trucks, and 2 shovel vehicles engaged in transporting solid waste in Kota Kinabalu City. In addition to this, KKCH also has three water jet tank vehicles to clean the bins and bin centers. There are 252 community bins built by KKCH in Kota Kinabalu City. The key facts and figures of the solid waste management sector are given in Table 10.

Table 10: Solid Waste Management—Facts and Figures

Item	Unit
Total waste generation	300 TPD (2018)
Collection service coverage	100%
Extent of segregation	0%
Efficiency in collection of solid waste management charges	100%

TPD = ton per day.
Source: Kota Kinabalu City Hall.

Presently, Kota Kinabalu City generates approximately 300 tons of municipal solid waste daily which is estimated to be around 440 grams per capita per day. KKCH has six solid waste collection zones—Zone 1: Pusat CBD, Zone 2: Kawasan Tanjung Aru and Kepayan, Zone 3: Kawasan Luyang, Zone 4: Kawasan Likas, Zone 5: Kawasan Kolombong Inanam, Zone 6: Kawasan Menggatal and Telipok. Municipal solid waste is broadly characterized as dry waste and wet waste. The handling, storage, and treatment of scheduled and clinical waste is the responsibility of generators and approved operators, as specified in the 1989 environmental quality regulation.

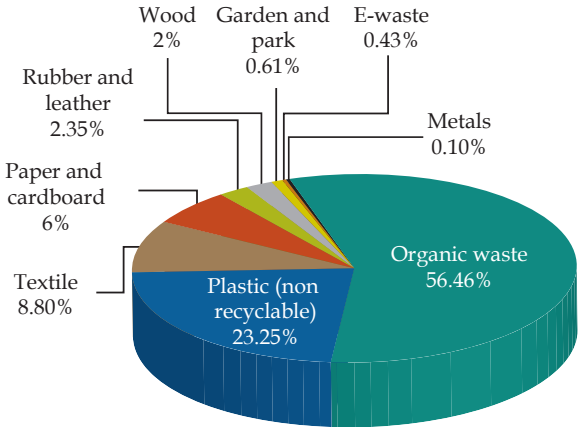
KKCH has recently, on a pilot basis, characterized the physical composition of waste generated from three pockets of Kota Kinabalu City including Taman Green View, Taman Jindo, and Alam Damai. The average waste composition from the three sites indicates that biodegradable waste accounts for 56.46% of all waste generated in the city. Nonrecyclable plastics account for 23.5% and other material such as textile, paper and cardboard, rubber, leather, wood, garden waste, etc. account for 20.29% of the municipal solid waste. The percentage share of different types of waste generated in the city, based on this pilot study are given in Table 11 and Figure 8, respectively.

Table 11: Municipal Solid Waste Composition

Type	Percentage (%)
Organic waste	56.46
Plastic (nonrecyclable)	23.25
Textile	8.80
Paper and cardboard	6.00
Rubber and leather	2.35
Wood	2.00
Garden and park waste	0.61
E-waste	0.43
Metals	0.10

Source: Kota Kinabalu City Hall.

Figure 8: Municipal Solid Waste Composition



Source: Kota Kinabalu City Hall (2018).

However, a city-wide assessment of the quantity and physical/chemical characteristics of municipal solid waste should be conducted, in order to inform the selection of centralized waste processing/treatment facilities. The challenges in the municipal solid waste management sector are given in Box 5.

KKCH along with civil society groups and nongovernment organizations has implemented a few initiatives to address the solid waste management issues in the city of Kota Kinabalu. Some of these important initiatives include "Bring Your Own Bag Days" campaign by Environmental Action Committee; food waste segregation at the Kota Kinabalu Central Market; Program Khidmat Masyarakat and Gotong Royong; food and garden waste compost-making by Environmental Action Committee; Tzu Chi recycling points and collection centers; and Sabah Computer Society E-waste drives.

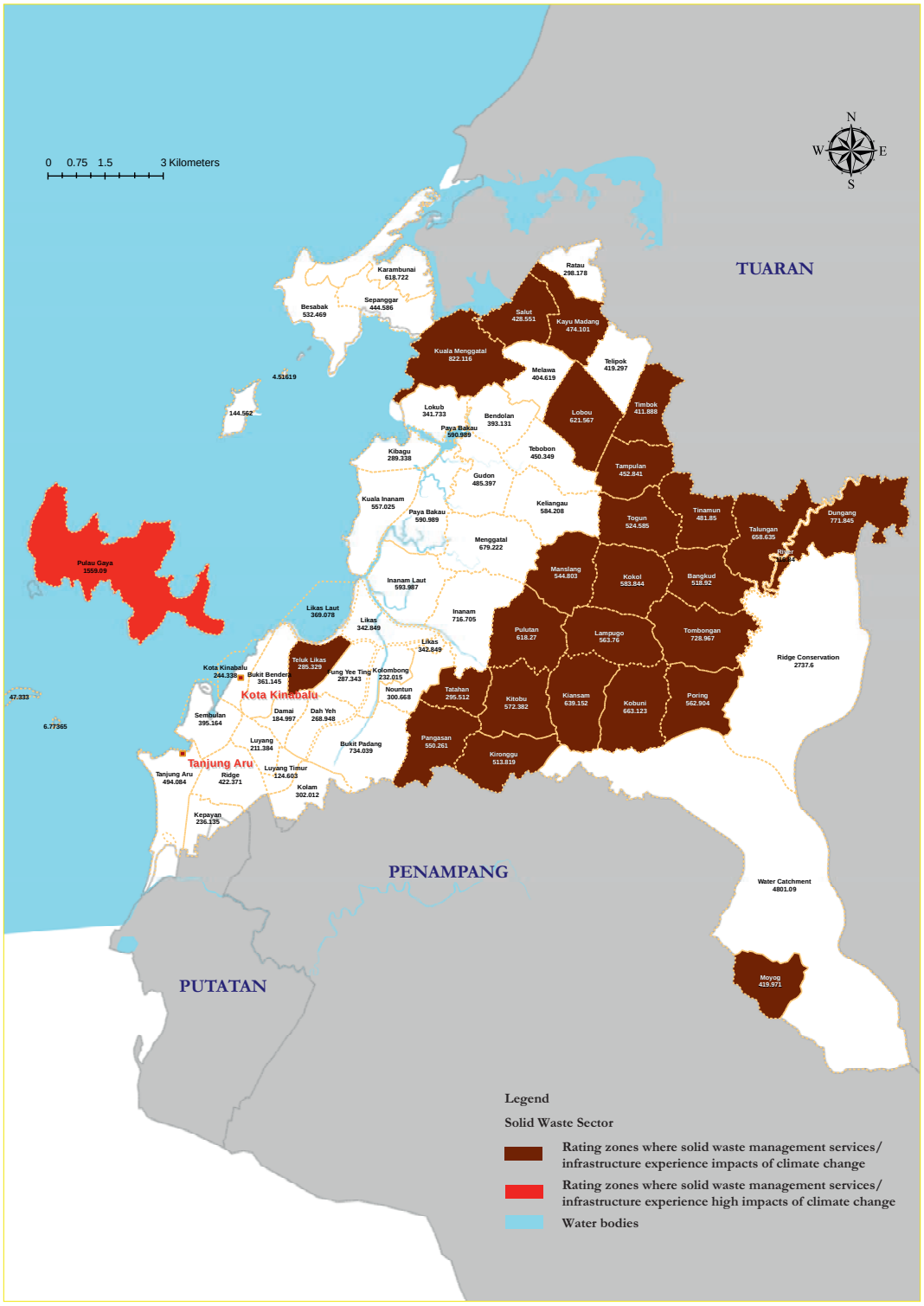
However, KKCH has still to undertake several coordinated and comprehensive interventions to improve the solid waste management system in the city. It is important to involve citizens and civil-society-based organizations in waste management activities, in order to realize the objective of providing efficient solid waste management services. It is also important to regulate and manage municipal solid waste generated by micro and small-scale commercial entities, operating within residential colonies. Rating zones where municipal solid waste are vulnerable to climate change impacts are shown in Map 8.

Box 5: Challenges in the Municipal Solid Waste Management Sector

i) Segregation of waste is not currently practiced; this requires special attention.
ii) The city does not have operational municipal solid waste processing and treatment facilities.
iii) There is no mechanism for processing construction and demolition waste. Construction and demolition waste is directly dumped at the Kayu Madang dump site.
iv) Absence of scientific processing and disposal of e-waste.
v) Practice of disposing municipal solid waste in stormwater drains is observed.
vi) Lack of awareness on importance and need for efficient and scientific solid waste management systems.

Source: ICLEI South Asia's findings during meetings with the Kota Kinabalu City Hall and other stakeholders.

Map 8: Solid Waste Management—Vulnerable Areas



Source: ICLEI South Asia analysis.

5.6 Energy

Energy consumption in Kota Kinabalu was assessed in the process of preparing the KK GCAP. It was estimated that the transport sector is the largest consumer of energy; accounting for 65% of all energy consumed in the city in 2017/18. The second highest consumer is the commercial and institutional buildings/facilities sector, with a share of 18% of the total energy consumption followed by residential buildings (13%) and manufacturing industries and construction sector (4%). Energy consumption and resultant GHG emissions in the year 2017/18 are given in Table 12. The challenges in the energy sector are given in Box 6.

Table 12: Energy Facts and Figures

Sector	Energy Use (GJ) (2017/18)
Residential buildings	2,299,352
Commercial and institutional buildings/facilities	4,781,776
Manufacturing industry and construction (i.e., industrial sector)	1,105,843
On-road transport	17,408,832
Total	**25,595,804**

GJ = gigajoule.
Source: Engineering Department, Kota Kinabalu City Hall (2018).

Box 6: Challenges in the Energy Sector

i) Intermittent power supply.
ii) Energy audits of government-owned buildings and commercial buildings are not mandated and/or undertaken; there is no information on the potential for energy savings.
iii) Use of conventional electrical, non-efficient appliances contribute to larger power loads.
iv) No instance of scaled-up deployment of renewable energy and/or energy efficiency measures.

Source: ICLEI South Asia's findings during meetings with the Kota Kinabalu City Hall and other stakeholders.

5.7 Street Lighting

Kota Kinabalu has three entities that are responsible for the operation and management of street lighting within the jurisdiction of Kota Kinabalu district: the KKCH, JKR, and SESB. As of September 2018, Kota Kinabalu has a total of 27,649 public streetlights. It has been estimated that the responsible entities incur an annual operational expense of RM3.4 million toward power consumption and another RM3 million for annual maintenance of the street lighting system. The energy use details and GHG emissions profile of street lighting sector are given in Table 13. The challenges of street lighting sector are given in Box 7.

Table 13: Kota Kinabalu—Power Consumption in Public Street Lighting

Existing Luminaire	Quantity	Annual Electricity Consumption (kWh)	Annual Electricity Cost (RM)
70 W HPS	571	175,069	35,539
100 W HPS	1,850	810,300	164,491
125 W HPS	5,475	2,997,563	608,505
150 W HPS	1,904	1,250,928	253,938
250 W HPS	9,884	10,822,980	2,197,065
400 W HPS	128	224,256	45,524
1000 W HPS	48	210,240	42,677
60 W LED	246	64,649	13,124
80 W LED	85	29,784	6,046
125 W LED	133	72,818	14,782
165 W LED	76	54,925	11,150
Total		**16,713,512**	**3,392,841**

HPS = high-pressure sodium lamps, kWh = kilowatt-hour, LED = light emitting diode, RM = Malaysian ringgit, W = watt.
Source: Engineering Department, Kota Kinabalu City Hall (2018).

Box 7: Challenges in the Street Lighting Sector

i) The inventory of street lighting assets is not up-to-date.
ii) High maintenance and operational costs of street lighting infrastructure.
iii) Existing conventional street lighting infrastructure is associated with relatively high energy consumption; there is a significant potential to shift to energy-efficient street lighting technologies.

Source: ICLEI South Asia's findings during meetings with the Kota Kinabalu City Hall and other stakeholders.

5.8 Buildings

The Kota Kinabalu Structure Plan 2030 specifies zoning regulations for the city. As per the latest estimates available with KKCH, there are 68,257 residential; 20,632 commercial; and 3,276 industrial properties in Kota Kinabalu City (Table 14). It is estimated that the Kota Kinabalu City requires at least 100,000 new dwellings before 2030, out of which 40,000 dwellings are required to meet the demand due to population increase alone, 30,000 dwellings are required to replace squatter and transition housing, and 300,000 to replace the aging housing stock.[12]

In August 2017, KKCH mandated that all new building plans should consider and incorporate energy-efficient overall transfer thermal value (OTTV) and roof insulation codes. The goal of an OTTV assessment is to minimize the energy consumption by reducing the solar heat influx through the building envelope, thus improving the energy efficiency of the building.

[12] Kota Kinabalu City Hall. 2010. *Kota Kinabalu Structure Plan 2030.*

Table 14: Number of Properties in Kota Kinabalu City, 2018

Divisions	Number of Properties		
	Commercial	Industrial	Residential
Urban	9,384	165	14,846
Suburban	6,169	1,732	16,235
New rating area	5,079	1,379	37,176
Total	**20,632**	**3,276**	**68,257**

Source: Property Department, Kota Kinabalu City Hall (KKCH).

Kota Kinabalu attracts a large number of migrants from neighboring countries, mainly from the Philippines and Indonesia. Sections of the immigrant community are economically challenged and usually without any form of social security; they are forced to live in slums, having only substandard living conditions. The dwellers of such migrant squatter communities have limited access to water supply, schools, primary health care, and other social infrastructure.

In the medium to long term, climate change is expected to increase energy demand for cooling, also increasing water demand. Heavy, more frequent precipitation events are expected and will increase the risk and severity of urban flooding and landslides. This is likely to disrupt economic activity and infrastructure. In the longer term, sea-level rise also threatens the city and the costs of coastal protection are expected to increase over time. The challenges in the buildings sector are given in Box 8.

Box 8: Challenges in the Building Sector

i) Insufficient basic housing stock.
ii) Inadequate socioeconomic and demographic data, especially of migrants, hinder planning efforts; and housing affordability statistics required to guide planning are not available.
iii) Land parcels are generally odd-shaped, making it hard to plan and design subdivisions and infrastructure.
iv) Large areas of squatter housing are located on prime coastal land, located within 5 kilometers of the Kota Kinabalu commercial and business district.
v) There are no mandated guidelines on building and/or facade design, siting, or infrastructure requirements relative to size of development and landscaping.
vi) Regulation of migrant squatter communities is a challenge, as is evident from the large number and spread of squatter housing; as well as regulation of unapproved structures and unauthorized extensions of residential housing, including commercial activities in the Kota Kinabalu commercial and business district.
vii) Since the planning department has limited human resources with adequate technical know-how, adequate engagement with building or development owners in order to ensure sustainable design, is not possible.

Source: ICLEI South Asia's findings during meetings with the Kota Kinabalu City Hall and other stakeholders.

5.9 Greenhouse Gas Emissions Inventory

The GHG emissions inventory of Kota Kinabalu for 2013 to 2017 was prepared in order to provide required information on energy use and on the carbon footprint of city actions. This information was also used to assess the mitigation potential of proposed KK GCAP interventions. The GHG emissions inventory includes emissions resulting from community and government activities within the KKCH's administrative jurisdiction. This includes emissions from sources and/or activities from stationary units (residential buildings, commercial and institutional building/facilities, manufacturing industries, and construction), mobile transport units, and municipal solid waste.

5.9.1 Harmonized Emission Analysis Tool *plus*

In an effort to develop a comprehensive energy use and GHG emissions inventory, an emissions accounting software package developed by ICLEI was used. The Harmonized Emission Analysis Tool *plus* (HEAT+) tool incorporates the latest technical findings of the Intergovernmental Panel on Climate Change (IPCC) 2006 and is based on the new international reporting requirements and standards outlined in the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories (GPC).

5.9.2 Data Sources and Collection

Financial year 2017/18 is considered the baseline year. Based on data sources and scope of the inventory, the GPC classifies community-scale inventories such as BASIC and BASIC+. A BASIC-level GHG emissions inventory covers scope 1 and scope 2 emissions from stationary energy and transport sources, as well as scope 1 and scope 3 emissions from waste. A BASIC+ inventory additionally includes emissions from industrial processes and product use; agriculture, forestry, and land use; and transboundary transport. A BASIC inventory, as per the GPC methodology, was prepared for Kota Kinabalu covering the stationary, mobile, and municipal solid waste sectors for a period of 6 years (2013/14 to 2017/18).

With support from the ADB consultant team, KKCH staff sourced the relevant energy consumption and activity data from municipal, local, and subnational stakeholders through data questionnaires and meetings. Supply and demand-side data were collected and analyzed. Supply-side refers to the classification of both primary and secondary energy types that are distributed to the demand-side for use; these include liquid and solid fuels, electricity, and renewables. Demand-side energy refers to the energy end user, i.e., the sectors like residential buildings, commercial and institutional building/facilities, manufacturing industries, and construction activities, within an urban jurisdiction. Various energy sources and other relevant data considered in the report are elaborated in Table 15.

5.9.3 Summary of Community-Wide Energy Use and GHG Emissions

The overall energy consumption trend across all sectors is shown in Figure 9. In 2017/18, 25.59 million gigajoules (GJ) of energy was consumed in Kota Kinabalu. The overall energy use in the city decreased at 1.8% CAGR from 2013/14 to 2017/18. The commercial and institutional buildings/facilities, manufacturing industries and construction and residential buildings sectors witnessed an increase in energy use at 3.8%, 3.2%, and 2.6% CAGR, respectively. The transport sector witnessed a negative CAGR of around 4% from 2013/14 to 2017/18. The sector-wise energy use data and trend are shown in Table 16.

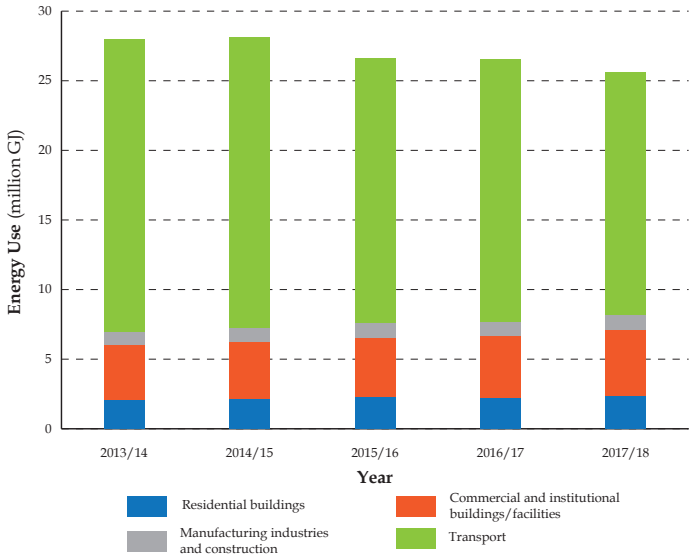
Total GHG emissions from all community-wide activities, including government operations, in Kota Kinabalu in 2017/18 amount to 2.51 million tons of carbon dioxide equivalent (tCO_2e); the sector-wise contribution is shown in Table 17. Taking this into consideration, the average per capita GHG emission for the year 2017/18

Table 15: Greenhouse Gas Emissions Inventory—Data Sources

Fuel Type	Sector	Source of Data
Electricity	Residential buildings	Sabah Electricity Sdn Bhd
	Commercial and institutional buildings/facilities	Sabah Electricity Sdn Bhd
	Manufacturing industry and construction	Sabah Electricity Sdn Bhd
	Municipal buildings	Kota Kinabalu City Hall (KKCH)
	Water treatment plants and pumping stations	Water Department, Government of Sabah
	Drainage pumping stations and sewage treatment plants	Department of Irrigation and Drainage (DID), Government of Sabah
	Street lights	KKCH
	Solid waste management—waste transfer stations	KKCH
Diesel	Community transport	Oil marketing companies (Petronas, Petron, and Shell)
	Municipal vehicles	KKCH
Petrol	Community transport	Oil marketing companies (Petronas, Petron, and Shell)
	Municipal vehicles	KKCH
LPG	Residential buildings	Oil marketing companies (Petronas, Petron, and Shell)
	Commercial and institutional buildings/facilities	Oil marketing companies (Petronas, Petron, and Shell)
Kerosene	Residential buildings	Ministry of Trade and Industry, Government of Sabah

Source: ICLEI South Asia findings.

Figure 9: Sectoral Trends in Energy Use (GJ)



GJ = gigajoule.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

Table 16: Sector-Wise Annual Energy Use (GJ)

Sector	Energy Use (GJ)				
	2013/14	2014/15	2015/16	2016/17	2017/18
Residential buildings	2,022,572	2,092,670	2,275,486	2,214,735	2,299,352
Commercial and institutional buildings/facilities	3,960,864	4,102,024	4,205,498	4,394,909	4,781,776
Manufacturing industries and construction	945,677	1,069,549	1,089,766	1,069,884	1,105,843
Transport	21,066,614	20,848,481	19,070,097	18,864,742	17,408,832
Total	**27,995,726**	**28,112,725**	**26,640,847**	**26,544,270**	**25,595,804**

GJ = gigajoule.
Source: ICLEI South Asia findings.

Table 17: Sector-Wise Annual Greenhouse Gas Emissions

Sector	GHG Emissions (tCO_2e)				
	2013/14	2014/15	2015/16	2016/17	2017/18
Residential buildings	301,450	311,716	339,462	329,729	342,732
Commercial and institutional buildings/facilities	581,860	602,999	620,661	641,266	680,345
Manufacturing industries and construction	123,316	139,927	140,637	139,825	145,426
Transport	1,520,570	1,502,611	1,369,274	1,352,931	1,247,827
Waste	77,646	81,920	87,263	89,044	92,605
Total	**2,604,841**	**2,639,174**	**2,557,296**	**2,552,794**	**2,508,936**

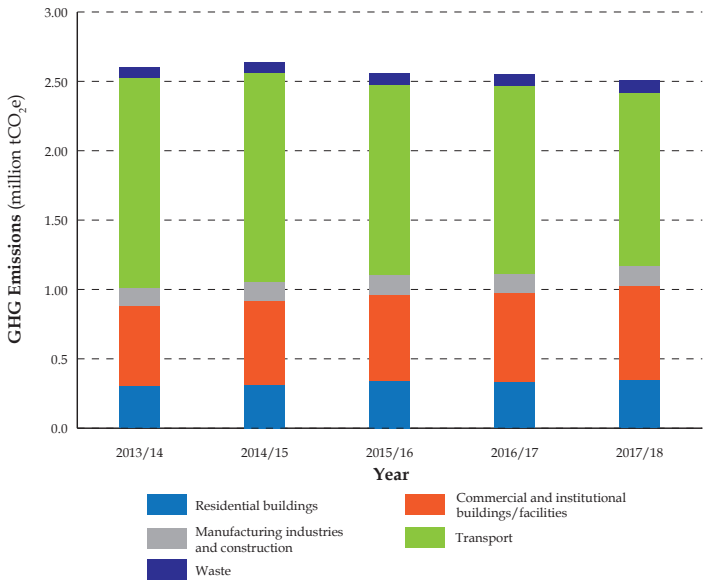
GHG = greenhouse gast, CO_2e = ton of carbon dioxide equivalent.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

for Kota Kinabalu City was 4.20 tons of CO_2e, which is lower than Malaysia's per capita GHG emission of 8.53 tCO_2e for 2016.[13]

The sector-wise trend of GHG emissions for Kota Kinabalu City is shown in Figure 10. GHG emissions decreased at 0.7% CAGR from 2013/14 to 2017/18. GHG emissions from the waste sector witnessed the highest growth at 3.59% CAGR, followed by emissions from the manufacturing industries and construction sector (3.35%), commercial and institutional buildings/facilities (3.18%), and residential buildings (2.60%); GHG emissions from the transport sector decreased at 4% CAGR from 2013/14 to 2017/18.

[13] Knoema. 2016. World Data Atlas, Malaysia, Environment. https://knoema.com/atlas/Malaysia/CO2-emissions-per-capita (accessed 4 December 2018).

Figure 10: Sector-Wise Trend of Greenhouse Gas Emissions



GHG = greenhouse gas, tCO_2e = ton of carbon dioxide equivalent.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

5.9.4 Supply-Side Energy and Emissions

Supply-side refers to the classification of both primary and secondary energy types that are distributed to the demand-side sectors for use; these include liquid, solid and gaseous fuels, and electricity. Table 18 provides an overview of the energy types used in Kota Kinabalu and the resultant GHG emissions for 2017/18.

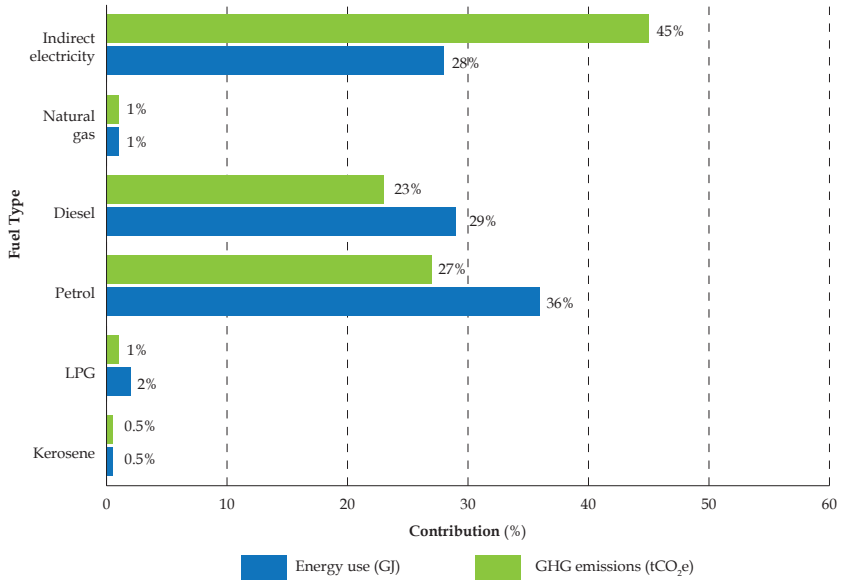
Petrol is the predominant energy type and makes up 36% of the energy mix, being used prominently in all sectors in Kota Kinabalu City (Figure 11). Petrol is followed by diesel, electricity, LPG, natural gas, and kerosene. It is

Table 18: Energy Mix and Greenhouse Gas Emissions in Kota Kinabalu, 2017/2018

Fuel/Energy Source	Energy Use by Source Category (GJ)		GHG Emissions by Source Category (tCO_2e)	
	Stationary Units	Mobile Units	Stationary Units	Mobile Units
Petrol	–	9,614,884	–	668,513
Diesel	–	7,793,947	–	579,315
Natural gas	284,233	–	16,017	–
LPG	523,275	–	33,098	–
Kerosene	1,207	–	88	–
Indirect electricity	7,378,256	–	1,119,300	–

– = not applicable, GJ = gigajoule, LPG = liquefied petroleum gas, tCO_2e = ton of carbon dioxide equivalent.
Source: analysis ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

Figure 11: Energy Use and Greenhouse Gas Emissions by Energy Source, 2017/2018 (%)



GJ = gigajoule, GHG = greenhouse gas, LPG = liquefied petroleum gas, tCO_2e = ton of carbon dioxide equivalent.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

interesting to note that although electricity accounts for 28% of the energy mix it contributes to 45% of the GHG emissions in Kota Kinabalu, largely due to the GHG intensive coal-based power generation system.

5.9.5 Demand-Side Energy and Emissions

Demand-side energy refers to the energy use by end users i.e., sector-like residential buildings, commercial and institutional buildings/facilities, manufacturing industry, and construction and transport within an urban area. Transport is the largest consumer of energy in Kota Kinabalu, accounting for 68% of the total energy use in the city. This is followed by energy use in commercial and institutional buildings/facilities (19%), residential buildings (9%), and manufacturing industry and construction sector (4%). Energy use in 2017/18, disaggregated by end-use, is shown in Table 19.

In 2017/18, major contributors to GHG emissions are the sectors of transport, and commercial and institutional buildings/facilities, followed by residential buildings, manufacturing and construction, and waste sector. Transport energy use contributed to nearly half of the total GHG emissions while commercial and institutional buildings/facilities accounted for 27% of emissions. Transport sector is the major contributor of GHG emissions due to high dependence on private vehicles and absence of an effective and efficient public transport system.

Subsequent sections provide further details on energy use and GHG emissions across key sectors from 2013/14 up to 2017/18.

Table 19: Energy Use by Sector in Kota Kinabalu, 2017/2018

Sector	Energy Use (GJ)
Stationary Units	**8,186,972**
Residential buildings	2,299,352
Commercial and institutional buildings/facilities	4,781,776
Manufacturing industries and construction	1,105,843
Mobile Units	**17,408,832**
Transport	17,408,832
Total	**25,595,804**

GJ = gigajoule.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

5.9.6 Energy Indirect Emissions from Grid Electricity

The pattern of electricity use within the city has undergone significant changes in the last few years; the consumption grew by over 263 million kilowatt-hours (kWh) (14.72%) from 2013/14 to 2017/18 (1,787 million kWh in 2013/14 to 2,050 million kWh in 2017–18). This has been fueled by the growing demand in the commercial and institutional buildings/facilities sector due to rising population and commercial growth (Table 20). The electricity demand in the residential buildings and manufacturing industries and construction sectors demand is seen to be increasing in the considered time period, except in the years 2016/17 and 2015/16, respectively. The trend of electricity consumption in each sector is shown in Table 20 and Figure 12.

