Climate Technology Centre Network (CTCN) Technical Assistance

for the Development of a Climate-Smart City in Kurunegala, Sri Lanka

Roadmap Report for the Transition to a Low Emission Municipality

"to support the implementation of the priority climate technologies"

CTCN Request No. 2019000048

Vol. 5

December 2020

Kurunegala, Sri Lanka

Contributing researchers:

Mr. Soon-chul Jung, General Manager, Econetwork(Inc.)
Ms. Jeong-lyoung, Ryu, CEO, Econetwork(Inc.)
Dr. Lizzy Seo, Senior Researcher, Econetwork(Inc.)
Mr. Whi-lim, Son, Senior Researcher, Econetwork(Inc.)
Mr. Yunho Choi, Senior Researcher, Econetwork(Inc.)
Mr. Gi-hun Kim, Researcher, Econetwork(Inc.)
Mr. Hwansu Kim, Researcher, Econetwork(Inc.)
Ms. Jung Nahyun Seo, Researcher, Econetwork(Inc.)
Ms. Jisun Lee, Researcher, Econetwork(Inc.)
Eng. Samantha Kumarasena, CEO, National Cleaner Production Centre Sri Lanka
Eng. Ruwan Wijemanne, Energy Expert, National Cleaner Production Centre Sri Lanka
Ms. Nisansala Ranundeniya, RECP Expert, National Cleaner Production Centre Sri Lanka
Eng. M.M.Munsif, RECP Engineer, National Cleaner Production Centre Sri Lanka
Ms. Harshini Rananjali, RECP Technologist, National Cleaner Production Centre Sri Lanka

Coordinated and report reviewed by:

Mr. Pradeep Thillekeratne, Municipal Commissioner, Kurunegala Municipal Council
Dr. Priyantha Muthunayake, Chief Medical Officer of Health, Kurunegala Municipal
Ms. Kumudini Vidyalankara, Director, Climate Change Secretariat, Ministry of Environment
Ms. Hasula Wickremasinghe, Program Assistant, Climate Change Secretariat, Ministry of Environment

CTCN
CLIMATE TECHNOLOGY CENTRE & NETWORK

eco ne-I-work

The Climate Technology Centre & Network (CTCN) has provided Technical Assistance to Kurunegala Municipal Council (KMC) and Ministry of Environment in Sri Lanka through pro-bono support from Econetwork and Green Technology Center in the Republic of Korea.

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AHP	Analytic Hierarchy Process
BRT	Bus Rapid Transit
CCS	Climate Change Secretariat
CDM	Clean Development Mechanism
CEB	Ceylon Electricity Board
CEDAW	Convention on Elimination of all forms of Discrimination Against Women
CPS	Country Partnership Strategy
CTCN	Climate Technology Centre and Network
DOC	Degradable Organic Carbon
ESCO	Energy Service Company
ESS	Energy Storage System
FCEV	Fuel Cell Vehicle
GCF	Green Climate Fund
GHG	Greenhouse Gas
HEV	Hybrid Electric Vehicle
IEA	International Energy Agency
INDC	Intended Nationally Determined
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change
KAP	Knowledge, Attitude, and Practices survey
KEITI	Korea Environmental Industry and Technology Institute
KMC	Kurunegala Municipal Council
KOICA	Korea International Cooperation Agency
KPI	Key Performance Indicator
LED	Light-emitting Diode
MSW	Municipal Solid Waste
NCPC	National Cleaner Production Centre
NRPS	National Rainwater Policy and Strategy
ODA	Official Development Assistance
PV	Photovoltaic
SDM	Sustainable Development Mechanism
SGBV	Sexual and Gender-based Violence
UDA	Urban Development Authority
UNFCCC	United Nations Framework
WHH	Women-Headed Household

TABLE OF CONTENTS

I. Introduction

1. Background and Objectives

The importance of responding to climate change is relevant worldwide because of its critical impact and influence on human life. To address this issue, the role of science and technology is emphasized as a solution and the technological development and transfer cooperation among countries are conducted as emphasized in Article 10 of the Paris Agreement.

Regarding climate change response and preparedness, the International Energy Agency reported that two-thirds of global GHG emissions from energy consumption were emitted in cities (IEA, 2008) and that the total GHG emissions of developing countries have exceeded that of developed countries. Because of the climate change vulnerability of developing countries, in which economic and social infrastructures are not fully developed, those cities in developing countries must act to prevent further adverse impacts of climate change (Korean Institute for International Economic Policy, 2014).

Sri Lanka, as one of the developing countries, is vulnerable to climate change because of the geographical characteristics of the island. The result has been severe damage to human life, food security, and ecosystems because of the increase in the frequency and intensity of droughts, floods, and landslides; difficulty in climate forecasting; and rising temperatures and water levels (Korea Institute for International Economic Policy, 2017). To mitigate the critical impact of climate change, Sri Lanka also intends to reduce its GHG emissions, against the business-as-usual scenario, unconditionally by 7% (energy sector 4%, other sectors 3%) and conditionally by 23% (energy sector 16%, other sectors 7%) by 2030. Sri Lanka submits its NDCs under four areas: mitigation, adaptation, loss, and damage, and means of implementation (CTCN, 2016).

Kurunegala City, located in the North-Western Province of Sri Lanka, is one of the most intensively developing economic and administrative capitals. The population growth rate of Kurunegala city is approximately 0.438%, which is relatively high, considering the residential area. Kurunegala is one of the central cities in Sri Lanka and is connected to main cities such as Colombo, Kandy, Dambulla, Negombo, Anuradhapura, and Trincomalee and Negombo. The geographical characteristic of the city and the condition of the roads cause severe traffic congestion, and the growing population increases energy consumption and the generation of waste. Representatively, GHG emissions are increasing because of rapid urban development in the city of Kurunegala, Sri Lanka. To address this issue, policymakers should promote the

introduction of climate technologies (low carbon developments strategies) and establish an action plan to reduce GHGs in the energy and transportation sectors in Kurunegala.

Initiated at the summit (2017) in commemoration of the 40th anniversary of diplomatic relations between the Republic of Korea and Sri Lanka, the former promised the latter that it would expand EDCF support and grant aid through KOICA until 2019 and, specifically, to actively support climate change responses with mentioning the key assumption of environment changes to forecast and preparedness from the Country Partnership Strategy.

Cooperation has been established between the two countries, and the vulnerability of Sri Lanka to climate change has been observed. Thus, this project supports the initial stage of Sri Lanka's development of climate change responses and preparedness through technical support. This support includes, for example, proposing a roadmap to climate technology introduction and financing plans to transform Kurunegala into a low-carbon climate-smart city.

Sri Lanka has recognized the global climate change problem and its adverse impacts and is committed to the global effort to reduce GHG. Becoming a low-carbon society has become one of the country's development objectives, and they expect to achieve it by 2050. To achieve the commitment of the NDCs, policymakers have devised high-level plans that address climate change mitigation, including a strategic plan. One of the key cross-cutting issues for implementation outlined in the master plan is the need for a robust database of sectoral GHG emissions and mitigation measures to facilitate scenario development and mitigation planning. The plan also outlines short-term actions, for example, "to identify greenhouse gas emissions reduction targets and capacity of each sector by 2020." Therefore, economic impact analysis for the reduction targets—assessing its potential effect on sectoral growth—is imperative for setting a reduction target that balances GHG mitigation and economic development.

The objectives of this roadmap are as follows:

- Collect the findings of policies and laws and the status of each sector to recommend pathways for the selected climate technologies.
- Provide a credible, robust evidence base on which policymakers and other stakeholders can base their decisions to achieve cost-effective and appropriate climate technology adoption in each sector.
- Enhance the capacity of policymakers and other stakeholders to act by recommending

short-, medium- and long-term actions that mitigate implementation barriers of climate technologies' adoption options and reduce GHG emissions while considering wider socioeconomic impacts. Here, a few aspects are highlighted, namely, those deemed crucial for a satisfactory understanding of the roadmap.

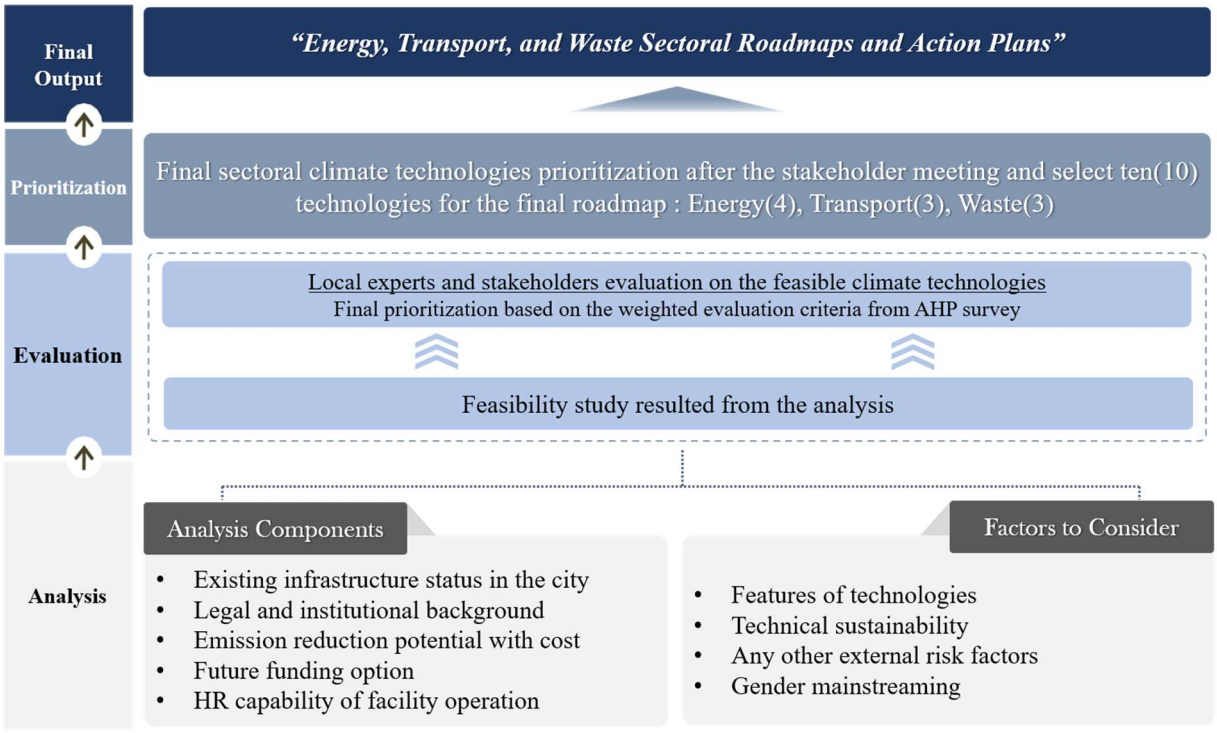
On the basis of the results from output 3 of this technical assistance—a prioritized climate technologies list—the roadmap is developed to introduce nine technologies in each energy, transportation, and waste sector. The roadmap outlines the steps to be followed to implement or adopt the prioritized technologies and approaches. The completed roadmap comprises sectoral-specific action plans as necessary.

II. Approach of Developing the Roadmaps

1. Basic Approach

The objective is to create a well-defined, detailed roadmap as the final output for the transition of Kurunegala to a low-carbon smart city. Prioritizing climate technologies for the energy, transportation, and waste sectors is a prerequisite to drawing out the optimal low-carbon options available to Kurunegala. Thus, this research employs a feasibility analysis to examine Kurunegala's various technological, economic, social, and environmental aspects.

Therefore, the basic approach to develop this roadmap is derived from the technology's prioritization based on situation analysis and evaluation through sectoral and regional experts.



[Basic approach to the roadmap's development]

2. Incorporating Gender Mainstreaming

A generalized gender assessment based on questionnaires was conducted. The result is in the Analysis report (ref). The questionnaire focused on the legal framework of gender mainstreaming in Sri Lanka and did not specifically relate to the energy, transport and waste sectors.

The key finding of the survey was that the government and stakeholders are in their initial stage of incorporating gender equality into policy, legal provisions, and employment, and gender mainstreaming's incorporation should be pursued in the context of realizing gender equality as means for reducing poverty, supporting inclusive growth and other broad development outcomes, and enhancing sustainability.

The project implementer incorporated the recommendations, which is based on the "Tool Kit on Gender Equality Results and Indicators" by the ADB and Australian Aid, for the gender mainstreaming in each sectoral action plan, to enable the local/national authority to set the indicators that reflect the goals, objectives, and expected results of a policy, program, project, or other type of initiative regarding gender mainstreaming, especially female workforce empowerment.

III. Developing GHG Inventory

1. Introduction

A GHG inventory is necessary to comprehend the total GHG emissions and contributions of each energy, transportation, and waste sector. Therefore, the project implementer prepared the GHG inventory format such that it includes the automatic formulation incorporated; thus, after the person-in-charge inputs the data, the GHG emissions are automatically calculated. The format is developed based on the 2006 IPCC Guidelines.

Due to the physical limitations of COVID-19 prevention measures, the data and information gathering were difficult. For example, curfews and restrictions to prevent the transfer to other regions or districts were implemented inside Sri Lanka and at its borders. Therefore, data availability and quality were the main challenges in developing the GHG inventory. Data collection was conducted by a local consultancy firm, National Cleaner Production Centre. The final version of the Kurunegala GHG Inventory will be submitted by incorporating the collected data into the format.

2. Result of the Estimation of GHG emissions

The GHG emissions in the Kurunegala city are calculated based on the general information and activity data collected by NCPC. The target year of quantification is set from 2017 to 2019.

The inventory of GHG emissions of Kurunegala city is identical from 2017 and 2019. The inventory of GHG emission is largely divided into 'Direct emission' and 'Indirect emission'. The 'Direct emission' is classified into the low level as 'Stationary Combustion', 'Mobile Combustion', 'Waste', and the 'Indirect emission is categorized to 'Electricity Use' and 'Heat Use'.

Owing to the restrictions to collect the actual data, the assumptions are applied in the calculation process.

- For Electrical vehicles, we have assumed that the electricity was used under commercial category
- To convert kgs to litres (LPG), 1l=0.516 kg factor was used
- For on-road transportation, fuel sales method was used for data collection. Induced and resident activity method were not used for this study due to lack of relevant data

And some components are excluded from the inventory boundary on account of data gaps. Biomass use is excluded from the boundary of GHG emissions because residents were not significantly using biomass and no records in survey sheets regarding the biomass consumption. The stationary combustion of diesel is also excluded because of data gaps.

Here are the methodologies applied in the energy and waste sector. In the energy sector, the main greenhouse gases are carbon dioxide, methane and nitrous oxide. This inventory has been prepared considering the year 2017, 2018 and 2019, following IPCC Guidelines 2006, its' Fifth Assessment Report (AR5) – 2014, Global Warming Potential values for 100 year time horizon, and Global Protocol standard for Community-Scale Greenhouse Gas Emission Inventories. All calculations were done based on GHG activity data multiplied by an appropriate GHG emission factor. Unless stated otherwise, all emission factors were obtained from the International Panel on Climate Change (IPCC). As per IPCC 5th assessment report, all the greenhouse gases (GHGs) are converted to carbon dioxide using global warming potentials (GWP) (C02 -1, CH4 -28, N2O- 265). GHG reporting was done

as CO2 equivalent (CO2e). For the waste sector, it has assumed, for the year 2017, 2018 and 2019 January to June, compost production is 2 tons per day. For the year 2019 September to December, compost production is 6 tons per day. 2019 July and August the composting process was stopped due to installation of Kawashima plant. For 2017, 2018 and 2019 amount of open burning assume to be same. Wastewater treatment plant was operated since 2018 September. 35% of the area covered by the DWW Treatment plant and 65% was not covered. Only plastic waste taken for the open burning due to unavailability of other data. Default values of semi continuous incinerators were used for clinical waste incineration

The GHG inventory of the direct emissions in energy and waste sectors is established through the classification of GHG emission sources by the guidance of the 2006 IPCC Guidelines to match with the national GHG inventory. In the indirect emissions, the guidance presented by Korean Environmental Corporation is applied to the classification of electricity or energy.

Based on the classification of GHG inventory, NCPC collected the activity data of each emission sources during the time period from 2017 to 2019.

- **Activity data of GHG emissions**

Sector		Emissions sources	Activity data	Unit	Amounts		
					2017	2018	2019
Direct Emission	Stationary Combustion	Residential buildings	LPG	kL/yr	893.00	973.00	1,166.80
		Residential buildings	Kerosene	kL/yr	601.00	977.00	1,360.00
	Mobile Combustion	Road vehicles	Motor Gasoline (Petrol)	kL/yr	14,529.46	15,232.80	15,863.50
		Road vehicles	Diesel Oil	kL/yr	16,667.84	18,555.90	19,348.10
		Locomotive vehicles	Diesel Oil (Railway)	kL/yr	437.60	408.49	425.10
	Waste	Landfill	Amounts of Solid Waste	Gg/yr	9.80	8.79	8.98
		Composting plant	Amounts of Solid Waste	ton/yr	730.00	730.00	1,080.00
		Waste incineration plant	Amounts of Solid Waste	ton/yr	8.80	22.08	21.58

		Open burning facility	Amounts of Solid Waste	ton/yr	1.20	1.20	1.20
		Outside of the Domestic Wastewater treatment plant	Amounts of BOD	kgBOD/yr	317,063.00	281,297.00	207,830.00
		Domestic Wastewater treatment plant	Amounts of Wastewater	Nm3 /yr	-	85,400.00	912,500.00
Indirect Emission	Electricity Use	Residential buildings	Electricity	MWh	17,311.88	17,398.63	18,051.86
		Commercial buildings	Electricity	MWh	39,438.63	41,511.01	43,534.59
		Industrial buildings	Electricity	MWh	2,820.39	3,336.57	3,746.50
		Transmission & Distribution Loss	Electricity	MWh	5,033.74	5,191.33	5,376.90
		Electric vehicle	Electricity	MWh	-	8.38	9.54

The emission factors and energy densities and other parameters for calculating the amounts of GHG emissions are derived from the 2006 IPCC Guidelines and the Sri Lanka governments. With these parameters, the GHG emissions amounts of each emission source are estimated such as below. Since there was no domestic wastewater treatment plant and electric vehicle charging station in 2017, the GHG emissions are not occurring in that emission sources.