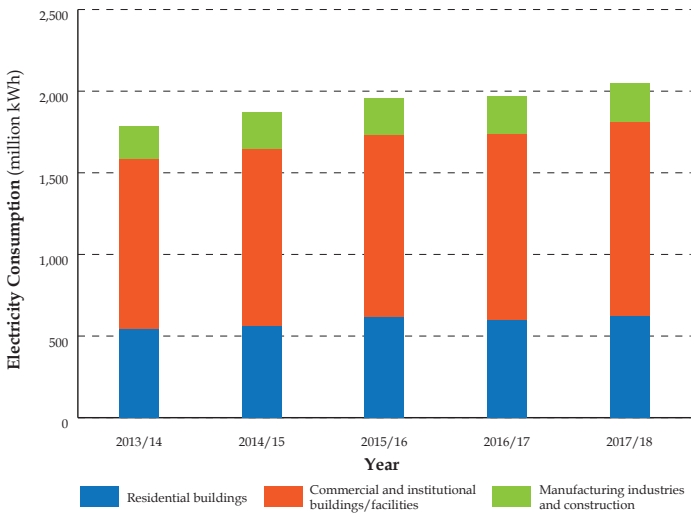
In 2017/18, the commercial and institutional buildings/facilities sector was the largest end user of electricity, accounting for approximately 58% of the total electricity consumption. This was followed by residential buildings and manufacturing industries and construction sectors, which consumed 30% and 12% of total electricity, respectively (Figure 13).

Table 20: Sectoral Trends in Electricity Use

Sector	Annual Electricity Use (million kWh)					CAGR (%)
	2013/14	2014/15	2015/16	2016/17	2017/18	
Residential buildings	545	563	614	596	620	2.61
Commercial and institutional buildings/facilities	1,041	1,080	1,115	1142	1,188	2.68
Manufacturing industries and construction	201	232	231	232	242	3.78
Total	**1,787**	**1,875**	**1,960**	**1,970**	**2,050**	**2.78**

CAGR = compound annual growth rate, kWh = kilowatt-hour.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

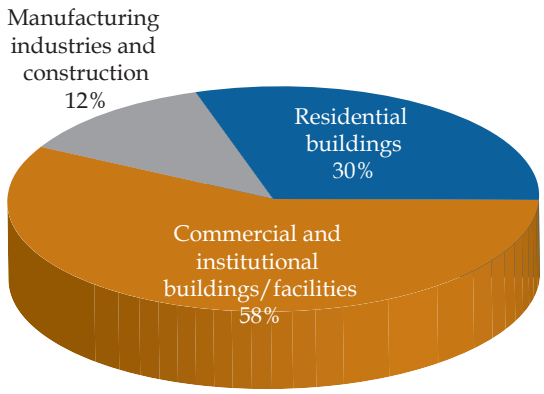
Figure 12: Trends in Electricity Use by Sector



kWh = kilowatt-hour.

Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

Figure 13: Electricity Use by Sector, 2017–2018 *(%)*



Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

Total GHG emissions from electricity use have witnessed an increase of 2.76% CAGR from 2013/14 (0.98 million tCO_2e) to 2017/18 (1.12 million tCO_2e) in Kota Kinabalu (Table 21). Since the GHG emission is derived by multiplying the applicable emissions factor with the electricity consumption values, the sector shares of GHG emissions from electricity use are the same as the shares of consumption. In 2017/18, the commercial and institutional buildings/facilities sector is the largest contributor, emitting 648,648 tCO_2e (58%). It is followed by residential buildings and manufacturing industries and construction sectors that emit 338,520 tCO_2e (30%) and 132,132 tCO_2e (12%), respectively.

Table 21: Sectoral Greenhouse Gas Emissions from Electricity Use

Sector	GHG Emissions (tCO_2e)					Share 2017/18 (%)
	2013/14	2014/15	2015/16	2016/17	2017/18	
Residential buildings	297,570	307,398	335,244	325,416	338,520	30
Commercial and institutional buildings/facilities	568,386	589,680	608,790	623,532	648,648	58
Manufacturing industries and construction	110,838	126,672	126,126	126,672	132,132	12
Total	**976,794**	**1,023,750**	**1,070,160**	**1,075,620**	**1,119,300**	**100**

tCO_2e = ton of carbon dioxide equivalent.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

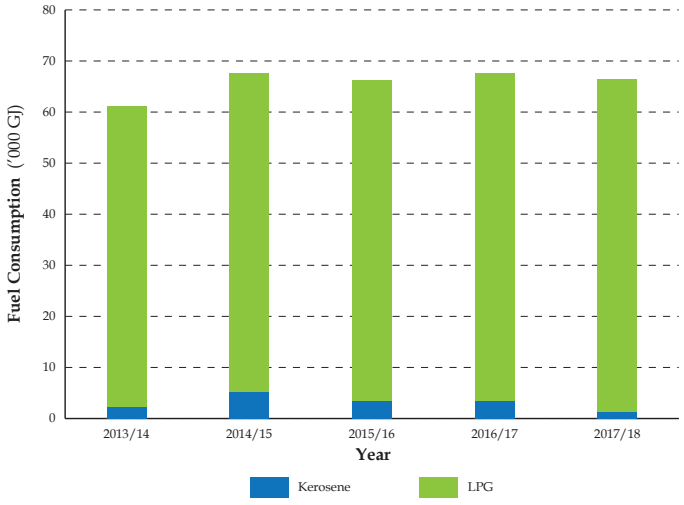
5.9.7 Direct Emissions from Stationary Combustion

Stationary combustion refers to fuel used for all purposes other than transport (e.g., LPG and kerosene used for residential and commercial purposes, natural gas used for commercial and industrial purposes). Direct GHG emissions are driven by the volume and type of fuels used for stationary combustion across sectors such as residential, commercial and institutional buildings/facilities, and manufacturing industries and construction sector. Direct emissions are estimated by multiplying the fuel consumption by the specific GHG emission factor of the respective fuel.

Stationary Fuel Use in Residential Buildings Sector and Resultant GHG Emissions

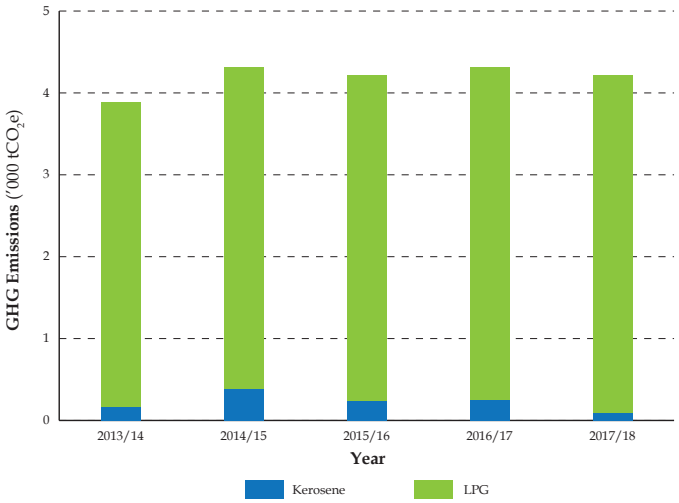
LPG and kerosene are fuels used to meet cooking requirements in the residential buildings sector. In Kota Kinabalu, LPG is retailed by all of the oil marketing companies. Kota Kinabalu does not have piped natural gas supply as of now. LPG accounts for 98% (65,212 GJ) of the total stationary fuel use in the sector. The share of kerosene consumption stands at 2% (1,207 GJ) in the year 2017/18 (Figure 14).

Figure 14: Trend of Fuel Consumption in Residential Building Sector



GJ = gigajoule, LPG = liquefied petroleum gas.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

Figure 15: Trends in Greenhouse Gas Emissions from Stationary Fuel



LPG = liquefied petroleum gas, tCO_2e = ton of carbon dioxide equivalent.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

In the last 5 years, there has been an increase in GHG emissions from residential stationary fuel use in Kota Kinabalu, rising from 3,880 tCO_2e in 2013/14 to 4,212 tCO_2e in 2017/18 (Figure 15).

Stationary Fuel Use in Commercial and Institutional Buildings and/or Facilities Sector and Resultant GHG Emissions

Primary fuels used by commercial end users in Kota Kinabalu such as hotels, shops, malls, educational institutes, private office buildings, etc., are LPG and natural gas. LPG is used mainly to meet energy requirements for cooking purposes while natural gas is combusted primarily for water heating and space cooling. Petronas, Petron, and Shell are companies that supply LPG to the commercial and institutional buildings/facilities sector in Kota Kinabalu City, through a network of dealers.

From 2013/14 to 2017/18, consumption of stationary fuel in this sector witnessed a growth of 18.78%. During this period, use of natural gas and LPG consumption increased by 34.42% and 17.65% CAGR, respectively. LPG is the dominant fuel in this sector, with a share of 90% of total energy use, as compared with natural gas's share of 10%, in 2017/18 (Figure 16).

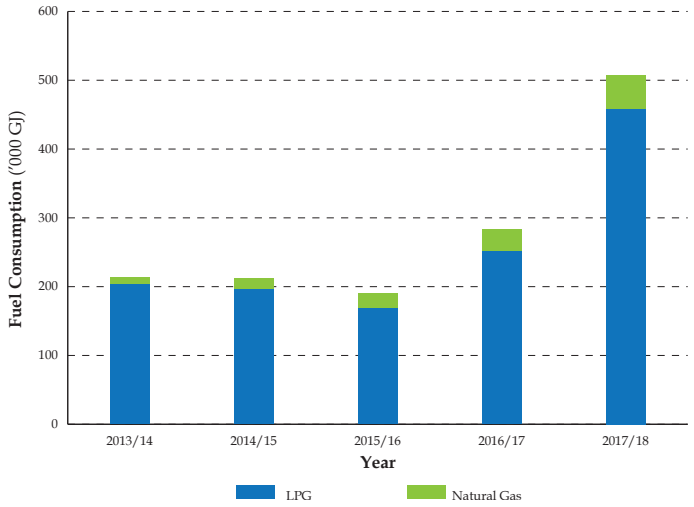
In the last 5 years, there has been a significant increase in the overall emissions from stationary fuel use in the commercial and institutional buildings/facilities sector, with emissions increasing from 13,474 tCO_2e in 2013/14 to 31,697 tCO_2e in 2017/18. This trend is demonstrated in Figure 17.

LPG use accounts for 91% of the total GHG emissions, while natural gas use accounts for 9% of the total emissions from stationary fuels use in this sector.

Stationary Fuel Use in Manufacturing Industries and the Construction Sector and Resultant GHG Emissions

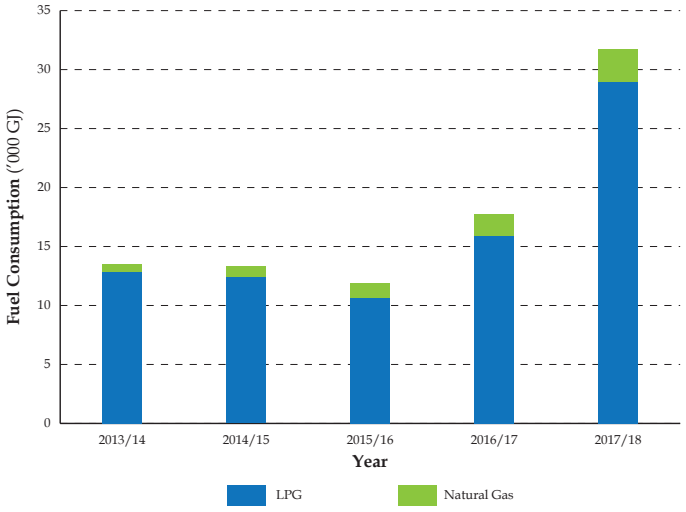
Kota Kinabalu is particularly rich in oil, natural gas, timber, and palm oil, which is the driving force behind the resource-based industries. Various solid, liquid, and gaseous fuels are used in industries. However, there is no

Figure 16: Trends in Fuel Consumption in Commercial and Institutional Buildings or Facilities Sector



GJ = gigajoule, LPG = liquefied petroleum gas.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

Figure 17: Trends in Greenhouse Gas Emissions from Stationary Fuel Use in the Commercial and Institutional Buildings or Facilities Sector

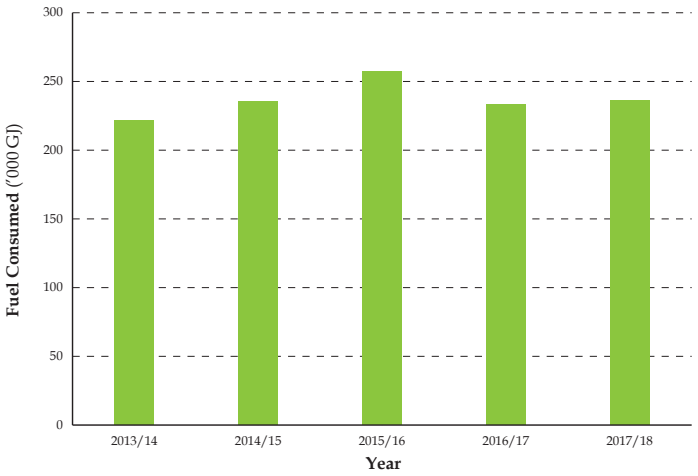


GJ = gigajoule, LPG = liquefied petroleum gas.
Source: ICLE I South Asia analysis based on information from Kota Kinabalu City Hall.

centralized record of fuel consumption, except for natural gas. Natural gas is used in the industrial sector as a fuel for process heating, in heating and power systems, and as a raw material to produce chemicals and fertilizer. Natural gas consumption has grown at 1.27% CAGR from 2013/14 to 2017/18 (Figure 18).

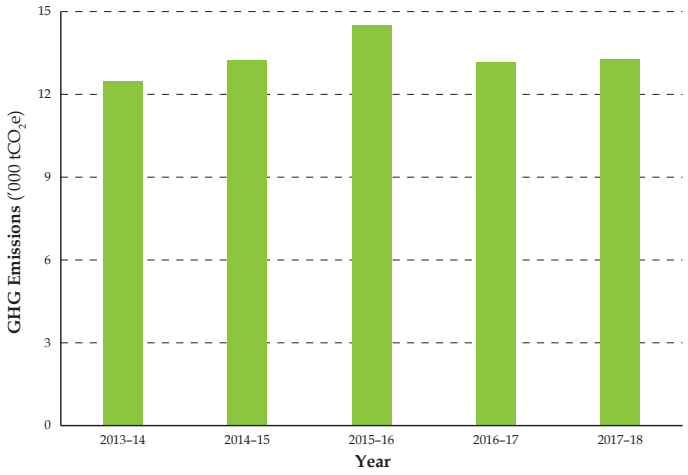
In the last 5 years, there has been a marginal increase in GHG emissions from the manufacturing industries sector in Kota Kinabalu. GHG emissions from natural gas consumption in this sector increased marginally from 12,478 tCO_2e in 2013/14 to 13,294 tCO_2e in 2017/18 (Figure 19), while the total emissions from the use of electricity and fuel combined increased from 123,316 to 145,426 tCO_2e at the rate of 3.35% CAGR.

Figure 18: Trends in Natural Gas Consumption in Manufacturing Industries and the Construction Sector



GJ = gigajoule.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

Figure 19: Trends in Greenhouse Gas Emissions from Natural Gas in Manufacturing Industries and the Construction Sector

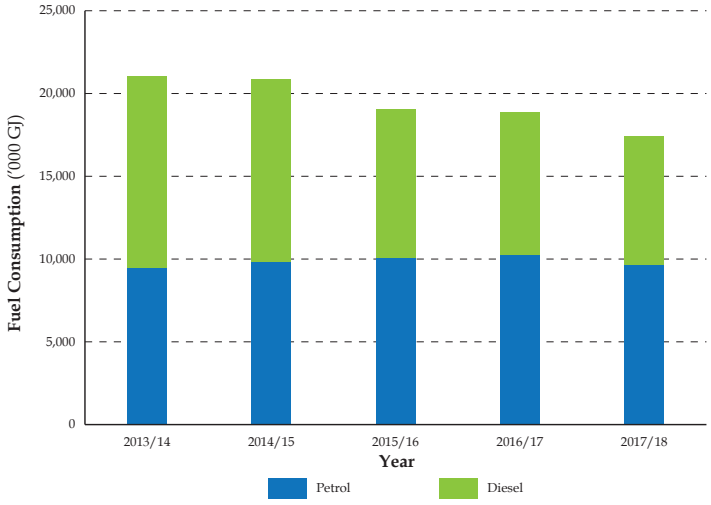


GHG = greenhouse gas, tCO_2e = ton of carbon dioxide equivalent.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

5.9.8 Direct Emissions from Mobile Combustion (Transport Sector)

Diesel and petrol are the major fuels used for on-road transport. Petronas, Petron, and Shell are the major fuel suppliers. The overall fuel consumption for on-road transport shows an annual increase of 2% CAGR between 2013/14 to 2017/18 (Figure 20).

Figure 20: Trends in Fuel Consumption in the Transport Sector



GJ = gigajoule.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

The trend also portrays a significant decline in auto-LPG consumption. Petrol is the dominant fuel in the transport sector, contributing to 55% of total energy use followed by diesel which has a share of 45% in the year 2017/18.

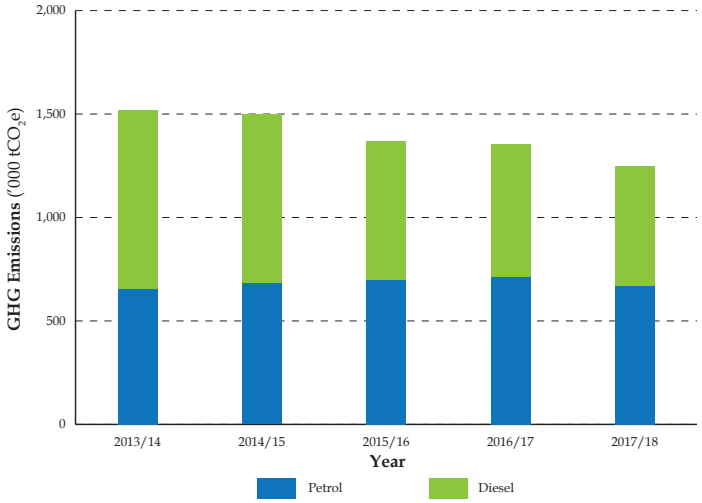
The transport sector is a major contributor to GHG emissions in Kota Kinabalu City. This sector accounts for 48% (1.25 million tCO_2e) of the total Kota Kinabalu GHG emissions in the year 2017/18. GHG emissions from the transport sector have declined at 3.88% CAGR from 2013/14 to 2017/18, mainly because of decrease in the consumption of diesel (Figure 21).

Municipal solid waste usually includes biodegradable matter (such as paper, textiles, food waste, straw, and yard waste), partially biodegradable matter (such as wood, disposable napkins, sludge) and non-degradable materials (such as leather, plastics, rubbers, metals, glass, ash from fuel burning like coal, briquettes or woods, dust, and electronic waste).

Kota Kinabalu's annual waste generation in the baseline year 2017/18 was 94,900 tons in contrast to 79,570 tons during the period 2011/12—a 19.27% increase during this period. The mixed waste generated by the city is disposed at the Kayu Madang dumpsite.

Anaerobic decomposition of biodegradable matter present in municipal solid waste generates GHG emissions. Methane emissions from solid waste disposal sites are the largest source of GHG emissions in the waste sector. Direct GHG emissions from solid waste were estimated based on the amount of waste that was generated by the city and dumped at the Kayu Madang dump site between the first year of operation of the dumpsite and

Figure 21: Trends in Greenhouse Gas Emissions from the Transport Sector

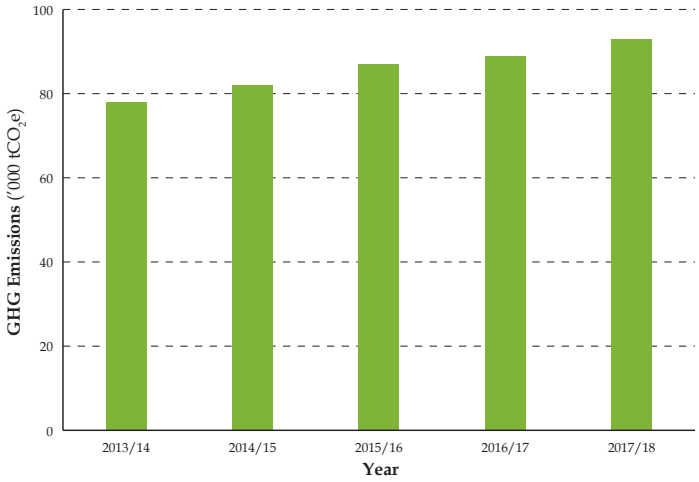


GHG = greenhouse gas, tCO_2e = tons carbon dioxide equivalent.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

the inventory year. Municipal solid waste generated by the city in 2017/18 is 94,900 tons, working out to about 265 tons per day. Owing to factors such as the rising number of household and commercial establishments, municipal solid waste generated has increased at a CAGR of 3.59%.

The city has experienced a significant growth in GHG emissions from waste disposal during the inventory period, with total sector emissions increasing from 77,646 tCO_2e in 2013/14 to 92,605 tCO_2e in 2017/18 (Figure 22).

Figure 22: Kota Kinabalu—Trends in Greenhouse Gas Emissions from Disposal of Municipal Solid Waste



GHG = greenhouse gas, tCO_2e = tons carbon dioxide equivalent.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

5.9.9 Key Sustainability Indicators for Kota Kinabalu City

Key sustainability indicators for Kota Kinabalu City are given in Table 22. These indicators enable a comparison of the energy and GHG emissions profile across multiple cities, both within Malaysia and globally as well. However, such comparisons should consider differing local contexts (in terms of socioeconomic conditions and drivers), data availability, prevalent data management practices, and the overall methodology adopted for developing the GHG emissions inventory.

The GHG emissions inventory reports for 2013 to 2017/18, prepared using the HEAT+ software, are included in Appendix 3.

Table 22: Key Sustainability Indicators for Kota Kinabalu City

Sustainability Indicator	Unit of Measure	Kota Kinabalu (2017–2018)
Total energy consumption	GJ	25,595,804
Total GHG emission	tCO_2e	2,508,936
Energy consumption per capita	GJ/capita	43
GHG emission per capita	tCO_2e/capita	4.20
Energy consumption per household	GJ/HH	257
GHG emission per household	tCO_2e/HH	25
Energy consumption per unit area	GJ/km^2	72,923
GHG emission per unit area	tCO_2e/km^2	7,148

GHG = greenhouse gas, GJ = gigajoule, HH = household, km^2 = square kilometer, tCO_2e = ton of carbon dioxide equivalent.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall.

5.10 Highlights of Climate Change Vulnerability Assessment

The climate change vulnerability assessment of urban systems is conducted by using shared learning dialogues (SLDs) as per the ICLEI Asian Cities Climate Change Resilience network Process (IAP). The IAP tool kit consists of a series of simple tools that are discussed in an open dialogue through an SLD with multiple stakeholders from different urban sectors, to assess the climate vulnerability of a city. It helps the local authority to assess their fragilities with respect to the existing development pressures and trends and projections of climate change in the city. These urban systems could include "core systems" such as water, sewerage, and transport, which are essential for the city's functioning; and "secondary systems" such as health, education, sanitation which rely on the core systems. The urban system analysis identified the following fragile urban systems for Kota Kinabalu: stormwater drainage, solid waste, sewerage, land use and development, water supply, and transport.

At the SLD, trends of temperature and precipitation in Kota Kinabalu were discussed with the stakeholders. A consensus was arrived at, suggesting that the city was experiencing rising temperatures over the years. While rainfall has not shown any marked changes in total precipitation, the intensity and frequency of heavy rainfall events have changed and are seen to be increasing over the past 20–30 years. Kota Kinabalu is also likely to suffer from impacts of sea level rise. Studies have shown that sea level has risen in Kota Kinabalu by 2.6 mm in the last 11 years and is likely to rise by 2.4 mm by 2020.[14] However, the calculated rate of rise is lower than the

[14] Maryam, D. S., W. Anwar, and T. Aung. 2011. Method to Estimate the Land Loss from Sea Level Rise due to Gradual Warming in Kota Kinabalu, Sabah. *Borneo Science*. Vols. 18–28. http://borneoscience.ums.edu.my/wp-content/uploads/2012/03/3-Method-to-Estimate- The-Land-Loss-From-Sea-Level-Rise-Due-To-Gradual-Warming-In-Kota-Kinabalu-Sabah.pdf.

IPCC global average rate, since it does not consider El Niño–Southern Oscillation phenomenon, waves, currents, etc. The rise therefore should be taken into consideration when the city is making plans, particularly for the beaches and coastal areas.

An urban systems fragility analysis was conducted in terms of the climate risks identified earlier of increased intensity and frequency of precipitation and increased temperatures. Almost all the identified urban systems are impacted by the projected climatic changes. A climate fragility statement was developed for each system on the basis of this analysis.

In case of stormwater, the major impact was from increased precipitation. Since both frequency and intensity of precipitation are expected to increase, this will impact the carrying capacity of the existing drainage system, and may result in water logging and flooding. This is particularly true if drains are clogged from solid waste that is dumped indiscriminately. Water logging and flooding can cause knock-on health impacts by encouraging the growth of vectors and vector borne diseases or through contamination of water sources by carrying rubbish into them.

In case of solid waste management, both increased temperatures and increased precipitation could have severe impacts. Temperature rise could cause disturbances in the processing and treatment facilities, increase decomposition in open dumps, causing odor issues and may lead to fires in the landfill. It can also cause vector borne diseases and increase air pollution, impacting the health of citizens. Higher rainfall results in increased leachate flows from landfills and open dumps thereby contaminating ground and surface water and impacting public health.

In case of sewerage systems, higher temperatures can impact the efficiency of the treatment plants that can in turn result in polluting receiving waters. Increased precipitation can also impact hydraulic loads in the plants and decrease their efficiency, also leading to water pollution.

Land-use policies do not consider climate change as a major factor and leave the city unprepared for major changes in temperature and rainfall. A climate-sensitive design of urban landscape and buildings is essential to address impacts of heat stress. Rising temperatures, coupled with an increase in paved surfaces, reduction in green cover, and proliferation of space cooling units could further enhance heat island effects. Sea level rise can have a serious impact on the development plans of the city. All coastal and new development areas must take into consideration the impacts of sea level rise, particularly in the case of beachfront or foreshore development.

Water supply is directly impacted by high temperatures and heavy rainfall incidents. The former will increase demand of water, which may compel people to move toward increasing ground extraction, thereby increasing chances of water salinity. The cost of supplying water through tankers to meet increased demand is also an added expense for the local authority. Heavy rainfall can cause siltation and contamination of water sources that will increase costs of treatment of water and if not treated, may result in health impacts.

High temperatures indirectly impact the transport sector by encouraging people to use private vehicles, which are more comfortable. This will increase emissions in the long run. High precipitation events can damage road infrastructure and cause accidents. Poor road conditions have a major impact on access to emergency services.

These climate impacts are outlined in climate fragility statements provided in Table 23. Risks associated with the stated climate fragility of urban systems were assessed by the stakeholder group in the SLD. A risk assessment exercise was conducted with the group. The risks were calculated in terms of the likelihood of occurrence and the consequence of the identified fragility on the population and the city. The likelihood and consequence were multiplied to get the final risk score and status in Table 23. The fragile systems with the highest risks, as per the assessment, were investigated further to identify populations and areas that are impacted by them. The likelihood and consequence scoring matrix and the calculation of the risk in Kota Kinabalu is in Appendix 4.

Table 23: Urban System Risk Assessment

Urban System	Climate Fragility Statement	Risk Score	Risk Status
Land Use and Development	**Increased Temperature:** Policies do not address climate change impacts explicitly in the documents, thereby restricting action taken in the city on climate change. This may affect population adversely if temperature increases.	9	Medium
	Increased Precipitation: Higher rainfall and flash floods may restrict access to and cause serious damage to infrastructure (electricity, water supply, roads, flyovers) if planning and enforcement is not effective; for example, if stormwater outflow are not considered at the planning stage, it may lead to water logging in high rainfall scenarios.	12	High
	Sea Level Rise: Land use planning and development can be adversely impacted, since sea level rise can lead to land loss, impacting beach tourism and compromising beachfront infrastructure.	12	High
Water Supply	**Increased Temperature:** Increased temperature may increase water demand with a consequence of increased groundwater extraction, lowering of the water table, increase in saltwater intrusion and an overall reduction in the potability of groundwater.	16	High
	Increased Temperature: Use of tankers may increase the cost of operation and maintenance.	9	Medium
	Increased Precipitation: Increased rainfall may cause damage to pipes, siltation, and contamination. This can increase health impacts and costs of treatment.	4	Low
Sewerage	**Increased Temperature:** Higher temperatures may lower efficiency of biological treatment systems. This can cause water and air pollution, and health impacts.	8	Medium
	Increased Precipitation: Increased rainfall may raise hydraulic load in treatment plants, leading to overflow of untreated sewage and cause water pollution and health impacts.	15	High
Stormwater Drainage	**Increased Precipitation:** Increased rainfall events may increase floods and water logging, especially if drains are blocked with solid waste. This can cause knock-on impacts on health.	15	High
Solid Waste	**Increased Temperature:** Higher temperatures may increase the possibility of fire and odor from waste dumps. This would increase emissions and cause health impacts.	20	Extreme
	Increased Precipitation: High rainfall events may cause pollution of water (groundwater and surface water) due to increased leachate generation and infiltration from the landfill.	20	Extreme
Transport	**Increased Temperature:** Higher temperature may increase private vehicle usage, generating more emissions, impacting health and air quality.	12	Medium
	Increased Precipitation: Increased rainfall events (flash flood and landslides) may cause damage to roads, traffic congestion, accidents; resulting in an overall loss in economic productivity.	25	Extreme
	Increased Precipitation: Increased rainfall may adversely impact the access to general and emergency services.	25	Extreme

Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall and stakeholders.