- **GHG emission amounts in each emission source**

Sector	Subsector	Emissions sources	Unit	Amounts		
				2017	2018	2019
Direct Emission	Stationary Combustion	Residential buildings	tCO_2eq	1,282.78	1,397.69	1,676.08
		Residential buildings	tCO_2eq	1,610.52	2,618.09	3,644.43
	Mobile Combustion	Road vehicles	tCO_2eq	37,110.21	38,906.64	40,517.53
		Road vehicles	tCO_2eq	47,564.26	52,952.13	55,212.80
		Locomotive vehicles	tCO_2eq	1,357.51	1,267.20	1,318.73

	Waste	Landfill	tCO_2eq	13,522.43	12,128.79	12,390.96
		Composting plant	tCO_2eq	128.19	128.19	189.65
		Waste incineration plant	tCO_2eq	7.15	17.77	17.37
		Open burning facility	tCO_2eq	2.18	2.18	2.18
		Outside of the Domestic Wastewater treatment plant	tCO_2eq	534.79	483.60	368.53
		Domestic Wastewater treatment plant	tCO_2eq	-	0.01	0.09
Indirect Emission	Electricity Use	Residential buildings	tCO_2eq	10,118.80	10,169.50	10,551.31
		Commercial buildings	tCO_2eq	23,051.88	24,263.18	25,445.97
		Industrial buildings	tCO_2eq	1,648.52	1,950.22	2,189.83
		Transmission & Distribution Loss	tCO_2eq	2,942.22	3,034.33	3,142.80
		Electric vehicle	tCO_2eq	-	4.90	5.58
Total GHG emission amounts			tCO_2eq	140,881.42	149,324.44	156,673.83

In order to see the trend of GHG emissions in the sector-wise, emission sources as the lowest classification level are incorporated into 'Stationary combustion', 'Mobile combustion', 'Waste' and 'Electricity use'.

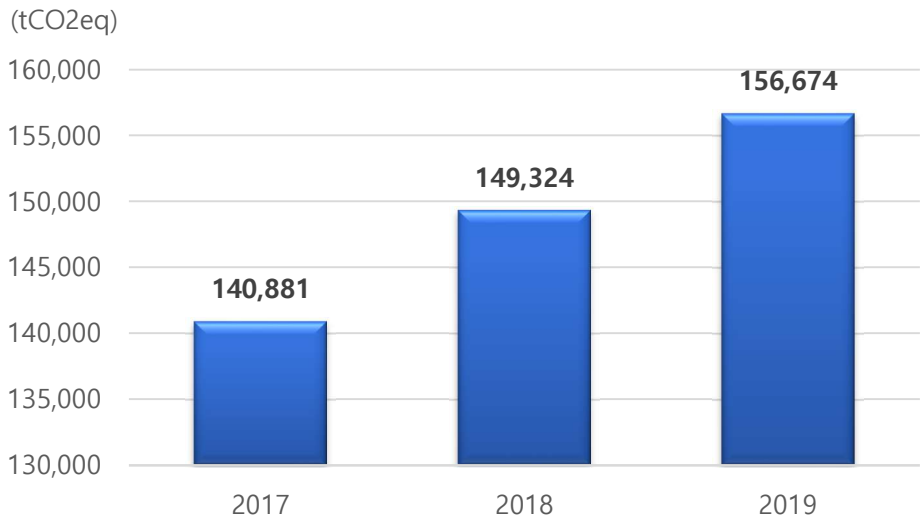
- **GHG emission amounts in each sector**

Sector	Subsector	Unit	Amounts		
			2017	2018	2019
Direct Emission	Stationary Combustion	tCO_2eq	2,893.29	4,015.79	5,320.51
	Mobile Combustion	tCO_2eq	86,031.98	93,125.97	97,049.06
	Waste	tCO_2eq	14,194.74	12,760.54	12,968.78
Indirect Emission	Electricity Use	tCO_2eq	37,761.41	39,422.14	41,335.48
Total GHG emission amounts		tCO_2eq	140,881.42	149,324.44	156,673.83

Total GHG emission amounts of each year are 140,881.42 tCO_2eq in 2017, 149,324.44 tCO_2eq in 2018 and 156,673.83 tCO_2eq in 2019. The GHG emissions of each year are

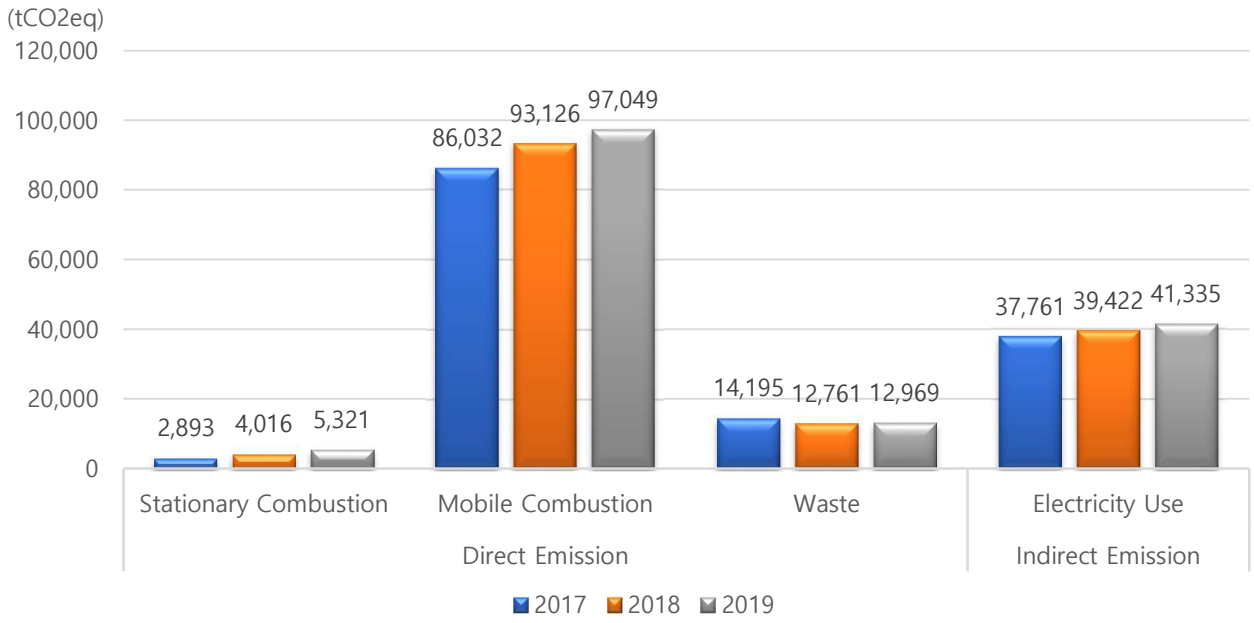
gradually increasing.

➢ **GHG emission trends from 2017 to 2019**



All GHG emissions in the subsector are rising apart from waste sector from 2017 to 2019. The exceptional decrease of GHG emission between 2017 and 2018 in waste sector is assumed that the solid waste started to be disposed in the incineration plant instead of landfill.

➢ **Subsector-wise GHG emission trends from 2017 to 2019**



The GHG emission share from 2017 to 2019 are almost similar. The largest emission share is 'Mobile combustion' over 60% and the 'Electricity use' as second-largest sector has 26% to 27% of GHG emission shares. The subsector taking third rank is the waste sector as of 8% to 10%. These 3 sectors cover 98% of GHG emissions of Kurunegala city.

- **GHG emission share of each year from 2017 to 2019**

Sector	Subsector	Share		
		2017	2018	2019
Direct Emission	Stationary Combustion	2%	3%	3%
	Mobile Combustion	61%	62%	62%
	Waste	10%	9%	8%
Indirect Emission	Electricity Use	27%	26%	26%
Total GHG emission share		100%	100%	100%

3. Data Collection and Management Framework

Activity data is a fundamental and paramount component for thoroughly and precisely calculating the GHG emissions. It should be managed and collected under an apt framework to connect between the point that happens actual GHG emissions and the point that collects overall activity data and calculates the GHG emissions. As the bond is systematic and well-established, the reliability of the activity data is rising and easiness of GHG calculation is guaranteed.

For establishing the sustainable framework, the data sources of the activity data should be identified, and the collection period should be set by each GHG emission source with consideration of the type of activity data. For the data collection period, at least the activity data should be collected and reported once a year to the division of managing the GHG inventory and emission amounts. If it is possible, data collection period is recommended to set every half year for the control and assurance of the activity data.

Sector		Emissions sources	Activity data	Data source	Collection period
Direct Emission	Stationary Combustion	Residential buildings	LPG	Litro/ Laugfs	yearly
		Residential buildings	Kerosene	Ceypetco	yearly
	Mobile Combustion	Road vehicles	Motor Gasoline (Petrol)	IOC	yearly
		Road vehicles	Diesel Oil	IOC	yearly
		Locomotive vehicles	Diesel Oil (Railway)	Railway Dept	yearly
	Waste	Landfill	Amounts of Solid Waste	Kurunegala Municipal Council	yearly
		Composting plant	Amounts of Solid Waste	Kurunegala Municipal Council	yearly
		Waste incineration plant	Amounts of Solid Waste	MOH- Kurunegala	yearly
		Open burning facility	Amounts of Solid Waste	Kurunegala Municipal Council	yearly
		Outside of the Domestic Wastewaster treatment plant	Amounts of BOD	National Water Supply and Drainage Board	yearly
		Domestic Wastewaster treatment plant	Amounts of Wastewater	National Water Supply and Drainage Board	yearly
Indirect Emission	Electricity Use	Residential buildings	Electricity	CEB	yearly

		Commercial buildings	Electricity	CEB	yearly
		Industrial buildings	Electricity	CEB	yearly
		Transmission & Distribution Loss	Electricity	CEB	yearly
		Electric vehicle	Electricity	EV charging station	yearly

4. Data Challenges and Recommendations

In Kurunegala, the information on data and the data are not consolidated in one mechanism, institution, or agency. The literature recommends having a detailed overview and description of the available data, location, and mechanism to compile the data from each organization responsible. This mechanism facilitates the selection and scoping of sectors and helps avoid data duplication. This detailed overview also further identifies data gaps, which may require further data consolidation and data collection in the medium or longer term. Similarly, guides to existing datasets should be easily available, with descriptions of their contents and definitions.

Additionally, the data system for the GHG inventory should be further developed in the long term.

Main Challenges	Recommendation
Data accessibility and quality	Delegate responsibility to one organization to control and manage the consolidated, integrated data system necessary for GHG inventories and roadmaps. Processes for data collection can be automated and simplified.
Location of the data is not clear, making it difficult to access to data	Publicize a "GHG Inventory Guidelines Booklet," necessary for managing GHG inventories. The guide should address data needs and provide information on data availability, content, location, and access/request procedures and standard forms. Guides and forms should be available in hard and soft copy. The same organization responsible for the data system should facilitate data requests from the other institution, agency, or organization.

IV. Energy Sector Roadmap and Action Plans

1. Introduction

The energy sector roadmap presents the allocation of duties concerning the usage and deploying energy resources between the public and private sectors. The definition of "energy resources" is not limited to primary and secondary sources and encompasses energy technology including direct production of electricity from renewable energy and indirect energy conservation from climate technologies.

The overall implementation roadmap is shown in the table below. The roadmap for climate technology implementation in the energy sector of Kurunegala comprises the following technologies:

- Rooftop photovoltaic generation systems
- Green buildings
- Rainwater recycling
- Light replacement to LED (fluorescent lights/incandescent lights/streetlights)

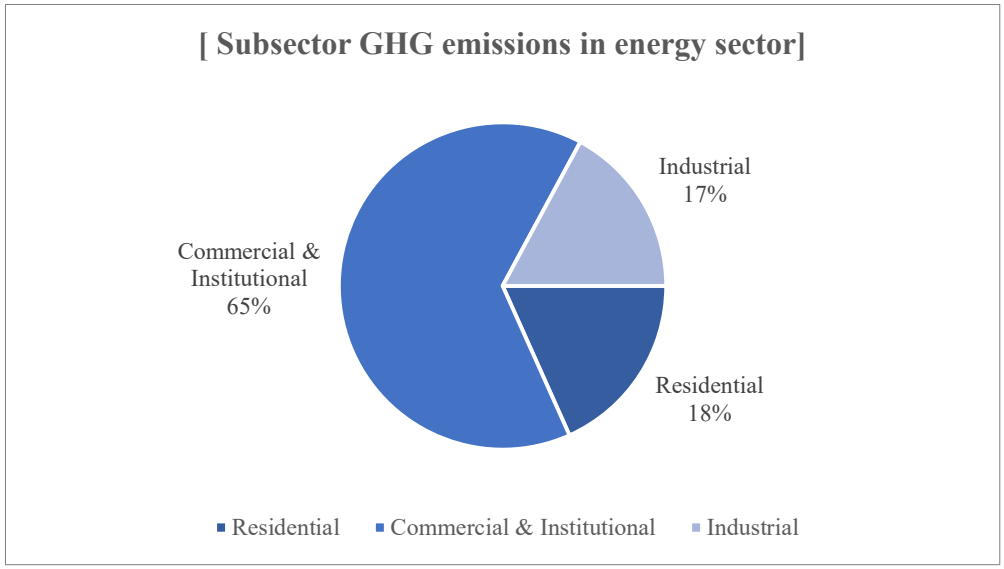
[Emission Trend of the Energy Sector]

The GHG emissions have increased from 58,797tonCO2eq in 2012-2013 to 82,563tonCO2eq in 2016-2017. The increase rate between 2013 and 2017 is 40.42%. The GHG emission trends of each year is presented in the Table below.

Year	2012-13	2013-14	2014-15	2015-16	2016-17
GHG emission ($tonCO_2eq$)	58,797	60,645	65,545	71,846	82,563

The total GHG emissions of the City in 2016-2017 are 82,563tonCO2eq, stationary energy is the highest emission source, followed by transport sector and waste sector by order. GHG emissions in Scope 1 means direct GHG emissions by fossil fuel consumption or by the process of waste treatment. GHG emissions in Scope 2 means indirect GHG emissions by electricity consumption. The GHG emissions in Scope 2 by electricity consumption are only produced in stationary energy sector referred as residential, commercial, institutional buildings and facilities and industrial plants or facilities.

In consideration of GHG emissions from Scope 1 and Scope 2 in the stationary energy sector, GHG emissions of commercial and institutional buildings and facilities are the main emission source (65%), and GHG emissions of residential buildings and industrial sector is 18% and 17% respectively.



2. Energy Sector Roadmap

Category	Type of actions	Period			Implementing authority	Funding option
		Short term	Mid term	Long term		
Policy, plan reform and establishment	Establish policies and plans related to the energy sector	■			CEB	External funding
	Preparation of ordinances related to the energy sector	■			CEB	Internal budget
	Establish a support system related to the energy sector		■		CEB	Internal budget
	Raising financial resources for support projects related to the energy sector		■	■	CEB	Internal budget
	Energy performance evaluation and policy/plan revision			■	CEB	External funding
Physical projects	Conduct a feasibility study for project implementation		■		UDA	External funding
	Projects for public institutions (Rooftop, Rainwater)		■	■	UDA, SLSEA	External funding
	Compulsory project for public institutions (Green building, LED)		■	■	CEB, UDA	Internal budget
	Compulsory project for the private sector (Green building, LED)			■	CEB	Private finance
	Private support projects (Rooftop, Green building, Rainwater, LED)		■	■	CEB	External funding
Capacity Building	Training programs to strengthen the capacity of policymakers in the energy sector	■	■		External expert	External funding
	Training programs to strengthen the competency of participants in the energy sector infrastructure construction		■	■	External expert	External funding
	Training programs to strengthen the capabilities of system and program operators in the energy sector		■		External expert	External funding
	Training programs to strengthen the capacity of researchers to conduct R&D in the energy field		■		External expert	External funding
	Education and campaigns for ordinary citizens that raise interest in responding to climate change in the energy sector		■	■	External expert	Internal budget

3. Action Plan per Climate Technology

3-1. Rooftop Photovoltaic

A. Introduction

[Technology Brief in Local Context]

Through this technology, electricity is generated by the photovoltaic panels on the rooftops of commercial or residential buildings. Utilizing the electricity from renewable energy decreases supply-side electricity generation. In addition, the panels installed on the rooftop create shade, blocking the direct contact of sunlight on buildings, and reduce electricity consumption, for example, that used for air conditioning.