The vulnerability assessment helps to assess the city in terms of the geographic location, demography, infrastructure, socioeconomic condition, ecological condition, and the impacts of climate change on these. The Intergovernmental Panel on Climate Change defines vulnerability as a function of three parameters: the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.[15]

Vulnerability assessment through the IAP consists of identification of vulnerable areas and actors for all the prioritized fragile urban systems and an analysis of their adaptive capacities. Vulnerability assessment of Kota Kinabalu considered the following elements:

5.10.1 Identification of Vulnerable Places

Those locations or areas, where identified fragile urban systems were highly vulnerable to climate change impacts, were identified and mapped to arrive at vulnerable hotspots. Vulnerable hotspots are those locations which are impacted by a maximum number of fragile urban systems. The vulnerability maps for each of the focus sectors are given in the urban sectoral descriptions above.

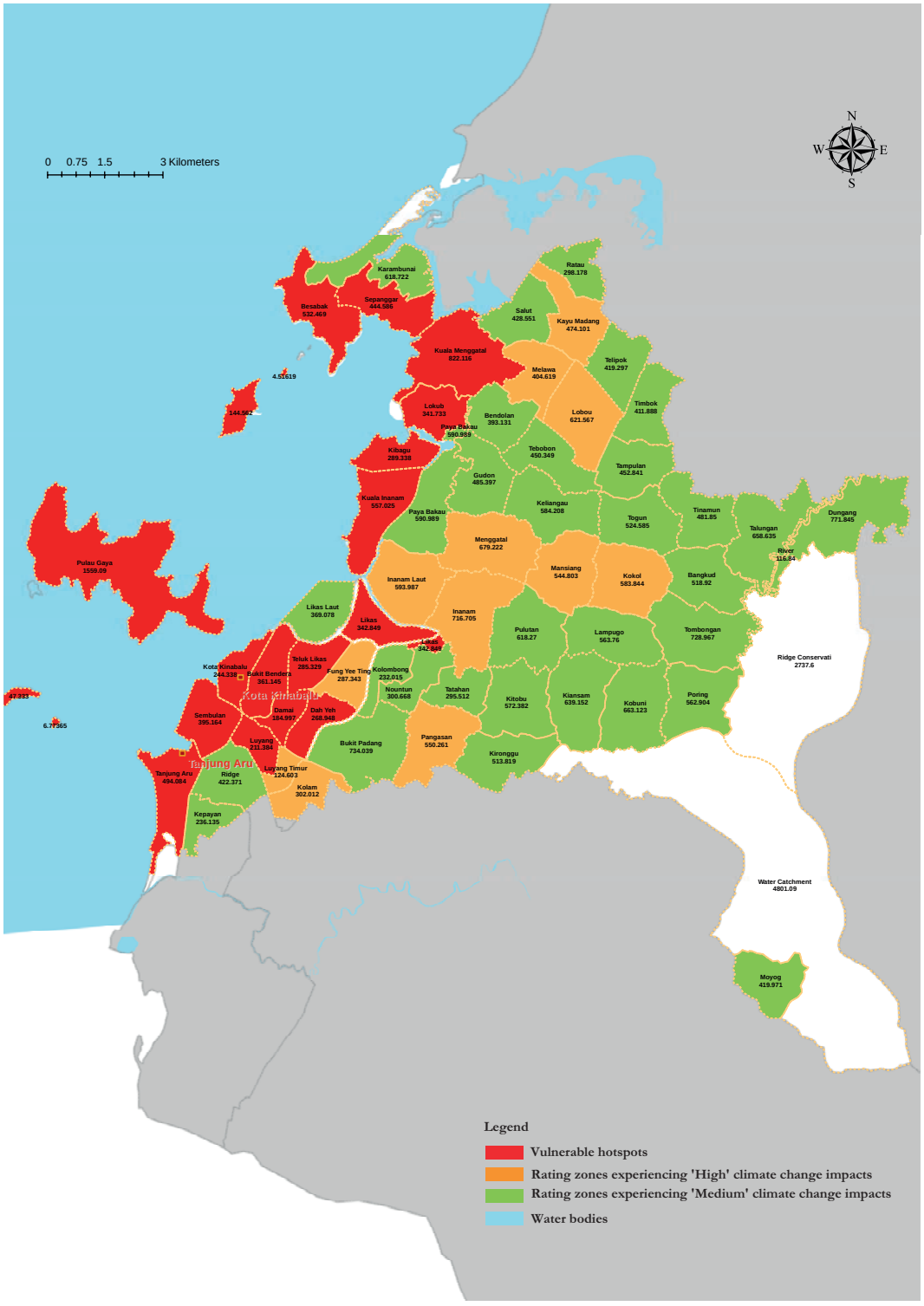
The vulnerability assessment also resulted in the identification of 16 vulnerable hotspots (Map 9). The vulnerable hotspots are Menggatal, Sepanggar, Besabak, Lokub, Kibagu, Kuala Innanam, Teluk Likas, Bukit Bendera, Kota Kinabalu CBD, Sembulan, Tanjung Aru, Pulau Gaya, Likas, Damai, Dah Yeh Villa, Luyang. These areas are impacted most due to the presence of climate fragile urban systems which includes sewerage, stormwater drainage, waste and transport, among others. They are also vulnerable to flooding and water logging, impacting access and development. The areas were identified in discussions with local stakeholders during the SLDs and in discussions with the city. Infrastructure and development in these areas need attention as they are impacted by multiple fragile urban systems.

5.10.2 Identification of Vulnerable Actors and Their Adaptive Capacity

In each of the vulnerable areas, the actors that play a critical role in building urban resilience were identified and assessed in terms of their capacity to organize and respond to threat or disruption, access to resources necessary for response (manpower, technology, funds), and access to information necessary to develop effective plans and interventions and improve responses to disruptions. These determine the adaptive capacity or resilience of the identified actors for a particular fragile system. They are characterized as vulnerable actors, with low adaptive capacity, and supporting actors, with medium or high adaptive capacity. The adaptive capacity matrix for urban actors is attached in Appendix 5.

[15] IPCC. 2007. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, eds. Cambridge, UK: Cambridge University Press.

Map 9: Vulnerability Hotspots of Kota Kinabalu



Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall and stakeholders.

For each sector, the vulnerable areas and respective actors are outlined below:

1. Land Use and Development

Climate Fragility Statement	**Increased Temperature:** Policies do not address climate change impacts explicitly in the documents, thereby restricting action taken in the city on climate change. This may affect population adversely if temperature increases. **Increased Precipitation:** Higher rainfall and flash floods may restrict access to and cause serious damage to infrastructure (electricity, water supply, roads, flyovers) if planning and enforcement is not effective; for example, if stormwater outflow is not considered at the planning stage, it may lead to water logging in high rainfall scenarios. **Sea Level Rise:** Land use planning and development can be adversely impacted, since sea level rise can lead to land loss, impacting beach tourism and compromising beachfront infrastructure.
Vulnerable Areas	Newly developed northern parts of the city
Actors	**Vulnerable actors:** Residents, Water Department
	Supporting actors: KKCH, JKR, DID, Health Ministry, SESB, Fire Department

2. Water Supply

Climate Fragility Statement	**Increased Temperature:** a) Increased temperature may increase water demand with a consequence of increased groundwater extraction, lowering of the water table, increase in saltwater intrusion and an overall reduction in the potability of groundwater. b) Use of tankers may increase the cost of operation and maintenance. **Increased Precipitation:** Increased rainfall may cause damage to pipes, siltation, and contamination. This can increase health impacts and costs of treatment.
Vulnerable Areas	Northern hilly parts of the city
Actors	**Vulnerable actors:** General public
	Supporting actors: JKR, KKCH, Sabah Water Supply

3. Sewage

Climate Fragility Statement	**Increased Temperature:** Higher temperatures may lower efficiency of biological treatment systems. This can cause water and air pollution, and health impacts. **Increased Precipitation:** Increased rainfall may raise hydraulic load in treatment plants, leading to overflow of untreated sewage and cause water pollution and health impacts.
Vulnerable Areas	Melawa, Telipok, Kayu Madang, Lobou, Timbok, Mansiang, Pulutan, Tatahan, Pangasan, Kinronggu, Kitobu, Kiansam, Kobuni, Lampugo, Tombongan, Bangkud, Kokol, Lampugo, Poring, Tinamun, Talungan, Dungang, Togun, Pulau Gaya and other locations.
Actors	**Vulnerable actors:** General public
	Supporting actors: JKR, KKCH

4. Stormwater Drainage

Climate Fragility Statement	**Increased Precipitation:** Increased rainfall events may increase floods and water logging, especially if drains are blocked with solid waste. This can cause knock-on impacts on health.
Vulnerable Areas	Menggatal, Likas, Damai, Dah Yeh, Luyang
Actors	**Vulnerable actors:** General Public, Schools, Hospitals, KKCH
	Supporting actors: DID, JKR, National Security Council, Fire Brigade, Police

5. Solid Waste

Climate Fragility Statement	**Increased Temperature:** Higher temperatures may increase the possibility of fire and odor from waste dumps. This would increase emissions and cause health impacts. **Increased Precipitation:** High rainfall events may cause pollution of water (groundwater and surface water) due to increased leachate generation and infiltration from the landfill.
Vulnerable Areas	Kuala Menggatal, Salut, Kayu Madang, Lobou, Timbok, Mansiang, Pulutan, Tatahan, Pangasan, Kinronggu, Kitobu, Kiansam, Kobuni, Lampugo, Tombongan, Bangkud, Kokol, Lampugo, Poring, Tinamun, Talungan, Dungang, Togun, Pulau Gaya, Tampulan, Teluk Likas
Actors	**Vulnerable actors:** Residential areas (low-income groups), Schools (primary), General public
	Supporting actors: Resort (Karambunai), Fishery industry/Tourism industry, Hospital, Local authorities

6. Transport

Climate Fragility Statement	**Increased Temperature:** Higher temperature may increase private vehicle usage, generating more emissions, impacting health and air quality. **Increased Precipitation:** a) Increase rainfall events (flash flood and landslides) may cause damage to roads, traffic congestion, accidents; resulting in an overall loss in economic productivity. b) Increased rainfall may adversely impact the access to general and emergency services.
Vulnerable Areas	Menggatal, Likas, Teluk Likas, Fung Yee Ting, Dah Yeh, Damai, Luyang, Luyang Timur, Telipok, Kolombong, Bukit Padang, Kokol, Inanam Laut, Kolam, Pulutan, Inanam
Actors	**Vulnerable actors:** Hospital and clinics, Traffic police, People with no private vehicles, General public
	Supporting actors: JKR, JPS, KKCH, Emergency Response

CHAPTER 6

Kota Kinabalu Green City Action Plan and Strategy

Kota Kinabalu City has identified interventions and strategies related to eight selected urban sectors, focusing on their strategic importance, sustainability impacts, and green growth potential. The technical committee, including representatives of concerned authorities and agencies of Kota Kinabalu City and the Government of Sabah met in April, July, and September 2018 to deliberate on and prioritize the sectoral action plans, on the basis of a critical assessment of the city's municipal service delivery status and existing capabilities.

The Green City Action Plan consists of two types of measures: soft measures (consisting primarily of policy interventions, awareness-raising activities, assessments, or studies); and hard measures (consisting of infrastructure measures, including redevelopment, retrofitting, renovation as well as new development). Appropriate interventions with potential climate mitigation benefits, which also address the climate vulnerability of each sector, are suggested. The applicable mitigation and adaptation benefits and associated Sustainable Development Goals (SDGs) have also been identified. In the KK GCAP, interventions are formulated to help improve fiscal and institutional capacity, create durable partnerships, and strengthen the regulatory framework and ability to finance projects.

Several interventions are proposed in the KK GCAP. These interventions have been identified based on the GHG emissions inventory and the climate change vulnerability assessment. For instance, for the transport sector that is emissions-intensive, a set of comprehensive climate resilience measures to promote sustainable transportation are prioritized and proposed, keeping an eye on the overall objective of mitigating GHG emissions from the sector.

This long list of interventions is given in Table 24. The table gives the GHG emissions mitigation potential and the total resilience score for each action. The total resilience score is a function of the different resultant impacts of the action on the related urban system, i.e., creating redundancy and flexibility in the system, improving responsiveness to climate change impacts and enhancing access to information. The feasibility score is a function of the political feasibility (that assesses whether the intervention is supported by regulations and policies and if it is of political interest and is acceptable socially), technical feasibility (that assesses whether KKCH has the technical ability to implement the intervention or it can access the technical support for it), and financial feasibility (that assesses whether the financial resources are available for the implementation or it can be accessed by KKCH). Interventions are classified as short-, medium-, and long-term interventions based on the time it takes to effect a change in terms of mitigating or adapting to climate change impacts. Finally, Table 24 also provides the impact of each intervention on the overall resilience of the city. These five parameters, i.e., the GHG mitigation potential, resilience score, feasibility score, duration, and resilience impact, are used to calculate the overall priority score of each intervention and assign a priority rank to them. The resilience scoring for the interventions is given in Appendix 6 and the feasibility assessment of the interventions is given in Appendix 7. From this long list of interventions, priority projects that are of immediate strategic importance to the city are further elaborated in subsequent sections.

These green city interventions not only result in reduction of GHG emissions and develop the city's adaptive capacity, but also contribute to the city's overall sustainable development. These contributions are referred to

Table 24: Long List of Resilience Interventions

Urban Sector Interventions	A - Mitigation Potential (*Yes - 1, No - 0*)	B - Resilience Score	C - Feasibility Score	D - Impact (Duration) (*Short Term- 3, Medium Term - 2, Long Term - 1*)	E - Impact (Resilience) (*Low - 1, Medium - 2, High - 3*)	Priority Ranking (A + B + C + D + E)	Rank (*5–10: Low; 11–15: Medium; 16–17: High; 18–20: Very High*)
Land Use and Development							
Soft Measures							
Incorporation of climate change considerations in the city Master Plan and other relevant sectoral plans	1	3	8	2	3	17	High
Preparation of a comprehensive long-term coastal management plan along with climate-intelligent zoning considering current and future climate risks: Policy measures, structural engineering, and nature-based solutions should be included in the plan. It must take into consideration future sea level rise impacts and land loss.	1	4	6	1	3	15	Medium
Implement and enforce land use-related policies effectively	1	4	8	1	3	17	High
Formulation of working committees or associations and training them to respond quickly when flooding occurs to reduce damage	0	2	9	2	2	15	Medium
Regularly monitor residential areas in rainy season, particularly those which are prone to flooding	0	2	9	3	2	16	High
Conduct frequent site inspections of new construction sites to create awareness regarding water logging and prevent outbreak of diseases	0	2	8	3	2	15	Medium
Organize awareness campaigns on proper response to floods and actions to be taken before, during, and after flooding for students, teachers, researchers, and the general public	0	2	9	3	3	17	High
Hard Measures							
Introduce sustainability initiatives in particularly vulnerable areas, e.g., Pulau Gaya islands with vulnerable populations; initiatives on water, wastewater management, and solid waste management should be undertaken	1	3	8	3	3	18	Very High
Build in sustainability initiatives in newly developing areas to integrate climate-resilient planning and development, e.g., Jesselton Waterfront City	1	4	8	3	3	19	Very High
Redevelopment of old housing stock (more than 40 years old)	1	3	8	3	3	18	Very High
Development of green field social housing in areas along existing transport corridors, e.g., the Telipok area lies along the northern corridor and DBKK and JKR intend to improve the connectivity of this area to the corridor via an arterial network. Given this scenario and considering that adequate land is available for development of social housing, the Telipok area may be considered as an appropriate location for transit-oriented development	1	4	8	3	3	19	Very High
Protect treated water during all natural disasters, e.g., from floods	0	2	8	3	2	15	Medium

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Table 24 *continued*

Urban Sector Interventions	A - Mitigation Potential (*Yes - 1, No - 0*)	B - Resilience Score	C - Feasibility Score	D - Impact (Duration) (*Short Term - 3, Medium Term - 2, Long Term - 1*)	E - Impact (Resilience) (*Low - 1, Medium - 2, High - 3*)	Priority Ranking (A + B + C + D + E)	Rank (*5–10: Low; 11–15: Medium; 16–17: High; 18–20: Very High*)
Water							
Soft Measures							
Preparation of integrated urban water management (IUWM) Plan, to ensure reuse and recycling of wastewater, reduction in demand, and efficient use of existing resources	1	4	7	3	3	18	Very High
Water Audit: Identification of water losses (technical and commercial) and leak detection (T&D and NRW) in bulk water supply system to promote water conservation	1	2	8	3	3	17	High
Implementation of tariff rationalization for water distribution and improved metering at areas with high consumption of water supply to increase cost recovery	1	2	6	2	3	14	Medium
Promote use of smart water saving fittings in residential and commercial complexes to promote conservation of water	1	4	7	3	3	18	Very High
Hard Measures							
Review of water metering system in the city and undertake corrective measures in case of errors in functioning for improving cost recovery	1	2	8	3	3	17	High
Upgradation of 50% of city water distribution network to ductile iron pipes with diameter range 100 mm to 900 mm for 24x7 water supply	1	1	7	1	1	11	Medium
Three SCADA systems for effective monitoring and information on water flows, to promote conservation and efficient use of water	1	2	7	3	2	15	Medium
Use of power saver devices in the pump houses and booster stations; regular water-energy audits to be conducted to ensure proper functioning and taking timely corrective measures	1	4	8	3	3	19	Very High
Twenty units of RWH systems, particularly in municipal complexes, for groundwater recharge and reuse for nonpotable purposes. Promotion of household RWH structures, particularly in areas where piped supply is not available	0	3	8	3	3	17	High
Sewerage and Stormwater Drainage							
Soft Measures							
Preparation of an erosion and sediment control plan	0	4	8	3	2	17	High
Strengthening institutional and technical capacity of city staff for effective operation and maintenance of sewerage system through regular training	0	2	9	1	1	13	Medium

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Table 24 *continued*

Urban Sector Interventions	A - Mitigation Potential (*Yes - 1, No - 0*)	B - Resilience Score	C - Feasibility Score	D - Impact (Duration) (*Short Term - 3, Medium Term - 2, Long Term - 1*)	E - Impact (Resilience) (*Low - 1, Medium - 2, High - 3*)	Priority Ranking (A + B + C + D + E)	Rank (*5–10: Low; 11–15: Medium; 16–17: High; 18–20: Very High*)
Expedite the formation of the new Sabah Sewerage Services Department so that more funds and manpower can be allocated to sewerage management	0	2	5	1	2	10	Low
Revise sewerage tariff (currently at 20 cents/cubic meter) to a fair fee which can help sustain the new sewerage department financially	0	2	8	1	1	12	Medium
Systematic weather forecast monitoring for early warning systems to forewarn against high intensity rainfall events via text messages and/or community radio	0	2	8	3	3	16	High
General public policy campaigns of no rubbish in drains; move out permanently or temporarily in case of flood	0	2	8	2	3	15	Medium
Increase public awareness on the importance of connecting to a centralized sewerage system for better management of sewage	0	1	9	1	1	12	Medium
Regularly update sewerage network database	0	2	8	1	2	13	Medium
Hard Measures							
DEWAT systems to serve the remote and isolated areas	1	4	9	3	3	20	Very high
Inspect existing sewer pipeline regularly for maintenance	0	2	8	3	2	15	Medium
Improve landscape near sewage treatment systems to avoid root systems of plants from disrupting sewage lines	1	2	9	3	2	17	High
Improve the design or technology of existing and new sewage treatment systems which can adapt to varying hydraulic loads	1	4	6	2	3	16	High
Install odor scrubber at existing and new sewage treatment plants and pumping station to reduce odor pollution due to rising temperature	0	2	6	3	1	12	Medium
SCADA system for effective monitoring	1	3	6	3	3	16	High
Use of power saver devices in the Sewerage Treatment Plants; regular water-energy audits to be conducted to ensure proper functioning and taking timely corrective measures	1	3	6	1	2	13	Medium
Wastewater Recycling: Reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, etc.	1	3	7	3	3	17	High
Upgradation of urban drains to reinforced concrete drains, including deepening and widening of existing drains, depending on future rainfall projections	0	3	6	3	3	15	Medium
Increasing the number of culverts to facilitate drainage	0	2	6	3	3	14	Medium

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Table 24 *continued*

Urban Sector Interventions	A - Mitigation Potential (*Yes - 1, No - 0*)	B - Resilience Score	C - Feasibility Score	D - Impact (Duration) (*Short Term - 3, Medium Term - 2, Long Term - 1*)	E - Impact (Resilience) (*Low - 1, Medium - 2, High - 3*)	Priority Ranking (A + B + C + D + E)	Rank (*5–10: Low; 11–15: Medium; 16–17: High; 18–20: Very High*)
Construction of detention basins to prevent flooding and facilitate retention of water	0	2	6	3	3	14	Medium
Installation of tidal gates and pumps	0	2	6	3	3	14	Medium
Residential complexes and other institutional buildings to have dual plumbing system for separation of grey and black water and promoting reuse of treated water	0	3	6	3	3	15	Medium
Transport							
Soft Measures							
Promote nonmotorized transport and other low emission vehicles	1	3	6	2	3	15	Medium
Preparation of the Kota Kinabalu City comprehensive mobility plan; develop transport corridors from Inamam to Telipok and Inamam toward Bukit Padang (up to Beverly Hills Town Centre), so that social housing can be developed around those nodes and corridors.	1	4	7	1	3	16	High
Enact a policy that will encourage the public to shift from private vehicle to public transport	1	3	6	1	3	14	Medium
Rationalization of operational route of buses and business model development	1	2	5	2	2	12	Medium
Conduct outreach programs to educate the public regarding use of public transport. Disseminate real time information regarding bus routes and timings (TV, radio, strategic locations), engage with stakeholders (community, technical experts)	0	2	6	1	2	11	Medium
Establish a crisis management center to manage emergency situation of flooding and road blockage	1	2	6	3	2	14	Medium
Hard Measures							
Procurement of 50 electric buses for electric mobility promotion	1	3	6	3	3	16	High
Solid Waste							
Soft Measures							
Preparation of a Kota Kinabalu City Holistic Waste Management Plan:							
(a) Comprehensive baseline report on current and future waste generation and composition from all sources	1	2	7	2	2	14	Medium
(b) To have a holistic waste management strategy addressing solid waste from all sources and characteristics (hazardous and nonhazardous)	1	4	6	2	3	16	High

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Table 24 *continued*

Urban Sector Interventions	A - Mitigation Potential (*Yes - 1, No - 0*)	B - Resilience Score	C - Feasibility Score	D - Impact (Duration) (*Short Term - 3, Medium Term - 2, Long Term - 1*)	E - Impact (Resilience) (*Low - 1, Medium - 2, High - 3*)	Priority Ranking (A + B + C + D + E)	Rank (*5–10: Low; 11–15: Medium; 16–17: High; 18–20: Very High*)
Preparation of Reject Management Plan for utilization of output materials from proposed processing facility	0	3	6	2	2	13	Medium
Hard Measures							
Intensive household-level segregation and collection of waste by involvement of self-help groups and official workers	1	3	7	2	3	16	High
Plan A: 100 TPD Biomethanation Plant and MRF Action Plan to use high calorific value waste in the cement industry and recycling	1	3	6	3	3	16	High
Plan B: Integrated Waste Management Facility—800 TPD (Mechanical Biological Treatment, plastic recycling, e-waste recovery, C&D waste and rubber processing, and waste-to-energy plant)	1	3	6	2	3	15	Medium
Energy							
Soft Measures							
Preparation of the city-wide energy efficiency strategy and action plan	1	4	8	1	3	17	High
Hard Measures							
Grid-connected large-scale deployment of solar PV system	1	3	8	3	3	18	High
Installing units of 5–15 kW solar PV systems in various municipal office buildings categorized according to their monthly bills falling in the range of < 1,000 kWh, 1,000–2,000 kWh, and 2,000–5,000 kWh	1	3	7	3	2	16	High
Installing solar PV systems in 56 municipal schools	1	3	7	3	2	16	High
Use of solar water heaters in municipal hospitals, hotels, and restaurants for hot water requirement	1	3	7	3	2	16	High
Replacement of LPG-fueled cooking stove to solar cooker	1	3	6	3	2	15	Medium
Deploy rooftop solar PV systems with inverter, for supplementing conventional power and for power supply during load-shedding hours, replacing DG sets	1	3	6	3	2	15	Medium
Solar steam cooker for cooking in schools, hostels, hotels, and restaurants	1	3	7	3	2	16	High
Replacement of conventional air conditioners with EE star rated air conditioners	1	3	8	3	2	17	High
Replacement of conventional refrigerators with EE star rated refrigerators	1	3	8	3	2	17	High
Replacement of conventional water pumps with EE water pumps	1	3	8	3	2	17	High

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Table 24 *continued*

Urban Sector Interventions	A - Mitigation Potential (*Yes - 1, No - 0*)	B - Resilience Score	C - Feasibility Score	D - Impact (Duration) (*Short Term - 3, Medium Term - 2, Long Term - 1*)	E - Impact (Resilience) (*Low - 1, Medium - 2, High - 3*)	Priority Ranking (A + B + C + D + E)	Rank (*5–10: Low; 11–15: Medium; 16–17: High; 18–20: Very High*)
Replacement of conventional ceiling fans with efficient ceiling fans	1	3	8	3	2	17	High
Street Lighting							
Soft Measures							
Investment Grid Energy Audit (IGEA)	1	4	6	3	2	16	High
Hard Measures							
Option 1: LED fixtures—no digital connectivity—10 years warranty option. Meters installed at the feeder panel are used for energy monitoring	1	3	7	3	2	16	High
Option 2: LED fixtures—individual point-to-point digital connectivity, addressability and control through GSM technology hardware and software for network infrastructure with 10 years warranty	1	3	7	3	2	16	High
Option 3: LED fixtures—group digital connectivity control and voltage dimming at smart feeder panel (group connectivity). Hardware and software for network infrastructure with 10-year warranty	1	3	7	3	2	16	High
Option 4: 150 W HPS, 250 HPS and 400 W luminaires are replaced by dimmable LED fixtures with point-to-point digital connectivity and 10-year warranty option	1	3	7	3	2	16	High
Buildings							
Soft Measures							
Social housing stock to be planned, considering public transport corridors, to facilitate transit-oriented development	1	4	7	3	3	18	Very High
Enforcement of KKCH Green Building Policy: All new building submission (both residential and nonresidential) shall comply with MS 1525* on Overall Thermal Transfer Value and roof insulation	1	4	8	1	3	17	High
Public awareness generation campaigns aimed at energy conservation practices	0	2	8	2	2	14	Medium
Regular energy auditing of all public buildings	0	2	6	1	2	11	Medium
Regular energy auditing of all industrial units of KKIP	0	2	6	1	2	11	Medium
Pre-feasibility assessment of energy efficiency in residential and commercial buildings	0	2	7	1	2	12	Medium
Provision of training programs on energy efficiency and renewable energy to KKCH staff	0	2	6	1	2	11	Medium
Assessment cooling	0	2	7	1	2	13	Medium

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Table 24 *continued*

Urban Sector Interventions	A - Mitigation Potential (*Yes - 1, No - 0*)	B - Resilience Score	C - Feasibility Score	D - Impact (Duration) (*Short Term - 3, Medium Term - 2, Long Term - 1*)	E - Impact (Resilience) (*Low - 1, Medium - 2, High - 3*)	Priority Ranking (A + B + C + D + E)	Rank (*5–10: Low; 11–15: Medium; 16–17: High; 18–20: Very High*)
Hard Measures							
Construction of the green affordable housing units for low-income households	1	4	8	2	3	18	Very high
Energy management system: Includes programming, commissioning, and training	0	2	7	1	3	13	Medium
Replacement of electrical appliance (lights, fans, air conditioner, and refrigerator) in residential and commercial sector	1	3	8	2	2	16	High
Building design: Implement shading systems to reduce solar glare and minimize solar heat gain in public buildings—utilize daylighting	1	3	8	3	3	18	Very High
Energy-efficient buildings: Advance metering infrastructure in all KKCH public buildings	1	3	7	2	2	15	Medium
Adaptive measures: White rooftops, with a reflective surface, as a measure to prevent heat ingress from the roof, resulting in cooler interiors	1	3	7	2	3	16	High

C&D = construction and demolition, DEWAT = decentralized wastewater treatment, EE = energy-efficient, KKCH = Kota Kinabalu City Hall, KKIP = Kota Kinabalu Industrial Park, kWh = kilowatt-hour, LED = light-emitting diode, LPG = liquefied petroleum gas, MRF = materials recovery facility, PV = photovoltaic, SCADA = Supervisory Control and Data Acquisition, SDG = Sustainable Development Goal, TPD = ton per day.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall and stakeholders.

as co-benefits. Development in Kota Kinabalu has always proceeded with people at the forefront, giving equal consideration to city's rich cultural and natural heritage. In subsequent sections, for each sector, a selection of strategic, sustainable, and green interventions are further detailed. These projects were selected based by the stakeholders and the city, based on the established priority, and based on developmental priorities of the city. Some of the selected development projects were not considered when the long list was discussed and prioritized by the stakeholders.

Of the 17 SDGs, those related to Clean Water and Sanitation (SDG 6), Affordable and Clean Energy (SDG 7), Decent Work and Economic Growth (SDG 8), Industry, Innovation, and Infrastructure (SDG 9), Sustainable Cities and Communities (SDG 11), and Climate Change (SDG 13) are especially relevant for KK GCAP. For each of the strategic projects elaborated further, the relevant SDG link is also indicated in subsequent sections.

6.1 Land Use and Development

Kota Kinabalu City is witnessing rapid urbanization. This results in increased pressure on the current physical and transport infrastructure, especially in the Central Business District (CBD) area. It also has a huge impact on the local environment. Kota Kinabalu City intends to be one of the first coastal cities, to not only plan for but also implement initiatives to ensure integrated urban development.

The city's focus is on land use-transport-infrastructure integration. By initiating density mapping along major roads and in critical wards, a plan for physical and transport infrastructure will be developed. This information can also help in selecting the best mode of road/public transport for the city and could also discourage encroachments and illegal development in the future. The city's micro-climate is defined by the surrounding hills and physical features. Considering the current land use pattern and the increasing risk of climate change impacts such as sea level rise, the city recognizes the need for embarking on an environmentally sustainable development framework. Table 25 presents a list of strategic, sustainable, and green interventions for the land use and development sector under the KK GCAP.

Table 25: Land Use and Development Sector Interventions

Sector Interventions	Potential Impacts	Potential Co-Benefits	Approx Cost ($)	SDG	Lead Agency
Soft Measures					
Incorporation of climate change considerations in the city Master Plan and other relevant sectoral plans	Protect wetlands, habitats, and other environmentally sensitive resources	Efficient use of resources	No cost	11	KKCH, TRPD
Preparation of a comprehensive long- term coastal management plan along with climate-intelligent zoning considering current and future climate risks: Policy measures, structural engineering and nature-based solutions should be included in the plan. It must take into consideration future sea level rise impacts and land loss.	Integrated land development	Promote economic growth and satisfy housing, industrial, and commercial needs	500,000	11	KKCH
Implement and enforce land use-related policies effectively	Improved land use management	Efficient use of resources	No cost	11	KKCH, TRPD
Formulation of working committees or associations and training them to respond quickly when flooding occurs to reduce damage	Awareness generation	Improved quality of urban environment	5,000 per training	11	KKCH, TRPD
Regularly monitor residential areas in rainy season, particularly those which are prone to flooding	Prevention of disease outbreak	Better quality of life, better health, and better productivity	20,000	11	KKCH, TRPD
Conduct frequent site inspections of new construction sites to create awareness regarding water logging and prevent outbreak of diseases	Awareness generation	Improved land management	50,000	11	KKCH, TRPD
Organize awareness campaigns on proper response to floods and actions to be taken before, during, and after flooding for students, teachers, researchers, and the general public	Capacity building	New green jobs	10,000 per camp	11	KKCH, TRPD
Hard Measures					
Introduce sustainability initiatives, particularly vulnerable areas, e.g., in Pulau Gaya islands; initiatives on water, wastewater management, solid waste management should be undertaken	Protect habitats, and other environmentally sensitive areas	Improved public health, opportunities for tourism, better economy	710,000 for 4 interventions as per PIN document	11	KKCH, TRPD

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Table 25 *continued*

Sector Interventions	Potential Impacts	Potential Co-Benefits	Approx Cost ($)	SDG	Lead Agency
Ensure climate-resilient planning and implementation of sustainable development initiatives in proposed townships and growth areas, e.g., in Jesselton Waterfront City	Protect habitats and other environmentally sensitive areas	Improved public health, opportunities for tourism, better economy	8.64 million	11	KKCH, TRPD
Redevelopment of old housing stock (more than 40 years old)	Access to housing	Potential for developing green buildings, better economy	Dependent on construction	11	KKCH, TRPD
Development of green field social housing in areas along existing transport corridors, e.g., the Telipok area lies along the northern corridor and KKCH and JKR intend to improve the connectivity of this area to the corridor via an arterial network. Given this scenario and considering that adequate land is available for development of social housing, the Telipok area may be considered as an appropriate location for transit-oriented development.	Access to housing	Potential for social housing, green buildings, better economy	Dependent on construction	11	KKCH, TRPD
Protect treated water during all natural disasters, e.g., from floods	Protection of water resource	Efficient use of resources	10,000 per year	11	KKCH

KKCH = Kota Kinabalu City Hall, TRPD = Town and Regional Planning Department.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall and stakeholders.

6.2 Water Supply

Based on an analysis of secondary data and primary consultations, it was observed that although the average per capita water supply in Kota Kinabalu City is more than the estimated demand, there still exist certain issues with regard to the water supply system, which need to be addressed. It is estimated that transmission and distribution losses account for 25% to 30% of the total supply. This is mainly due to an old and compromised water supply network, resulting in water leakage and reduced water pressure.

Due to an increasing trend in rainfall, stormwater management remains a challenge for the city authority. Considering the vulnerability of different groups of society to urban flooding, remedial measures have been suggested.

Energy consumption for water supply and sewerage management has a substantial share in overall energy consumption in Kota Kinabalu City. Use of energy-efficient pumps, water energy audits to assess energy efficiency potential, and use of renewable energy can address this to a great extent. In addition, enforcement of certain bylaws, such as for wastewater reuse, rainwater harvesting, dual plumbing, etc., would also be useful. Table 26 presents a list of strategic, sustainable, and green interventions for the water supply sector.

Table 26: Water Supply Sector Interventions

Sector Interventions	Potential Impacts	Potential Co-Benefits	Approx Cost ($)	SDG	Lead Agency
Soft Measures					
Preparation of integrated urban water management plan, to ensure reuse and recycling of wastewater, reduction in demand, and efficient use of existing resources.	Efficient use of resources	Improve information and lead to better decision-making, circular economy	100,000	6, 11, 13	Sabah Water Department
Water Audit: Identification of water losses (technical and commercial) and leak detection (T&D and NRW) in bulk water supply system to promote water conservation	Increased understanding of system deficiency	Reduction in water losses	150,000	6, 11, 13	Sabah Water Department
Implementation of tariff rationalization for water distribution and improved metering at areas with high consumption of water supply to increase cost recovery	Less energy demand for water pumping will reduce GHG emission	Social equity and justice	No cost	6, 11, 13	Sabah Water Department
Promote use of smart water saving fittings in residential and commercial complexes to promote conservation of water	Reduce in water demand and improvement in efficiency	Innovation and introduction of new technologies	10,000 per training	6, 11, 13	Sabah Water Department
Hard Measures					
Review of water metering system in the city and undertake corrective measures in case of errors in functioning for improving cost recovery	Improve water quality; reduce GHG emissions; air quality benefits	Increased public awareness on conservation of water	According to selected measures	6, 11, 13	Sabah Water Department
Upgradation of 50% of city water distribution network to ductile iron pipes with diameter range 100 mm to 900 mm for 24x7 water supply	Improve return on investments by reducing environmental risks	Public health improvement	60,000 per km	6, 11, 13	Sabah Water Department
Three Supervisory Control and Data Acquisition systems for effective monitoring and information on water flows, to promote conservation and efficient use of water	System efficiency	Improved water conservation	500,000 per unit	6, 11, 13	Sabah Water Department
Use of power saver devices in the pump houses and booster stations; regular water-energy audits to be conducted to ensure efficient functioning and for enabling timely corrective measures	Reduction in power consumption and GHG emissions	Better efficiency	100,000	6, 11, 13	Sabah Water Department
Twenty units of rainwater harvesting systems, particularly in municipal complexes, for groundwater recharge and reuse for nonpotable purposes. Promotion of household RWH structures, particularly in areas where piped supply is not available.	Improved water supply	Efficient use of environmental resources	20,000 per unit	6, 11, 13	Sabah Water Department

GHG = greenhouse gas, NRW = nonrevenue water, RWH = rainwater harvesting.

Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall and stakeholders.

6.3 Sewerage and Stormwater Drainage

The city needs to adopt an integrated water management approach as current wastewater treatment coverage is not at 100% and the centralized sewage treatment system needs to be improved. Effective watershed management interventions can be implemented, which would result in rejuvenating water bodies. In the absence of an advanced sewerage treatment system in certain areas, untreated or poorly treated sewage is discharged into the sea and water bodies; DEWATS can thus be encouraged, especially in the peri-urban areas of the city. The city can adopt economic and regulatory instruments to minimize the discharge of raw sewage. These steps will not only help to reduce water pollution but will improve the deteriorating water quality near the shoreline and in water bodies. Table 27 presents a list of strategic, sustainable, and green interventions for the sewerage and stormwater drainage sector.

Table 27: Sewerage and Stormwater Drainage Sector Interventions

Sector Interventions	Potential Impacts	Potential Co-Benefits	Approx Cost ($)	SDG	Lead Agency
Soft Measures					
Decentralized wastewater treatment systems to serve the remote and isolated areas	Reducing pollution by up to 90%; higher treatment efficiency	Reduced risks to public health from waterborne diseases	120,000 per 100 kiloliters per day (KLD)	6, 11	JKR
Preparation of an erosion and sediment control plan	Preventing illicit discharge; establishing baseline, benchmarking, analysis, and evaluation	Improved life in water	100,000	6, 11	DID
Strengthening institutional and technical capacity of city staff for effective O&M of sewerage system through regular training	System efficiency improvement	Improved management of resources; recycling and reuse of wastewater for non-potable uses	10,000 per training	6, 11	JKR
Expedite the formation of the new Sabah Sewerage Services Department so that more funds and manpower can be allocated to sewerage management	Institutionalization of sewerage services planning	Robust policy preparation and efficient resource management	No cost	6, 11	JKR
Revise sewerage tariff (currently at 20 cents/cubic meter) to a fair fee which can help sustain the new sewerage department financially	Improved sewerage services to the public	Social equity and justice	No cost	6, 11	JKR
Systematic weather forecast monitoring for early warning systems to forewarn against high intensity rainfall events via text messages/community radio	Mitigate the loss of human life and national resources	Improved liveability and disaster preparedness	10,000	6, 11	JKR
General public: Policy campaigns of no rubbish in drains; move out permanently or temporarily in case of flood	Awareness generation; increased safety and cleanliness	Sustainable and liveable economy	10,000 per campaign	6, 11	JKR
Increase public awareness on the importance of connecting to a centralized sewerage system for better management of sewage	Improved understanding and knowledge of sewerage management	Reduced risks to public health from waterborne diseases	10,000 per camp	6, 11	JKR

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Table 27 *continued*

Sector Interventions	Potential Impacts	Potential Co-Benefits	Approx Cost ($)	SDG	Lead Agency
Regularly update sewerage network database	Improved urban planning and faster response to tackle sewerage issues	Informed decision and resource allocation	No cost	6, 11	JKR
Hard Measures					
Inspect existing sewer pipeline regularly for maintenance	Identify and rectify defects	Improved stormwater management and reduced risk of flooding; improved water quality	No cost	6, 11	JKR
Improve landscape near sewage treatment systems to avoid root systems of plants from disrupting sewage lines	Avoid damage to the sewer due to plant roots	Reduced risks to public health from waterborne diseases	No extra cost	6, 11	JKR
Improve the design/technology of existing and new sewage treatment systems which can adapt to varying hydraulic loads	Enhanced wastewater treatment	Protection of public health and safety	Financial assessment required	6, 11	JKR
Install odor scrubber at existing and new sewage treatment plants and pumping station to reduce odor pollution due to rising temperature	Reduction in odor; enhanced cleanliness and liveability	Protect the environment, enrich the land, and improve air quality	Financial assessment required	6, 11	JKR
Supervisory control and data acquisition (SCADA) system for effective monitoring	Optimize the time spent; delegate work efficiently	Maintain efficiency, process data for smarter decisions, and communicate system	600,000 per unit	6, 11	JKR
Use of power saver devices in the sewerage treatment plants; regular water-energy audits to be conducted to ensure proper functioning and taking timely corrective measures	Energy consumption reduction; GHG emission reduction	Advance systems efficiency	Financial assessment required	6, 11	JKR
Wastewater recycling: Reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, etc.	Resource and financial savings; groundwater recharge	Enhanced wetlands and riparian (stream) habitats	Financial assessment required	6, 11	JKR
Upgradation of urban drains to reinforced concrete drains, including deepening and widening of existing drains, depending on future rainfall projections	Average annual flood damage reduction	Threats from flooding are reduced, particularly for low-income and elderly residents living in low-lying areas	Financial assessment required	6, 11	DID
Increasing the number of culverts to facilitate drainage	Average annual flood damage reduction	Threats from flooding are reduced, particularly for low-income and elderly residents living in low-lying areas	Financial assessment required	6, 11	DID
Construction of detention basins to prevent flooding and facilitate retention of water	Average annual flood damage reduction	Threats from flooding are reduced, particularly for low-income and elderly residents living in low-lying areas	Financial assessment required	6, 11	DID

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Table 27 *continued*

Sector Interventions	Potential Impacts	Potential Co-Benefits	Approx Cost ($)	SDG	Lead Agency
Installation of tidal gates and pumps	Average annual flood damage reduction	Threats from flooding are reduced, particularly for low income and elderly residents living in low lying areas	Financial assessment required	6, 11	DID
Residential complexes and other institutional buildings to have dual plumbing system for separation of grey and black water and promoting reuse of treated water	Reuse of water, conservation of water	Better utilization of freshwater resources	Depending on size of buildings, approx 1,500–15,000 per unit	6, 11	JKR

DID = Department of Irrigation and Drainage, JKR = Jabatan Kerja Raya (Public Works Department), SDG = Sustainable Development Goal.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall and stakeholders.

6.4 Transport

Transport is one of the most important priority sectors which needs to be addressed in order to reduce GHG emissions. Significant intervention is required from the state and local government to ensure that sustainable transport initiatives are implemented. Some initiatives that can be implemented include (i) the introduction of a robust public transport system that is managed by the city, (ii) route rationalization and rationalization of private bus operators, (iii) deployment of an adequate number of buses including an electric fleet, (iv) construction of bridges and flyovers, and (v) provision of additional dedicated parking lanes or parking bays.

It has emerged that strengthening the public transport system is the first priority of the city. While several studies exist, there is a need to update the public transport plan of the city and immediately define a phased approach to ensuring a timely, robust, well-managed, and sustainably operated public transport system. Table 28 presents a list of strategic, sustainable, and green interventions for the transport sector.

Table 28: Transport Sector Interventions

Sector Interventions	Potential Impacts	Potential Co-Benefits	Approx Cost ($)	SDG	Lead Agency
Soft Measures					
Promote nonmotorized transport and other low-emission vehicles	Reduce fuel consumption, reduce congestion	Improved economic productivity, healthier lifestyle	NA	3, 9, 11	KKCH, JKR
Preparation of the Kota Kinabalu City comprehensive mobility plan; develop transport corridors from Inamam to Telipok and Inamam toward Bukit Padang (up to Beverly Hills Town Centre), so that social housing can be developed around those nodes and corridors	Structured situation, assessment and informed policy decision, better managed transport options	Reduced environmental damage and pollution	100,000	3, 9, 11	KKCH, JKR
Enact a policy that will encourage the public to shift from private vehicles to public transport	Regularization of the public transport, lower emissions	Integrated land development, healthier lifestyle	NA	3, 9, 11	KKCH, JKR

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Table 28 *continued*

Sector Interventions	Potential Impacts	Potential Co-Benefits	Approx Cost ($)	SDG	Lead Agency
Rationalization of operational route of buses and business model development	Fuel savings, efficiency improvement, time savings, reduce traffic congestion	Improved public transport, healthier lifestyle	Financial assessment required	3, 9, 11	KKCH, JKR
Conduct outreach programs to educate the public regarding use of public transport; disseminate real time information regarding bus routes and timings (web based apps and display boards in bus stops)	Reduce congestion and GHG emissions	Efficient use of environmental resources	10,000 per outreach event	3, 9, 11	KKCH, JKR
Establish a crisis management center to manage emergency situations such as traffic congestion and road blockage due to localized flooding	Customer service redressal, air quality benefits	Productivity increased through optimization	30,000 year one cost; recurring costs of staff	3, 9, 11	KKCH, JKR
Procurement of 50 electric buses for promotion of electric mobility	Reduce dependence on fossil fuel supplies	Reduced environmental damage and pollution, healthier lifestyle	500,000 per bus	3, 9, 11	KKCH, JKR

DID = Department of Irrigation and Drainage, JKR = Jabatan Kerja Raya (Public Works Department), KKCH = Kota Kinabalu City Hall, SDG = Sustainable Development Goal.

Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall and stakeholders.

6.5 Municipal Solid Waste

Municipal solid waste management is one of the major functions of KKCH. Scientific and well-managed waste processing facilities are the need of the hour in Kota Kinabalu City. The Kayu Madang landfill has reached its capacity and it is well noted by the city that land filling can no longer be the only available option for waste management. While the city is in the process of identifying a private operator for implementing waste management facilities, it is imperative that all sources of waste be considered for processing—including municipal solid waste, electronic waste, construction and demolition waste, hospital waste, and industrial waste (both hazardous and nonhazardous). Disposal of sludge from wastewater treatment plants is also to be considered.

Excessive diesel consumption by vehicles for solid waste transportation is also a major challenge that needs to be addressed. Use of energy-efficient vehicles can be helpful in addressing this issue. Sustainable solid waste management is possible through the adoption of a mix of technologies, to address each waste stream. Table 29 presents the list of strategic sustainable and green interventions for the municipal solid waste sector.

Table 29: Solid Waste Sector Interventions

Sector Interventions	Potential Impacts	Potential Co-Benefits	Approx Cost ($)	SDG	Lead Agency
Soft Measures					
Preparation of a Kota Kinabalu City holistic waste management plan: (a) Comprehensive baseline report on current and future waste generation and composition from all sources (b) To have a holistic waste management strategy addressing solid waste from all sources and characteristics (hazardous and nonhazardous)	Baseline, benchmarking, target setting, sustainability frameworks for waste management	Enhanced environment safety, hygiene; reduced methane emissions	150,000	11, 12	KKCH
Preparation of Reject Management Plan for utilization of output materials from proposed processing facility	Use resources wisely, reduce pollution and energy consumption	Circular economy	50,000	11, 12	KKCH
Hard Measures					
Intensive household-level segregation and collection of waste by involving self-help groups and official workers	Waste reduction and efficient use of solid waste services, create opportunities for developing a recycling product industry, increase in public awareness	Reduce waste that goes to landfills; introduction of new technologies, new livelihoods	30,000 per rating area	11, 12	KKCH
Plan A: 100 TPD Biomethanation Plant and Materials Recovery Facility to use high calorific value waste in the cement industry and recycling	Reduces soil and water pollution; reduces landfill waste	Augmenting the environment, hygiene, and sanitation; use of gas or electricity can ensure resource use efficiency; circular economy	8.5 million	11, 12	KKCH
Plan B: Integrated Waste Management Facility—800 TPD (Mechanical Biological Treatment, plastic recycling, e-waste recovery, C&D waste and rubber processing and waste to energy plant)	Reduces soil and water pollution; reduces landfill waste	Augmenting the environment, hygiene, and sanitation, circular economy	15.02 million	11, 12	KKCH

C&D = construction and demolition, KKCH = Kota Kinabalu City Hall, SDG = Sustainable Development Goal, TPD = ton per day.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall and stakeholders.

6.6 Energy

It is expected that the energy demand of Kota Kinabalu City will continue to increase. Kota Kinabalu, being the capital city of Sabah, intends to play its part in realizing the federal government's target of having 20% renewable energy in the nation's power generation mix by 2030. The GCAP proposes a set of renewable energy and energy efficiency measures for Kota Kinabalu which is mentioned in Table 30.

Table 30: Energy Sector Interventions

Sector Interventions	Potential Impacts	Potential Co-Benefits	Approx Cost ($)	SDG	Lead Agency
Soft Measures					
Preparation of a citywide energy efficiency strategy and action plan	Streamlined action plan for implementation of energy efficiency and renewable energy measures	Economic benefits from energy conservation	100,000	7, 11, 13	SEDA, SESB, KKCH
Hard Measures					
Grid Connected Large Scale Deployment of Solar Photovoltaic (PV) System	Use of renewable source of energy supply; reduces electricity bills; low maintenance costs; reduces GHG emissions	Save money on energy bills; increased public awareness	2,134 per kWp	7, 11, 13	SEDA, SESB, KKCH
Installing units of 5–15 kW solar PV systems in various municipal office buildings categorized according to their monthly bills falling in the range of <1,000 kWh, 1,000–2,000 kWh and 2,000–5,000 kWh.	Use of renewable source of energy supply; reduces electricity bills; low maintenance costs; reduces GHG emissions	Save money on energy bills; increased public awareness	2,134 per kWp	7, 11, 13	SEDA, SESB, KKCH
Installing solar PV systems in 56 municipal schools	Use of renewable source of energy supply; reduces electricity bills; low maintenance costs; reduces GHG emissions	Save money on energy bills; increased public awareness	2,134 per kWp	7, 11, 13	SEDA, SESB, KKCH
Use of solar water heaters in municipal hospitals, hotels, and restaurants for hot water requirement	Use of renewable source of energy supply; reduces electricity bills; low maintenance costs; reduces GHG emissions	Save money on energy bills; increased public awareness	5,000–10,000 per unit	7, 11, 13	SEDA, SESB, KKCH
Replacement of LPG-fueled cooking stove to solar cooker	Use of renewable source of energy supply; reduces electricity bills; low maintenance costs; reduces GHG emissions	Save money on energy bills; increased public awareness	100–500 per unit	7, 11, 13	SEDA, SESB, KKCH

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Table 30 *continued*

Sector Interventions	Potential Impacts	Potential Co-Benefits	Approx Cost ($)	SDG	Lead Agency
Deploy rooftop solar PV systems with inverter, for supplementing conventional power and for power supply during load-shedding hours, replacing DG sets	Use of renewable source of energy supply; reduces electricity bills; low maintenance costs; reduces GHG emissions	Save money on energy bills; increased public awareness	3,000 per kWp	7, 11, 13	SEDA, SESB, KKCH
Solar steam cooker for cooking in schools, hostels, hotels, and restaurants	Use of renewable source of energy supply; reduces electricity bills; low maintenance costs; reduces GHG emissions	Save money on energy bills; increased public awareness	500–1,000 per unit	7, 11, 13	SEDA, SESB, KKCH
Replacement of conventional air conditioners with EE star rated ACs	Improve indoor comfort; reduces fossil fuel use and greenhouse gas emissions	Save money on energy bills; breathe healthy, fresh, clean air; increase building resale value; increased public awareness	1,000 per unit	7, 11, 13	SEDA, SESB, KKCH
Replacement of conventional refrigerators with EE star rated refrigerators	Reduce fossil fuel use and greenhouse gas emissions	Save money on energy bills; increased public awareness	1,000 per unit	7, 11, 13	SEDA, SESB, KKCH
Replacement of conventional water pumps with EE water pumps	Reduce fossil fuel use and greenhouse gas emissions	Save money on energy bills; increased public awareness	5,000 per unit	7, 11, 13	SEDA, SESB, KKCH
Replacement of conventional ceiling fans with efficient ceiling fans	Reduce fossil fuel use and greenhouse gas emissions	Save money on energy bills; increased public awareness	100 per unit	7, 11, 13	SEDA, SESB, KKCH

EE = energy-efficient, GHG = greenhouse gas, KKCH = Kota Kinabalu City Hall, SDG = Sustainable Development Goal.
Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall and stakeholders.

6.7 Street Lighting

KKCH is responsible for the procurement, installation, and maintenance of the street lighting system. Baseline information available with KKCH reveals that an assessment of the inventory of infrastructure has not been conducted in the recent past. The coverage of streetlights in the municipal area seems to be inadequate, to provide quality service to the citizens. Table 31 presents the list of strategic, sustainable, and green interventions for the street lighting sector.

Table 31: Street Lighting Sector Interventions

Sector Interventions	Potential Impacts	Potential Co-Benefits	Approx Cost ($)	SDG	Lead Agency
Soft Measures					
Investment Grid Energy Audit	Determine where cost-effective changes can be made	Improved economic productivity	500,000	7,11,13	KKCH
Hard Measures					
Option 1: LED fixtures—no digital connectivity—10-year warranty option. Meters installed at the feeder panel are used for energy monitoring	Reduce electricity consumption and related GHG emissions	Potential long-term cost savings; increased public awareness	Financial assessment required	7,11,13	KKCH
Option 2: LED fixtures—individual point-to-point digital connectivity, addressability and control through GSM technology hardware and software for network infrastructure with 10-year warranty	Reduce electricity consumption and related GHG emissions	Potential long-term cost savings; increased public awareness	Financial assessment required	7,11,13	KKCH
Option 3: LED fixtures—group digital connectivity control and voltage dimming at smart feeder panel (Group connectivity). Hardware and software for network infrastructure with 10-year warranty	Reduce electricity consumption and related GHG emissions	Potential long-term cost savings; increased public awareness	19.41 million	7,11,13	KKCH
Option 4: 150 W HPS, 250 HPS, and 400 W luminaires are replaced by dimmable LED fixtures with point-to-point digital connectivity and 10-year warranty option	Reduce electricity consumption and related GHG emissions	Potential long-term cost savings; increased public awareness	Financial assessment required	7,11,13	KKCH

HPS = high-pressure sodium lamps, KKCH = Kota Kinabalu City Hall, LED = light emitting diode, SDG = Sustainable Development Goal.

Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall and stakeholders.

6.8 Buildings

Energy consumption in buildings is the highest contributor to GHG emissions in the city. Adoption of renewable energy in industrial, commercial, and residential buildings can significantly reduce this demand. There is considerable potential for energy savings through the use of energy-efficient appliances in residential, commercial, and institutional buildings. Industrial energy consumption can be reduced by exploring avenues for adopting green building design to reduce lighting and cooling requirements. Table 32 presents the list of strategic, sustainable, and green interventions for the building sector.

Table 32: Building Sector Interventions

Sector Interventions	Potential Impacts	Potential Co-Benefits	Approx Cost ($)	SDG	Lead Agency
Soft Measures					
Enforcement of KKCH Green Building Policy: All new building submission (both residential and nonresidential) shall comply with MS 1525* on Overall Thermal Transfer Value and roof insulation	Construction of green buildings, reduction in energy demand from housing sector, savings on energy spending, health and well-being of people	Cost-effective for homeowners, sustainable housing models, public awareness	Financial assessment required	7, 13	KKCH
Public awareness generation campaigns aimed at energy conservation practices	Results in energy savings and carbon emission reduction	Healthier, happier, and more productive lives	No cost	7, 13	KKCH
Regular energy auditing of all public buildings	Reduce energy costs; reduce GHG emission	Increased efficiency of energy use and saving financial benefits for other use	10,000 per camp	7, 13	KKCH
Regular energy auditing of all industrial units of KKIP	Reduce energy costs; reduce GHG emission	Increased efficiency of energy use and saving financial benefits for other use	10,000	7, 13	KKCH
Pre-feasibility Assessment of Energy Efficiency in Residential and Commercial Buildings	Demand side management; GHG reduction	Low-carbon development	10,000	7, 13	KKCH
Provision of training programs on energy efficiency and renewable energy to KKCH staff	Awareness building	Reduction of electricity consumption, clean energy development	100,000	7, 13	KKCH
Assessment for identifying potential for district cooling	Reduction in energy consumption for space cooling and thereby GHG emissions reduction	Reduction in heat generated from multiple air conditioning units, reducing contribution to urban heat island effects	10,000 per training	7, 13	KKCH
Assessment for identifying potential for district cooling	Reduction in energy consumption for space cooling and thereby GHG emissions reduction	Reduction in heat generated from multiple air conditioning units, reducing contribution to urban heat island effects	250,000	7, 13	KKCH

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Table 32 *continued*

Sector Interventions	Potential Impacts	Potential Co-Benefits	Approx Cost ($)	SDG	Lead Agency
Hard Measures					
Construction of green affordable housing units for low-income households	Green buildings, low cost, and affordable construction	Sustainable development of city, particularly new development areas	Financial assessment required	7, 13	KKCH
Energy management system: Includes programming, commissioning, and training	Optimize energy usage in all public buildings	Low-carbon development	5,000–25,000 per unit depending on size of unit	7, 13	KKCH
Replacement of electrical appliance (lights, fans, air conditioner, and refrigerator) in residential and commercial sectors	Lower energy bills; reduce GHG emission	Reduced consumption of natural resources	100–10,000 depending on unit	7, 13	KKCH
Building design: Implement shading systems to reduce solar glare and minimize solar heat gain in public buildings—utilize daylighting	Reductions in annual cooling energy consumption	Visual comfort by controlling glare and reducing contrast ratios	100,000	7, 13	KKCH
Energy-efficient buildings: Advance metering infrastructure in all KKCH public buildings	Improving the accuracy of meter reads, energy theft detection, and response to power outages	Improved data integrity	5,000	7, 13	KKCH
Adaptive measures: White rooftops, with a reflective surface, as a measure to prevent heat ingress from the roof, resulting in cooler interiors	Lower air conditioning costs	Lower levels of local air pollution	5 per ft^2	7, 13	KKCH

ft^2 = square foot, GHG = greenhouse gas, KKCH = Kota Kinabalu City Hall, SDG = Sustainable Development Goal.

Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall and stakeholders.

CHAPTER 7

Priority Projects in Kota Kinabalu Green City Action Plan

KK GCAP indicates that transport, energy, solid waste management, water supply, sewerage and stormwater drainage, buildings and land use and development are key focus sectors for the city at present. A long list of technically feasible projects were identified, based on their propensity to enhance climate resilience, provide mitigation benefits, and improve socioeconomic conditions, as presented in Chapter 6. From within this long list, based on identified priority and by also considering development priorities as defined by KKCH, a few strategic, high-priority projects were selected, and their benefits and cost of implementation were also presented in Chapter 6 (subsections 6.1 to 6.8)

From among the high-priority projects, nine projects which directly address the city's development priorities were selected by the Steering Committee, for immediate implementation. For these nine projects, detailed project information note documents, which detail the need for these projects, sustainability benefits, scale of projects, mode of implementation, and tentative costs of implementation, were prepared. These project information note documents are included in Appendix 8.

The nine selected high priority projects are listed in Table 33. It is intended that KKCH, with support from ADB, will source financing for structuring and/or implementing these projects. Bilateral and multilateral funding agencies, private investors, and national and state government programs will be approached for funding. The project information note documents will facilitate such a dialogue.