In Sri Lanka, the Ministry of Power ~~and Renewable Energy~~ has launched the community-based power generation project "Soorya Bala Sangramaya" (Battle for Solar Energy) in collaboration with the Sri Lanka Sustainable Energy Authority (SLSEA), CEB, and Lanka Electricity Company (Private) Limited (LECO) to promote the setting up of small solar power plants on the rooftops of households, religious places, hotels, commercial establishments, and industries. This project is expected to add 200 MW of solar electricity to the national grid by 2021 and 1000 MW by 2025 through this intervention.

Because of the technical readiness for this technology at the local level, solar companies have registered under the SLSEA, one solar panel manufacturing facility is available at the local level, and one company is capable of manufacturing the railings. However, inverters must still be imported from overseas.

[Expected Cost and GHG Mitigation Effect]

Regarding the "Line of Credit for Solar Rooftop Segment for Commercial, Industrial, and Residential Housing Sectors (GCF Project FP081)," the introduction cost of 250 MW of grid-connected solar rooftop PV systems is USD 250,000,000, which is 1,000,000 USD/MW and the abatement cost is 48 USD/tonCO2eq. The GHG reduction amount per annum is 260,610 tonCO2eq, which is 1,042 tonCO2eq/year/MW.

B. Action Plan

Category	Action Plans	Period(year)										Implementing authority
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
Policy, plan reform and establishment	Establish KMC's renewable energy expansion policy and master plan	■										CEB
	Establish KMC's ordinances related to renewable energy		■									CEB, SLSEA
	Establish the supportive regulation or policy for the renewable energy sector in KMC		■	■								CEB, SLSEA
	Raise financial resources for the supportive project of the renewable energy sector in KMC		■	■	■	■	■	■	■	■	■	CEB
	Monitoring and evaluation system settlement					■			■			CEB
Physical projects	Feasibility study for the physical project		■	■								CEB, UDA
	Public sector project			■	■	■	■	■	■	■	■	CEB, UDA
	Project for encouraging the private sector to join			■	■	■	■	■	■	■	■	CEB
Capacity Building	Capacity building of policymakers	■	■		■	■		■	■			External Expert
	Capacity building in the installation/construction implementer			■	■	■	■	■	■			External Expert
	Capacity building in the implementation of the regulation and policy		■	■			■	■		■		External Expert
	Enhancement of R&D competency				■	■	■	■	■	■	■	External Expert
	Public awareness promotion and capacity building			■	■	■	■	■	■	■	■	External Expert

[Action plan 1] KMC's renewable energy expansion policy and master plan establishment.

➢ **Expected Implementation**

Period	Expected Implementation
1st year	▪ Establish KMC-level policies according to the national level renewable energy supply plans and a systematic master plan to implement them. ▪ Achieve the national renewable energy development goals and ensure that KMC's master plan presents reasonable goals and establishes feasible implementation methods. ▪ Include in the master plan the annual expansion rate of renewable energy and renewable energy capacity that can be installed.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Policies and plans must be established that support the national renewable energy policy direction.
Economy	▪ Financial resources are necessary to establish renewable energy policies and master plans. Also necessary is cooperation with international agencies such as the KEITI, KOICA, GCF, and CTCN.
Social	▪ Policies and plans must be established that reflect the social status of renewable energy in Kurunegala.
Technology	▪ When developing policies and plans to expand renewable energy, poverty and gender equality must be considered. ▪ Technology for developing renewable energy policies and plans is necessary, and [Action Plan 9] should be complemented with strengthening the capabilities of policymakers.
Environment	▪ The expected environmental impact should be considered in developing policies and plans for the expansion of renewable energy.
Legal	▪ A policy direction must be established that does not conflict with other relevant laws.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of policies and plans establishment	Check the progress of policy establishment and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the policies and plans
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for future implementation is incorporated in the legal document	Prepare the grounds for the future performance of, for example, ordinances, by-laws, and systems	▪ Confirm the contents of the legal documents that indicate future activities regarding, for example, ordinances, by-laws, system.
Gender mainstreaming is incorporated in the policy	Ensure that energy policy, strategies, and reforms incorporate gender equality objectives based on gender analysis of need, demand, and supply	▪ Training policymakers on gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated

[Action plan 2] Establish of KMC's ordinances related to renewable energy.

Period	Expected Implementation
2nd year	The ordinance specifies the ▪ definition and scope of renewable energy; ▪ supportive regulation, policy for the expansion and distribution of renewable energy, and the basis for the implementation of the distribution support project; and ▪ basis for the capacity-building activities of stakeholders in the expansion and distribution of renewable energy projects.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Enacting an ordinance in line with Kurunegala's policy and plans to expand renewable energy is necessary.
Economy	▪ Local authority level budgeting is required to enact the Kurunegala municipal ordinance on Renewable Energy.
Social	▪ Preparing an ordinance that reflects the social status of renewable energy in Kurunegala is necessary. ▪ When preparing the renewable energy ordinance, the energy poor and gender equality must be considered.
Technology	▪ Technology for enacting ordinances is necessary and should complement each other through [Action Plan 9] and [Action Plan 11].
Environment	▪ Environmental impacts of the performance included in the renewable energy ordinance should be fully considered.
Legal	▪ Enacting an ordinance that does not conflict with other laws and Kurunegala's ordinances is necessary.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of ordinances/by-laws are established	Check the progress of ordinances/by-laws and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the ordinances or by-laws
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation is incorporated in the legal document	Prepare the basis for the future supportive system or plans, subsidies, strengthening the capabilities of stakeholders, and so forth.	▪ Confirmation of future performance, for example, supportive system or plans, subsidies, and strengthening stakeholder capabilities,.
Gender mainstreaming incorporated into ordinances/by-laws	Ordinances and by-laws include gender equality objectives based on gender analysis of need, demand, and supply	▪ Training the policymakers on gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality has incorporated successfully

[Action plan 3] Establish the supportive regulation or policy for the renewable energy sector in KMC.

Period	Expected Implementation
2nd and 3rd year	▪ Consider subsidies or tax-free benefits as a support plan for expanding and distributing renewable energy. ▪ Establish the target, period, and scope of subsidies for expanding and distributing renewable energy. ▪ Provide benefits such as tax exemption and scope for users of renewable energy facilities. ▪ Prepare a fast track for business and project permits and approvals for expansion and distribution of renewable energy. ▪ Ease business license and approval standards for expanding and distributing renewable energy. ▪ Enforce the ESCO project in which an energy-saving company directly bears the cost of facility investment and recovers the resulting profit.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Prepare supportive plans or subsidies in line with Kurunegala's renewable energy ordinances.
Economy	▪ Budgets are necessary to prepare supportive plans or subsidies for the renewable energy sector in Kurunegala.
Social	▪ Establish supportive plans or subsidies that reflect the social status of renewable energy in Kurunegala. ▪ Fully consider the residents in poverty who have less access to energy and gender quality than wealthier groups when establishing renewable energy supportive plans and subsidies.
Technology	▪ Technology is necessary to prepare supportive plans and subsidies, and [Action Plan 11] should be complemented and strengthened by the system operator.
Environment	▪ Environmental impacts of renewable energy supportive plans and subsidies should be fully considered.
Legal	▪ Enact an ordinance that does not conflict with other supportive plans and subsidies.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of supportive regulations, policies, or plans establishment	Check the progress of supportive regulations, policies, or plans and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the supportive regulations, policies, or plans
Feasibility of the implementation of the supportive regulations, policies, or plans	Establish the feasible objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation of supportive projects or subsidies is included	Prepare the basis for future supportive projects or subsidies	▪ Confirmation of the basis of supportive projects or subsidies in the legal document

[Action plan 4] Raising financial resources for the supportive project of the renewable energy sector in KMC.

Period	Expected Implementation
2nd–10th year	▪ Implement a supportive project to distribute and expand renewable energy. The detailed concept shall be established by specifying the project. ▪ Separate the private and public sectors, set the type and scale of renewable energy to be supported for each year, and calculate the estimated input cost. ▪ Set the rate of supply of renewable energy by type by year. ▪ Search and apply for international financial institutions and ODA projects that can be linked to renewable energy distribution supportive projects. ▪ Consider securing financial resources by attracting domestic and foreign private investment. ▪ Consider profit generation plans through the CDM project. ▪ Establish the financial foundation for project execution

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ A plan to raise funds in accordance with Kurunegala's renewable energy ordinance/by-laws is necessary. ▪ Complete the legal basis for the private sector's investment.
Economy	▪ A budget is necessary to finance Kurunegala's renewable energy supportive project. ▪ If there is no central government budget, support may not be available.
Social	▪ When applying for a project funded by an international financial organization, the project's design must integrate poverty- and gender-inclusive components. ▪ Creating a favorable social atmosphere for private sector investment is necessary.
Technology	▪ Technology must be prepared to support the international financial institution funding project and the ODA

	project, and the preparation of a proposal is required. ▪ Technology is necessary to raise funds, and [Action Plan 11] should be complemented and strengthened by the system operator.
Environment	▪ When financing an international financial institution support project, the environmental impact of the project should be fully considered.
Legal	▪ Enactment of ordinances that do not conflict with other systems is necessary when financing is provided. ▪ Investment in the private sector should not conflict with other laws, and legal assistance should be reviewed.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of budgeting and funding planning	Check the progress of securing budget or funds by each year	▪ Official letter or document of the annual budget's plan by local authority level ▪ Progress reports from the officer-in-charge
Budget allocation from the central government	Check the progress of the supportive action/plans from the central level	▪ Budget allocation request for central government
Funding proposal for international organizations	Propose funding projects that cannot be secured by national level budgeting	▪ Review of the status of composing, e.g., funding proposals and concept notes
Private sector investment	Establish the atmosphere and system for the private sector to invest	▪ Review of the atmosphere and system for the private sector to invest through stakeholder and expert review workshop

[Action plan 5] Monitoring and Evaluation system settlement.

Period	Expected Implementation
5th and 8th year	▪ Project performance evaluation indicators are set for each action plan, from revisions of ordinances established in the master plan, provision of supportive regulations and policy, and project financial resources to project execution and capacity building. ▪ When setting the project performance evaluation index or indicator, use a quantitative index or indicator to evaluate whether the goal is achieved. ▪ Based on the results of the project evaluation, improvement and supplementary items are derived, and the action plan is revised by reflecting them in the next action plan or next year's project. ▪ Set up the indicators for gender mainstreaming in terms of economic empowerment of women in the labor market and government sector.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Performance evaluation based on Kurunegala's renewable energy ordinances/by-laws shall be conducted. ▪ When revising the legal basis and plan related to renewable energy, it should be based on the renewable energy ordinance.
Economy	▪ Budgeting is necessary to supplement modifications such as performance evaluation and related systems and plans.
Social	▪ Social status should be reflected when supplementing modifications such as performance evaluation and related systems and plans.
Technology	▪ Technology is necessary to modify and supplement performance evaluation and related systems and plans and complement each other with [Action Plan 9] and [Action Plan 11].

Environment	▪ The environmental impact that can occur when supplementing modifications such as performance evaluation and related systems and plans should be fully considered.
Legal	▪ When supplementing modifications such as performance evaluation and related systems and plans, they should not conflict with other laws.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of planning and legal basis	Review and confirm the needs of the modification(revision)	▪ Survey and analysis of the result of the performance evaluation and the impact on the social changes
Track the monitoring and evaluation indicators of each action plan	Monitor and evaluate the achievements and failures of each action and then reflect that information in the future roadmap	▪ Compose the logical framework and matrix for monitoring and evaluation
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Feasibility of the implementation of the legal system	Establish feasible objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge

Number and percentage of jobs generated by the project for women and men	Increase employment and enterprise opportunities for women and men to mainstream gender equality in the renewable energy sector	▪ Sex-disaggregated statistical data from the related authority
Number and percentage of women and men employed, by type of job and pay rates, and proportion of women employed in unskilled, technical, management, and supervisory roles		
Evidence of the type of incentives designed to recruit women, increase their capacity, and provide career development in renewable energy sector and service providers		
Evidence that climate finance facilities include special windows for funding activities with women's groups and gender-sensitive guidelines for all funded activities and employ women and men in fund management	Equal access for women to small grants for climate change projects	▪ Check the guidelines/action plans prepared by the government ▪ Sex-disaggregated statistical data from the related authority

[Action plan 6] Feasibility study for the physical project.

Period	Expected Implementation
2nd and 3rd year	▪ Analyze the natural and physical conditions of the target area for rooftop PV installation and distribution, and review whether the conditions are satisfied. ▪ Rooftop PV installation and distribution target, distribution scale and target area shall be set. ▪ Calculate the estimated input cost for rooftop PV installation and distribution. ▪ Conduct a project feasibility study by separately considering the profits generated assuming that it is linked to the CDM/sustainable development mechanism project. ▪ When evaluating project feasibility, consider the effect of GHG reduction through rooftop PV installation and distribution projects.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Projects based on Kurunegala's policies, plans, and ordinances for the expansion of renewable energy should be targeted.
Economy	▪ Budgeting is required for feasibility studies for the implementation of the Rooftop PV generation system project. ▪ If the central government and Kurunegala lack resources, preparing measures to utilize the resources of international financial institutions and ODA projects is necessary.
Social	▪ When conducting feasibility studies for implementing the Rooftop PV generation system project, consideration of individuals who have less access to energy use and gender quality is required. ▪ When reviewing the feasibility of the target site, the details of what causes and resolves conflicts between regions should be reviewed.
Technology	▪ When conducting feasibility studies for implementing the Rooftop PV generation system project, CEB and UDA

	should internalize(localize) the technology.
Environment	▪ Environmental impact assessment should be conducted for environmental impacts caused by the installation of the Rooftop PV generation system.
Legal	▪ Review conflicts with other laws and legal procedures because of the installation of the Rooftop PV generation system.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of feasibility review	Check the progress of the feasibility review and implementation results	▪ Review the feasibility review status and results through stakeholder and experts' workshop ▪ Progress reports from the officer-in-charge
Rationality of the methodology of feasibility review	Establish the reasonable implementation methodology	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Result of the feasibility review	Check the feasibility of the project implementation	▪ Review various conditions, e.g., natural and physical conditions, costs, and returns, to ensure project feasibility

[Action plan 7] Public sector project.

Period	Expected Implementation
3rd and 4th year	▪ Identify public institutions that can install Rooftop PV and estimate the size that can be installed. ▪ Establish rooftop PV installation plan for each year. ▪ Install facilities preferentially on sites with good location and high-power generation for installing Rooftop PV.
5th–10th year	▪ Establish a plan with the goal of installing Rooftop PV in all public institutions in the mid to long term. ▪ Through the operation of initially installed facilities, identify problems and improvement points then reflected in the future project.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of public institution installation projects based on Kurunegala's policies, plans, and ordinances to expand renewable energy.
Economy	▪ Budgeting is required for the installation of the Rooftop PV generation system in public institutions. ▪ If the central government and Kurunegala lack resources, preparing measures to utilize the resources of international financial institutions and ODA projects is necessary.
Social	▪ When installing the Rooftop PV generation system in public institutions, the contents of causing and resolving conflicts between public institutions should be reviewed.
Technology	▪ When installing the Rooftop PV generation system in public institutions, CEB and UDA should internalize the technology, complement each other with strengthening capabilities for [Action Plan 10] and enhancing capabilities for [Action Plan 12] R&D.
Environment	▪ The environmental impact of the Rooftop PV generation system in public institutions should be minimized.

Legal	▪ Review legal procedures and conflicts with other laws due to the installation of the Rooftop PV generation system in public institutions.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of securing the budget	Secure the budget for the planned installation	▪ Check the annual budget's status
Management status of Rooftop PV generation facility	To fulfill the estimated power generation	▪ Check the power generation efficiency through facility management
Percentage of the public institutions installed Rooftop PV	100% installed by 2030	▪ Check the percentage of the public institution installation
Proportion of electricity generation through Rooftop PV generation	30% of electricity use from the Rooftop PV generation in public institutions by 2030	▪ Check the percentage of the electricity used by public institutions

[Action plan 8] Project for encouraging the private sector to join.

Period	Expected Implementation
3rd–5th year	▪ Conduct a survey on demand for installation of rooftop PV facilities and calculate the size that can be installed in homes and commercial buildings. ▪ Establish the scope of support and targets for the installation and distribution of rooftop PV power generation facilities. ▪ Policy support projects such as simplifying licensing for installing the Rooftop PV generation system and operating the fast track are implemented preferentially. ▪ Establish rooftop PV installation plan for each year.
6th–10th year	▪ Subsidy support or low-interest loan support for installation in households and commercial buildings. ▪ Tax reduction is provided for businesses that directly invest in the rooftop PV installation business, and the installation business divides and recovers the profits generated from direct investment in facilities over several years. ▪ Benchmarking ESCO projects encourages the activation of the Rooftop PV generation system in the mid to long term.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of private installation support projects based on Kurunegala's policies, plans, and ordinances to expand renewable energy
Economy	▪ Budgeting is required for private installation support projects. ▪ If the central government and Kurunegala lack resources, preparing measures to utilize the resources of international financial institutions and ODA projects is necessary.
Social	▪ When implementing a private installation support project, the details of what causes and resolves conflicts between demand institutions should be reviewed.

Technology	▪ Technologies such as operating process and R&R establishment are necessary for the operation of private installation support projects, and [Action Plan 11] should be complemented with the enhancement of capabilities of the system operator.
Environment	▪ When supporting private installation, the environmental impact should be minimized, and projects with large environmental impact should not be supported.
Legal	▪ Reviewing conflicts with other laws in support of private installation support projects and reviewing legal procedures are necessary.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of securing the budget	Secure the budget for the planned support projects	▪ Check the annual budget's status
Number of supported and subsidized projects	500 cases by 2030	▪ Check the number of private sector applications for the support from the government
Proportion of electricity generation through Rooftop PV generation	3% of Kurunegala electricity usage by 2030	▪ Check the private Rooftop PV generation ratio

[Action plan 9] Capacity building of the policymakers.