Table 33: List of Kota Kinabalu Green City Action Plan Priority Projects

Project	Lead Agencies	Project Cost ($ million)	Implementation Mode
Implementation of 100 megawatt solar photovoltaic systems (rooftop and solar farm)	KKCH and SEDA	138	PPP
Energy-efficient street lighting	KKCH, SESB, and JKR	19.41	Energy Savings Company
Integrated public transport system	KKCH, JKR, and Road Transport Department, Sabah	35 (Sustainability initiatives) *(Civil infrastructure cost 117[a])*	PPP
Integrated solid waste management facility	KKCH and Borneo Waste	15	Private investment
Energy efficient buildings project	KKCH	25	Energy Performance Contract

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Table 32 *continued*

Project	Lead Agencies	Project Cost ($ million)	Implementation Mode
Education for sustainable development (eco-schools, eco-campus [UMS and others], training and sensitization)	UMS and KKCH	2.62	Technical assistance
Reduction of nonrevenue water	Sabah Water Department, KKCH	1.50	Technical Assistance
Sustainability initiatives in Pulau Gaya Island	KKCH	3.47	Private Investment
Jesselton Waterfront City	KKCH and Suria Capital Holdings Berhad	91.30	Private Investment
Total		**331.30**	

JKR = Jabatan Kerja Raya (Public Works Department), KKCH = Kota Kinabalu City Hall, PPP = public–private partnership, SEDA = Sustainable Energy Development Authority, SESB = Sabah Electricity Sdn. Bhd., UMS = Universiti Malaysia Sabah.

[a] Land procurement and construction cost of Northern, Southern, Eastern integrated terminals including software supporting system.

Source: ICLEI South Asia findings from meetings with KKCH and stakeholders.

CHAPTER 8

Way Forward

KK GCAP is a comprehensive document that assesses the current and projected climate risks of eight core urban systems and identifies corresponding mitigation and adaption measures, as described in previous chapters. This makes it a useful tool that the city can refer to, for incorporating sector-specific climate-resilient interventions into ongoing or new policies, plans, and programs such as in the Structure Plan, the Local Plan, and other development schemes and programs that are in place and which are updated as and when needed.

The Sabah State Government and KKCH are planning to design and implement various innovative urban development schemes and plans. There is a very good opportunity to link KK GCAP with one or many of these plans and programs, wherever applicable, so as to ensure implementation. Baseline studies, assessments, and planning that have already been carried out during the preparation of the GCAP in Kota Kinabalu can serve as quality resources to inform further planning.

The long list of climate resilience measures and their identified priorities will guide the city in implementing the action plan. There are several soft and hard measures proposed. Technical studies that are required to identify future course of action in critical areas, such as in implementing an integrated transport system, are also identified. KKCH could approach bilateral and multilateral donor entities for seeking finance to conduct these assessments, in case self-funding or financing from state or central government programs/funds is not possible. Policy recommendations included in the long list should be duly noted and action taken immediately by KKCH, since policy frameworks are essential to support the implementation of integrated projects.

The PIN documents could be used as the basis for sourcing finance for the implementation of the nine shortlisted high-priority projects. For all implementation projects included in the KK GCAP, KKCH could seek funds from several sources. Potential funding sources include

(i) self-financing;

(ii) public–private partnerships;

(iii) grants from state/central government programs;

(iv) grants from bilateral/multilateral development/financing agencies;

(v) floating green bonds and accessing finance through other market-based mechanisms;

(vi) adopting a blended finance approach by seeking funds from philanthropies and international donors;

(vii) accessing soft loans from either the state/center or international financing entities;

(viii) global funds such as the Green Climate Fund or the Global Environment Facility, for medium- to large-scale projects (with support from the Government of Malaysia); and

(ix) other market mechanisms and/or investments from private entities.

It is important to showcase the GCAP at the state and national level, in order to ensure buy-in and support for implementation. Several international funding mechanisms seek sovereign guarantees, especially for large-scale projects.

KK GCAP is a first integrated action plan of its kind that focuses on climate resilient development. ADB is expected to support the preparation of GCAPs in other cities in the BIMP-EAGA region. Based on the experience gained in the process of preparing its GCAP, the city of Kota Kinabalu can potentially function as a resource city for other cities in the region, which are embarking on preparing their GCAPs.

The implementation of the KK GCAP is to be managed by a new Steering Committee. It is intended that the Deputy Permanent Secretary would chair this committee and the committee would include the Sabah Town and Regional Planning Department, to ensure that proposed climate-resilient actions can be scaled up to the entire state. The proposed structure of the Green Council for KK GCAP implementation, which would have implementation oversight and would provide strategic guidance, is presented in Appendix 1. It is envisaged that the State Secretary would chair the Green Council. The Secretariats of the Steering Committee and the Green Council will be hosted by the office of the Mayor of Kota Kinabalu.

APPENDIX 1

Kota Kinabalu Green Council and Kota Kinabalu Green City Action Plan Steering Committee Members

Green Council

The Green Council is being constituted to ascertain conformity of the Kota Kinabalu Green City Action Plan (KK GCAP) with the development priorities of the State of Sabah and also to ensure that the city of Kota Kinabalu receives the necessary support to ensure implementation of the GCAP. Nominated members of the Green Council and their roles are given in Table A1.1.

Table A1.1: Green Council Members and Roles

Position	Agency	Designation	Function of Agency
Chair	Pejabat Timbalan Setiausaha Kerajaan Negeri Sabah (Office of Deputy Sabah State Secretary)	Timbalan Setiausaha Kerajaan negeri (TSKn) (Deputy Permanent State Secretary)	Functions of the Office of Deputy State Secretary(Development) i) Administration and Finance ii) Special Development Projects iii) ICT Development Project iv) Development and Promotion of Indigenous Languages Program Special duties include being the program coordinator for: Heart of Borneo, Biodiversity, Biotechnology, Cleanliness and Environmental Sustainability at state and national levels and responsible for setting up Sabah Green Business Profile Information; listing companies involved in green technology and eco-product businesses which include Green Energy, Green Transport, Green Building, Waste Technology and Management, and Clean Water Technology and Management.
Member	Kota Kinabalu City Hall (KKCH)	Mayor	The Mayor is responsible for the administration of KKCH and executing all the bylaws constituted under the local Government Ordinance, 1961. He is also tasked to guide KKCH to realize its vision for a "Nature Resort City: A Clean, Green and Livable City."
Member	Kementerian Kerajaan Tempatan Dan Perumahan (KKTP)—Ministry of Local Government and Housing (MIGH)	Setiausaha Tetap (Permanent secretary)	Ministry of Local Government and Housing is responsible for administrating statewide local authorities and the Town and Housing Development Board which deals with public housing and the State Town and Regional Planning Department.
Member	Jabatan Perlindungan Alam Sekitar (JPAS) Environment Protection Department (EPD)	Pengarah (Director)	The department plays a major role in advising the State Government through the Environment Protection Council on the strategies and action plans necessary to address current critical environmental issues, and to enhance environmental management in Sabah. The responsibilities include integrating environmental factors into the planning, regulation, and implementation of development activities and exploitation of natural resources, the protection of sensitive areas for the maintenance of environmental quality and stability, and enhancement of public awareness on the importance of environmental protection and conservation.

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Table A1.1 *continued*

Position	Agency	Designation	Function of Agency
Member	Unit Perancang Ekonomi Negeri (UPEN) State Economic Planning Unit (EPU)	Pengarah (Director)	UPEN Sabah has the responsibility to provide short-, medium-, and long-term strategic economic and physical planning and development for the State. This includes providing guidance to ensure all development meets socioeconomic objectives and addresses the national agenda of sustainability—economically, environmentally, and socially.
Member	Asian Development Bank (ADB)	Country Specialist	ADB introduced the development of Green Cities Action Plans (GCAP) under its Urban Operational Plan 2012–2020 to promote livable cities across Asia ("cities that are competitive, socially inclusive, and environmentally attractive"). GCAP is one of the programs designed to focus on integrating urban development and environment planning initiatives that can be rolled out across cities in Asia, with specific focus on the BIMP-EAGA region. This includes setting up urban management partnership programs as mechanisms to promote peer-to-peer learning on green cities.
Member	Centre for IMT-GT Subregional Cooperation (CIMT)	Deputy Director	ADB, one of IMT-GT's key development partners, actively supports CIMT. CIMT's principal objective is to accelerate subregional cooperation by providing a more cohesive institutional structure to coordinate and facilitate projects. It helps to strengthen coordination and consultation among IMT-GT institutions as well as provides institutional framework to support public and private sector activities. It improves facilitation and implementation of priority projects, and monitors them. It helps to establish and enhance external relations with potential investors and donors and develop useful databases of IMT-GT activities and enhance information dissemination within and outside the subregion.[a]
Member	BIMP-EAGA Facilitation Centre		The main functions of the BIMP-EAGA Facilitation Centre (BIMP-FC) are to provide technical/substantive support to the various BIMP-EAGA institutions through the BIMP-EAGA Central Secretariat, to coordinate, monitor and evaluate, and facilitate BIMP-EAGA programs, projects, and activities, to carry out research and advisory to contribute to the strategic development of BIMP-EAGA, to facilitate the flow of information within and outside the subregion, and to enhance external relations with BIMP-EAGA Development Partners, external partners, and potential investors.
Member	KKCH Planning Department	Director of Planning	The role and functions of the Planning Department are to prepare and implement a development plan of Kota Kinabalu City in the context of the socioeconomic, cultural, and natural aspects of the city, interpret the state and local development policies, assist in coordinating and promoting development investments of federal, state, and private agencies within the city, plan and implement a development program that is in line with local goals and the Agenda 21 which emphasizes community participation in development, to plan and manage the traffic and public transport system for effective and efficient mobilization, to provide information that can be used to maximize the natural resources of the city, to provide clear and effective guidelines for investments and to ensure the universal Paradigm of Design which is one of Malaysia's physical planning vision, in all aspects of planning and development.[b]

[a] Centre for IMT-GT Subregional Cooperation. About CIMT. http://imtgt.org/about-cimt/ (accessed 17 December 2018).
[b] DBKK. http://www.dbkk.sabah.gov.my/index.php/en/jabatan-unit/sektor-perancangan-dan-pembangunan2/jabatan-perancangan- bandaraya (accessed 17 December 2018).

Steering Committee

The Steering Committee is constituted at the city level to facilitate preparation of the KK GCAP in a manner that is consistent with the development priorities of the city. The Steering Committee is responsible for defining the scope of the KK GCAP and approving the provisions of the final KK GCAP. The steering committee will also periodically review the progress of KK GCAP preparation.

Table A1.2: Kota Kinabalu Green City Action Plan—Steering Committee Members and Roles

Position	Agency	Designation	Function of Agency
Chair	Kota Kinabalu City Hall	Mayor	The Mayor is responsible for the administration of KKCH and executing all the bylaws constituted under the local Government Ordinance, 1961. He is also tasked to guide KKCH to realize its vision for a "Nature Resort City: A Clean, Green and Livable City."
Member	Environment Protection Department	Director	The department plays a major role in advising the State Government through the Environment Protection Council on the strategies and action plans necessary to address critical environmental issues, and to enhance environmental management in Sabah. The responsibilities include integrating environmental factors into the planning, regulating, and implementation of development activities and exploitation of natural resources, protecting sensitive areas for the maintenance of environmental quality and stability, and enhancing public awareness on the importance of environmental protection and conservation.
Member	Unit Perancang Ekonomi negeri (uPEn) Economic Planning unit (EPu)	Director	uPEn Sabah has the responsibility to provide short-, medium-, and long-term strategic, economic, and physical planning and development for the State. This includes providing guidance to ensure all development meets stated socioeconomic objectives and addresses the national agenda for sustainability—economically, environmentally, and socially.
Member	BIMP-EAGA representative	Senior Representative	BIMP-EAGA was launched in 1994 as a cooperation initiative by Brunei Darussalam, Indonesia, Malaysia, and the Philippines, all of which are member countries of the regional Association of Southeast Asian Nations (ASEAN). The objective behind the creation of BIMP-EAGA is to accelerate economic development in the four countries' "focus areas" which, although geographically distant from their national capitals, are in strategic proximity to each other, in one of the world's most resource-rich regions. The BIMP-EAGA initiative is market-driven and operates through a decentralized organization structure involving the four governments and the private sector.
Member	ADB	Country Specialist	ADB introduced the development of Green Cities Action Plans (GCAP) under its Urban Operational Plan 2012–2020 to promote livable cities across Asia ("cities that are competitive, socially inclusive, and environmentally attractive"). GCAP is one of the programs designed to focus on integrating urban development and environment planning initiatives that can be rolled out across cities in Asia, with specific focus on the BIMP-EAGA region. This includes setting up urban management partnership programs as mechanisms to promote peer-to-peer learning on green cities. ADB is providing funds for the development of the GCAP.
Member	Centre for Indonesia–Malaysia–Thailand Subregional Cooperation (CIMT)	Deputy Director	ADB, one of IMT-GT's key development partners, actively supports CIMT, particularly in the area of economic research and development studies, technical advice, and financial assistance which includes the development of GCAPS across member nations.

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Table A1.2 *continued*

Position	Agency	Designation	Function of Agency
Member	Sustainable Energy Development Authority (SEDA)	Director	Sustainable Energy Development Authority of Malaysia (SEDA Malaysia) is a statutory body formed under the Sustainable Energy Development Authority Act 2011 (Act 726). The key role of SEDA is to administer and manage the implementation of the feed-in tariff mechanism which is mandated under the Renewable Energy Act 2011 (Act 725).
Member	Department of Irrigation and Drainage (DID)	Director	DID is responsible for a wide range of functions ranging from irrigation and agricultural drainage, coastal engineering, flood mitigation, main trunk drainage in urban areas, to State water resources management.
Member	KeTTHA (Ministry of Energy, Green Technology and Water)	Director	Initiate innovation and strategic resource management for sustainability in the provision of energy and water services. Also function as national advocate for green technology.
Member	Malaysia Green Building Confederation (MGBC) Sabah Chapter	Director	MGBC is supported by the professional, industrial, and government sectors to lead in the building industry, embracing responsible measures to realize energy savings, water conservation, a healthier indoor environment, better public connectivity, recycling of valuable resources, and provision of greenery in developments.
Member	University Malaysia Sabah	Chancellor	UMS EcoCampus Management Centre serves as a platform for the university to implement the EcoCampus Transformation Plan and to deliver: i) sustainable development, ii) ecological protection, iii) environmental compatibility, iv) resource conservation, and v) environmental stewardship.

APPENDIX 2

Notes on Shared Learning Dialogues

First Shared Learning Dialogue

The first shared learning dialogue (SLD) was held on 10 April 2018 in Kota Kinabalu City. The objective of the first SLD was to introduce stakeholders to the need and rationale behind the preparation of KK GCAP. The flexible methodology and process of KK GCAP preparation was also discussed in detail.

The stakeholders learned about the fundamentals of climate change and how it impacts the city of Kota Kinabalu and how climate change is exacerbating the existing vulnerability of the urban systems in the city. This SLD introduced the KK GCAP team to the local agencies and partners.

The SLD also clarified to all stakeholders the role and responsibility and institutional mechanism involved in the preparation of the KK GCAP. Stakeholders were informed that the entire process of KK GCAP preparation is stakeholder driven and iterative in nature. The dialogue also helped the KK GCAP team to identify and select the local agencies and institutions that would form the steering committee (Appendix 1). The stakeholders were encouraged to participate in the entire deliberation in order to build the local technical capacity to carry out a similar exercise in future, without much external support. Preliminary discussions were held on the qualitative and quantitative data requirements preparing the KK GCAP. The SLD provided an important opportunity to local and state-level departments and agencies to understand the importance of proper data base management systems and some of the related good practices.

As one of the important outcome of the first SLD, the important urban systems in Kota Kinabalu City were selected as KK GCAP sectors. Due consideration was given to the local priorities, existing development policies and programs while selecting these sectors. A total of 12 sectors were identified of which only 8 were finally selected based on mutual consensus among stakeholders. The broader issues and challenges of the selected KK GCAP sectors were discussed during the SLD. At the end of SLD, the KK GCAP team handed over the sector-wise data collection forms to representatives of concerned departments/agencies and requested them to compile data and information for baseline assessment and preparation of the KK GCAP.

Second Shared Learning Dialogue

The second SLD of KK GCAP was held on 11–12 July 2018 with an objective to conduct a vulnerability assessment, risk assessment, identification of green interventions, and prioritization of interventions for all selected eight priority sectors following a multi stakeholder's consultation process as per the IAP methodology. The preliminary findings of the GHG emission and data gaps were also discussed in detail with the 40 participating officials representing various agencies and departments of the public and private sector. Sector-wise working groups were formed during the SLD by categorically selecting officials with relevant subject background to facilitate productive discussions among with the stakeholders.

The KK GCAP team discussed natural disasters and hazards that have occurred in and around Kota Kinabalu and across the state of Sabah. Based on the detailed discussion among stakeholders, three climate risks have been identified for Kota Kinabalu City, including rise in temperature, frequent high intensity rainfall, and sea level rise.

In a subsequent technical session, stakeholders discussed the fragility of the urban sectors in terms of intrinsic issues and challenges for all the eight sectors. The main issues pertained to service delivery and lack of efficiency in management either due to aged infrastructure or lack of stringent innovative policies (Chapter 5). A climate impact assessment was carried out for the existing fragile urban sectors. The likelihood and consequences of each climate impact were scored based on the IAP methodology. Simultaneously, a sector-wise list of vulnerable and supporting actors (public and private sector institutions or local champions) was also identified and analyzed based on their level of awareness and ability to access resources and information.

In addition, the vulnerable areas among the rating zones of KKCH were identified for all sectors. Based on the sector-wise vulnerable areas, a set of vulnerable hotspots with multiple fragile sectors was also identified.

Finally, the list of green interventions, on the basis of their role in mitigation of GHG emissions and building the adaptive capacities and resilience of the urban systems was discussed. The interventions were categorized into soft measures and hard measures. All the green interventions were discussed in detail based on their feasibility and impact on resilience.

Third Shared Learning Dialogue

The third SLD was held on 19 September 2018 in the premises of KKCH. It was convened with the overall objective to present the progress and seek stakeholders' inputs on the findings of the GHG emission inventory and vulnerability assessment and review the long list of resilience interventions that have been prioritized.

During the session on GHG emissions inventory, the stakeholders raised two main points. First was to include the emissions from the aviation industry. The KK GCAP team clarified that the data collection forms circulated at the beginning of project did seek records on the domestic and international landing and takeoff during the inventory period. However, since there was no response despite regular follow-up from the concerned agencies, the inventory was prepared without the emissions from the aviation sector. However, the KK GCAP team further clarified that though the GHG emissions inventory of Kota Kinabalu City qualifies the basic level requirement as per the GPC protocol, the aviation sector emission is mandatory for the basic plus reporting of GPC.

In addition, stakeholders had questions about the methodology followed for the vulnerability assessment and risk assessment as some new public and private sector representatives were not present in earlier discussions. The KK GCAP team explained the methodology in detail. While the green interventions were prioritized based on the resilience, feasibility, and impact scores, due consideration was given to local strategic developmental priorities and interest. The financial implications and climate resilience benefits were also discussed in detail for each of the sector-wise long list and priority interventions. For each intervention, risks and opportunities particularly with respect to environment, social, and governance were also discussed.

In the transport sector, it was discussed that the first step the government should take would be to regularize the operation of the public transport system. The current system is inconsistent and inefficient and leads to an increase of private vehicles on the city roads. The entire system should be systematized by incorporating a self-sustaining business model that favors both individual bus operators and general public at large. It was further elaborated that efficient and timely public transport would encourage the public to switch from private vehicles to public transport.

Details of measures pertaining to integrated urban water management, affordable housing, and ESD were also discussed. Considering the high level of NRW, the SLD discussed the potential of implementing a comprehensive project around abatement of current NRW level and improving the overall water distribution systems. The need for deploying advanced wastewater treatment technologies was also discussed.

All stakeholders appreciated the Kota Kinabalu Industrial Park (KKIP) for having developed a comprehensive program on affordable housing which certainly increased the impact of KK GCAP. The poor and low-income households were identified as top vulnerable actors during the vulnerability assessment exercise in light of existing and future climate risks. Therefore it is essential to ensure proper, clean, and safe yet affordable housing. Interestingly, the proposed project includes implementation of industrialized building system technologies and sustainability measures which would make the project unique in the region and popular among institutional investors. KKIP along with its partners are reaching out to various other agencies and financing agencies to implement the first phase of the project.

The instrumental role of academic institutions including schools and higher education institutions in contributing to the objectives of KK GCAP was also discussed. A detailed program on the ESD has been designed, involving schools and higher education institutions as part of ongoing eco-campus and eco-school programs. A series of sensitization programs focusing on the information, education, and communication aspect of sustainability is also included in the project.

All stakeholders stressed the need for coordinating efforts to realize the Vision 2020 of KKCH and objectives of KK GCAP. All stakeholders were encouraged to regularly share updates of their progress and accomplishments on sustainability initiatives.

APPENDIX 3

Greenhouse Gas Emissions Inventory for Kota Kinabalu City, 2013/14–2017/18

I·C·L·E·I Local Governments for Sustainability

Community GHG and CAP Emissions Time Series Report

HEATplus
HARMONIZED EMISSIONS ANALYSIS TOOL

Local Authority	:	Municipal corporation in Kota Kinabalu
City	:	Kota Kinabalu
Year	:	2013,2014,2015,2016,2017
Country	:	Malaysia

HEATplus

Detailed Energy Consumption by Year

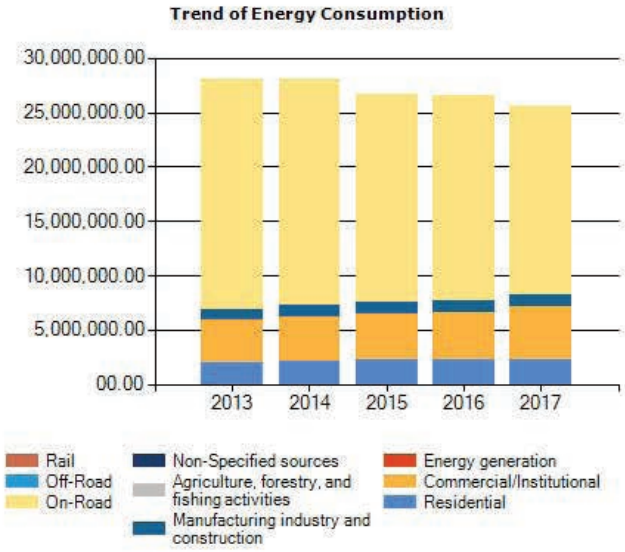
Sector	Energy Source	Consumption by Year 2013	2014	2015	2016	2017	Units	% Change in Consumption
1.0 Stationary Units								
1.1 Residential	Electricity(grid average)	545,000	563,000	614,000	596,000	620,000	MWh	14
	Kerosene	63	147	93	95	34	thousand liters	-46.03
	LPG	1,242	1,316	1,329	1,359	1,378	tonnes	11
1.2 Commercial/Institutional	Electricity(grid average)	1,041,000	1,080,000	1,115,000	1,142,000	1,188,000	MWh	14
	LPG	4,295	4,136	3,559	5,306	9,682	tonnes	125
	Natural gas	296,012	449,015	582,129	885,142	1,299,051	thousand liters	339
1.3 Manufacturing industry and construction	Electricity(grid average)	203,000	232,000	231,000	232,000	242,000	MWh	19
	Natural gas	5,952,424	6,323,339	6,922,159	6,274,422	6,341,633	thousand liters	7
2.0 Mobile Units (Transportation)								
2.1 On-Road	Diesel	303,308	288,140	235,511	224,288	203,232	thousand liters	-32.99
	Gasoline	285,642	296,649	303,913	310,727	291,096	thousand liters	2

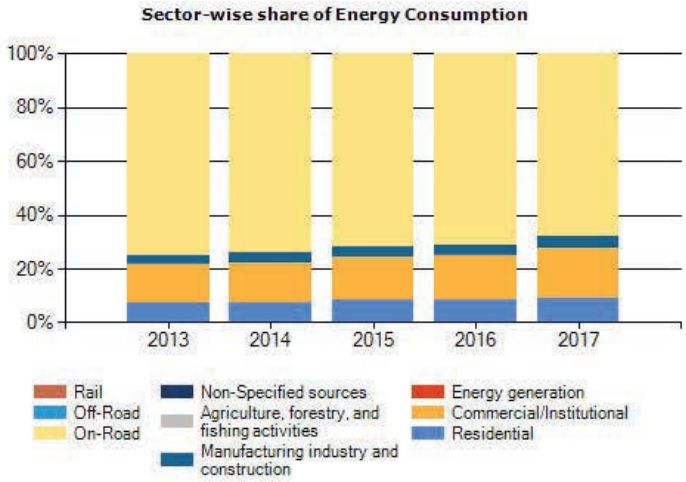
Activity Level by Year

Sector	Activity Particulars	Activity Data by Year 2013	2014	2015	2016	2017	Units	% Change in Activity Data
3.0 Waste								
3.1 Solid Waste Disposal	Wet Landfill	79,570	83,950	89,425	91,250	94,900	tonnes	19

Trend of Total Energy Consumption by Year

Sector	Energy Consumption by Year (GJ) 2013	2014	2015	2016	2017	% Change in Energy Consumption
1.0 Stationary Units						
1.1 Residential	2,023,011	2,094,316	2,276,600	2,213,291	2,298,409	14
1.2 Commercial/Institutional	3,961,827	4,100,406	4,204,069	4,395,211	4,783,263	21
1.3 Manufacturing industry and construction	952,611	1,070,833	1,089,547	1,069,010	1,107,515	16
2.0 Mobile Units (Transportation)						
2.1 On-Road	21,066,617	20,848,486	19,070,093	18,864,758	17,408,848	-17.36





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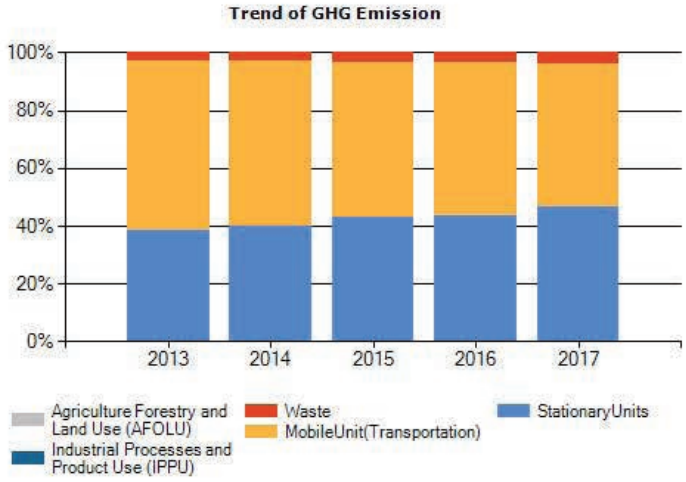
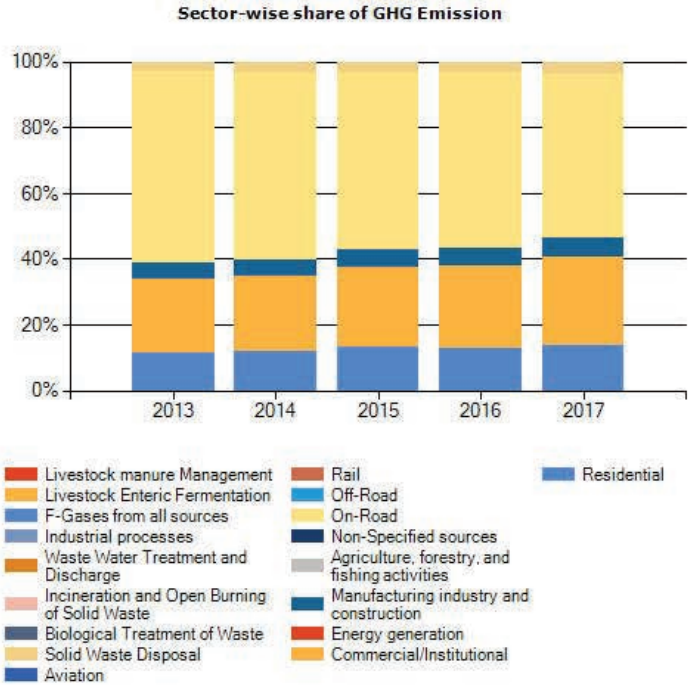
Trend of GHG Emission (tonnes) by Year at Community Level

Sector	GHG emissions by Year (in tonnes of CO_2e)					% Change in GHG emissions
	2013	2014	2015	2016	2017	
1.0 Stationary Units						
1.1 Residential	301,450	311,716	339,462	329,729	342,732	14
1.2 Commercial/Institutional	581,860	602,999	620,661	641,266	680,345	17
1.3 Manufacturing industry and construction	123,316	139,927	140,637	139,825	145,426	18
2.0 Mobile Units (Transportation)						
2.1 On-Road	1,520,570	1,502,611	1,369,274	1,352,931	1,247,827	-17.94
3.0 Waste						
3.1 Solid Waste Disposal	77,646	81,920	87,263	89,044	92,605	19





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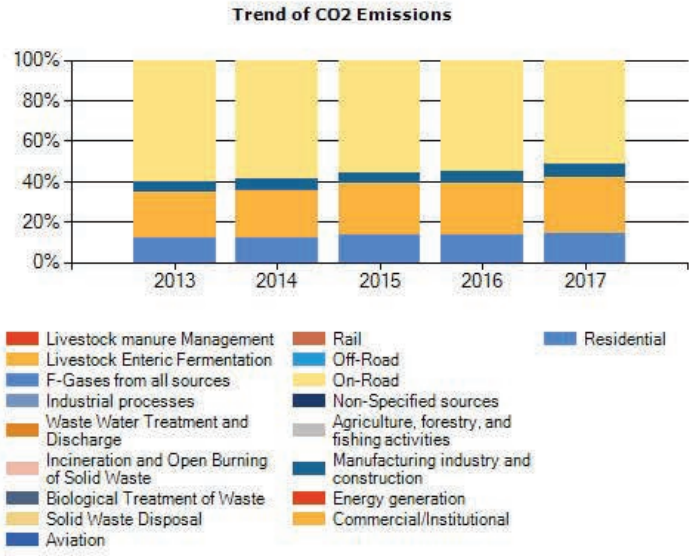
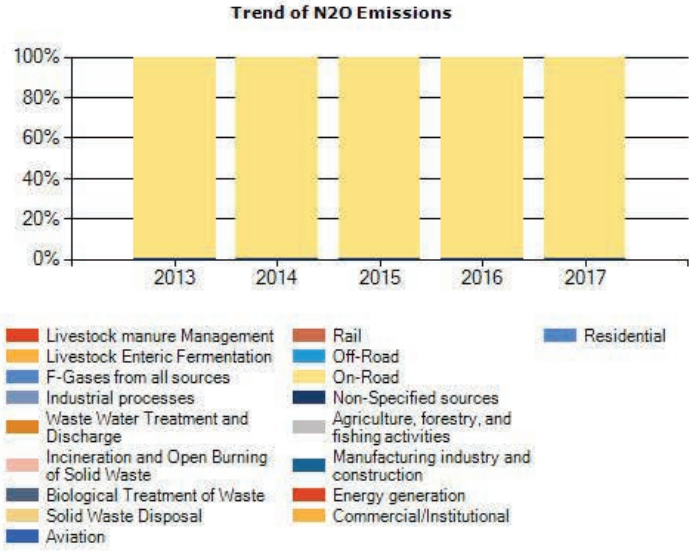
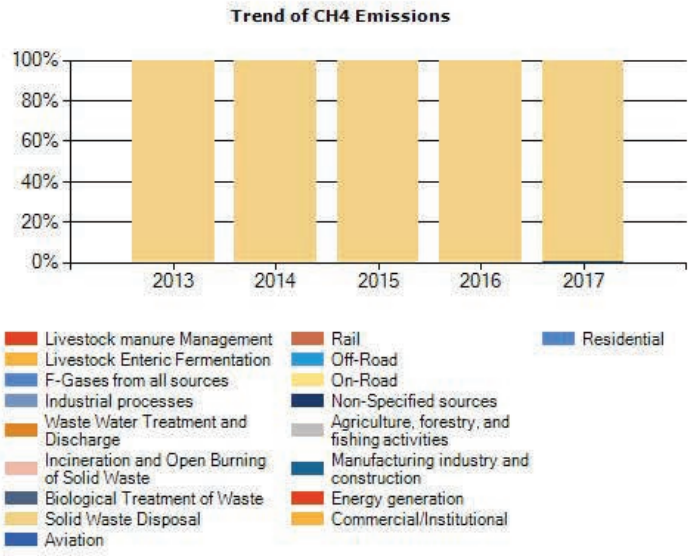
Sector-wise GHG emission (tonnes) by Year from Community Actions

Sector	GHG emissions	Carbon Dioxide (CO2)	Methane (CH4)	Nitrous Oxide (N2O)
1.0 Stationary Units				
1.1 Residential	**2013**	301,440	0.32	0.01
	2014	311,704	0.36	0.01
	2015	339,450	0.35	0.01
	2016	329,717	0.36	0.01
	2017	342,721	0.34	0.01
1.2 Commercial/Institutional	**2013**	581,827	1	0.02
	2014	602,966	1	0.02
	2015	620,631	0.95	0.02
	2016	641,222	1	0.03
	2017	680,267	3	0.05
1.3 Manufacturing industry and construction	**2013**	123,282	1	0.02
	2014	139,891	1	0.02
	2015	140,597	1	0.03
	2016	139,789	1	0.02
	2017	145,389	1	0.02
2.0 Mobile Units (Transportation)				
2.1 On-Road	**2013**	1,515,750	42	13
	2014	1,497,841	42	13
	2015	1,364,910	38	11
	2016	1,348,615	38	11
	2017	1,243,844	35	10
3.0 Waste				
3.1 Solid Waste Disposal	**2013**	—	3,106	—
	2014	—	3,277	—
	2015	—	3,491	—
	2016	—	3,562	—
	2017	—	3,704	—



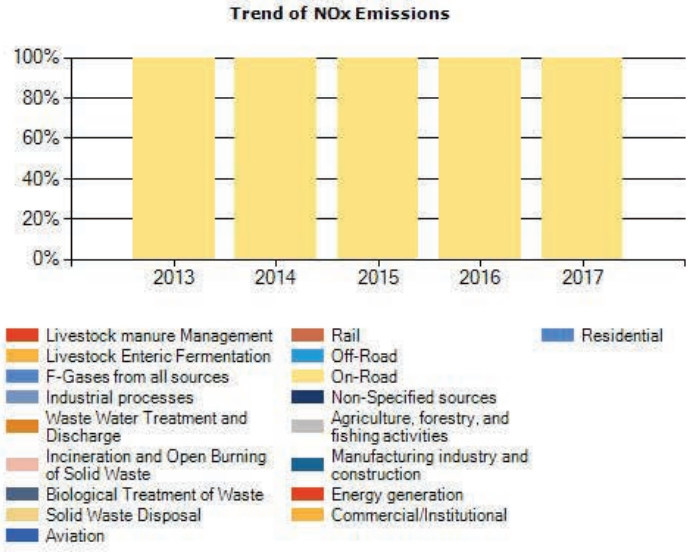




HEATplus

Sector-wise CAP emission (tonnes) by Year from Community Actions

Sector		CAP emissions	Carbon Monoxide (CO)	Nitrogen Oxide (NOx)	PM10	PM2.5	SOx	TSP	VOC
1.0 Stationary Units									
1.1 Residential	**2013**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	2014	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	2016	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
1.2 Commercial/Institutional	**2013**	4	0.00	0.00	0.00	0.00	0.00	0.00	
	2014	7	0.00	0.00	0.00	0.00	0.00	0.00	
	2015	9	0.00	0.00	0.00	0.00	0.00	0.00	
	2016	13	0.00	0.00	0.00	0.00	0.00	0.00	
	2017	19	0.00	0.00	0.00	0.00	0.00	0.00	
1.3 Manufacturing industry and construction	**2013**	89	0.00	0.00	0.00	0.00	0.00	0.00	
	2014	94	0.00	0.00	0.00	0.00	0.00	0.00	
	2015	103	0.00	0.00	0.00	0.00	0.00	0.00	
	2016	94	0.00	0.00	0.00	0.00	0.00	0.00	
	2017	95	0.00	0.00	0.00	0.00	0.00	0.00	
2.0 Mobile Units (Transportation)									
2.1 On-Road	**2013**	259,017	28,668	1,953	1,112	1,794	2,472	10,276	
	2014	268,580	27,820	1,891	1,077	1,734	2,394	10,516	
	2015	274,228	24,161	1,633	930	1,490	2,067	10,428	
	2016	280,119	23,503	1,585	903	1,445	2,007	10,567	
	2017	262,315	21,517	1,450	826	1,320	1,835	9,859	



APPENDIX 4

Climate Risk Assessment

The likelihood of occurrence of each climate fragility statement was assessed and corresponding scores were assigned on the basis of following the "Likelihood Rating and Scoring" (Table A4.1).

Table A4.1: Likelihood Rating and Scoring

Likelihood Rating	Description	Score
Almost Certain	Could occur several times per year—likelihood probably greater than 50%	5
Likely	May arise once per year—50/50 chance	4
Possible	May arise once in 10 years—probability less than 50% but still quite high	3
Unlikely	May arise once in 10 to 25 years—unlikely but should still be considered – probability significantly greater than zero	2
Rare	Unlikely in foreseeable future—negligible probability	1

The consequence rating for each climate fragility statement was assessed and corresponding scores were assigned on the basis of following the "Consequence Rating and Scoring" (Table A4.2).

Table A4.2: Consequence Rating and Scoring

Consequence Rating	Impact on System	Impact on City Government	Score
Catastrophic	System fails completely and is unable to deliver critical services, may lead to failure of other connected systems	Widespread loss of confidence and criticism in city government for failing to manage the crisis situation adequately	5
Major	Serious impact on the system's ability to deliver critical services, however not complete system failure	Loss of confidence and criticism in city government, ability to achieve city vision and mission seriously affected	4
Moderate	System experiences significant problems, but still able to deliver some degree of service	City government's reputation may be affected, possibly some political implications	3
Minor	Some minor problems experienced, reducing effective service delivery, possibly affecting certain other systems or groups	Minor impact on city government's reputation, no major problems with achieving vision and mission	2
Insignificant	Minimal impact on system—may require some review or repair, but still able to function	Minimal impact on reputation of city government, may present opportunity to review and improve system	1

The risk score (RS) was arrived by multiplying the "Likelihood" and "Consequence" score for each climate fragility statement. The risk status is based on the following risk matrix in Table A4.3.

Table A4.3: Summary of Risk Matrix

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Medium (RS* = 5)	Medium (RS = 10)	High (RS = 15)	Extreme (RS = 20)	Extreme (RS = 25)
Likely	Low (RS = 4)	Medium (RS = 8)	High (RS = 12)	High (RS = 16)	Extreme (RS = 20)
Possible	Low (RS = 3)	Medium (RS = 6)	Medium (RS = 9)	High (RS = 12)	High (RS = 15)
Unlikely	Low (RS = 2)	Low (RS = 4)	Medium (RS = 6)	Medium (RS = 8)	Medium (RS = 10)
Rare	Low (RS = 1)	Low (RS = 2)	Low (RS = 2)	Low (RS = 4)	Medium (RS = 5)

Source: ICLEI South Asia IAP methodology.

The risk status for all climate fragility statements is summarized in Table A4.4.

Table A4.4: Climate Fragility Risk Assessment

Urban System	Climate Fragility Statement	Likelihood (L)	Consequence (C)	Risk Score (L × C)	Risk Status
Land Use and Development	Increased Temperature: Policies do not address climate change impacts explicitly in the documents, thereby restricting action taken in the city on climate change. This may affect population adversely if temperature increases.	3	3	9	Medium
	Increased Precipitation: Higher rainfall and flash floods may restrict access to and cause serious damage to infrastructure (electricity, water supply, roads, flyovers) if planning and enforcement is not effective; for example, if stormwater outflow is not considered at the planning stage, it may lead to water logging in high rainfall scenarios.	4	3	12	High
	Sea Level Rise: Land use planning and development can be adversely impacted, since sea level rise can lead to land loss, impacting beach tourism and compromising beachfront infrastructure.	4	3	12	High

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Table A4.4 *continued*

Urban System	Climate Fragility Statement	Likelihood (L)	Consequence (C)	Risk Score (L × C)	Risk Status
Water Supply	Increased Temperature: Higher temperatures may lower efficiency of biological treatment systems. This can cause water and air pollution, and health impacts.	4	4	16	High
	Increased Precipitation: Increased rainfall may raise hydraulic load in treatment plants, leading to overflow of untreated sewage and cause water pollution and health impacts.	3	3	9	Medium
	Increased Precipitation: Increased rainfall events may increase floods and water logging, especially if drains are blocked with solid waste. This can cause knock-on impacts on health.	2	2	4	Low
Sewerage	Increased Temperature: Higher temperatures may increase the possibility of fire and odor from waste dumps. This would increase emissions and cause health impacts.	4	2	8	Medium
	Increased Precipitation: High rainfall events may cause pollution of water (groundwater and surface water) due to increased leachate generation and infiltration from the landfill.	5	3	15	High
Stormwater Drainage	Increased Temperature: Higher temperature may increase private vehicle usage, generating more emissions, impacting health and air quality.	5	3	15	High
Solid Waste	Increased Precipitation: Increased rainfall events (flash flood and landslides) may cause damage to roads, traffic congestion, accidents; resulting in an overall loss in economic productivity.	5	4	20	Extreme
	Increased Precipitation: Increased rainfall may adversely impact the access to general and emergency services.	5	4	20	Extreme
Transport	Increased Temperature: Higher temperature may increase private vehicle usage, generating more emissions, impacting health and air quality.	4	3	12	Medium
	Increased Precipitation: Increased rainfall events (flash flood and landslides) may cause damage to roads, traffic congestion, accidents; resulting in an overall loss in economic productivity.	5	5	25	Extreme
	Increased Precipitation: Increased rainfall may adversely impact the access to general and emergency services.	5	5	25	Extreme

Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall and stakeholders.

APPENDIX 5

Adaptive Capacity Assessment

The actors related to land use and development, sewerage, stormwater drainage, transport and solid waste sectors, and their adaptive capacities in the Kota Kinabalu Green City Action Plan, are detailed in Tables A5.1, A5.2, A5.3, A5.4, and A5.5.

Table A5.1: Land Use and Development

Actors	Capacity to Organize and Respond (A)	Access to Resources (B)	Access to Information (C)	Adaptive Capacity (A × B × C)
Residents	1	2	1	2
KKCH	2	2	3	12
JKR	3	3	3	27
DID	3	3	3	27
Health Ministry	3	3	3	27
SESB	2	3	2	12
Fire Department	3	3	3	27
Water Department	2	1	3	6

Source: ICLEI South Asia findings during the KK GCAP stakeholder consultation.

Table A5.2: Sewerage

Actors	Capacity to Organize and Respond (A)	Access to Resources (B)	Access to Information (C)	Adaptive Capacity (A × B × C)
General public	1	1	1	1
JKR	3	1	3	9
KKCH	3	1	3	9

Source: ICLEI South Asia findings during the KK GCAP stakeholder consultation.

APPENDIX 5

Table A5.3: Stormwater Drainage

Actors	Capacity to Organize and Respond (A)	Access to Resources (B)	Access to Information (C)	Adaptive Capacity (A × B × C)
General public	1	1	1	1
DID	2	3	3	18
KKCH	2	2	2	8
JKR	2	3	3	18
Schools	1	1	1	1
Hospitals	3	1	1	3
National Security Council	3	2	2	12
Fire brigade	3	2	2	12
Police	3	2	2	12

Source: ICLEI South Asia findings during the KK GCAP stakeholder consultation.

Table A5.4: Transport

Actors	Capacity to Organize and Respond (A)	Access to Resources (B)	Access to Information (C)	Adaptive Capacity (A × B × C)
Jabatan Kerja Raya (Public Works Department)	3	3	3	27
JPS	3	2	2	12
Kota Kinabalu City Hall	3	2	3	18
Emergency response	3	2	3	18
Hospital and clinics	1	1	1	1
Traffic police	1	1	1	1
General public	1	1	1	1
State Town and Regional Planning Department	3	3	3	27
People with no private vehicles	1	1	1	1

Source: ICLEI South Asia findings during the KK GCAP stakeholder consultation.

Table A5.5: Solid Waste

Actors	Capacity to Organize and Respond (A)	Access to Resources (B)	Access to Information (C)	Adaptive Capacity (A × B × C)
Residential areas (low-income groups)	1	1	1	1
Schools (primary)	1	1	2	2
Resort (Karambunai)	2	2	3	12
Fishery industry and/or Tourism industry	3	3	3	27
Hospital	3	3	3	27
Local authorities	3	3	3	27
General public	2	2	2	8

Source: ICLEI South Asia findings during the KK GCAP stakeholder consultation.

APPENDIX 6

Resilience Score of Kota Kinabalu Green City Action Plan Interventions

Table A6: Resilience Score of Kota Kinabalu Green City Action Plan Interventions

Sector Interventions	Resilience Score				Resilience Score (A+B+C+D)
	A	B	C	D	
	Flexibility—Intervention Helps System to Function in Different Climate Conditions	Redundancy—Intervention Helps to Provide Backup to System	Responsiveness—Intervention Helps System to Respond to Climate Stress	Access to Information—Intervention Helps Provide Info That May Be Used Later	
Land Use and Development					
Soft Measures					
Incorporation of climate change considerations in the city Master Plan and other relevant sectoral plans	1	1	1	0	3
Preparation of a comprehensive long- term coastal management plan along with climate-intelligent zoning considering current and future climate risks: Policy measures, structural engineering, and nature-based solutions should be included in the plan. It must take into consideration future sea level rise impacts and land loss.	1	1	1	1	4
Implement and enforce land use-related policies effectively	1	1	1	1	4
Formulation of working committees or associations and training them to respond quickly when flooding occurs to reduce damage	0	0	1	1	2
Regularly monitor residential areas in rainy season, particularly those that are prone to flooding	0	0	1	1	2
Conduct frequent site inspections of new construction sites to create awareness regarding water logging and prevent outbreak of diseases.	0	0	1	1	2
Organize awareness campaigns on proper response to floods and actions to be taken before, during, and after flooding for students, teachers, researchers, and the general public	0	0	1	1	2
Hard Measures					
Introduce sustainability initiatives in particularly vulnerable areas, e.g., Pulau Gaya islands with vulnerable populations; initiatives on water, wastewater management, solid waste management should be undertaken	1	1	1	0	3

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Table A6 *continued*

Sector Interventions	Resilience Score				Resilience Score (A+B+C+D)
	A	B	C	D	
	Flexibility—Intervention Helps System to Function in Different Climate Conditions	Redundancy—Intervention Helps to Provide Backup to System	Responsiveness—Intervention Helps System to Respond to Climate Stress	Access to Information—Intervention Helps Provide Info That May Be Used Later	
Build sustainability initiatives into newly developing areas to integrate climate resilient planning and development, e.g., in Jesselton Waterfront City	1	1	1	1	4
Redevelopment of old housing stock (more than 40 years old)	1	0	1	1	3
Development of green field social housing in areas along existing transport corridors, e.g., Telipok area lies along the northern corridor, and DBKK and JKR intend to improve the connectivity of this area to the corridor via an arterial network. Given this scenario and considering that adequate land is available for development of social housing, the Telipok area may be considered an appropriate location for transit-oriented development.	1	1	1	1	4
Protect treated water during all natural disasters, e.g., from floods	1	0	1	0	2
Water					
Soft Measures					
Preparation of integrated urban water management plan, to ensure reuse and recycling of wastewater, reduction in demand, and efficient use of existing resources.	1	1	1	1	4
Water Audit: Identification of water losses (technical and commercial) and leak detection (T&D and NRW) in bulk water supply system to promote water conservation	0	0	1	1	2
Implementation of tariff rationalization for water distribution and improved metering at areas with high consumption of water supply to increase cost recovery	0	0	1	1	2
Promote use of smart water saving fittings in residential and commercial complexes to promote conservation of water	1	1	1	1	4
Hard Measures					
Review of water metering system in the city and undertake corrective measures in case of errors in functioning for improving cost recovery	0	0	1	1	2
Upgradation of 50% of city water distribution network to ductile iron pipes with diameter range 100 mm to 900 mm for 24x7 water supply	0	1	0	0	1
Three SCADA systems for effective monitoring and information on water flows, to promote conservation and efficient use of water	0	0	1	1	2

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Table A6 *continued*

Sector Interventions	Resilience Score				Resilience Score (A+B+C+D)
	A	B	C	D	
	Flexibility—Intervention Helps System to Function in Different Climate Conditions	Redundancy—Intervention Helps to Provide Backup to System	Responsiveness—Intervention Helps System to Respond to Climate Stress	Access to Information—Intervention Helps Provide Info That May Be Used Later	
Use of power saver devices in the pump houses and booster stations; regular water-energy audits to be conducted to ensure proper functioning and taking timely corrective measures.	1	1	1	1	4
Twenty units of rainwater harvesting systems, particularly in municipal complexes, for groundwater recharge and reuse for nonpotable purposes. Promotion of household RWH structures, particularly in areas where piped supply is not available.	1	1	1	0	3
Sewerage and Stormwater Drainage					
Soft Measures					
Preparation of an erosion and sediment control plan	1	1	1	1	4
Strengthening institutional and technical capacity of city staff for effective operation and maintenance of sewerage system through regular training	0	0	1	1	2
Expedite the formation of new Sabah Sewerage Services Department so that more funds and manpower can be allocated to sewerage management	0	0	1	1	2
Revise sewerage tariff (currently at 20 cents/cubic meter) to a fair fee which can help sustain the new sewerage department financially	0	0	1	1	2
Systematic weather forecast monitoring for early warning systems to forewarn against high intensity rainfall events via text messages/community radio	0	0	1	1	2
General public—policy campaigns of no rubbish in drains; move out permanently or temporarily in case of flood	0	0	1	1	2
Increase public awareness on the importance of connecting to a centralized sewerage system for better management of sewage	0	0	0	1	1
Regularly update sewerage database	0	0	1	1	2
Hard Measures					
DEWAT systems to serve the remote and isolated areas	1	1	1	1	4
Inspect existing sewer pipeline regularly for maintenance	0	0	1	1	2
Improve landscape near sewage treatment systems to avoid root systems of plants from disrupting sewage lines	0	0	1	1	2

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Table A6 *continued*

Sector Interventions	Resilience Score				Resilience Score (A+B+C+D)
	A	B	C	D	
	Flexibility—Intervention Helps System to Function in Different Climate Conditions	Redundancy—Intervention Helps to Provide Backup to System	Responsiveness—Intervention Helps System to Respond to Climate Stress	Access to Information—Intervention Helps Provide Info That May Be Used Later	
Improve the design/technology of existing and new sewage treatment systems which can adapt to varying hydraulic loads	1	1	1	1	4
Install odor scrubber at existing and new sewage treatment plants and pumping station to reduce odor pollution due to rising temperature.	0	1	1	0	2
SCADA system for effective monitoring	1	0	1	1	3
Use of power saver devices in the sewerage treatment plants; regular water-energy audits to be conducted to ensure proper functioning and taking timely corrective measures.	1	0	1	1	3
Wastewater Recycling: Reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, etc.	1	1	1	0	3
Upgradation of urban drains to reinforced concrete drains, including deepening and widening of existing drains, depending on future rainfall projections	1	1	1	0	3
Increasing the number of culverts to facilitate drainage	1	1	0	0	2
Construction of detention basins to prevent flooding and facilitate retention of water	1	0	1	0	2
Installation of tidal gates and pumps	1	0	1	0	2
Residential complexes and other institutional buildings to have dual plumbing system for separation of grey and black water and promoting reuse of treated water	1	1	1	0	3
Transport					
Soft Measures					
Promote nonmotorized transport and other low emission vehicles	1	1	1	0	3
Preparation of the Kota Kinabalu City comprehensive mobility plan; develop transport corridors from Inamam to Telipok and Inamam toward Bukit Padang (up to Beverly Hills Town Centre), so that social housing can be developed around those nodes and corridors.	1	1	1	1	4
Enact a policy that will encourage the public to shift from private vehicle to public transport	1	1	0	1	3
Rationalization of operational route of buses and business model development	0	1	1	0	2

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Table A6 *continued*

Sector Interventions	Resilience Score				Resilience Score (A+B+C+D)
	A	B	C	D	
	Flexibility—Intervention Helps System to Function in Different Climate Conditions	Redundancy—Intervention Helps to Provide Backup to System	Responsiveness—Intervention Helps System to Respond to Climate Stress	Access to Information—Intervention Helps Provide Info That May Be Used Later	
Conduct outreach programs to educate the public regarding use of public transport. Disseminate real time information regarding bus routes and timings (TV, radio, strategic locations), engage with stakeholders (community, technical experts).	0	1	1	0	2
Establish a crisis management center to manage emergency situation of flooding and road blockage	0	0	1	1	2
Hard measures					
Procurement of 50 electric buses for electric mobility promotion	1	1	1	0	3
Solid Waste					
Soft Measures					
Preparation of a Kota Kinabalu City Holistic Waste Management Plan:					
(a) Comprehensive baseline report on current and future waste generation and composition from all sources	0	0	1	1	2
(b) To have a holistic waste management strategy addressing solid waste from all sources and characteristics (hazardous and nonhazardous)	1	1	1	1	4
Preparation of Reject Management Plan for utilization of output materials from proposed processing facility	1	0	1	1	3
Hard Measures					
Intensive household level segregation and collection of waste by involvement of self-help groups and official workers	1	1	1	0	3
Plan A: 100 TPD Biomethanation Plant and Material Recover Facility Action Plan to use high calorific value waste in the cement industry and recycling	1	1	1	0	3
Plan B: Integrated Waste Management Facility—800 TPD (Mechanical Biological Treatment, plastic recycling, e-waste recovery, C&D waste and rubber processing and waste-to-energy plant)	1	1	1	0	3
Energy					
Soft Measures					
Preparation of the city-wide energy efficiency strategy and action plan	1	1	1	1	4

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Table A6 *continued*

Sector Interventions	Resilience Score				Resilience Score (A+B+C+D)
	A	B	C	D	
	Flexibility—Intervention Helps System to Function in Different Climate Conditions	Redundancy—Intervention Helps to Provide Backup to System	Responsiveness—Intervention Helps System to Respond to Climate Stress	Access to Information—Intervention Helps Provide Info That May Be Used Later	
Hard Measures					
Installing units of 5–15 kW solar PV systems in various municipal office buildings categorized according to their monthly bills falling in the range of < 1,000 kWh, 1,000–2,000 kWh, and 2,000–5,000 kWh	1	1	1	0	3
Installing solar PV systems in 56 municipal schools	1	1	1	0	3
Use of solar water heaters in municipal hospitals, hotels, and restaurants for hot water requirement	1	1	1	0	3
Replacement of liquefied petroleum gas-fueled cooking stove to solar cooker	1	1	1	0	3
Deploy rooftop solar PV systems with inverter, for supplementing conventional power and for power supply during load-shedding hours, replacing DG sets	1	1	1	0	3
Solar steam cooker for cooking in schools, hostels, hotels, and restaurants	1	1	1	0	3
Replacement of conventional air conditioners with EE star rated air conditioners	1	1	1	0	3
Replacement of conventional refrigerators with EE star rated refrigerators	1	1	1	0	3
Replacement of conventional water pumps with EE water pumps	1	1	1	0	3
Replacement of conventional ceiling fans with efficient ceiling fans	1	1	1	0	3
Solar steam cooker for cooking in schools, hostels, hotels, and restaurants	1	1	1	0	3
Replacement of conventional air conditioners with EE star rated air conditioners	1	1	1	0	3
Replacement of conventional refrigerators with EE star rated refrigerators	1	1	1	0	3
Replacement of conventional water pumps with EE water pumps	1	1	1	0	3
Replacement of conventional ceiling fans with efficient ceiling fans	1	1	1	0	3

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Table A6 *continued*

Sector Interventions	Resilience Score				Resilience Score (A+B+C+D)
	A	B	C	D	
	Flexibility—Intervention Helps System to Function in Different Climate Conditions	Redundancy—Intervention Helps to Provide Backup to System	Responsiveness—Intervention Helps System to Respond to Climate Stress	Access to Information—Intervention Helps Provide Info That May Be Used Later	
Street Lighting					
Soft Measures					
Investment grid energy audit	1	1	1	1	4
Hard Measures					
Option 1: LED fixtures—no digital connectivity—10-year warranty option. Meters installed at the feeder panel are used for energy monitoring	1	1	1	0	3
Option 2: LED fixtures—individual point-to-point digital connectivity, addressability, and control through GSM technology hardware and software for network infrastructure with 10-year warranty	1	1	1	0	3
Option 3: LED fixtures—group digital connectivity control and voltage dimming at smart feeder panel (group connectivity). Hardware and software for network infrastructure with 10-year warranty	1	1	1	0	3
Option 4: 150 W HPS, 250 HPS, and 400 W luminaires are replaced by dimmable LED fixtures with point-to-point digital connectivity and 10-year warranty option	1	1	1	0	3
Buildings					
Soft Measures					
Social housing stock to be planned, considering public transport corridors, to facilitate transit-oriented development	1	1	1	1	4
Enforcement of KKCH Green Building Policy: All new building submission (both residential and nonresidential) shall comply with MS 1525* on Overall Thermal Transfer Value and roof insulation	1	1	1	1	4
Public awareness generation campaigns aimed at energy conservation practices	0	0	1	1	2
Regular energy auditing of all the public buildings	0	0	1	1	2
Regular energy auditing of all industrial units of KKIP	0	0	1	1	2
Pre-feasibility assessment of energy efficiency in residential and commercial buildings	0	0	1	1	2
Provision of training programs on energy efficiency and renewable energy to KKCH staff	0	0	1	1	2
Assessment for identifying potential for district cooling	0	0	1	1	2

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Table A6 *continued*

Sector Interventions	Resilience Score				Resilience Score (A+B+C+D)
	A	B	C	D	
	Flexibility—Intervention Helps System to Function in Different Climate Conditions	Redundancy—Intervention Helps to Provide Backup to System	Responsiveness—Intervention Helps System to Respond to Climate Stress	Access to Information—Intervention Helps Provide Info That May Be Used Later	
Hard Measures					
Construction of green affordable housing units for the low-income households	1	1	1	1	4
Energy management system: Includes programming, commissioning, and training	0	0	1	1	2
Replacement of electrical appliance (lights, fans, air conditioner, and refrigerator) in residential and commercial sectors	1	1	1	0	3
Building design: Implement shading systems to reduce solar glare and minimize solar heat gain in public buildings—utilize daylighting	1	1	1	0	3
Energy-efficient buildings: Advance metering infrastructure in all KKCH public buildings	1	1	1	0	3
Adaptive measures: White rooftops, with a reflective surface, as a measure to prevent heat ingress from the roof, resulting in cooler interiors	1	1	1	0	3

C&D = construction and demolition, DBKK = Dewan Bandaraya Kota Kinabalu, DEWAT = decentralized wastewater treatment, EE = energy-efficient, KKCH = Kota Kinabalu City Hall, KKIP = Kota Kinabalu Industrial Park, kWh = kilowatt-hour, LED = light-emitting diode, PV = photovoltaic, SCADA = Supervisory Control and Data Acquisition, TPD = ton per day.

Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall and stakeholders.