Period	Expected Implementation
1st and 2nd, 4th and 5th, 7th and 8th year	▪ Development and operation of training programs to strengthen the capabilities of policymakers who establish policies and plans to expand renewable energy. ▪ The first year in which the policy and plan are established, and the fourth and seventh years in which the system and plan are directly modified and supplemented and are implemented from the beginning to the next year. ▪ Basic education on the economic, environmental, and social changes and expected effects on Kurunegala because of climate change and the introduction of renewable energy, and policy-oriented case education for expansion and dissemination of renewable energy in similar-income or higher-income countries.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education/training to strengthen the capabilities of policymakers based on Kurunegala's renewable energy expansion policies, plans, and ordinances.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the policymakers, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen the capacity of the system's planners and on causing and resolving conflicts between regions.
Technology	▪ Program design and implementation techniques for strengthening the capabilities of institutional planners are necessary, and the ability to improve the system on its own should be strengthened with the assistance of experts from outside agencies. ▪ [Action plan 1] Renewable energy expansion policies and plans, [Action plan 2] enactment of renewable energy-related ordinances, [Action plan 5] performance evaluation, and related systems and plans should supplement

	each other.
Environment	▪ Development of the drafting program should minimize environmental impact.
Legal	▪ When developing the education program for policymakers, the contents of the relevant law and its relationship with other laws are specified, and the contents related to the development of the law and the institution are specified.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	Ensure that policymakers are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% or more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Result of the capacity-building training	70% or more are outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 10] Capacity building of the installation/construction implementer.

Period	Expected Implementation
3rd–8th year	▪ Training on core factors to be considered and the procedure for feasibility analysis when placing a rooftop PV facility. ▪ Training on key factors and installation procedures to be considered when installing rooftop PV facilities. ▪ Training on know-how for rooftop PV facility installation technicians. ▪ Rooftop PV power generation facility management and operation technology training.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen the capacity of the installation/construction implementer based on Kurunegala's policies, plans, and ordinances for the expansion of renewable energy.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the installation/construction implementer, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen the capacity of the installation/construction implementer and on causing and resolving conflicts between regions.
Technology	▪ Installation implementers need technology to design and implement their capabilities and strengthen their ability to perform their installation and Operation and Maintenance (O&M) with the assistance of external experts. ▪ [Action plan 7] Must be complemented with the public institution installation project.
Environment	▪ Installation/construction implementer training program must be developed to include the contents that emphasize minimizing the environmental impact.
Legal	▪ Installation/construction implementer training program development must include legal procedures.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	300 individuals of installation/construction implementers attended the training program	▪ Train 50 engineers per year
Rationality of the capacity-building training module and program	Develop a reasonable capacity-building training module or program	▪ Stakeholder review workshop
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Women's employment during construction, operation, and maintenance and in renewable energy agencies	Encourage women's employment on the site	▪ Evidence showed that contracts and tender documents for subcontractors require the recruitment of women as unskilled labor

[Action plan 11] Capacity building in the implementation of the regulation and policy

Period	Expected Implementation
2nd and 3rd, 6th and 7th, 9th year	▪ Establish R&R and operate a support system for each department or division. ▪ Establish a support system and operation process for support projects. ▪ Assistance in establishing supportive regulations and policy and all necessary matters during the implementation. ▪ Training to improve understanding of project evaluation indicators.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen the capacity of legal system operators based on Kurunegala's policies, plans, and ordinances for the expansion of renewable energy.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the legal system operators, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen the capacity of the legal system operators and on causing and resolving conflicts between regions.
Technology	▪ Design and implementation technology of the legal system operator's capacity enhancement program is required, and the ability to improve the legal system by supporting experts from outside organizations is necessary. ▪ [Action plan 8] Must be complemented with the private installation support projects.
Environment	▪ Legal system operator's training program must be developed to minimize environmental impact.
Legal	▪ When developing a legal system operator's training program, the contents of the relevant law and the relationship with other laws should be specified, and the contents of legal procedures should be included.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	Ensure the system operators are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Rationality of the capacity-building training module and program	Develop a reasonable capacity-building training module or program	▪ Stakeholder review workshop
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 12] Enhancement of R&D competency.

Period	Expected Implementation
4th–10th year	▪ Development and operation of training programs to strengthen R&D capabilities of renewable energy based on policies, plans, and ordinances for the expansion of renewable energy. ▪ After the installation of the Rooftop PV generation system, it is continuously conducted from the 4th year, and R&D capabilities are strengthened for optimization and high efficiency of the Rooftop PV generation system. ▪ Support research to enhance technology development capabilities for efficient operation and monitoring of the Rooftop PV generation system. ▪ Support the development of intangible technologies (e.g., O&M technologies suitable for Sri Lanka) in the short term and types of products in the long term.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen the R&D capabilities based on Kurunegala's policies, plans, and ordinances for the expansion of renewable energy.
Economy	▪ Financial resources are necessary to strengthen the R&D capabilities, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen the R&D capabilities and on causing and resolving conflicts between regions.
Technology	▪ Requires R&D capacity-building program design and implementation technology and strengthens the ability to optimize and implement technology on its own with the assistance of experts from outside organizations. ▪ [Action plan 7] Must be complemented with the public institution installation project.
Environment	▪ R&D capacity-building program must be developed to minimize environmental impact.

Legal	▪ When developing an R&D training program, include legal procedures.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Participant's attendance percentage	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training	350 individuals of R&D professionals received training	▪ Train 50 engineers per year
Rationality of the capacity-building training module and program	Develop a reasonable capacity-building training module or program	▪ Stakeholder review workshop
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training

[Action plan 13] Public awareness promotion and capacity building.

Period	Expected Implementation
3rd–10th year	▪ Development and operation of educational programs and campaigns to raise public interest in responding to climate change based on policies, plans, and ordinances for expanding renewable energy. ▪ Education and campaigns to strengthen public awareness to cope with climate change are conducted continuously from the third year, when policies, plans, and ordinances for the expansion of renewable energy are completed. ▪ Establish a foundation for interest in the contents through the development and operation of educational programs that help ordinary citizens understand and sympathize with the impact of climate change and the need to respond. ▪ Various activities are implemented to positively recognize the expansion of renewable energy through education on the necessity and importance of renewable energy, including the Rooftop PV generation system.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen public awareness based on Kurunegala's policies, plans, and ordinances for the expansion of renewable energy.
Economy	▪ Financial resources are necessary to strengthen public awareness.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen public awareness and on causing and resolving conflicts between regions.
Technology	▪ Design and implementation skills in the general citizen's capacity-building program are required, and education programs and campaigns should be led by institutional planners, installation/construction implementers, institutional (legal system) operators, and internal personnel who have completed R&D capacity-building training.
Environment	▪ Public awareness program must be developed to include the dissemination of the importance of the minimization

	of the environmental impact
Legal	▪ When developing education programs for public awareness, introduce related laws to the public.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions/campaign targeted at women and men, with a gender mainstreaming theme	Raise the awareness of gender equality among the citizens	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	4,000 citizens received the training by 2030	▪ Train 500 citizens per year
Target of the campaign participants (by women and men disaggregated data)	8,000 citizens participated in the campaign by 2030	▪ 1,000 citizens participate in the campaign per year
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training/campaign	Minimum 30% of women participating in each session/event	▪ Check attendance rate of the capacity-building program and the registration lists for the campaign

3-2. Green Building

A. Introduction

[Technology Brief in Local Context]

Generally, solar energy heats the building during the day, and energy for cooling the building is necessary, causing GHG emissions from the air conditioning powered by fossil fuels. Green Building technology is divided into two main categories: a green roof/wall and eco-friendly material used in buildings. A green roof and green walls help the building absorb less heat from solar energy and reduce energy consumption for cooling by covering the building partially or completely with vegetation and plants.

At Life Cycle Assessment in Sri Lanka, the GREENSL® RATING SYSTEM is being developed through an open, consensus-based process under the supervision of the Green Environmental Rating and Life Cycle Assessment Committee, composed of a diverse group of practitioners and experts representing a cross-section of the construction industry. UDA introduced the “Green Rating” for a proposed project to promote and encourage sustainable development through the construction of environmentally friendly buildings. Starting in 2017, all the government and semi-government new buildings had to receive “green building certification” from UDA. Other buildings also can receive “green building certification” from UDA.

[Expected Cost and GHG Mitigation Effect]

In the “Comprehensive Plan for Response to Climate Change in Busan, 2010” for the green roof, the total budget is USD 2,612,000, which is 34 USD/m2-roof area, and the expected abatement cost is 20 USD/tonCO2eq. The expected GHG mitigation effect by referring to this plan is 12,768 tonCO2eq/year, and the reduction factor is 12 kgCO2eq/year/m^2-roof area according to the Korea Environment Corporation, GHG Reduction and Management Technology, 2013.

B. Action Plan

Category	Action Plans	Period(year)										Implementing authority
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
Policy, plan reform and establishment	KMC's green building policy and master plan establishment	■										UDA
	KMC's ordinance establishment for green building certification		■									UDA
	Establish green building certification supportive of regulations and policy		■	■								UDA
	Monitoring and evaluation system settlement					■			■			UDA
Physical projects	Compulsory green building certification for the public sector				■	■	■	■	■	■	■	UDA
	Compulsory green building certification for private sectors over a certain size				■	■	■	■	■	■	■	UDA
Capacity Building	Strengthening the capacity of green building policymakers	■	■		■	■		■	■			External Expert
	Enhancement of competency for green building legal system operators		■	■			■	■		■		External Expert
	Public awareness promotion and capacity building			■	■	■	■	■	■	■	■	External Expert

[Action plan 1] KMC's green building policy and master plan establishment.

Period	Expected Implementation
1st year	▪ Establish the KMC-level green building expansion policy and master plan. ▪ Establish the master plan per each private and public building and plans for existing and new buildings. ▪ When setting the target, the percentage of green building expansion for private and public buildings is set annually. ▪ Master plan includes plans for, for example, ordinances, supportive regulations and policy, and funding.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Establish polices and plans in line with the national green building policy direction.
Economy	▪ Financial resources are necessary for the establishment of green building policies and plans.
Social	▪ Establish policies and plans that reflect the social status of green building in Kurunegala and consider gender equality in the employment rate of women/men when planning and expanding green buildings.
Technology	▪ Green building policies and plans must be established to complement each other and [Action plan 7], strengthening capabilities of policymakers.
Environment	▪ Consider the expected environmental impact of developing policies and plans for green building expansion.
Legal	▪ Establish a policy direction that does not conflict with other relevant laws.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of policies and plans establishment	Check the progress of policy establishment and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the policies and plans
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation is incorporated in the legal document	Preparing grounds for the performance of, e.g., ordinances, by-laws, and systems in the future	▪ Confirm the contents of the legal document that indicates the future activities regarding, e.g., ordinances, by-laws, and systems
Gender mainstreaming is incorporated in the policy	Energy policy, strategies, and reforms incorporate gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 2] KMC's Ordinance establishment for green building certification.

Period	Expected Implementation
2nd year	▪ In accordance with the standards suggested by the GREENSL RATING SYSTEM, the standards to be satisfied for each green building grade are specified in the ordinance from the KMC level. ▪ In the ordinance, the basis of implementing the supportive regulations and policy is specified. ▪ In the ordinance, the basis for the activities to strengthen the capacity of stakeholders in the green building expansion and distribution supportive project is specified.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Enact an ordinance in line with Kurunegala's policy and plan to expand green building is required.
Economy	▪ Local authority level budgeting is required to enact the Kurunegala municipal ordinance on green building.
Social	▪ Prepare an ordinance that reflects the social status of green building in Kurunegala. ▪ When preparing the green building ordinance, consider the individuals who have less access to energy and gender equality.
Technology	▪ Technology for enacting ordinances is necessary and should complement the [Action Plan 7] and [Action Plan 8].
Environment	▪ The environmental impact of the performance included in the green building ordinance should be fully considered.
Legal	▪ Enact an ordinance that does not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of ordinances/by-laws establishment	Check the progress of ordinances/by-laws and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the ordinances or by-laws
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation is incorporated in the legal document	Prepare the basis for the future supportive system or plans, subsidies, strengthening the capabilities of stakeholders, and so forth.	▪ Confirmation of future performance, e.g., supportive system or plans, subsidies, and strengthening stakeholder capabilities
Gender mainstreaming is incorporated in the ordinances/by-laws	Ordinances and by-laws include gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 3] Establish green building certification supportive of regulation and policy.

Period	Expected Implementation
2nd and 3rd year	▪ Provide subsidies or tax exemption as a support plan for the supply of high-efficiency energy equipment. ▪ Establish the target, period, and scope of support funds for expanding and distributing green buildings. ▪ Establish tax exemption items and their scope for expanding and distributing green buildings. ▪ Prepare a fast track to facilitate construction permits and approvals for projects for expanding and distributing green buildings. ▪ Ease the construction permit and approval standards for projects to expand and distribute green buildings.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Prepare supportive plans or subsidies in accordance with Kurunegala's green building ordinance/by-law.
Economy	▪ A budget is necessary to prepare supportive plans or subsidies for the green building sector in Kurunegala.
Social	▪ Establish supportive plans or subsidies that reflect the social status of green building in Kurunegala. ▪ Fully consider the individuals in poverty who have less access to energy and gender quality when establishing green building certification supportive plans and subsidies.
Technology	▪ Technology is necessary to prepare supportive plans and subsidies, and [Action Plan 8] should be complemented and strengthened by the system operator.
Environment	▪ Environmental impact of green building certification supportive plans and subsidies should be fully considered.
Legal	▪ Enact an ordinance that does not conflict with other supportive plans and subsidies.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of the establishment of supportive regulations, policies, or plans	Check the progress of supportive regulations, policies, or plans and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the supportive regulations, policies, or plans
Feasibility of the implementation of the supportive regulations, policies, or plans	Establish feasible objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation of supportive projects or subsidies is included	Prepare the basis for the future supportive projects or subsidies	▪ Confirmation of the basis of supportive projects or subsidies in the legal document

[Action plan 4] Monitoring and Evaluation system settlement.

Period	Expected Implementation
5th year, 8th year	▪ Project performance evaluation indicators are set for each action plan, from revisions of ordinances established in the master plan, provision of supportive regulations and policy, and project financial resources to project execution and capacity building. ▪ When setting the project performance evaluation index or indicator, use a quantitative index or indicator to evaluate whether the goal is achieved. ▪ Based on the results of the project evaluation, improvement and supplementary items are derived, and the action plan is revised by reflecting them in the next action plan or next year's project.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Performance evaluation based on Kurunegala's green building ordinances/by-laws shall be conducted. ▪ Revisions to the legal basis and plan related to green building should be based on the green building ordinance.
Economy	▪ Budgeting is necessary to supplement modifications such as performance evaluation and related systems and plans.
Social	▪ Social status should be reflected when supplementing modifications such as performance evaluation and related systems and plans. ▪ Create a social atmosphere for private sector investment.
Technology	▪ Technology is necessary to modify and supplement performance evaluation and related systems and plans and complement each other with [Action Plan 7] and [Action Plan 8].
Environment	▪ The environmental impact that can occur when supplementing modifications such as performance evaluation and related systems and plans should be fully considered.

Legal	▪ When supplementing modifications such as performance evaluation and related systems and plans, they should not conflict with other laws.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of planning and legal basis	Review and confirm the needs of the modification(revision)	▪ Survey and analysis of the result of the performance evaluation and the impact on the social changes
Track the monitoring and evaluation indicators of each action plan	Monitor and evaluate the achievements and failures of each action and then reflect that information in the future roadmap	▪ Compose the logical framework and matrix for monitoring and evaluation
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Feasibility of the implementation of the legal system	Establish feasible objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge

Number and percentage of jobs generated by the project for women and men	Increase employment and enterprise opportunities for women and men to mainstream gender equality in the energy sector	▪ Sex-disaggregated statistical data from the related authority
Number and percentage of women and men employed, by type of job and pay rates, and proportion of women employed in unskilled, technical, management, and supervisory roles		
Provide evidence of the type of incentives designed to recruit women, increase their capacity, and provide career development in the energy sector and with service providers		
Provide evidence that climate finance facilities offer special windows for funding activities with women's groups and gender-sensitive guidelines for all funded activities and employ women and men in fund management	Equal access for women to small grants for climate change projects	▪ Check the guidelines/action plans prepared by the government ▪ Sex-disaggregated statistical data from the related authority

[Action plan 5] Compulsory green building certification for the public sector.