APPENDIX 7

Feasibility Score of Kota Kinabalu Green City Action Plan Interventions

Table A7: Feasibility Score of Kota Kinabalu Green City Action Plan Interventions

Sector Interventions	Feasibilty Score			Total Feasibility Score (1+2+3)
	1	2	3	
	Political (L—1, M—2, H—3)—**regulations are there/political will is there/socially acceptable**	**Technical** (L—1, M—2, H—3)**—technical capability is present in the KKCH or can be easily accessed**	**Financial** (L—1, M—2, H—3)**—financial resources are present or can be accessed easily**	
Land Use and Development				
Soft Measures				
Incorporation of climate change considerations in the city Master Plan and other relevant sectoral plans	2	3	3	8
Preparation of a comprehensive long-term coastal management plan along with climate-intelligent zoning considering current and future climate risks: Policy measures, structural engineering, and nature-based solutions should be included in the plan. It must take into consideration future sea level rise impacts and land loss.	2	2	2	6
Implement and enforce land use-related policies effectively	2	3	3	8
Formulation of working committees or associations and training them to respond quickly when flooding occurs to reduce damage	3	3	3	9
Regularly monitor residential areas in rainy season, particularly those which are prone to flooding	3	3	3	9
Conduct frequent site inspections of new construction sites to create awareness regarding water logging and prevent outbreak of diseases.	2	3	3	8
Organize awareness campaigns on proper response to floods and actions to be taken before, during, and after flooding for students, teachers, researchers, and the general public	3	3	3	9
Hard Measures				
Introduce sustainability initiatives in particularly vulnerable areas, e.g., Pulau Gaya islands with vulnerable populations; initiatives on water, wastewater management, and solid waste management should be undertaken	3	3	2	8
Build in sustainability initiatives in newly developing areas to integrate climate-resilient planning and development, e.g., Jesselton Waterfront City	3	3	2	8
Redevelopment of old housing stock (more than 40 years old)	3	3	2	8

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Table A7 *continued*

Sector Interventions	Feasibilty Score			Total Feasibility Score (1+2+3)
	1	2	3	
	Political (L—1, M—2, H—3)—**regulations are there/political will is there/socially acceptable**	**Technical** (L—1, M—2, H—3)**—technical capability is present in the KKCH or can be easily accessed**	**Financial** (L—1, M—2, H—3)**—financial resources are present or can be accessed easily**	
Development of green field social housing in areas along existing transport corridors, e.g., Telipok area lies along the northern corridor, and DBKK and JKR intend to improve the connectivity of this area to the corridor via an arterial network. Given this scenario and considering that adequate land is available for development of social housing, the Telipok area may be considered an appropriate location for transit-oriented development.	3	3	2	8
Protect treated water during all natural disasters, e.g., from floods	3	3	2	8
Water				
Soft Measures				
Preparation of integrated urban water management plan, to ensure reuse and recycling of wastewater, reduction in demand and efficient use of existing resources.	3	3	1	7
Water audit: Identification of water losses (technical and commercial) and leak detection (T&D and NRW) in bulk water supply system to promote water conservation	3	3	2	8
Implementation of tariff rationalization for water distribution and improved metering at areas with high consumption of water supply to increase cost recovery.	2	3	1	6
Promote use of smart water saving fittings in residential and commercial complexes to promote conservation of water.	3	3	1	7
Hard Measures				
Review of water metering system in the city and undertake corrective measures in case of errors in functioning for improving cost recovery	3	3	2	8
Upgradation of 50% of city water distribution network to ductile iron pipes with diameter range 100 mm to 900 mm for 24x7 water supply	3	3	1	7
Three SCADA systems for effective monitoring and information on water flows, to promote conservation and efficient use of water	3	3	1	7
Use of power saver devices in the pump houses and booster stations; regular water-energy audits to be conducted to ensure proper functioning and taking timely corrective measures.	3	3	2	8
Twenty units of rainwater harvesting systems, particularly in municipal complexes, for groundwater recharge and reuse for nonpotable purposes. Promotion of household RWH structures, particularly in areas where piped supply is not available.	3	3	2	8

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Table A7 *continued*

Sector Interventions	Feasibilty Score			Total Feasibility Score (1+2+3)
	1	2	3	
	Political (L—1, M—2, H—3)—**regulations are there/political will is there/socially acceptable**	**Technical** (L—1, M—2, H—3)**—technical capability is present in the KKCH or can be easily accessed**	**Financial** (L—1, M—2, H—3)**—financial resources are present or can be accessed easily**	
Sewerage and Stormwater Drainage				
Soft Measures				
Preparation of an erosion and sediment control plan	2	3	3	8
Strengthening institutional and technical capacity of city staff for effective operation and maintenance of sewerage system through regular training	3	3	3	9
Expedite the formation of new Sabah Sewerage Services Department so that more funds and manpower can be allocated to sewerage management	3	1	1	5
Revise sewerage tariff (currently at 20 cents/cubic meter) to a fair fee which can help sustain the new sewerage department financially	2	3	3	8
Systematic weather forecast monitoring for early warning systems to forewarn against high intensity rainfall events via text messages or community radio	3	3	2	8
General public: Policy campaigns of no rubbish in drains; move out permanently or temporarily in case of flood	3	3	2	8
Increase public awareness on the importance of connecting to a centralized sewerage system for better management of sewage	3	3	3	9
Regularly update sewerage network database	2	3	3	8
Hard Measures				
DEWAT systems to serve the remote and isolated areas	3	3	3	9
Inspect existing sewer pipeline regularly for maintenance	3	3	2	8
Improve landscape near sewage treatment systems to avoid root systems of plants from disrupting sewage lines	3	3	3	9
Improve the design or technology of existing and new sewage treatment systems which can adapt to varying hydraulic loads	2	3	1	6
Install odor scrubber at existing and new sewage treatment plants and pumping station to reduce odor pollution due to rising temperature	2	3	1	6
SCADA system for effective monitoring	2	3	1	6
Use of power saver devices in the sewerage treatment plants; regular water-energy audits to be conducted to ensure proper functioning and taking timely corrective measures	2	3	1	6
Wastewater Recycling: Reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, etc.	2	3	2	7

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Table A7 *continued*

Sector Interventions	Feasibilty Score			Total Feasibility Score (1+2+3)
	1	2	3	
	Political (L—1, M—2, H—3)—**regulations are there/political will is there/socially acceptable**	**Technical** (L—1, M—2, H—3)**—technical capability is present in the KKCH or can be easily accessed**	**Financial** (L—1, M—2, H—3)**—financial resources are present or can be accessed easily**	
Upgradation of urban drains to reinforced concrete drains, including deepening and widening of existing drains, depending on future rainfall projections	2	3	1	6
Increasing the number of culverts to facilitate drainage	2	3	1	6
Construction of detention basins to prevent flooding and facilitate retention of water	2	3	1	6
Installation of tidal gates and pumps	2	3	1	6
Residential complexes and other institutional buildings to have dual plumbing system for separation of grey and black water and promoting reuse of treated water	2	3	1	6
Transport				
Soft Measures				
Promote nonmotorized transport and other low-emission vehicles	2	3	1	6
Preparation of the Kota Kinabalu City comprehensive mobility plan; develop transport corridors from Inamam to Telipok and Inamam toward Bukit Padang (up to Beverly Hills Town Centre), so that social housing can be developed around those nodes and corridors	2	3	2	7
Enact a policy that will encourage the public to shift from private vehicle to public transport	2	3	1	6
Rationalization of operational route of buses and business model development	2	2	1	5
Conduct outreach programs to educate the public regarding use of public transport. Disseminate real time information regarding bus routes and timings (TV, radio, strategic locations), engage with stakeholders (community, technical experts)	2	2	2	6
Establish a crisis management center to manage emergency situation of flooding and road blockage	2	2	2	6
Hard Measures				
Procurement of 50 electric buses for electric mobility promotion	2	3	1	6
Solid Waste				
Soft Measures				
Preparation of a Kota Kinabalu City Holistic Waste Management Plan:				
(a) Comprehensive baseline report on current and future waste generation and composition from all sources	2	3	2	7
(b) To have a holistic waste management strategy addressing solid waste from all sources and characteristics (hazardous and nonhazardous)	2	3	1	6

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Table A7 *continued*

Sector Interventions	Feasibilty Score			Total Feasibility Score (1+2+3)
	1	2	3	
	Political (L—1, M—2, H—3)—**regulations are there/political will is there/socially acceptable**	**Technical** (L—1, M—2, H—3)**—technical capability is present in the KKCH or can be easily accessed**	**Financial** (L—1, M—2, H—3)**—financial resources are present or can be accessed easily**	
Preparation of Reject Management Plan for utilization of output materials from proposed processing facility	2	3	1	6
Hard Measures				
Intensive household level segregation and collection of waste by involvement of self-help groups and official workers	2	3	2	7
Plan A: 100 TPD Biomethanation Plant and Materials Recovery Facility Action Plan to use high calorific value waste in the cement industry and recycling	2	3	1	6
Plan B: Integrated Waste Management Facility—800 TPD (Mechanical Biological Treatment, plastic recycling, e-waste recovery, C&D waste and rubber processing, and waste-to-energy plant)	2	3	1	6
Energy				
Soft Measures				
Preparation of the city-wide energy efficiency strategy and action plan	3	3	2	8
Hard Measures				
Installing solar PV systems in 56 municipal schools	3	3	2	8
Use of solar water heaters in municipal hospitals, hotels, and restaurants for hot water requirement	2	3	2	7
Replacement of LPG-fueled cooking stove to solar cooker	2	3	2	7
Deploy rooftop solar PV systems with inverter, for supplementing conventional power and for power supply during load-shedding hours, replacing DG sets	2	3	2	7
Solar steam cooker for cooking in schools, hostels, hotels, and restaurants	2	3	1	6
Replacement of conventional air conditioners with EE star rated ACs	2	3	1	6
Replacement of conventional refrigerators with EE star rated refrigerators	2	3	2	7
Replacement of conventional water pumps with EE water pumps	2	3	3	8
Replacement of conventional ceiling fans with efficient ceiling fans	2	3	3	8
Replacement of conventional water pumps with EE water pumps	2	3	3	8
Replacement of conventional ceiling fans with efficient ceiling fans	2	3	3	8

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Table A7 *continued*

Sector Interventions	Feasibilty Score			Total Feasibility Score (1+2+3)
	1	2	3	
	Political (L—1, M—2, H—3)—regulations are there/political will is there/socially acceptable	Technical (L—1, M—2, H—3)—technical capability is present in the KKCH or can be easily accessed	Financial (L—1, M—2, H—3)—financial resources are present or can be accessed easily	
Street Lighting				
Soft Measures				
Investment grid energy audit	2	3	1	6
Hard Measures				
Option 1: LED fixtures—no digital connectivity—10-year warranty option. Meters installed at the feeder panel are used for energy monitoring	3	3	1	7
Option 2: LED fixtures—individual point-to-point digital connectivity, addressability and control through GSM technology hardware and software for network infrastructure with 10-year warranty	3	3	1	7
Option 3: LED fixtures—group digital connectivity control and voltage dimming at smart feeder panel (group connectivity). Hardware and software for network infrastructure with 10-year warranty	3	3	1	7
Option 4: 150 W HPS, 250 HPS, and 400 W luminaires are replaced by dimmable LED fixtures with point-to-point digital connectivity and 10-year warranty option	3	3	1	7
Buildings				
Soft Measures				
Social housing stock to be planned, considering public transport corridors, to facilitate transit-oriented development	3	3	1	7
Enforcement of KKCH Green Building Policy: All new building submissions (both residential and nonresidential) shall comply with MS 1525* on Overall Thermal Transfer Value and roof insulation	3	3	2	8
Public awareness generation campaigns aimed at energy conservation practices	3	3	2	8
Regular energy auditing of all the public buildings	2	3	1	6
Regular energy auditing of all industrial units of KKIP	2	3	1	6
Pre-feasibility assessment of energy efficiency in residential and commercial buildings	2	3	2	7
Provision of training programs on energy efficiency and renewable energy to KKCH staff	2	3	1	6
Assessment for identifying potential for district cooling	2	3	2	7
Hard Measures				
Construction of green affordable housing units for the low-income households	3	3	2	8
Energy Management System: Includes programming, commissioning, and training	2	3	2	7

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Table A7 *continued*

Sector Interventions	Feasibilty Score			Total Feasibility Score (1+2+3)
	1	2	3	
	Political (L—1, M—2, H—3)—**regulations are there/political will is there/socially acceptable**	**Technical** (L—1, M—2, H—3)**—technical capability is present in the KKCH or can be easily accessed**	**Financial** (L—1, M—2, H—3)**—financial resources are present or can be accessed easily**	
Replacement of electrical appliances (lights, fans, air conditioner, and refrigerator) in residential and commercial sector	3	3	2	8
Building design: Implement shading systems to reduce solar glare and minimize solar heat gain in public buildings—utilize daylighting	3	3	2	8
Energy efficient buildings: Advance metering infrastructure in all of the KKCH public buildings	3	3	1	7
Adaptive measures: White rooftops, with a reflective surface, as a measure to prevent heat ingress from the roof, resulting in cooler interiors	2	3	2	7

C&D = construction and demolition, DBKK = Dewan Bandaraya Kota Kinabalu, DEWAT = decentralized wastewater treatment, EE = energy-efficient, KKCH = Kota Kinabalu City Hall, KKIP = Kota Kinabalu Industrial Park, kWh = kilowatt-hour, LED = light-emitting diode, LPG = liquefied petroleum gas, MRF = materials recovery facility, PV = photovoltaic, SCADA = Supervisory Control and Data Acquisition, SDG = Sustainable Development Goal, TPD = ton per day, TRPD = Town and Regional Planning Department.

Source: ICLEI South Asia analysis based on information from Kota Kinabalu City Hall and stakeholders.

APPENDIX 8

Project Information Notes

Implementation of the Grid-Connected 100 Mega-Watt peak Solar Photovoltaic System

Background

The solar energy generation potential of Kota Kinabalu City is one of the highest in the country. This is due to the fact that the city accounts for one of the highest average annual solar radiation (around 4.2 kWh/m^2/day). The energy sector features in the list of vulnerable sectors in KK GCAP because of a number of inherent issues and challenges that the city is experiencing with regard to energy generation and distribution. Implementation of solar photovoltaic (SPV) systems has been prioritized in the long list of KK GCAP interventions, based on the overall mitigation potential, resilience potential, socioeconomic and technical feasibility, and resilience impact. SPV power plants generate clean electricity, using sunlight and thereby offsetting the GHG emissions produced by fossil-fuel-based power systems.

The Kota Kinabalu City Hall (KKCH), with support from the Sustainable Energy Development Authority (SEDA) has proposed to install 100 Mega-Watt peak grid-connected SPV systems in Kota Kinabalu City in the next 5 years. Currently, power production in the state of Sabah is predominantly coal- and natural-gas-based, which leads to significant emissions of carbon dioxide and other air pollutants. If the untapped solar energy potential is realized, the emissions of carbon dioxide and other toxic gases can be lowered significantly, which will in turn help to address environmental degradation. Every kilowatt of solar energy produced is thus a small but major step toward mitigating impacts of climate change and ensuring good air quality. This project will also contribute to the Malaysian national target of achieving 18% clean energy generation by the year 2030.

The proposed 100 Mega-Watt peak SPV power plant is estimated to generate about 132.60 million kWh of clean energy per year, which will in turn help to reduce 72,400 tons of GHG emissions per year. Many government and commercial buildings in Kota Kinabalu use diesel generator (DG) sets as standby power supply systems. The generation cost of electricity from DG sets is high. These DG sets also cause pollution due to fossil fuel combustion. SPV power plants generate electricity at a much lower cost than DG sets and can replace the DG set completely.

Project Summary

The objectives of the project are as follows:

(i) To generate clean electricity and offset GHG emissions generated by combustion of fossil fuels

(ii) To tap the potential of solar energy

(iii) To develop an alternate electricity supply system, thereby avoiding load-shedding hours

(iv) To reduce cost of electricity for consumers in the long run

(v) To reduce peak loads of conventional electricity consumption by substituting with solar power

Main Activities

It is proposed to install solar PV plants at several locations, on government-owned buildings and land, having a cumulative capacity of 100 MW. This would help develop a model renewable energy power system and set an example that will encourage entrepreneurs to invest in such projects. Trained manpower will be deployed to maintain the systems and explain about the benefits to the interested visitors/entrepreneurs.

Indicators of Achievement

Some of the potential indicators for project evaluation include

(i) Electricity generated annually and supplied to the grid

(ii) Reduction in peak demand of conventional electricity from grid

(iii) Reduction in electricity bills of associated buildings/entities

(iv) Reduction in annual GHG emissions resulting from electricity use

Target Beneficiaries

Beneficiary	Remarks
Public Authorities: Sabah Electricity Sdn Bhd Private Limited and KKCH	a) Energy consumption from grid is reduced and reduction of peak load demand. b) The success of the pilot SPV system will help in developing similar projects in future.
Industries, educational institutes, and commercial establishments	Potential project sites: Universiti Malaysia Sabah (UMS), Kota Kinabalu Industrial Park (KKIP), Kota Kinabalu City Hall (KKCH) Public buildings, Sabah government public buildings, Universiti Institut Teknologi Mara (UITM)—Kota Kinabalu Campus, Sabah Ports, Kota Kinabalu International Airport (KKIA)
Citizens	Citizens will benefit from reduction in load-shedding hours, better access to electricity, and reduced electricity cost. Indirect benefits include better public health due to reduction in combustion of fossil fuels.

Implementation Schedule

The implementation schedule for the project is as follows:

Activities/Year	2019	2020	2021	2022	2023
Application/clearance from local authority/ distribution licensees, etc.					
Procurement process					
Site survey to testing and commissioning can span from 2020 to 2022 and O&M and performance and data monitoring can span from 2020 until 2023					
Erection of array mounting structure					
Module mounting and cabling					
Connection to the grid					
Testing and commissioning					
Operation and maintenance					
Performance and data monitoring					

APPENDIX 8

Project Cost and Financing Details

The total cost of the project is estimated to be $138 million. The breakup of project costs are provided below:

Particulars	**Cost** ($ million)
Cost of systems hardware	120.4
Cost of transportation, insurance	3.6
Cost of civil works and electrical works	7.2
Cost of installation and commissioning	6.0
Cost of annual maintenance for 5 years	0.6
Any other related costs	0.2
Total	**138.0**

Contact Information

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Energy-Efficient Street Lighting Project in Kota Kinabalu

Background

Street lighting is one of most vital components of urban infrastructure. It is a basic facility provided by local governments to ensure better visibility, safety, and security in the city at nighttime. The streetlights in Kota Kinabalu City are operated by three local- and state-level entities, Kota Kinabalu City Hall (KKCH), Sabah Electricity Sdn Bhd (SESB), and Public Works Department (JKR). Electricity consumption of the street lighting system in Kota Kinabalu is quite high due to an inefficient system that is not designed to standards. Street lighting was identified as a vulnerable sector in the KK GCAP. This is primarily due to system and operational fragility, which warrants urgent action from the local government. Interventions that address street lighting were identified as high priority interventions in the KK GCAP. This ranking is based on overall mitigation potential, resilience potential, socioeconomic and technical feasibility, and resilience impact. The project is packaged to include a comprehensive audit of the street lighting infrastructure and an assessment of a mix of technology replacement options, based on the strategic development interests of the local and state governments. Typical technology replacement options include IED luminaires that are stand-alone systems without any digital connectivity or IED systems with point-to-point or group digital connectivity. Both systems can be deployed with or without dimming capability. Automatic timer technology can also be introduced—either photo sensor-based timers or mechanical timers can be introduced, either at each individual streetlight pole or at the feeder panel level. Smart feeder panels could also be introduced.

Provision of street lighting services is directly linked to energy demand. The cost for operation and maintenance of the system is borne by the local government. There is tremendous scope for energy saving, considering that the existing system is not energy-efficient. KKCH intends to switch to an advanced, energy-efficient, and automated street lighting system, thereby saving on significant levels of energy consumption and associated costs.

Street lighting is one of the major sources of energy consumption in the municipal area of Kota Kinabalu. The existing system in Kota Kinabalu consists of approximately 27,000 streetlights which are a mix of 70 W, 100 W, 150 W, 250 W, and 400 W high-pressure sodium lamps (HPSV) without automatic daylight controls.

The light emitting diode (LED) technology in street lighting offers a significant energy saving potential. In general, LED streetlights, considering a standard 10-hour operation, have a life of 10 plus years. The upfront cost of the IED streetlight is higher than the cost of an equivalent conventional lamp, however the energy consumption of LED lights is significantly less than conventional lamps, making it financially viable for local governments to invest in a IED streetlight system.

There are a number of financial and implementation models that can be adopted by local governments, based on their propensity to fund capital-intensive projects. Public–private partnership (PPP)-based models are usually adopted; implementation through an energy savings company, is one such example.

Project Summary

The main objective of this project is to reduce the energy consumption of the existing street lighting system in Kota Kinabalu City, by replacing the existing street lighting infrastructure with more efficient LED-based street lighting. In order to achieve this objective it is essential to design a suitable system, from a technology, finance, and maintenance standpoint, which is conducive to local circumstances and which also meets the requirements of applicable street lighting standards, such as the Minimum Energy Performance Standards of Malaysia.

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Main Activities

Project activities include:

(i) Investment-grade energy audit of the existing street lighting infrastructure
  (a) Assessment of existing luminaire asset inventory records
  (b) Sample field survey of street lighting infrastructure
(ii) Preparation of a feasibility report and detailed project report
(iii) Replacement of conventional lights with energy-efficient streetlights

Indicators of Achievement

Some indicators of achievements include

(i) Reduction in energy consumption: this project is expected to result in 60% to 70% reduction in the total,
(ii) Expenditure incurred for operating the existing street lighting infrastructure,
(iii) Reduction in incurred annual maintenance costs, and
(iv) Reduction in GHG emissions.

Target Beneficiaries

All three responsible entities will be direct beneficiaries of the project, i.e., KKCH, SESB, and JKR. Furthermore, citizens of Kota Kinabalu will benefit as well, as the quality and uniformity of light provided by a LED-based street lighting system is superior to an HPSV-based street lighting system.

Implementation Schedule

The implementation schedule of the project is as follows

Activities/Year	2019	2020	2021	2022	2023
Investment-grade energy audit					
Preparation of a feasibility report and detailed project report					
Replacement of conventional street lights with energy-efficient LED lights					

Project Cost and Financing Details

The total cost of the project is $19.41 million. The breakup of project costs is as follows:

Particulars	**Cost** ($ million)
Investment-grade energy audit	0.25
Preparation of the feasibility report and detailed project report	
Replacement of 27,000 high-pressure sodium lamps to energy-efficient lighting (capital expenditure)	19.16
Total	**19.41**

Contact Information

Primary contact details of the project proponent are as follows:

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APPENDIX 8

Integrated Public Transport System for Kota Kinabalu

Background

The public transport system in Kota Kinabalu is unregulated and dominated by private bus operators. Buses do not follow a fixed schedule, nor are the routes fixed. The tariff system is not transparent and ad hoc. These issues dissuade citizens from using the public bus system and increase their reliance on private modes of transport. Traffic congestion is also a critical problem in Kota Kinabalu City, owing to the high volume of personal cars.

The Kota Kinabalu City Hall has prepared two transport plans, namely the Kota Kinabalu Public Transport Master Plan and the Traffic Improvement and Urban Transport Master Plan for Kota Kinabalu Central Business District (CBD), in 2012. Though these plans aim to upgrade and enhance the city's public transport system to make it more systematic and efficient, the implementation of both these plans was delayed due to various technical and financial issues.

Kota Kinabalu has however implemented a well-planned pedestrian walkway and cycleway project. In its current phase it extends up to 24 km, from Tanjung Aru to University of Malaysia—Sabah, passing through the CBD area and heritage sites, i.e., Australian Place and Atkinson Tower. This project was successfully completed in 2014. In continuation, as per the Kota Kinabalu Cycleway master plan, the next phase of 11 km is proposed in two zones namely: Zone A—Jln Istiadat Likas–Jln Sport Complex–Pump house at Likas Bay; Zone B—Sport Complex Traffic Light–Jln Damai–Damai /Foh Sang Traffic Light–Damai/Foh Sang Traffic Light–Jln Kolam–Jln Penempatan–Bukit Padang Car Park.

The KK GCAP identified the transport sector as one of the sectors most vulnerable to potential impacts of climate change. Interventions related to strengthening the integrated public transport system were prioritized in the long list of interventions, based on the overall mitigation potential, resilience potential, socioeconomic and technical feasibility, and resilience impact. The project on preparation of the comprehensive mobility plan, for instance, received a very high score.

Based on the strategic development interest of the local and state governments, the integrated public transport system project for Kota Kinabalu has been packaged to include the preparation of requisite plans through detailed assessment of baseline situation, business models, assessment of bus rapid transit options, implementation of bicycle sharing systems, and electric mobility.

Project Summary

The objective of the project is to develop an efficient, accessible, safe, and environmentally-friendly transport system that caters to the need for public transport in the region.

Main Activities

Key activities include the following:

(i) Preparation of comprehensive mobility plan

(ii) Defining a business model and scheme for operating existing and proposed public transport facilities

(iii) Procurement of electric buses

(iv) Assessment of the feasibility for development of bus rapid transit (BRT) corridor and implementation of the same (if found feasible)

(v) Construction of a pedestrian/cycling track, in line with and beyond the proposed phase 2 of the Kota Kinabalu Cycleway master plan.

Indicators of Achievement

Increased ridership of the public bus system, cost per vehicle kilometer traveled in public buses, and increase in operational efficiency of the public bus system. Other qualitative indicators include rider comfort, travel speed, reliability, affordability, and customer satisfaction.

Target Beneficiaries

The Integrated Public Transport System project will significantly benefit citizens as well as operators, authorities, the tourists, and floating population. The project will help increase the mode share of public transport in the city.

Implementation Schedule

The implementation schedule for the Integrated Public Transport project is as follows

Activities/Year	2019	2020	2021	2022	2023
Preparation of the comprehensive mobility plan					
Defining a business model and scheme for operation of existing and proposed public transport facilities					
Procurement of electric buses and implementation of the public transport system					
Pedestrian/cycling track construction					
Bus Rapid Transit Corridor					

Project Cost and Financing Details

The total cost of the project is $35 million for the duration of 2019 to 2023 in the city of Kota Kinabalu. The breakup of project costs is as follows

Particulars	Cost ($ million)
Preparation of the comprehensive mobility action plan	1
Defining the business model and scheme for operation of existing and proposed public transport facilities	
Procurement of 50 electric buses and implementation of the integrated public transport system	28
Bus Rapid Transit Corridor[a]	n/a
Pedestrian/cycling track[b]	6
Total	**35**

[a] Detailed study required to identify feasible corridors, requisite infrastructure, and related costing.
[b] As per costs indicated by local landscape architects in Kota Kinabalu.

APPENDIX 8

Contact Information

Primary contact details of the project proponent are as follows:

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Integrated Solid Waste Management in Kota Kinabalu

Background

Management of solid waste is a major environmental and public health challenge in urban areas across the globe. This is compounded by the fact that owing to rapid urbanization and increasing living standards, solid waste generation in cities is constantly on the rise. Kota Kinabalu City is also grappling with the challenge of managing municipal solid waste. 600–900 metric tons of waste is generated per day and is transported and dumped at Kayu Madang Sanitary Landfill. This landfill is the only regional landfill serving the capital of Sabah and its neighboring districts; this landfill caters to a total population of about 1 million. At source, segregation of waste is not practiced by the citizens of Kota Kinabalu City, and its four neighboring districts (Penampang, Putatan, Tuaran, and Kota Belud). The incoming waste has significant quantities of recyclables, with a recovery potential of 70%.

Solid waste management figures as one of the urban service sectors most vulnerable to climate change. This is due to the inadequacy of the present system and the GHG emissions from the unmanaged landfill. Interventions that would result in improving the existing solid waste management system were prioritized due to their overall mitigation potential, resilience potential, socioeconomic and technical feasibility, and resilience impact. For instance, based on these criteria, the integrated 100 TPD biomethanation and materials recovery facility (MRF) was identified as a high priority intervention.

An integrated waste management approach ensures sustainable management of solid waste. This approach addresses all aspects of waste management, including generation, segregation, transfer, sorting, treatment, recovery, and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency.

It is proposed to establish an 800-ton per day integrated solid waste management facility in Kota Kinabalu, based on the design, build, finance, and operate (DBFO) model, with a project life of 30 years. An integrated facility is proposed to be constructed in an area of 20 acres within the KMSI. The facility will also include a sanitary landfill.

The integrated waste management facility will reduce the solid waste that reaches the landfill. Biodegradable waste will be diverted from the landfill, which will help reduce odor and reduce leachate generation and vermin problems at the landfill site. The choice of waste processing technology in the integrated facility should be based on a feasibility assessment, considering waste characteristics. This project information note document considers the costs of establishing a sorting and composting facility using mechanical biological treatment technology, plastic recycling plant, electronic waste recovery plant, recyclables buy-back center, construction and demolition waste processing plant, and rubber tire processing plant. This would enhance and improve the environmental performance of KMSI. A plastic recycling plant is proposed to be developed for processing various types of plastic wastes (polyethylene terephthalate, polypropylene pipe, high density polyethylene, LDPE). These will be converted into renewed plastics in the form of flakes or pellets. An e-waste recovery plant is also proposed to be included in the integrated facility. A buy-back center for sorted recyclables such as metals (ferrous and nonferrous), paper, glass, wire, and other recyclables should also be planned for. Units for processing construction and demolition (C&D) waste and waste tires should be included. Waste-to-energy technology could also be considered as a viable option and should be assessed for feasibility.

The implementation of the integrated solid waste management facility will result in

(i) Longer life of the landfill since only inerts will be disposed there

(ii) Better resource recovery:

(a) Biodegradable waste is converted into fertilizer or energy

(b) Plastic waste is recycled into pellets and used in the manufacturing industry

(c) Valuable metals are recovered from e-waste and the rest is disposed safely

(d) C&D waste is processed to make construction materials

(e) Processed rubber is used in the manufacturing sector

(iii) Waste-to-energy facilities are sources of alternate energy

(iv) Better public health due to improved waste management

(v) Waste management becomes a revenue-generating system and not a cost-intensive system.

Project Summary

The overall objective of solid waste management is efficient management of solid waste through maximum resource utilization (waste to resource and waste to energy) and minimal disposal of waste

Main Activities

The project is to be implemented in two phases.