Period	Expected Implementation
3rd–5th Year	▪ Based on policies, plans, and ordinances to expand green buildings, the mandatory green building certification is enforced for new public institutions. ▪ Based on policies, plans, and ordinances to expand green buildings, the energy efficiency growth target is set.
6th–10th year	▪ Energy consumption efficiency of existing buildings of public institutions is investigated and analyzed to derive and implement measures that can save energy, and saving energy is mandatory. ▪ Based on policies, plans, and ordinances to expand green buildings, mid- to long-term equipment is used to implement GHG reduction through retrofitting existing buildings in target public institutions.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of public institution installation projects based on Kurunegala's policies, plans, and ordinances to expand green building.
Economy	▪ Budgeting is required to support certification of green buildings in public institutions.
Social	▪ Information on the mandatory certification of green buildings in new public institutions and supporting retrofitting of existing buildings, and conflicts between public institutions, should be reviewed.
Technology	▪ When retrofitting the existing buildings in public institutions, UDA must implement technology internalization.
Environment	▪ The environmental impact of retrofitting existing buildings in public institutions should be minimized.
Legal	▪ Review conflicts with other laws due to the retrofitting buildings in public institutions. These conflicts should be minimized. Review legal procedures.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of securing the budget	Secure the budget for the planned installation	▪ Check the annual budget's status
Green building certification for new public institution buildings	100% certification by 2030	▪ Verification of the green building certification ratio of public institutions
Retrofitting existing buildings increases energy efficiency	20% increase in energy efficiency by 2030	▪ Check the electricity usage of public institutions

[Action plan 6] Compulsory green building certification for private sectors over a certain size.

Period	Expected Implementation
3rd–5th year	▪ Based on policies, plans, and ordinances for expanding green buildings, mandatory green building certification and support projects for the target private sector at least a certain size are implemented, and annual expansion goals are established. ▪ Green building certification buildings are provided with policy support such as simplification of licensing. Additionally, operation of the fast tracks occurs. ▪ Among the economic support projects, projects with little financial resources such as tax exemption are implemented first.
6th–10th year	▪ Lower the standard so that more of the new private buildings are subject to green building certification obligations. ▪ Maintains policy support and economic support projects implemented in the mid term. Operates subsidy support or low-interest loan projects for retrofit when securing financial resources for support projects.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of private installation support projects based on Kurunegala's policies, plans, and ordinances to expand green building.
Economy	▪ Budgeting is required for private installation support projects.
Social	▪ When implementing a private installation support project, the details of what causes and resolves conflicts between demand institutions should be reviewed.
Technology	▪ Technologies such as operating process and R&R establishment are necessary for the operation of private installation support projects, and [Action Plan 8] should be complemented with the enhancement of capabilities of the system operator.

Environment	▪ When supporting private installation, the environmental impact should be minimized, and projects with large environmental impact should not be supported.
Legal	▪ Reviewing conflicts with other laws in support of private installation support projects and reviewing legal procedures are necessary.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of securing the budget	Secure the budget for the planned support projects	▪ Check the annual budget's status
Number of private retrofitting support projects	50 cases supported by 2030	▪ Check the number of applications
Retrofitting existing buildings increases energy efficiency	20% increase in energy efficiency by 2030	▪ Check the electricity usage of the buildings

[Action plan 7] Strengthening the capacity of green building policymakers.

Period	Expected Implementation
1st and 2nd, 4th and 5th, 7th and 8th year	▪ Development and operation of training programs to strengthen the capabilities of policymakers who establish policies and plans to expand green building. ▪ The first year in which the policy and plan are established, and the fourth and seventh years in which the system and plan are directly modified and supplemented and are implemented from the beginning to the next year. ▪ Basic education on the economic, environmental, and social changes and expected effects of Kurunegala because of climate change and the introduction of green building, and policy-oriented case education for expansion and dissemination of green building in similar-income or higher-income countries.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education/training to strengthen the capabilities of policymakers based on Kurunegala's green building policies, plans, and ordinances.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the policymakers, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen the capacity of the system's planners and on causing and resolving conflicts between regions.
Technology	▪ Program design and implementation techniques for strengthening the capabilities of institutional planners are necessary, and the ability to improve the system on its own should be strengthened with the assistance of experts from outside agencies. ▪ [Action plan 1], [Action plan 2], and [Action plan 4] Performance evaluations and the related systems and plans

	should supplement each other.
Environment	▪ Development of the drafting program must minimize environmental impact.
Legal	▪ When developing the education program for policymakers, the contents of the relevant law and its relationship with other laws are specified, and the contents related to the development of the law and the institution are specified.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	To ensure the policymakers are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 8] Enhancement of competency for green building legal system operators.

Period	Expected Implementation
2nd and 3rd, 6th and 7th, 9th year	▪ Establish R&R and operate a support system for each department or division. ▪ Establish a support system and operation process for support projects. ▪ Assistance in establishing supportive regulations and policy and all necessary matters during the implementation. ▪ Training to improve understanding of project evaluation indicators.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen the capacity of legal system operators based on Kurunegala's policies, plans, and ordinances for the expansion of green building.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the legal system operators, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen the capacity of the legal system operators and on causing and resolving conflicts between regions.
Technology	▪ Design and implementation technology of the legal system operator's capacity enhancement program is required, and the ability to improve the legal system by supporting experts from outside organizations is necessary. ▪ [Action plan 6] Must be complemented with the private installation support projects.
Environment	▪ Legal system operator's training program must be developed to minimize environmental impact.
Legal	▪ When developing a legal system operator's training program, the contents of the relevant law and the relationship with other laws should be specified, and the contents of legal procedures should be included.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	Ensure the system operators are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Rationality of the capacity-building training module and program	Develop a reasonable capacity-building training module or program	▪ Stakeholder review workshop
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 9] Public awareness promotion and capacity building.

Period	Expected Implementation
3rd–10th year	▪ Development and operation of educational programs and campaigns to raise public interest in responding to climate change based on policies, plans, and ordinances for expanding green building. ▪ Education and campaigns to strengthen public awareness to cope with climate change are conducted continuously from the third year, when policies, plans, and ordinances for the expansion of green building are completed. ▪ Establish a foundation for interest in the contents through the development and operation of educational programs that help ordinary citizens understand and sympathize with the impact of climate change and the need to respond. ▪ Various activities are implemented to positively recognize the expansion of green building through education on the necessity and importance of green building.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen public awareness based on Kurunegala's policies, plans, and ordinances for the expansion of green building.
Economy	▪ Financial resources are necessary to strengthen public awareness.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen public awareness and on causing and resolving conflicts between regions.
Technology	▪ Design and implementation skills in the general citizen's capacity-building program are required, and education programs and campaigns should be led by institutional planners, installation/construction implementers, institutional(legal system) operators, and internal personnel who have completed R&D capacity-building training.
Environment	▪ A public awareness program must be developed to include the dissemination of the importance of the minimization of the environmental impact.

Legal	▪ When developing education programs for public awareness, introduce related laws to the public.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions/campaign targeted at women and men, with a gender mainstreaming theme	Raise the awareness of gender equality among the citizens	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	4,000 citizens received the training by 2030	▪ Train 500 citizens per year
Target of the campaign participants (by women and men disaggregated data)	8,000 citizens participated in the campaign by 2030	▪ 1,000 citizens participate in the campaign per year
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training/campaign	Minimum 30% of women participating in each session/event	▪ Check attendance rate of the capacity-building program and the registration lists for the campaign

3-3. Rainwater Recycling

A. Introduction

[Technology Brief in Local Context]

Rainwater recycling systems can be applied at the city or community level. The underground rainwater storage system absorbs rainwater in rainy season and reduces the risk of floods by distributing the rainwater flowing into the stream or river. The collected rainwater can be utilized by facilities that use large amounts of water but not by those requiring clean water.

In Sri Lanka, the National Rainwater Policy and Strategy was adopted in 2005 to provide legal, institutional, and programmatic arrangements to optimize the management of rainwater. Rainwater harvesting was made mandatory in 2007 by amending the Urban Development Act. Sri The Lanka Rainwater Harvesting Forum was established at the beginning of 1996 and officially launched on the March 19, 1997, to identify existing rainwater harvesting practices in the country, research and develop further techniques for rainwater collection, and study efficient methods of rainwater harvesting and make recommendations. This forum has run over 700 programs with 75,000 beneficiaries.

Rainwater recycling has been promoted for 25 years. Projects have been implemented nationwide. Additionally, water tanks can be manufactured in Sri Lanka because the human resources and necessary skills for operating and management are available.

[Expected Cost and GHG Mitigation Effect]

In the “Basic Plan for Response to Climate Change in Daegu Metropolitan City, 2010,” the expected cost is USD 21 million. This was used for installing a storage tank approximately 13,000 cubic meters per year from 2011 to 2015, and 104 storage tanks were available from 2016 in public, residential, and commercial buildings. The expected GHG mitigation effect is 4,319 tonCO_2eq/year.

B. Action Plan

Category	Action Plans	Period(year)										Implementing authority
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
Policy, plan reform and establishment	Establish KMC's water reuse policy and master plan	■										WSDB
	Prepare KMC's Ordinance on water reuse		■									WSDB
	Establish rainwater reuse supportive regulations and policy		■	■								WSDB
	Raising funding for rainwater reuse support project		■	■	■	■	■	■	■	■	■	WSDB
	Monitoring and evaluation system settlement					■			■			WSDB
Physical projects	Feasibility study for project implementation		■	■								WSDB, UDA
	Public sector project			■	■	■	■	■	■	■	■	WSDB, UDA
	Private sector project			■	■	■	■	■	■	■	■	WSDB
Capacity Building	Capacity building of policymakers	■	■		■	■		■	■			External Expert
	Capacity building of project implementer			■	■	■	■	■	■			External Expert
	Capacity building of implementation of regulation and policy		■	■			■	■		■		External Expert
	R&D capacity building				■	■	■	■	■	■	■	External Expert
	Public awareness promotion and capacity building			■	■	■	■	■	■	■	■	External Expert

[Action plan 1] Establish KMC's water reuse policy and master plan.

Period	Expected Implementation
1st year	▪ Implement National Rainwater Policy and Strategy and Urban Development Act at the national level. Establish a systematic plan to implement policies and policies at the Kurunegala level and rational objectives within the plan and its feasible implementation. ▪ The water reuse plan for Kurunegala includes the expansion rate of annual water reuse facilities including rainwater reuse and the installation of water reuse facilities at the village and household levels. ▪ Establish an ordinance of Kurunegala, a supportive system, and a plan to raise funds for the expansion of water reuse of water. ▪ In addition, policies and plans provide a basis for implementing rainwater reuse projects and strengthening stakeholder capabilities.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Establish policy and plans in line with the national water reuse policy direction.
Economy	▪ Financial resources are necessary for the establishment of water reuse policies and plans.
Social	▪ Establish policies and plans that reflect the social status of water reuse in Kurunegala and consider gender equality in the employment rate of women/men when planning and expanding green buildings.
Technology	▪ Policies and plans should be established by understanding and considering the current status of technologies related to water reuse in Sri Lanka and Kurunegala. ▪ Water reuse policies and plans must be established to complement each other with [Action plan 9], strengthening capabilities of policymakers.

Environment	▪ Consider the expected environmental impact when developing policies and plans to expand water reuse.
Legal	▪ Establish a policy direction that does not conflict with other relevant laws.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of policies and plans establishment	Check the progress of policy establishment and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the policies and plans
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation is incorporated in the legal document	Preparing grounds for the performance of, e.g., ordinances, by-laws, systems in the future	▪ Confirm the contents of the legal document that indicates the future activities regarding, e.g., ordinances, by-laws, and systems
Gender mainstreaming is incorporated in the policy	Energy policy, strategies, and reforms incorporate gender equality objectives based on gender analysis of need, demand, and supply	▪ Training the policymakers on gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 2] Prepare KMC's Ordinance on water reuse.

Period	Expected Implementation
2nd year	▪ The ordinance is enacted based on Kurunegala's policy and plan to expand water reuse. ▪ State the scope of the definition and recognition of water reuse, the support system for expansion and dissemination, and the basis for the implementation of the support project. ▪ State the obligations and objectives for the expansion and dissemination of water reuse in public institutions. ▪ Specify the basis for capacity-building activities to expand and disseminate water reuse.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Enact an ordinance in line with Kurunegala policy and plan to expand water reuse.
Economy	▪ Local authority level budgeting is required to enact the Kurunegala municipal ordinance on water reuse.
Social	▪ Prepare an ordinance that reflects the social status of water reuse in Kurunegala. ▪ When preparing the water reuse ordinance, consider the individuals who have less access to energy and gender equality.
Technology	▪ Technology for enacting ordinances is necessary and should complement [Action Plan 9] and [Action Plan 11].
Environment	▪ The environmental impact of the performance included in the water reuse ordinance should be fully considered.
Legal	▪ Enact an ordinance that does not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of ordinances/by-laws establishment	Check the progress of ordinances/by-laws and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the ordinances or by-laws
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation is incorporated in the legal document	Prepare the basis for the future supportive system or plans, subsidies, strengthening the capabilities of stakeholders, and so forth.	▪ Confirmation of future performance, e.g., supportive system or plans, subsidies, and strengthening stakeholder capabilities
Gender mainstreaming is incorporated in the ordinances/by-laws	Ordinances and by-laws include gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 3] Establish rainwater reuse supportive regulations and policy.

Period	Expected Implementation
2nd and 3rd year	▪ A rainwater reuse support system is established based on Kurunegala's ordinance on water reuse. ▪ Economic and policy support systems are established to expand and encourage water reuse at the private level. ▪ The economic support system establishes a system for installing rainwater reuse facilities and providing subsidies to users or exempting taxes. ▪ Policy support systems include expanding water reuse, easing licensing standards for distribution projects, and preparing fast tracks for approval.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Prepare supportive plans or subsidies in accordance with Kurunegala's water reuse ordinance/by-law.
Economy	▪ A budget is necessary to prepare supportive plans or subsidies for the water reuse sector in Kurunegala.
Social	▪ Establish supportive plans or subsidies that reflect the social status of water reuse in Kurunegala. ▪ Fully consider the individuals in poverty who have less access to energy and gender quality when establishing water reuse supportive plans or subsidies.
Technology	▪ Technology is necessary to prepare supportive plans and subsidies, and [Action Plan 11] should be complemented and strengthened by the system operator.
Environment	▪ The environmental impact of the water reuse supportive plans and subsidies should be fully considered.
Legal	▪ Enact an ordinance that does not conflict with other supportive plans and subsidies.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of the establishment of supportive regulations, policies, or plans	Check the progress of supportive regulations, policies, or plans and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the supportive regulations, policies, or plans
Feasibility of the implementation of the supportive regulations, policies, or plans	Establish feasible objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation of supportive projects or subsidies is included	Prepare the basis for the future supportive projects or subsidies	▪ Confirmation of the basis of supportive projects or subsidies in the legal document

[Action plan 4] Raising funding for rainwater reuse support project.

Period	Expected Implementation
2nd–10th year	▪ To implement the rainwater reuse support system, the concept shall be established by specifying the project. ▪ Separate the private and public sectors, set the types of rainwater reuse facilities to be installed and the distribution targets for each year, and calculate the estimated input cost. ▪ In the case of large-scale rainwater storage tanks being installed in the public sector, the cost required to build infrastructure to collect surrounding rainwater is considered. ▪ Consider the components of the support project, search for a linkable international financial institution or ODA project, and apply for project support.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ A plan to raise funds in accordance with Kurunegala's water reuse ordinance/by-laws is necessary. ▪ Complete the legal basis for the private sector's investment.
Economy	▪ A budget is necessary to finance Kurunegala's water reuse supportive project. ▪ If there is no central government budget, support may not be available.
Social	▪ When applying for a project funded by an international financial organization, the project's design must integrate poverty- and gender-inclusive components. ▪ Creating a favorable social atmosphere for private sector investment is necessary.
Technology	▪ Technology must be prepared to support the international financial institution funding project and the ODA project, and the preparation of a proposal is required. ▪ Technology is necessary to raise funds, and [Action Plan 11] should be complemented and strengthened by the system operator.

Environment	▪ When financing an international financial institution support project, the environmental impact of the project should be fully considered.
Legal	▪ Enactment of ordinances that do not conflict with other systems is necessary when financing is provided. ▪ Investment in the private sector should not conflict with other laws, and legal assistance should be reviewed.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of budgeting and funding planning	Check the progress of securing budget or funds by each year	▪ Official letter or document of the annual budget's plan by local authority level ▪ Progress reports from the officer-in-charge
Budget allocation from the central government	Check the progress of the supportive action/plans from the central level	▪ Budget allocation request for central government
Funding proposal for international organizations	Propose funding projects that cannot be secured by national level budgeting	▪ Review of the status of composing, e.g., funding proposals and concept notes
Private sector investment	Establish the atmosphere and system for the private sector to invest and secure private sector investment by 2030	▪ Review of the atmosphere and system for the private sector to invest through stakeholder and expert review workshop

[Action plan 5] Monitoring and Evaluation system settlement.

Period	Expected Implementation
5th year, 8th year	▪ Project performance evaluation indicators are set for each action plan, from revisions of ordinances established in the master plan, provision of supportive regulations and policy, and project financial resources to project execution and capacity building. ▪ When setting the project performance evaluation index or indicator, use a quantitative index or indicator to evaluate whether the goal is achieved. ▪ Based on the results of the project evaluation, improvement and supplementary items are derived, and the action plan is revised by reflecting them in the next action plan or next year's project.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Performance evaluation based on Kurunegala's water reuse ordinances/by-laws shall be conducted. ▪ When revising the legal basis and plan related to water reuse, it should be based on the water reuse ordinance.
Economy	▪ Budgeting is necessary to supplement modifications such as performance evaluation and related systems and plans.
Social	▪ Social status should be reflected when supplementing modifications such as performance evaluation and related systems and plans. ▪ Create a social atmosphere for private sector investment
Technology	▪ Technology is necessary to modify and supplement performance evaluation and related systems and plans and complement each other with [Action Plan 9] and [Action Plan 11].
Environment	▪ The environmental impact that can occur when supplementing modifications such as performance evaluation and related systems and plans should be fully considered.

Legal	▪ When supplementing modifications such as performance evaluation and related systems and plans, they should not conflict with other laws.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of planning and legal basis	Review and confirm the needs of the modification(revision)	▪ Survey and analysis of the result of the performance evaluation and the impact on the social changes
Track the monitoring and evaluation indicators of each action plan	Monitor and evaluate the achievements and failures of each action and then reflect that information in the future roadmap	▪ Compose the logical framework and matrix for monitoring and evaluation
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Feasibility of the implementation of the legal system	Establish feasible objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge

Number and percentage of jobs generated by the project for women and men	Increase employment and enterprise opportunities for women and men to mainstream gender equality in the renewable energy sector	▪ Sex-disaggregated statistical data from the related authority
Number and percentage of women and men employed, by type of job and pay rates, and proportion of women employed in unskilled, technical, management, and supervisory roles		
Evidence of the type of incentives designed to recruit women, increase their capacity, and provide career development in the renewable energy sector and service providers		
Evidence that climate finance facilities include special windows for funding activities with women's groups and gender-sensitive guidelines for all funded activities and employ women and men in fund management	Equal access for women to small grants for climate change projects	▪ Check the guidelines/action plans prepared by the government ▪ Sex-disaggregated statistical data from the related authority

[Action plan 6] Feasibility study for project implementation.

Period	Expected Implementation
2nd and 3rd year	▪ Analysis of natural and physical conditions of rainwater reuse facilities and capacity design of rainwater reuse facilities while considering annual precipitation. ▪ Set up an area subject to supply while considering the possibility of flooding in the area where rainwater reuse facilities are installed and the appropriateness of installation of facilities. ▪ Review the feasibility of the project by considering the expected cost of the rainwater reuse facility installation and distribution project and indirect effects such as flood prevention and reduction of water use.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Projects based on Kurunegala's policies, plans, and ordinances for the expansion of water reuse should be targeted.
Economy	▪ Budgeting is required for feasibility studies for the implementation of the water reuse facility construction project. ▪ If the central government and Kurunegala lack resources, preparing measures to utilize the resources of international financial institutions and ODA projects is necessary.
Social	▪ When conducting feasibility studies for rainwater reuse facility construction project, consideration of individuals who have less access to energy use and gender quality is required. ▪ When reviewing the feasibility of the target site, the regional gap should be reviewed.
Technology	▪ WSDB and UDA should conduct feasibility studies for the implementation of rainwater reuse facility construction
Environment	▪ Environmental impact assessment should be conducted for environmental impacts caused by the construction of rainwater reuse projects.
Legal	▪ Review conflicts with other laws and legal procedures due to the rainwater reuse facility construction

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of feasibility review	Check the progress of the feasibility review and implementation results	▪ Review the feasibility review status and results through stakeholder and experts' workshop ▪ Progress reports from the officer-in-charge
Rationality of the methodology of feasibility review	Establish the reasonable implementation methodology	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Result of the feasibility review	Check the feasibility of the project implementation	▪ Review various conditions, e.g., natural and physical conditions, costs, and returns, to ensure project feasibility

[Action plan 7] Public sector project

Period	Expected Implementation
3rd and 4th year	▪ Identify public institutions that can install rainwater reuse facilities and estimate the size that can be installed. ▪ Establish a rainwater reuse facilities plan for each year. ▪ Establish a pilot project on a site with decent location conditions and amount of water reuse.
5th–10th year	▪ Establish a plan with the goal of rainwater reuse facilities' construction in all public institutions in the mid to long term. ▪ Through the operation of initially installed facilities, identify problems and improvement points then reflected in the future project.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of public institution installation projects based on Kurunegala's policies, plans, and ordinances to expand water reuse.
Economy	▪ Budgeting is required for the construction of rainwater reuse facilities in public institutions. ▪ If the central government and Kurunegala lack resources, preparing measures to utilize the resources of international financial institutions and ODA projects is necessary.
Social	▪ When establishing rainwater reuse facilities in public institutions, the contents of causing and resolving conflicts between public institutions should be reviewed.
Technology	▪ When establishing rainwater reuse facilities in public institutions, WSDB and UDA should internalize the technology, complement each other by strengthening the capabilities for [Action Plan 10], and enhance capabilities for R&D.
Environment	▪ The environmental impact of the construction of rainwater reuse facilities in public institutions should be

	minimized.
Legal	▪ Review legal procedures and conflicts with other laws due to the construction of rainwater reuse facilities in public institutions.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of securing the budget	Secure the budget for the planned installation	▪ Check the annual budget's status
Management status of rainwater reuse facilities	To fulfill the estimated water reuse amount	▪ Check the amount of water usage through facility management
Percentage of the public institutions constructed rainwater reuse facilities	100% installed by 2030	▪ Check the percentage of the public institution installation
Ratio of water reuse through rainwater reuse	30% reuse of water usage in public institutions by 2030	▪ Check the percentage of water use in public institutions

[Action plan 8] Private sector project.

Period	Expected Implementation
3rd–5th year	▪ Conduct a survey on demand for construction of water reuse facilities and calculate the size that can be installed in homes and commercial buildings. ▪ Establish the scope of support and targets for the construction of water reuse facilities. ▪ Preferentially implement policy support projects such as simplifying licensing for construction of water reuse facilities and operating the fast track. ▪ Establish construction of water reuse facilities plan for each year.
6th–10th year	▪ Subsidy support or low-interest loan support for installation in households and commercial buildings. ▪ Tax reduction is provided for businesses that directly invest in the water reuse facilities business, and the installation business divides and recovers the profits generated from direct investment in facilities over several years. ▪ Benchmarking ESCO projects encourages the activation of the construction of water reuse facilities in the mid to long term.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of private installation support projects based on Kurunegala's policies, plans, and ordinances to expand water reuse.
Economy	▪ Budgeting is required for private installation support projects. ▪ If the central government and Kurunegala lack resources, preparing measures to utilize the resources of international financial institutions and ODA projects is necessary.
Social	▪ When implementing a private installation support project, the details of what causes and resolves conflicts between demand institutions should be reviewed.

Technology	▪ Technologies such as operating process and R&R establishment are necessary for the operation of private installation support projects, and [Action Plan 11] should be complemented with the enhancement of capabilities of the system operator.
Environment	▪ When supporting private installation, the environmental impact should be minimized, and projects with large environmental impact should not be supported.
Legal	▪ Reviewing conflicts with other laws in support of private installation support projects and reviewing legal procedures are necessary.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of securing the budget	Secure the budget for the planned support projects	▪ Check the annual budget's status
Number of supported and subsidized projects	300 cases by 2030	▪ Check the number of private sector applications for the support from the government
Percentage of water reuse	3% of water reuse in Kurunegala by 2030	▪ Check the water reuse ratio

[Action plan 9] Capacity building of policymakers.

Period	Expected Implementation
1st and 2nd, 4th and 5th, 7th and 8th year	▪ Development and operation of training programs to strengthen the capabilities of policymakers who establish policies and plans to expand water reuse. ▪ The first year in which the policy and plan are established, and the fourth and seventh years in which the system and plan are directly modified and supplemented and are implemented from the beginning to the next year. ▪ Basic education on the economic, environmental, and social changes and expected effects of Kurunegala because of climate change and the introduction of water reuse, and policy-oriented case education for expansion and dissemination of water reuse in similar-income or higher-income countries.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education/training to strengthen the capabilities of policymakers based on Kurunegala's water reuse policies, plans, and ordinances.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the policymakers, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen the capacity of the system's planners and on causing and resolving conflicts between regions.
Technology	▪ Program design and implementation techniques for strengthening the capabilities of institutional planners are necessary, and the ability to improve the system on its own should be strengthened with the assistance of experts from outside agencies. ▪ [Action plan 1], [Action plan 2], and [Action plan 5] Performance evaluations and the related systems and plans should supplement each other.

Environment	▪ Development of the capacity-building program for policymakers must minimize environmental impact.
Legal	▪ When developing the education program for policymakers, the contents of the relevant law and its relationship with other laws are specified, and the contents related to the development of the law and the institution are specified.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	To ensure the policymakers are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 10] Capacity building of project implementer.

Period	Expected Implementation
3rd–8th year	▪ Training on key factors and feasibility analysis procedures to be considered when selecting a site to install rainwater reuse facilities. ▪ Training on key factors and installation procedures to be considered when installing rainwater reuse facilities. ▪ Transfer of installation know-how to rainwater reuse facility installation technicians. ▪ Management of rainwater reuse facilities and maintenance technology training.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen the capacity of the installation/construction implementer based on Kurunegala's policies, plans, and ordinances for the expansion of water reuse.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the installation/construction implementer, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen the capacity of the installation/construction implementer and on causing and resolving conflicts between regions.
Technology	▪ Installation/construction implementers need technology to design and implement their capabilities and strengthen their ability to perform their installation and O&M with the assistance of external experts. ▪ [Action plan 7] Must be complemented with the public institution installation project.
Environment	▪ Installation/construction implementer training program must be developed to include the contents that emphasize minimizing the environmental impact.
Legal	▪ Installation/construction implementer training program development must include legal procedures.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	300 individuals of installation/construction implementers attended the training program	▪ Train 50 engineers per year
Rationality of the capacity-building training module and program	Develop a reasonable capacity-building training module or program	▪ Stakeholder review workshop
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Women's employment during construction, operation, and maintenance and in renewable energy agencies	Encourage women's employment on the site	▪ Evidence showed that contracts and tender documents for subcontractors require the recruitment of women as unskilled labor

[Action plan 11] Capacity building of implementation of regulation and policy.

Period	Expected Implementation
2nd and 3rd, 6th and 7th, 9th year	▪ Establish R&R and operate a support system for each department or division. ▪ Establish a support system and operation process for support projects. ▪ Assistance in establishing supportive regulations and policy and all necessary matters during the implementation. ▪ Training to improve understanding of project evaluation indicators.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen the capacity of legal system operators based on Kurunegala's policies, plans, and ordinances for the expansion of water reuse.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the legal system operators, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen the capacity of the legal system operators and on causing and resolving conflicts between regions.
Technology	▪ Design and implementation technology of the legal system operator's capacity enhancement program is required, and the ability to improve the legal system by supporting experts from outside organizations is necessary. ▪ [Action plan 8] Must be complemented with the private installation support projects.
Environment	▪ Legal system operator's training program must be developed to minimize environmental impact.
Legal	▪ When developing a legal system operator's training program, the contents of the relevant law and the relationship with other laws should be specified, and the contents of legal procedures should be included.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	Ensure the system operators are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Rationality of the capacity-building training module and program	Develop a reasonable capacity-building training module or program	▪ Stakeholder review workshop
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 12] Enhancement of R&D competency.

Period	Expected Implementation
4th–10th year	▪ Development and operation of training programs to strengthen R&D capabilities of water reuse based on policies, plans, and ordinances for the expansion of water reuse. ▪ After the installation of the rainwater reuse facilities, it is continuously conducted from the 4th year, and R&D capabilities are strengthened for optimization and high efficiency of the rainwater reuse facilities. ▪ Support research to enhance technology development capabilities for efficient operation and monitoring of the rainwater reuse facilities. ▪ Support the development of intangible technologies (e.g., O&M technologies suitable for Sri Lanka) in the short term and types of products in the long term.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen the R&D capabilities based on Kurunegala's policies, plans, and ordinances for the expansion of water reuse.
Economy	▪ Financial resources are necessary to strengthen the R&D capabilities, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen the R&D capabilities and on causing and resolving conflicts between regions.
Technology	▪ Requires R&D capacity-building program design and implementation technology and strengthens the ability to optimize and implement technology on its own with the assistance of experts from outside organizations. ▪ [Action plan 7] Must be complemented with the public institution installation project.
Environment	▪ R&D capacity-building program must be developed to minimize environmental impact.

Legal	▪ When developing an R&D training program, include legal procedures.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	350 individuals of R&D professionals received training	▪ Train 50 engineers per year
Rationality of the capacity-building training module and program	Develop a reasonable capacity-building training module or program	▪ Stakeholder review workshop
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training

[Action plan 13] Public awareness promotion and capacity building.

Period	Expected Implementation
3rd–10th year	▪ Development and operation of educational programs and campaigns to raise public interest in responding to climate change based on policies, plans, and ordinances for expanding water reuse. ▪ Education and campaigns to strengthen public awareness to cope with climate change are conducted continuously from the third year, when policies, plans, and ordinances for the expansion of water reuse are completed. ▪ Establish a foundation for interest in the contents through the development and operation of educational programs that help ordinary citizens understand and sympathize with the impact of climate change and the need to respond. ▪ Various activities are implemented to positively recognize the expansion of water reuse through education on the necessity and importance of water reuse

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen public awareness based on Kurunegala's policies, plans, and ordinances for the expansion of water reuse.
Economy	▪ Financial resources are necessary to strengthen public awareness.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen public awareness and on causing and resolving conflicts between regions.
Technology	▪ Design and implementation skills in the general citizen's capacity-building program are required, and education programs and campaigns should be led by institutional planners, installation/construction implementers, institutional (legal system) operators, and internal personnel who have completed R&D capacity-building training.
Environment	▪ Public awareness program must be developed to include the dissemination of the importance of the minimization

	of the environmental impact.
Legal	▪ When developing education programs for public awareness, introduce related laws to the public.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions/campaign targeted at women and men, with a gender mainstreaming theme	Raise the awareness of gender equality among the citizens	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	4,000 citizens received the training by 2030	▪ Train 500 citizens per year
Target of the campaign participants (by women and men disaggregated data)	8,000 citizens participated in the campaign by 2030	▪ 1,000 citizens participate in the campaign per year
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training/campaign	Minimum 30% of women participating in each session/event	▪ Check attendance rate of the capacity-building program and the registration lists for the campaign

3-4. Light Replacement to LED

A. Introduction

[Technology Brief in Local Context]

Indoor LED light consumes less electricity than fluorescent light does; thus, the energy efficiency of LED light is better than that of fluorescent light. The lifespan of an LED light is almost 30,000 hours and is double the lifespan of a general fluorescent light. Additionally, a fluorescent light contains heavy metals such as mercury, whereas an LED light does not contain harmful substances. Typically, a high-pressure sodium-vapor lamp, with a high energy consumption capacity, is adopted for streetlights; however, LED lights can also perform this function. The light intensity of an LED light can be controlled according to factors in the environment, such as intensity of sunlight, and is brighter than that of a sodium lamp.

In Sri Lanka, industries and commercial buildings are moving from CFL to LED, and in 2019, a streetlight conversion project was implemented. The Sri Lankan government has received approval from the Cabinet to award a project to the Korean Telecom Cooperation to replace traditional street lighting with LED streetlights in Colombo and other main cities of Sri Lanka. Earlier, the Korean Telecom Cooperation had presented a proposal for the implementation of a project for the replacement of conventional streetlights with Smart LED streetlights. The multiple benefits of LED lighting (e.g., energy-saving and cost-effectiveness) have played a key role in this important decision.

[Expected Cost and GHG Mitigation Effect]

The Republic of Korea has conducted streetlight LED conversion projects. The cost was USD 48,900,000 to replace 63,000 streetlights, and the expected lifetime of LED lights was 30 years. The abatement cost was 158 USD/tonCO_2eq, and the total amount of GHG reduction was 308,820 tonCO_2eq.

B. Action Plan

Category	Action Plans	Period(year)										Implementing authority
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
Policy, plan reform and establishment	Establish policies and plans for KMC's energy efficiency	■										CEB
	Prepare the KMC Ordinance for Energy Efficiency		■									CEB
	Design the KMC Energy Efficiency Support System		■	■								CEB
	Monitoring and Evaluation system settlement					■			■			CEB
Physical projects	Mandatory replacement with LED lights in the public sector			■	■	■	■	■	■	■	■	CEB
	Mandatory replacement with LED lights for buildings larger than a certain size in the private sector and supportive project for private sector			■	■	■	■	■	■	■	■	CEB
Capacity Building	Empowering institutional planners	■	■		■	■		■	■			External Expert
	Empowering regulation and policy operators		■	■			■	■		■		External Expert
	Public awareness promotion and empowerment			■	■	■	■	■	■	■	■	External Expert

[Action plan 1] Establish policies and plans for KMC's energy efficiency.

Period	Expected Implementation
1st year	▪ Establish KMC-level energy efficiency policies and master plans to fulfill the minimum energy efficiency required by the National Energy Policy. ▪ Master plan establishes a plan in consideration of the types of high-efficiency energy devices to be applied to the private and public sectors, respectively. ▪ Master plan sets the target for the supply of high-efficiency energy devices per year. ▪ Master plan includes a plan for, for example, ordinances, supportive regulations and policy, and financing,.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Establish policies and plans in line with the national energy efficiency policy direction.
Economy	▪ Financial resources are necessary for the establishment of energy efficiency policies and master plans, and cooperation with international agencies such as KEITI, KOICA, GCF and CTCN is in need.
Social	▪ Establish policies and plans that reflect the social status of energy efficiency in Kurunegala. ▪ When developing policies and plans to expand energy efficiency, consideration of energy poverty and gender equality is necessary.
Technology	▪ Technology for developing energy efficiency policies and plans is necessary, and [Action Plan 7] should be complemented with strengthening capabilities for policymakers.
Environment	▪ Consider the expected environmental impact of developing policies and plans.
Legal	▪ Establish a policy direction that does not conflict with other relevant laws.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of policies and plans establishment	Check the progress of policy establishment and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the policies and plans
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation is incorporated in the legal document	Preparing grounds for the performance of, e.g., ordinances, by-laws, systems in the future	▪ Confirm the contents of the legal document that indicates the future activities regarding, e.g., ordinances, by-laws, and systems
Gender mainstreaming is incorporated in the policy	Energy policy, strategies, and reforms incorporate gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 2] Prepare the KMC Ordinance for Energy Efficiency.