Phase 1

(i) Develop a mechanical biological treatment-based compost plant that has a material recovery facility (MRF) or develop a waste-to-energy plant, based on feasibility

(ii) Develop a plastic recycling plant

(iii) Develop an e-waste recovery plant

(iv) Establish a buy-back center for sorted recyclables such as metals (ferrous and nonferrous), paper, glass, wires, and other sellable material

Phase 2

(i) Develop a construction and demolition (C&D) waste processing plant

(ii) Develop a used rubber tire processing plant

Indicators of Achievement

(i) Reduction in waste disposed at the landfill site (tons per day/annum)

(ii) Increased revenue from sale of compost/energy/RDF/recyclables

(iii) Reduction in GHG emissions from disposal of municipal solid waste

Target Beneficiaries

(i) KKCH—through implementation of scientific and environmentally sound waste management systems

(ii) Citizens—better solid waste management systems result in better public health and improved living conditions

Implementation Schedule

The design life of the integrated waste management facility is 30 years. The project is to be implemented over the next 5 years. The proposed implementation schedule is given below:

Activities/Year	2019	2020	2021	2022	2023
Preliminary contract activities between consignee and consigner					
Design and installation of plants[a]					
Testing and commissioning					
Operation and maintenance					

[a] Mechanical biological treatment, e-waste processing facility, and plastic waste processing plant to be designed, installed, and commissioned in the first 2 years (Phase 1). WTE plant, C&D plant, and rubber waste processing facility to be designed, installed, and commissioned by the 3rd year (Phase 2).

Project Cost and Financing Details

The project is projected to cost approximately $15 million, and could be implemented over a 36-month period. A viable PPP project could be structured to ensure successful implementation of this facility.

Contact Information

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Energy-Efficient Buildings Project in Kota Kinabalu

Background

Kota Kinabalu City has a vision to become a nature resort city; clean, green, and livable. This vision can only be achieved by ensuring a sustainably built environment. Buildings and facilities account for 28% of all energy consumed in Kota Kinabalu. KK GCAP has identified the buildings sector as one of the sectors most vulnerable to climate change impacts. Implementation of energy efficiency measures in buildings was included in the long list of interventions proposed in the KK GCAP. This intervention was given a "high" priority ranking based on the overall mitigation potential, resilience potential, socioeconomic and technical feasibility, and resilience impact.

The proposed project includes the preparation of an energy efficiency action plan, replacement of inefficient electrical appliances and a community awareness program. Strategic development interests of the local and state government were considered while designing this project.

The rapidly growing built environment has a major impact on energy consumption, both during construction and later, while in use. It is important to integrate energy-efficient technologies and strategies to reduce energy consumption, especially for lighting, cooling, and heating needs. It is better to invest in energy-efficient technologies than to invest in generation of electricity from fossil fuels, so as to move toward a low-carbon development pathway. It has been observed the capital investment requirements for energy efficiency improvements are significantly lower than the investment required for creating new sources of supply. Further, the payback period for energy efficiency investments is lower than the investment in energy generation. Thus, investing in energy-efficient buildings makes sense for a growing city like Kota Kinabalu.

The local and state governments are keen on enhancing energy efficiency in the existing building stock by implementing retrofit measures. They also aim to ensure that energy efficiency measures are planned and implemented in all new construction. This commitment was demonstrated by Kota Kinabalu City Hall (KKCH) by adopting the Green Building Policy, 2017 and by including the building sector as one of the priority sectors in the KK GCAP.

This project would result in

(i) Strengthened institutional capacities at various levels on the enactment and enforcement of the KKCH Green Building Policy and proposed energy efficiency strategy and action plan.

(ii) Enhanced technical capacity and expertise of local building practitioners and service providers.

(iii) A regulatory framework is in place and fiscal incentives are made available to investors and developers.

(iv) Readily available and easily accessible information on best practices regarding EE building technologies and measures.

(v) Increased understanding and awareness among public and private sector on the benefits of energy-efficient technologies.

(vi) Increased capacity of local professionals in the energy industry and creation of new job opportunities.

Project Summary

The overall objective of the project is to reduce energy consumption by enhancing energy efficiency in government offices, residential building, and commercial institutions and to demonstrate the benefits of energy-efficient strategies and technologies. The specific objectives are:

(i) Identify potential for energy efficiency in public buildings, residential and commercial properties by carrying out energy audits.

(ii) Enhance the capacity of KKCH as an institution to develop an Energy Efficiency Strategy and Action Plan with short-, medium-, and long-term measures, to reduce its energy burden.

(iii) Implement short term energy efficiency measures, derived from the strategy, to serve as pilots.

(iv) Share results with other institutions for replication and awareness generation.

Main Activities

The project activities include:

(i) Detailed analysis of the energy consumption in Kota Kinabalu buildings, and energy management and use.

(ii) Preparation of a city-wide Energy Efficiency Strategy and Action Plan.

(iii) Implementation of a pilot energy efficiency retrofit program, based on energy audits of selected buildings.

(iv) Design a financing scheme to ensure funding for implementation.

(v) Develop a communication plan to report on progress and share results with key stakeholders.

Indicators of Achievement

Some of the indicators of achievements include:

(i) Reduction in energy consumption in buildings sector (measured in % or million kWh)

(ii) Direct GHG emission reductions (measured in tCO_2e)

(iii) Increase in volume of investments in energy-efficient buildings in the buildings sector (measured in million $)

Target Beneficiaries

The project will benefit government agencies, utilities, building owners, industry, service providers, investors, and financial institutions. This project is designed to deploy a mix of soft and hard measures that would result in encouraging the market for energy-efficient buildings.

Implementation Schedule

Project activities are scheduled to be implemented from 2019 to 2023 in the first phase; the project could continue beyond 2023 based on the success of the first phase and contingent upon availability of funding.

Activities/Year	2019	2020	2021	2022	2023
Energy audit of selected buildings					
Kota Kinabalu Energy Efficiency Strategy and Action Plan					
Implementation of energy-efficient retrofit measures					
Awareness and training events on energy-efficient buildings					

Project Cost and Financing Details

The total cost of the project is $25 million. The breakup of project costs along with mitigation benefits of each action, where applicable, is as follows:

Activities	Number of Units	Cost ($ million)	Energy Saving (million kWh)	GHG Emissions Reduction (tCO_2e)
Energy audit of selected buildings	To be defined	Dependent on the number/ size/type of buildings	n/a	n/a
Kota Kinabalu Energy Efficiency Strategy and Action Plan	1	0.20	n/a	n/a
Implementation of energy efficiency retrofit program				
a) Super energy-efficient fans	136,514	11	19.93	10,882
b) Energy-efficient LED lights	273,028	0.55	22.92	12,515
c) Energy-efficient refrigeration (star rated)	10,239	9	3	1,639
d) Energy-efficient air conditioning (star rated)	10,239	4	6	3,278
Awareness and training events on energy-efficient buildings	50	0.25	NA	NA
Total		**25**	**52**	**28,314**

LED = light-emitting diode, n/a = not applicable.

Contact Information

Primary contact details of the project proponent are as follows:

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Education for Sustainable Development in Kota Kinabalu

Background

Education for Sustainable Development (ESD) supports environmental education, skill-based training, and certification in schools and colleges/institutions of higher education.

Community awareness generation and developing future leaders equipped with an understanding of renewable energy, energy efficiency, sustainability, and climate resilience is an integral part of all the interventions proposed in KK GCAP. The ESD project has been prioritized in KK GCAP, based on overall mitigation potential, resilience assessment, feasibility, and impact. Awareness campaigns for students, teachers, researchers, and citizens on flood response and actions to be taken before, during, and after flooding scored a high rank among the proposed list of resilience interventions. The project places emphasis on creating eco-schools and eco-campuses and includes a package of training and awareness generation activities in consonance with the interests of the local and state governments.

This project, conceptualized through the vulnerability assessment conducted in Kota Kinabalu City during the KK GCAP preparation, clearly identifies students, researchers, and teachers as key actors in addressing climate change. It includes the principles and approaches established in the "Eco-Schools Programme" which was first introduced during the United Nations Conference on Environment and Development, 1992 and launched 2 years later in Europe by the Foundation for Environmental Education, Europe.[1] It was launched in Malaysia in 2011 with WWF Malaysia being appointed as the national coordinator for the program. Similar to Eco-Schools, the FEE EcoCampus is an international award program that guides all third-level institutions on their sustainable journey, providing a simple framework to help make sustainability an integral part of campus life.[2]

The concept of ESD has already been factored in local policies and development programs, including for instance the Sabah Environmental Education Network 2005, Sabah Environmental Education Policy 2006, and the Communication, Education and Public Awareness (CEPA) Programme under Sustainable Development for Biodiversity and Ecosystem Conservation in Sabah (SDBEC) Project (2013–2017). Furthermore, Universiti Malaysia Sabah adopted the EcoCampus agenda in 2013, which incorporates due environmental considerations in the planning and activities of UMS.

Project Summary

The overall objective of the project is to provide information on the principles of sustainability thereby enabling change makers to contribute to the advancement of sustainable development.

Main Activities

The ESD project encourages students and teachers to take on larger responsibilities as leaders while teachers, parents, and others essay a largely supportive and assistive role. The ESD project adopts the following internationally recognized and approved seven-step process:[3]

(i) Formulation of the Eco-Committee

(ii) Carrying out Environmental Review

[1] The program is supported by members of the national eco-schools committee and currently have more than 120 schools registered in Malaysia. For more information, please visit; http://www.ecoschools.global/ (accessed 2 December 2018).

[2] http://www.ecoschools.global/ecocampus/ (accessed 2 December 2018).

[3] http://www.wwf.org.my/about_wwf/what_we_do/education_for_sustainable_development esd_/ecoschools/ (accessed 2 December 2018).

(iii) Action Plan development

(iv) Monitoring and evaluation

(v) Linking to the curriculum

(vi) Informing and involving

(vii) Developing an Eco-Code

In addition to carrying out the above activities in selected schools and higher educational institutions, students, teachers, and local community will be informed about the role of ESD, its benefits, and engaged through a series of targeted training and sensitization programs. A Monitoring and Evaluation Committee will subsequently assess the performance of the participating schools and higher educational institutions and winners will be announced every alternate year.

The ESD project empowers schools and higher education institutions to act as champions of a local sustainability movement. To qualify as an eco-school or eco-campus, the following parameters are monitored. The weight given to each parameter during monitoring and evaluation is also indicated:

(i) Environmental Sustainability Management [20%]

(ii) Public Awareness and Education [20%]

(iii) ICT and Innovation [20%]

(iv) Eco-Friendly Infrastructures and Nature Conservation [15%]

(v) Documentation and General Information Dissemination [15%]

(vi) Collaboration with Others [10%]

While there will not be any monetary incentives, the rankings will be acknowledged by the Ministry of Education and Innovation, Government of Sabah. KKCH is deemed as a strategic partner in terms of (1) promotion/ publicity; (2) joint acknowledgments of winners (prizes, incentives); and (3) provision of sponsorships, where possible. The UMS via the EcoCampus Management Centre, and its Strategic Partners will be part of the Monitoring and Evaluation Committee.

Indicators of Achievement

Activity-wise indicators for the ESD project are as follows:

Activities/Outcomes	Indicators
Formulation of Eco-Committee	a) Regular meetings of the Eco Committee (at least six to eight times a year) b) Meeting summaries are archived and shared with all the members
Environmental review	a) An Annual Environmental Review conducted regularly
The Action Plan	a) All the Eco-Committee members and beyond are consulted while preparation of action plan b) Action plan progress and implementation is monitored every year.
Monitoring and Evaluation	a) Report developed by the committee
Link to the curriculum	a) ESD is part of the course work and work taken up on the same is updated on the website of the institution

continued on next page

Table *continued*

Activities/Outcomes	Indicators
Inform and Involve	a) Everyone in school/college/university is aware of the ESD program b) At least 50% of the students and researchers participate regularly in ESD events and activities of their institutions
Produce an Eco-Code	a) Community feedback and inputs are incorporated in the Eco-Code b) The Eco-Code is shared on social media sites and media channels

Target Beneficiaries

The project will be implemented in five higher education institutions and 20 schools over the period of 2019 to 2023. The project follows an inclusive, participatory approach involving students, teachers, and the citizens at large. The target beneficiary population includes students and staff, local authority, local community, nongovernment organizations (NGOs), and the private sector and businesses.

Implementation Schedule

The project activities are scheduled to be implemented from 2019 to 2023 as a pilot initiative. It will be continued beyond 2023 based on the success of the pilot project and contingent to funding availability. The implementation schedule of the ESD project is as follows:

Activities/Year	2019	2020	2021	2022	2023
Seven step process implementation	* ^^^^	* ^^^^	* ^^^^	* ^^^^	* ^^^^
Number of training and sensitization events[a]	10	10	10	10	10
Awards and recognitions					

Note: Schools (^) Higher educational institutions (*).

[a] Locations of the training events will be conference halls of respective schools and higher education institutions.

Project Cost and Financing Details

The total cost of the project implementation between the years 2019 to 2023 is estimated to be is $2.62 million. The breakup of project costs and financing details are given in the table below.

S. No.	Particulars	Target Numbers of Campus/School	Intervention Cost per Unit ($)	1-Year Cost ($)	5-Year Cost ($)
1	Campus	5	25,000	125,000	625,000
2	Schools	20	10,000	200,000	1,000,000
A	Subtotal				1,625,000
	Particulars	**Training Per Year**	**Total Number of Training in 5 Years**	**Per Training Cost ($)**	**Total Cost of Training in 5 Years ($)**
B	Training and sensitization	10	50	20,000	1,000,000
A+B	**Total ESD Intervention Cost in Kota Kinabalu in 2019–2023**				**2,625,000**

ESD = Education for Sustainable Devleopment.

Source: ICLEI South Asia estimates based on discussions with stakeholders.

APPENDIX 8

Contact Information

The project proponent primary contact details are as follows:

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Reduction of Nonrevenue Water in Kota Kinabalu

Background

Kota Kinabalu City has high levels of NRW due to poor condition of the water distribution infrastructure and inefficient service management processes. There is significant gap between the total volume of water supplied to the network by the Sabah Water Department and the volume of water consumption that is billed. As per the estimates of Sabah Water Department, the current level of NRW stands at approximately 30%. There are a number of reasons for higher NRW, including leakages, un-registered water connections, and faulty bulk and service connection meters—all of which lead to increased operational costs and loss of revenue for the Sabah Water Department.

Water supply is one of the critical urban systems in Kota Kinabalu and is severely impacted by climate change risks. Water has thus been identified as one of the vulnerable sectors in KK GCAP. This is mainly due to the system design and operational fragility, which are further exacerbated due to climate change. Interventions focusing on water conservation and reduction of NRW have received a high ranking in the prioritization of interventions in KK GCAP, based on overall mitigation potential, resilience assessment, feasibility, and impact. Interventions on identification of losses (quantity as well as revenue) and leak detection (transmission and distribution losses and NRW) in the bulk water supply system emerged as high priority solutions.

There is significant scope for improving operational efficiencies across the water distribution system. NRW reduction would result in conserving water resources and reducing costs of operation. This would help improve water supply coverage, supply of adequate quantum and will ensure customer satisfaction. NRW reduction will contribute to the achievement of climate resilience objectives of the city. This project has been packaged to systematically include formulation of an interdepartmental working group or committee, preparation of a NRW action plan, and community awareness programs on water conservation. This project design is based on the strategic development interest of the local and state governments.

Implementation of the NRW action plan will result in

(i) Reduction in NRW

(ii) Improved availability of water resource

(iii) Increased revenue from the water supply service

(iv) Reduction in leakage, theft, and unbilled usage

(v) Improved water supply service management, monitoring, and delivery

(vi) Reduction in energy use and GHG emissions (due to reduction in amount of water that needs to be pumped for distribution)

Project Summary

The overall objective of the NRW reduction project is to develop an action plan, the implementation of which would decrease water losses and increase system efficiency.

Main Activities

The project activities include the following:

(i) Identification of core team and formulation of an interdepartmental NRW committee for identification of priority issues, measures, and to coordinate NRW reduction activities

(ii) Preparation of NRW action plan with clear strategies, resource requirements, and phase-wise implementation plan. A water audit will be conducted to inform the action plan.

(iii) Proper documentation and mapping of water supply system and its performance, including facilitation of ongoing annual status reporting

(iv) Conducting public awareness and education campaigns on water conservation, metering, and tariffs

Indicators of Achievement

The indicators for the achievement of NRW reduction are:

(i) Percentage of reduction in NRW

(ii) Increase in per capita water supply and continuity

(iii) Reduced cases of theft and leakage

(iv) Increased annual revenue from water supply services

Target Beneficiaries

The primary beneficiaries of the project are Kota Kinabalu City Hall (KKCH); Sabah Water Department; and domestic, industrial, and agricultural consumers.

Implementation Schedule

The implementation schedule of the NRW reduction program is as follows:

Activities/Year	2019	2020	2021	2022	2023
NRW Action Plan (water audit, developing action plan and setting targets and benchmarks)					
Forming a NRW management working committee					
NRW assessment					
Annual reporting					
Public awareness and education campaigns					

Project Cost and Financing Details

The total cost of the project is estimated to be $1.5 million for implementation between the years 2019 to 2023. The breakup of project costs and financing details are as follows:

Particulars	**Cost** ($ million)
NRW action plan	1.0
Awareness generation and education campaigns	0.5
Total	**1.5**

Contact Information

The primary contact details of the project proponent are as follows:

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Sustainability Initiatives in Pulau Gaya, Kota Kinabalu

Background

Pulau Gaya is the largest island in the Tunku Abdul Rahman Park near the coast of Kota Kinabalu. It has a strong cultural, historical, and strategic significance for the city of Kota Kinabalu. Almost 80% of the island is managed by the Sabah Parks, Government of Sabah while the rest is held privately. Pulau Gaya is considered as a future tourist hub.

Pulau Gaya incorporates five villages which are situated on the eastern side of the island. Delivery of municipal services to the island is a challenge as special networks and systems would need to be put in place. Since many of the inhabitants are not registered migrants, this adds an additional layer of complexity to the provision of services. With no access to services, inhabitants are forced to resort to unsanitary practices such as open defecation in the sea and on the islands and disposal of solid waste in the sea. This causes significant environmental degradation, impacting both water quality and marine biodiversity. Inhabitants are also contending with ensuing health issues.

In the KK GCAP, Pulau Gaya has been identified as a vulnerable area, particularly due to the lack of waste management systems and absence of sanitation facilities, among others. The inhabitants of the island lack access to regulated centralized municipal services and the unavailability of these services puts the whole island at risk. This vulnerability will further escalate due to climate change impacts expected in the coming years. The resilience measures proposed for Pulau Gaya island were assigned a “high” priority ranking in the long list of proposed KK GCAP interventions, based on their overall mitigation potential, resilience potential, socioeconomic and technical feasibility, and resilience impact. Setting up decentralized wastewater treatment systems ranked particularly high in the prioritization exercise. The proposed project has been packaged to include decentralized wastewater treatment, composting of organic waste, and deployment of a solar photovoltaic system. This intervention is well aligned with the strategic development interests of the local and state government.

Waste management is a key challenge faced by Pulau Gaya, particularly with regard to open littering of solid waste, disposal of mixed waste in open channels and on the shoreline, and occasional burning of plastic waste. The unscientific waste management affects the water quality inside the Tunku Abdul Rahman Park (TARP) while also posing direct health hazards. Establishing decentralized onsite treatment systems for solid waste can help effectively tackle Pulau Gaya’s waste management challenges. A wide range of economically viable decentralized systems with advanced treatment technologies are available in the market, to help combat the challenges and improve the adaptive capacity of the island’s residents.

This project proposes a set of sustainability measures for Pulau Gaya island and addresses solid waste management, sewerage systems, and sustainable energy supply.

Project Summary

The objective of the project is to improve basic service delivery in Pulau Gaya by implementing climate resilient and sustainable interventions.

Main Activities

The project covers sustainability measures across the solid waste, sewerage, and renewable energy sectors. The three selected measures under the project are as follows:

(i) Setting up five units of decentralized wastewater treatment systems of 100 KLD capacity each

(ii) Collection, segregation, and composting of solid waste by setting up four units of organic waste converter (OWC) with cumulative capacity of 10 tons per day in the villages of Lok Urai, Lobong Dan Kampung Pulau Gaya Asal, Kampung Gaya, and Kasuapan

(iii) Installing a 15 kilowatt solar photovoltaic system on the Pulau Gaya Government School

It is expected that the project will lead to the following benefits:

(i) Improved management of solid waste and wastewater

(ii) Improved water quality and reduced pollution

(iii) Production of compost from biodegradable waste

(iv) Improved access to clean power

Indicators of Achievement

(i) Indicators for decentralized wastewater treatment system

  (a) Reduction in number of reported cases of epidemics and vector borne diseases where decentralized wastewater treatment system are installed

  (b) Improved quality of marine waters

  (c) Treated wastewater meets prescribed quality standards

(ii) Indicators for solid waste management system

  (a) number of households covered by door-to-door/community waste collection

  (b) Reduction in quantity of waste disposed in marine waters/reaching the mainland dumpsite

  (c) Fertilizer, generated from processed biodegradable waste, used for horticulture in the island

  (d) Overall improvement in aesthetics, hygiene, and public health

(iii) Indicators for solar PV system

  (a) Measurable power output generated and consumed for captive purpose/supplied to the grid

  (b) Reduction in annual electricity demand and grid power consumption

  (c) Improved productivity during periods when grid power is not supplied

Target Beneficiaries

This project will be implemented in all five villages of Pulau Gaya island during the period of 2019 to 2023. Beneficiaries include island inhabitants, students/ school staff, and local authority.

Implementation Schedule

The implementation schedule of the Pulau Gaya project is as follows:

Activities/Year	2019	2020	2021	2022	2023
Setting up five units of decentralized wastewater treatment system with capacity of 100 kiloliters per day each					
Implementation of segregated collection and transport of solid waste to decentralized processing facility					
Installation of organic waste converter units for organic waste processing (four units, each with a capacity of 10 tons per day in the villages of Lok Urai, Lobong Dan Kampung Pulau Gaya Asal, Kampung Gaya, and Kasuapan, respectively)					
Installation of 15 kilowatt solar photovoltaic system in Pulau Gaya Government School					

Project Cost and Financing Details

The total cost of the project is estimated to be $3.47 million. The breakup of project costs is given in the table below.

Particulars	Cost ($)
Setting up five units of decentralized wastewater treatment system of 100 KLD capacity each	500,000
Implementation of segregated collection and transportation of solid waste	75,000
Installation of four organic waste converter units with capacity of 10 tons per day for organic waste processing in the villages of Lok Urai, Lobong Dan Kampung Pulau Gaya Asal, Kampung Gaya, and Kasuapan	2,857,143
Installation of 15 kWp solar photovoltaic system on the Pulau Gaya Government School	35,000
Total	**3,467,143**

Contact Information

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Jesselton Waterfront City

Background

Located near the heart of the city, Kota Kinabalu ("KK") Port is said to resemble the distinctive characteristics of Victoria and Albert Waterfront in Cape Town, South Africa given its strategic location and unique landscape setting, i.e., fronting the South China Sea with the mountain as the backdrop. Spanning over 75 acres of prime land, the entire KK Port land is in the process of being redeveloped into an integrated waterfront destination called the Jesselton Waterfront City ("JWC"), with a collective gross development value of at least RM9.2 billion.

JWC consists of five projects that complement each other, namely (1) Sabah International Convention Centre, (2) Kota Kinabalu Convention City, (3) Jesselton Quay, (4) One Jesselton Waterfront, and (5) the proposed international cruise and ferry terminal. Set to become the city's latest tourism frontier, JWC is poised to become the extension of the central business district of KK, a new city focus that is sustainable, attractive, accessible, and financially viable.

The first phase of JWC development commenced construction in December 2016 and completion is expected by 2031 when the last phase of the project, i.e., the proposed international cruise and ferry terminal is completed. In due time, KK Port will be transformed into a world-class waterfront destination that is set to elevate the competitiveness of KK City at the regional and international arena. This will help attract greater local and foreign investments, encourage more skilled and knowledge-based employment opportunities for the locals, and improve the level of amenity and livability of the city for its residents.

Given the magnitude and significance of JWC development, there is a need to incorporate green features within it to ensure sustainability and help KK City achieve green city status. Among the green projects that have been identified for potential implementation within JWC are a green cruise terminal, a green transport belt, water taxi service provision, construction of structures that comply with the Green Building Index ("GBI"), generation of renewable energy, and installation of a district cooling and heating system, waste management system ("IWMS") and rainwater harvesting system.

While these green initiatives are encouraging efforts to help achieve sustainability for KK City, it is acknowledged that the capital investments on the projects especially those requiring advanced technology are intensive. The population of KK and the traffic flow to JWC may not be substantial enough to justify such investments that may not generate sustainable returns to the investors. While developers of JWC who are private entities may commit to invest a certain amount of their profits on the green projects, grants and funding assistance will be required. Collaboration with DBKK and other agencies is equally as important to ensure success of the green projects.

Project Summary

The objectives of the projects are as follows:

(i) To have an environmentally-friendly cruise port infra and superstructure which reduces greenhouse gas emissions and dependence on traditional energy sources.

(ii) To reduce vehicular access within JWC, thereby reducing carbon emissions.

(iii) To generate solar energy as an alternative electricity supply system.

(iv) To reduce electricity and energy consumption.

(v) To reduce cost of electricity for consumers and operators in the long run.

(vi) To reduce waste and encourage recycling of waste.

(vii) To save water and reduce utility costs by recycling and reusing rainwater.

(viii) To help achieve green city accreditation for KK City.

Main Activities

Project activities include the following:

(i) To ensure that development of the green cruise terminal is well planned with the incorporation of key features such as sustainable energy supply, innovative reception facilities, and smart cruise port traffic solutions. This would also include extending the existing wharf of 350 meters to 700 meters and undertaking dredging works at the turning basin and approaching channel of KK Port to accommodate bigger cruise vessels so as to improve the seaside access to the cruise terminal.

(ii) To purchase boats and provide water taxi services as an alternative mode of transport to ease congestion and reduce vehicular access into JWC.

(iii) Detailed planning and design of the development layout to incorporate a green transport belt and a dedicated site for structures such as the district cooling and heating system, waste management system, and rainwater harvesting system.

(iv) To incorporate structures that comply with the GBI which include the use of sustainable green certified construction materials, energy-efficient or low voltage electrical fittings and appliances with timing devices for the buildings, green landscaping, etc. Green products will help in reducing energy consumption particularly in keeping indoor temperature cool.

(v) To adopt daylighting systems which help reduce electric lighting and save energy by controlling the admission of natural light, direct sunlight, and diffused skylight into a building. Through the use of daylight-responsive lighting control system and apertures such as skylights and windows, this system helps create a visually stimulating and productive environment for building occupants, while reducing as much as one-third of total building energy costs.

(vi) To install solar panels on the buildings and develop a solar system for the lighting especially in the common area.

(vii) To install a district cooling and heating system for air conditioning and water heater which would reduce energy loss and energy consumption. For district cooling system, the process begins by chilling water at a centralized plant. Chilled water is then pumped through a long piping network via underground to exchange heat in different buildings. The heat exchangers are used to transfer the chilling energy from the water, and cold air is then dissipated within the building via a typical fan coil unit and air handling units.

(viii) To reinforce litter-free compounds and waste segregation within JWC by implementing the necessary systems and providing the required materials.

(ix) To construct a rainwater harvesting system to collect, filter, store, and recycle rainwater for reuse within the JWC developments.

(x) To engage a consultant to conduct a feasibility study with detailed reports for each of the green projects proposed above.

Expected Outcome

(i) A new city development that is integrated, smart, green, and sustainable.

Indicators of Achievement

(i) A certified green cruise terminal.

(ii) Reduced vehicular access and increased usage of green public transport within JWC.

(iii) Adoption of water taxi services at JWC.

(iv) Reduced carbon emissions.

(v) Increased usage of green products in building construction.

(vi) Generation of solar energy to supplement electricity.

(vii) Reduced electricity and energy consumption (in electrical fittings, appliances, mechanical systems, etc.).

(viii) Reduced costs of electricity and water.

(ix) Reduced waste disposal at landfill site and improved segregation of waste for recycling purposes.

(x) Reduced usage of water from the mains supply.

Target Beneficiaries

The key beneficiaries of the projects will be

(i) Residents, operators, and building owners of the development due to reduced energy and water consumption and reduced costs of utility.

(ii) Passengers and the general public who patronize JWC and utilize the green cruise terminal, water taxi, and green public transport.

(iii) Public authorities such as SESB and DBKK due to reduction in energy consumption, reduction in waste disposal at landfill site, and improved traffic flow at the central business district.

(iv) KK City and its citizens as a whole.

Implementation Schedule

The implementation schedule of the projects is as follows:

Activities/Year	2019	2020	2021	2022	2023
Engagement of consultant to conduct feasibility study					
Completion of feasibility study and report by consultant					
Design and planning of the projects based on the feasibility study and report					
Implementation of the green projects identified based on the funding available					

Project Cost and Financing Details

Particulars	Cost ($ million)
Green cruise terminal	
– Extension of existing wharf from 350 meters to 700 meters to accommodate bigger cruise ships	50.0
– Dredging works at the turning basin and approaching channel of KK Port	14.8
Purchase of boats for water taxi operation	5.3
Solar energy generation system	3.0
Green building, daylighting system	2.0
District cooling system	14.2
Rainwater harvesting system	2.0
Total	**91.3**

Notes: Exchange rate as at 21 May 2019, $1 to MYR4.20. The above are estimates of project costs which are subject to change. Implementation will be subject to availability of grants or funding assistance and whether the projects would be feasible to generate returns on investments. The green projects identified for JWC are still at a very preliminary stage of design and planning and the engagement of a technical consultant is required to conduct the feasibility study and prepare the proposal for the green projects. The actual project cost and financial details of the respective green projects proposed will only be more accurately established at a later stage after the feasibility study is completed.

Contact Information

The primary contact details of the project proponent are as follows:

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