Period	Expected Implementation
2nd year	▪ Enact ordinances based on KMC's energy efficiency policy and master plan. ▪ The definition and recognition criteria of high-efficiency energy equipment are specified in the Ordinance. ▪ The Ordinance shall specify the basis for implementing the support system and projects for the dissemination of high-efficiency energy equipment. ▪ The Act stipulates the basis for the activities to strengthen the capabilities of the stakeholders in the project to support the supply of high-efficiency energy devices.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Enact an ordinance in line with Kurunegala's policy and a plan to expand energy efficiency.
Economy	▪ Local authority level budgeting is required to enact the Kurunegala municipal ordinance on energy efficiency.
Social	▪ Prepare an ordinance that reflects the social status of energy efficiency in Kurunegala. ▪ When preparing the energy efficiency ordinance, consider the individuals who have less access to energy and gender equality.
Technology	▪ Technology for enacting ordinances is necessary and should complement [Action Plan 7] and [Action Plan 8].
Environment	▪ The environmental impact of the performance included in the energy efficiency ordinance should be considered.
Legal	▪ Enact an ordinance that does not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of ordinances/by-laws establishment	Check the progress of ordinances/by-laws and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the ordinances or by-laws
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation is incorporated in the legal document	Prepare the basis for the future supportive system or plans, subsidies, strengthening the capabilities of stakeholders, and so forth.	▪ Confirmation of future performance, e.g., supportive system or plans, subsidies, and strengthening stakeholder capabilities
Gender mainstreaming is incorporated in the ordinances/by-laws	Ordinances and by-laws include gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 3] Design the KMC Energy Efficiency Support System.

Period	Expected Implementation
2nd and 3rd year	▪ Subsidized or low-interest loans are provided as a support measure for the dissemination of high-efficiency energy devices. ▪ Set the target, period, and scope of subsidies for the distribution of high-efficiency energy devices. ▪ Support for long-term low-interest loans to high-efficiency energy equipment buyers.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Prepare supportive plans or subsidies in accordance with Kurunegala's energy efficiency ordinance/by-law.
Economy	▪ A budget is necessary to prepare supportive plans or subsidies for the energy efficiency sector in Kurunegala.
Social	▪ Establish supportive plans or subsidies that reflect the social status of energy efficiency in Kurunegala. ▪ Fully consider the individuals in poverty who have less access to energy and gender quality when establishing energy efficiency supportive plans and subsidies.
Technology	▪ Technology is necessary to prepare supportive plans and subsidies, and [Action Plan 8] should be complemented and strengthened by the system operator.
Environment	▪ The environmental impact of the energy efficiency supportive plans and subsidies should be fully considered.
Legal	▪ Enact an ordinance that does not conflict with other supportive plans and subsidies.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of the establishment of supportive regulations, policies, or plans	Check the progress of supportive regulations, policies, or plans and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the supportive regulations, policies, or plans
Feasibility of the implementation of the supportive regulations, policies, or plans	Establish feasible objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation of supportive projects or subsidies is included	Prepare the basis for the future supportive projects or subsidies	▪ Confirmation of the basis of supportive projects or subsidies in the legal document

[Action plan 4] Monitoring and Evaluation system settlement.

Period	Expected Implementation
5th year, 8th year	▪ Project performance evaluation indicators are set for each action plan, from revisions of ordinances established in the master plan, provision of supportive regulations and policy, and project financial resources to project execution and capacity building. ▪ When setting the project performance evaluation index or indicator, use a quantitative index or indicator to evaluate whether the goal is achieved. ▪ Based on the results of the project evaluation, improvement and supplementary items are derived, and the action plan is revised by reflecting them in the next action plan or next year's project.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Performance evaluation based on Kurunegala's energy efficiency ordinances/by-laws shall be conducted. ▪ Revisions to the legal basis related to energy efficiency should be based on the energy efficiency ordinance.
Economy	▪ Budgeting is necessary to supplement modifications such as performance evaluation, systems, and plans.
Social	▪ Social status should be reflected when supplementing modifications such as performance evaluation and related systems and plans.
Technology	▪ Technology is necessary to modify and supplement performance evaluation and related systems and plans and complement each other with [Action Plan 7] and [Action Plan 8].
Environment	▪ The environmental impact that can occur when supplementing modifications such as performance evaluation and related systems and plans should be fully considered.
Legal	▪ When supplementing modifications such as performance evaluation and related systems and plans, they should not conflict with other laws.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of planning and legal basis	Review and confirm the needs of the modification(revision)	▪ Survey and analysis of the result of the performance evaluation and the impact on the social changes
Track the monitoring and evaluation indicators of each action plan	Monitor and evaluate the achievements and failures of each action and then reflect that information in the future roadmap	▪ Compose the logical framework and matrix for monitoring and evaluation
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Feasibility of the implementation of the legal system	Establish feasible objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Number and percentage of jobs generated by the project for women and men	Increase employment and enterprise opportunities for women and men to mainstream gender equality in the renewable energy sector	▪ Sex-disaggregated statistical data from the related authority

Number and percentage of women and men employed, by type of job and pay rates, and proportion of women employed in unskilled, technical, management, and supervisory roles		
Evidence of the type of incentives designed to recruit women, increase their capacity, and provide career development in the renewable energy sector and with service providers		
Evidence that climate finance facilities include special windows for funding activities with women's groups and gender-sensitive guidelines for all funded activities and employ women and men in fund management	Equal access for women to small grants for climate change projects	▪ Check the guidelines/action plans prepared by the government ▪ Sex-disaggregated statistical data from the related authority

[Action plan 5] Mandatory replacement with LED lights in the public sector.

Period	Expected Implementation
3rd–5th year	▪ Based on energy efficiency policies, plans, and ordinances, the government implements mandatory replacement with LED lights for existing buildings and installation of new buildings. ▪ Based on the energy efficiency plan and ordinance, the LED light replacement ratio target and supply support plan are established.
6th–10th year	▪ Energy consumption efficiency of existing buildings is investigated and analyzed by public institutions to derive and implement energy-saving measures other than replacing LED lights. ▪ Based on the energy efficiency policy, plans, and ordinances, mid- to long-term electricity reduction is conducted by replacing lights in all public institutions and public facilities, such as replacing street lamps with LED lights.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of the mandatory replacement with LED lights in public institutions based on Kurunegala's energy efficiency policies, plans, and ordinances.
Economy	▪ Budgeting is required for the replacement with LED lights in public institutions.
Social	▪ Information on the mandatory installation of LED lights in public institutions and the contents of causing and resolving conflicts among public institutions should be reviewed when replacing LED lights in existing buildings.
Technology	▪ UDA should develop and internalize the technology of LED lights.
Environment	▪ The environmental impact that can occur from the disposal of existing LED lights should be minimized.
Legal	▪ Legal procedures for support should be reviewed when replacing LED lights in public institutions.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of securing the budget	Secure the budget for the retrofitting	▪ Check the annual budget's status
Percentage of the new buildings installed LED	100% installed by 2030	▪ Check the percentage of the public institution installation
Percentage of the existing buildings' lights replaced with LED lights	100% installed by 2030	▪ Check the percentage of the existing public building's lights replaced with LED lights

[Action plan 6] Mandatory replacement with LED lights for buildings larger than a certain size in the private sector and supportive projects for the private sector.

Period	Expected Implementation
3rd–5th year	▪ Based on energy efficiency policies, plans, and ordinances, the government implements mandatory installation/replacement with LED lights of a certain size or larger for the private sector and establishes annual expansion goals. ▪ Among the economic support projects, projects that require less funding, such as reducing electricity bills, are implemented first.
6th–10th year	▪ Lower the standard so that more of the existing private buildings are obligated to replace existing lights with LED lights. ▪ Maintain policy support projects and economic support projects implemented in the mid term and operate subsidies or low-interest loans to replace existing lights with LED lights when securing financial resources for support projects.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Based on Kurunegala's energy efficiency policies, plans, and ordinances, mandatory replacement with LED lights in the private sector and implementation of support projects.
Economy	▪ Budgeting is required for private installation support projects.
Social	▪ When implementing a project to support the replacement of existing lights with LED lights in existing buildings in the private sector, review the contents of causing and resolving conflicts between demand agencies.
Technology	▪ Technologies such as operating process and R&R establishment are necessary for the operation of private installation support projects, and [Action Plan 8] should be complemented with the enhancement of capabilities

	of the system operator.
Environment	▪ When supporting the replacement of existing lights with LED lights in existing buildings in the private sector, environmental impacts should be minimized because of disposal, and projects with large environmental effects should not be supported.
Legal	▪ Reviewing legal procedures and conflicts with other laws in support of private installation support projects are necessary.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of securing the budget	Secure the budget for the planned support projects	▪ Check the annual budget's status
Number of projects to support the replacement with LED lights in the private sector	400 cases by 2030	▪ Check the number of private sector applications for the support from the government
Increased energy efficiency because of replacement with LED lights in existing buildings	Increase energy efficiency by 10% by 2030	▪ Check the building electricity usage

[Action plan 7] Empowering institutional planners.

Period	Expected Implementation
1st and 2nd, 4th and 5th, 7th and 8th year	▪ Development and operation of training programs to strengthen the capabilities of policymakers who establish policies and plans to expand energy efficiency. ▪ The first year in which the policy and plan are established, and the fourth and seventh years in which the system and plan are directly modified and supplemented and are implemented from the beginning to the next year. ▪ Basic education on the economic, environmental, and social changes and expected effects of Kurunegala because of climate change and the introduction of energy efficiency, and policy-oriented case education for expansion and dissemination of energy efficiency in similar-income or higher-income countries.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education/training to strengthen the capabilities of policymakers based on Kurunegala's energy efficiency policies, plans, and ordinances.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the policymakers, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen the capacity of the system's planners and on causing and resolving conflicts between regions.
Technology	▪ Program design and implementation techniques for strengthening the capabilities of institutional planners are necessary, and the ability to improve the system on its own should be strengthened with the assistance of experts from outside agencies. ▪ [Action plan 1], [Action plan 2], and [Action plan 4] Performance evaluations and the related systems and plans should supplement each other.

Environment	▪ Development of the drafting program must minimize environmental impact.
Legal	▪ When developing the education program for policymakers, the contents of the relevant law and its relationship with other laws are specified, and the contents related to the development of the law and the institution are specified.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	To ensure the policymakers are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 8] Empowering regulation and policy operators.

Period	Expected Implementation
2nd and 3rd, 6th and 7th, 9th year	▪ Establish R&R and operate a support system for each department or division. ▪ Establish a support system and operation process for support projects. ▪ Assistance in establishing supportive regulations and policy and all necessary matters during the implementation. ▪ Training to improve understanding of project evaluation indicators.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen the capacity of legal system operators based on Kurunegala's policies, plans, and ordinances for the expansion of energy efficiency.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the legal system operators, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen the capacity of the legal system operators and on causing and resolving conflicts between regions.
Technology	▪ Design and implementation technology of the legal system operator's capacity enhancement program is required, and the ability to improve the legal system by supporting experts from outside organizations is necessary. ▪ [Action plan 6] Must be complemented with the private installation support projects.
Environment	▪ Legal system operator's training program must be developed to minimize environmental impact.
Legal	▪ When developing a legal system operator's training program, the contents of the relevant law and the relationship with other laws should be specified, and the contents of legal procedures should be included.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	Ensure the system operators are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Rationality of the capacity-building training module and program	Develop a reasonable capacity-building training module or program	▪ Stakeholder review workshop
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 9] Public awareness promotion and empowerment.

Period	Expected Implementation
3rd–10th year	▪ Development and operation of educational programs and campaigns to raise public interest in responding to climate change based on policies, plans, and ordinances for expanding energy efficiency. ▪ Education and campaigns to strengthen public awareness to cope with climate change are conducted continuously from the third year, when policies, plans, and ordinances for the expansion of energy efficiency are completed. ▪ Establish a foundation for interest in the contents through the development and operation of educational programs that help ordinary citizens understand and sympathize with the impact of climate change and the need to respond. ▪ Various activities are implemented to positively recognize the expansion of energy efficiency through education on the necessity and importance of energy efficiency.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen public awareness based on Kurunegala's policies, plans, and ordinances for the expansion of energy efficiency.
Economy	▪ Financial resources are necessary to strengthen public awareness.
Social	▪ Include information on the individuals who have less access to energy and gender equality within the program to strengthen public awareness and on causing and resolving conflicts between regions.
Technology	▪ Design and implementation skills in the general citizen's capacity-building program are required, and education programs and campaigns should be led by institutional planners, installation/construction implementers, institutional (legal system) operators, and internal personnel who have completed R&D capacity-building training.
Environment	▪ Public awareness program must be developed to include the dissemination of the importance of the minimization

	of the environmental impact
Legal	▪ When developing education programs for public awareness, introduce related laws to the public.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions/campaign targeted at women and men, with a gender mainstreaming theme	Raise the awareness of gender equality among the citizens	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	4,000 citizens received the training by 2030	▪ Train 500 citizens per year
Target of the campaign participants (by women and men disaggregated data)	8,000 citizens participated in the campaign by 2030	▪ 1,000 citizens participate in the campaign per year
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training/campaign	Minimum 30% of women participating in each session/event	▪ Check attendance rate of the capacity-building program and the registration lists for the campaign

V. Transportation sector Roadmap and Action Plans

1. Introduction

Originally, the “transport” of it had to overcome physical limitations such as time, distance, and topography. Additionally, it is the spatial linking of a derived demand from users. This roadmap is more focused on public transportation than on general means of transportation. Public transportation is mainly derived from the passengers/users of the type of transportation. Group travel systems available to the public charge their users a fee to pay for their operations. The roadmap for climate technology implementation in the transportation sector of Kurunegala comprises the following technologies, and the overall implementation roadmap is shown in the table below:

- Eco-friendly vehicle (integration of an HEV and electric vehicle)

- Park and ride (P&R) system

The development of climate technology policies and plans in transportation is driven by the Transport Authority (TA), Road Development Authority (RDA), and Railway Department (RD). The deployment of infrastructure is driven by the Urban Development Authority (UDA). Capacity building is conducted by external experts.

[Emission Trend of the Transport Sector]

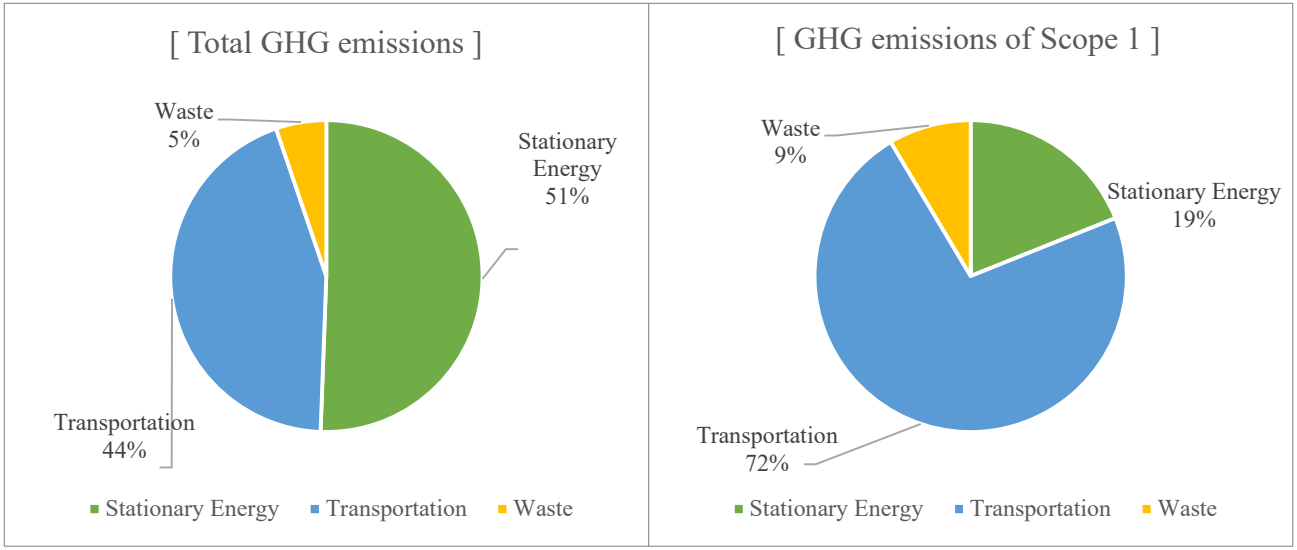
The GHG emissions have increased from 58,797tonCO2eq in 2012-2013 to 82,563tonCO2eq in 2016-2017. The increase rate between 2013 and 2017 is 40.42%. The GHG emission trends of each year is presented in the Table below.

Year	2012-13	2013-14	2014-15	2015-16	2016-17
GHG emission ($tonCO_2eq$)	58,797	60,645	65,545	71,846	82,563

The total GHG emissions of the City in 2016-2017 are 82,563tonCO2eq, stationary energy is the highest emission source, followed by transport sector and waste sector by order. GHG emissions in Scope 1 means direct GHG emissions by fossil fuel consumption or by the process of waste treatment. GHG emissions in Scope 2 means indirect GHG emissions by electricity consumption. The GHG emissions in Scope 2 by electricity consumption are only produced in stationary energy sector referred as residential, commercial, institutional buildings and facilities and industrial plants or facilities.

In the left figure, with consideration of scope 1 and scope 2, the stationary energy is 51% (41,773.35tonCO2eq) as the largest proportion of total GHG emissions, the second largest source is transport sector of 44% (36,480.25tonCO2eq) and the waste sector of 5% (4,308.98tonCO2eq) is the least emission source.

In the right figure, with considering only Scope 1, the order of emission sources share is changing. The major emission source is the transport sector of 72% (36,480.25tonCO2eq), and the rest of emissions are the stationary energy sector of 19% (9,529.69tonCO2eq) and the waste sector of 9% (36,480.25tonCO2eq).



2. Transportation sector Roadmap

Category	Type of actions	Period			Implementing authority	Funding option
		Short term	Mid term	Long term		
Policy, plan reform and establishment	Establishing policies and plans related to the transportation sector (eco-friendly vehicle, public transportation)	■			TA, RDA, RD	External funding
	Preparation of an ordinance related to the transportation sector	■			TA, RDA, RD	Internal budget
	Establishment of transportation-related support systems	■			TA, RDA, RD	Internal budget
	Funding for transportation-related support projects	■	■	■	TA, RDA, RD	Internal budget
	Performance evaluation and policy/plan modification in the transportation sector	■	■	■	TA, RDA, RD	External funding
Physical projects	Implement feasibility study to build infrastructure for project implementation	■	■	■	TA	External funding
	Establishment of basic infrastructure for using eco-friendly vehicles	■	■	■	TA, UDA	External funding
	Building a P&R system infrastructure	■	■	■	TA, RDA, RD	Internal budget
	Compulsory purchase of eco-friendly vehicles for public institutions	■	■	■	TA	Internal budget
	Support project for purchasing eco-friendly vehicles	■	■	■	TA	Internal budget
	Operation of P&R system	■	■	■	TA, RDA	Internal budget
Capacity Building	Training programs for policymakers in the transportation sector	■	■	■	External Expert	External funding
	Training programs for project implementers of infrastructure	■	■	■	External Expert	External funding
	Training programs to strengthen the capabilities of operators of transportation systems and programs	■	■	■	External Expert	External funding
	Education and campaigns for general citizens that can raise interest in responding to climate change in the transportation sector	■	■	■	External Expert	Internal budget

3. Action Plan per Climate Technology

3-1. Eco-friendly Vehicles

A. Introduction

[Technology Brief in Local Context]

An electric car is propelled by one or more electric motors and uses energy stored in rechargeable batteries. Because the electricity can be recharged only at the electric charging station, establishing the electric charging network is the most important component to introduce electric cars in the city boundary. An HEV (hybrid electric vehicle) is operated by both a combustion engine and electric motor. An HEV includes an essentially electric power train system as a secondary power source. This secondary power source supports the primary engine to consume less fuel by providing the energy absorbed and converted during decelerating the car. In general, an HEV has better fuel efficiency than conventional cars do.

In Sri Lanka, an estimated 7,000 electric cars are in operation in and for the hybrid vehicles; additionally, there were 1,232 units in January, up from 1,057 units the prior month, but a significant decline from 2,980 units 12 months ago in 2019. Currently, there are approximately 70 active charging stations spread mainly around the western, central, and southern provinces. The aim is to establish 100 charging stations by the end of 2020. Nissan Leaf, Hyundai Kona, BMW i5, are common electric vehicles used in Sri Lanka. Electric vehicle clubs and charging station clubs are there to solve electric vehicle-related issues.

[Expected Cost and GHG Mitigation Effect]

In 2010, the project to introduce electric buses and establish charging stations in Daegu Metropolitan City, Republic of Korea paid USD 75,000,000 for 33 electric buses and 7,000 electric charging stations. The abatement cost was 3,694 USD/tonCO_2eq, and the expected GHG mitigation effect was 2,030 tonCO_2eq/year. For the HEV project, the cost was approximately USD 19,200,000 to replace 29,430 private cars, 6,838 taxis, and 1,231 HEV buses. The GHG mitigation effect was 51,984 tonCO_2eq/year. The GHG reduction factor for HE taxi is 2,433 tonCO_2eq/year/vehicle, and that for HE private car is 0.579 tonCO_2eq/year/vehicle.

B. Action Plan

Category	Action Plans	Period(year)										Implementing authority
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
Policy, plan reform and establishment	Establishment of policies and master plans for expanding KMC's eco-friendly vehicles	■										TA
	Prepare the KMC's Ordinance		■									TA
	Design supportive regulations and policy for the distribution of KMC eco-friendly vehicles		■	■								TA
	Funding for projects to support the distribution of KMC eco-friendly vehicles		■	■	■	■	■	■	■	■	■	TA
	Monitoring and Evaluation system settlement					■			■			TA
Physical projects	Feasibility study for eco-friendly vehicle charging infrastructure		■			■			■			TA, UDA
	Establishment of charging infrastructure			■	■	■	■	■	■	■	■	TA, UDA
	Compulsory purchase of eco-friendly vehicles for public institutions			■	■	■	■	■	■	■	■	TA
	A project to support the purchase of eco-friendly vehicles			■	■	■	■	■	■	■	■	TA
Capacity Building	Empower policymakers	■	■		■	■		■	■			External Expert
	Empower infrastructure project implementer			■	■	■	■	■	■			External Expert
	Empower regulation and policy operators		■	■			■	■		■		External Expert
	Promoted public awareness and capacity building			■	■	■	■	■	■	■	■	External Expert

[Action plan 1] Establishment of policies and master plans for expanding KMC's eco-friendly vehicles.

Period	Expected Implementation
1st year	▪ Establishing policies and master plans that can be implemented at the KMC level in consideration of national policies related to the future distribution of eco-friendly vehicles. ▪ When establishing the master plan, electric vehicles and hybrid vehicles are defined as eco-friendly vehicles, and the types of vehicles are divided into the private sector and the public sector. ▪ A master plan is established that stipulates feasible goals and implementation methods for expanding and distributing eco-friendly vehicles. ▪ Setting the annual expansion rate of eco-friendly cars in the master plan and setting the distribution target for each category. ▪ Master plan includes a plan for, for example, ordinances, supportive regulations and policy, and financing.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Establish policies and plans in line with the direction of the national eco-friendly vehicle supply/dissemination policy.
Economy	▪ Financial resources are necessary to establish policies and plans for distributing eco-friendly vehicles, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Establish policies and plans that reflect the social status of eco-friendly vehicle accessibility in Kurunegala and consider gender equality in the employment rate of women/men when planning and expanding eco-friendly vehicles' accessibility.
Technology	▪ Policies and plans should be established by understanding and considering the current status of eco-friendly vehicle technology in Sri Lanka and Kurunegala.

	▪ Technology to expand and plan eco-friendly vehicles is necessary, and [Action Plan 10] should be complemented with strengthening capabilities of policymakers.
Environment	▪ Consider the expected environmental impact when developing policies and plans to expand eco-friendly vehicles.
Legal	▪ Establish a policy direction that does not conflict with other relevant laws.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of policies and plans establishment	Check the progress of policy establishment and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the policies and plans
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation is incorporated in the legal document	Preparing grounds for the performance of, e.g., ordinances, by-laws, systems in the future	▪ Confirm the contents of the legal document that indicates the future activities regarding, e.g., ordinances, by-laws, and systems
Gender mainstreaming is incorporated in the policy	Transport policy, strategies, and reforms include gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 2] Prepare the KMC's Ordinance for the Expansion of Eco-Friendly vehicles.

Period	Expected Implementation
2nd year	▪ The Ordinance shall specify the definition and scope of recognition of eco-friendly vehicles. ▪ The Ordinance shall specify the basis for implementing the supportive regulations and policy and the support project for the expansion and distribution of eco-friendly vehicles. ▪ The Ordinance shall specify the basis for the activities of expanding and distributing eco-friendly vehicles to strengthen the capabilities of stakeholders in the project. ▪ Revising the KMC's automobile regulations, including information on expanding eco-friendly vehicles, is necessary.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Enact an ordinance in line with Kurunegala's policy and plan to expand eco-friendly vehicles.
Economy	▪ Allocate a budget at the local/national authority level to enact the Kurunegala municipal ordinance on eco-friendly vehicles.
Social	▪ Prepare an ordinance that reflects the social status of eco-friendly vehicles in Kurunegala. ▪ When preparing the eco-friendly vehicles ordinance, consider the individuals who have less access to transportation and gender equality.
Technology	▪ Technology for enacting ordinances is necessary and should complement [Action Plan 10] and [Action Plan 12].
Environment	▪ The environmental impact of the performance should be considered in the eco-friendly vehicle's ordinance.
Legal	▪ Enact an ordinance that does not conflict with other relevant laws and Kurunegala's ordinance.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of ordinances/by-laws establishment	Check the progress of ordinances/by-laws and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the ordinances or by-laws
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation is incorporated in the legal document	Prepare the basis for the future supportive system or plans, subsidies, strengthening the capabilities of stakeholders, and so forth.	▪ Confirmation of future performance, e.g., supportive system or plans, subsidies, and strengthening stakeholder capabilities
Gender mainstreaming is incorporated in the ordinances/by-laws	Ordinances and by-laws include gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 3] Designing supportive regulations and policy for the distribution of KMC eco-friendly vehicles.

Period	Expected Implementation
2nd and 3rd year	▪ Consider subsidies or tax exemption benefits as a support measure for the expansion and distribution of eco-friendly vehicles. ▪ Establish the target, period, and scope of subsidies for the expansion and distribution of eco-friendly vehicles. ▪ Provide benefits such as tax exemption items and scope for eco-friendly car users. ▪ Seek additional benefits such as reduction of highway fares and discount of parking fees for eco-friendly car users.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Prepare supportive plans or subsidies in accordance with Kurunegala's eco-friendly vehicle ordinance/by-law.
Economy	▪ A budget is necessary to prepare supportive plans or subsidies for eco-friendly vehicles in Kurunegala.
Social	▪ Establish supportive plans or subsidies that reflect the social status of eco-friendly vehicles in Kurunegala. ▪ Fully consider the individuals in poverty who have less access to transport and gender quality when establishing eco-friendly vehicle supportive plans or subsidies.
Technology	▪ Technology is necessary to prepare supportive plans and subsidies, and [Action Plan 12] should be complemented and strengthened by the system operator.
Environment	▪ The environmental impact of eco-friendly vehicle supportive plans and subsidies should be fully considered.
Legal	▪ Enact an ordinance that does not conflict with other supportive plans and subsidies.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of the establishment of supportive regulations, policies, or plans	Check the progress of supportive regulations, policies, or plans and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the supportive regulations, policies, or plans
Feasibility of the implementation of the supportive regulations, policies, or plans	Establish feasible objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation of supportive projects or subsidies is included	Prepare the basis for the future supportive projects or subsidies	▪ Confirmation of the basis of supportive projects or subsidies in the legal document

[Action plan 4] Funding for projects to support the distribution of KMC eco-friendly vehicles.

Period	Expected Implementation
2nd–10th year	▪ Establishing a concept by specifying a project to implement a support system for the distribution of eco-friendly vehicles. ▪ The types and number of vehicles to be supported by classifying the private sector and the public sector are set annually, and the estimated input cost is calculated. ▪ In addition to the supply of vehicles, a separate annual goal is set for the construction of infrastructure such as electric vehicle stations for electric vehicles. ▪ Investigate international financial institutions or ODA projects that can be linked and apply for project support in consideration of the components of the support project.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ A plan to raise funds in accordance with Kurunegala's eco-friendly vehicle-related ordinance/by-laws is necessary. ▪ Complete the legal basis for the private sector's investment.
Economy	▪ A budget is necessary to finance Kurunegala's eco-friendly vehicle-related supportive project. ▪ If there is no central government budget, support may not be available.
Social	▪ When applying for a project funded by an international financial organization, the project's design must integrate poverty- and gender-inclusive components. ▪ Creating a favorable social atmosphere for private sector investment is necessary.
Technology	▪ Technology must be prepared to support the international financial institution funding project and the ODA project, and the preparation of a proposal is required.

	▪ Technology is necessary to raise funds, and [Action Plan 12] should be complemented and strengthened by the system operator.
Environment	▪ When financing an international financial institution support project, the environmental impact of the project should be fully considered.
Legal	▪ Enactment of ordinances that do not conflict with other systems is necessary when financing is provided. ▪ Investment in the private sector should not conflict with other laws, and legal assistance should be reviewed.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of budgeting and funding planning	Check the progress of securing budget or funds by each year	▪ Official letter or document of the annual budget's plan by local authority level ▪ Progress reports from the officer-in-charge
Budget allocation from the central government	Check the progress of the supportive action/plans from the central level	▪ Budget allocation request for central government
Funding proposal for international organizations	Propose funding projects that cannot be secured by national level budgeting	▪ Review of the status of composing, e.g., funding proposals and concept notes
Private sector investment	Establish the atmosphere and system for the private sector to invest and secure private sector investment by 2030	▪ Review of the atmosphere and system for the private sector to invest through stakeholder and expert review workshop

[Action plan 5] Monitoring and Evaluation system settlement.

Period	Expected Implementation
5th year, 8th year	▪ Project performance evaluation indicators are set for each action plan, from revisions of ordinances established in the master plan, provision of supportive regulations and policy, and project financial resources to project execution and capacity building. ▪ When setting the project performance evaluation index or indicator, use a quantitative index or indicator to evaluate whether the goal is achieved. ▪ Based on the results of the project evaluation, improvement and supplementary items are derived, and the action plan is revised by reflecting them in the next action plan or next year's project.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Performance evaluation based on Kurunegala's eco-friendly vehicle-related ordinances/by-laws shall be conducted. ▪ The revisions to the legal basis and plan related to eco-friendly vehicles should be based on the eco-friendly vehicle-related ordinance.
Economy	▪ Budgeting is necessary to supplement modifications such as performance evaluation and related systems and plans.
Social	▪ Social status should be reflected when supplementing modifications such as performance evaluation and related systems and plans. ▪ Create a social atmosphere for private sector investment

Technology	▪ Technology is necessary to modify and supplement performance evaluation and related systems and plans and complement each other with [Action Plan 10] and [Action Plan 12].
Environment	▪ The environmental impact that can occur when supplementing modifications such as performance evaluation and related systems and plans should be fully considered.
Legal	▪ When supplementing modifications such as performance evaluation and related systems and plans, they should not conflict with other laws.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of planning and legal basis	Review and confirm the needs of the modification(revision)	▪ Survey and analysis of the result of the performance evaluation and the impact on the social changes
Track the monitoring and evaluation indicators of each action plan	Monitor and evaluate the achievements and failures of each action and then reflect that information in the future roadmap	▪ Compose the logical framework and matrix for monitoring and evaluation
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge

Feasibility of the implementation of the legal system	Establish feasible objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Number and percentage of jobs generated by the project for women and men	Increase employment and enterprise opportunities for women and men to mainstream gender equality in the transportation sector	▪ Sex-disaggregated statistical data from the related authority
Number and percentage of women and men employed, by type of job and pay rates, and proportion of women employed in unskilled, technical, management, and supervisory roles		
Evidence of the type of incentives designed to recruit women, increase their capacity, and provide career development in the transportation sector and with service providers		
Evidence that climate finance facilities include special windows for funding activities with women and gender-sensitive guidelines for all funded activities and employ women and men in management	Equal access for women to small grants for climate change projects	▪ Check the guidelines/action plans prepared by the government ▪ Sex-disaggregated statistical data from the related authority

[Action plan 6] Feasibility study for eco-friendly vehicle charging infrastructure.

Period	Expected Implementation
2nd year, 5th year, 8th year	▪ Implemented in the second, fifth, and eighth years to select the target sites for charging infrastructure based on policies, plans, and ordinances for expanding eco-friendly vehicles. ▪ A feasibility study is conducted to establish the most efficient charging infrastructure. The feasibility study items are used to investigate and analyze the traffic flow of Kurunegala to determine the necessary and most effective locations and to calculate the project's expected input cost. ▪ Environmental impact of building eco-friendly vehicle charging infrastructure is reviewed.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Charging infrastructure based on Kurunegala's policies, plans, and ordinances to expand eco-friendly vehicles should be targeted.
Economy	▪ Budgeting is required for feasibility studies to build an eco-friendly vehicle charging infrastructure. ▪ If the central government and Kurunegala lack resources, preparing measures to utilize the resources of international financial institutions and ODA projects is necessary.
Social	▪ When conducting feasibility studies for eco-friendly vehicle charging infrastructure, consideration of individuals who have less access to the transport and gender quality is required. ▪ When reviewing the feasibility of the target site, the details of the regional gap should be considered.
Technology	▪ TA and UDA should conduct feasibility studies for charging infrastructure.
Environment	▪ Environmental impact assessment should be conducted for environmental impacts caused by the eco-friendly vehicle charging infrastructure construction.
Legal	▪ Review conflicts with other laws and legal procedures due to the eco-friendly vehicle charging infrastructure.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of feasibility review	Check the progress of the feasibility review and implementation results	▪ Review the feasibility review status and results through stakeholder and experts' workshop ▪ Progress reports from the officer-in-charge
Rationality of the methodology of feasibility review	Establish the reasonable implementation methodology	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Result of the feasibility review	Check the feasibility of the project implementation	▪ Review various conditions, e.g., natural and physical conditions, costs, and returns, to ensure project feasibility

[Action plan 7] Establishment of eco-friendly vehicle charging infrastructure.

Period	Expected Implementation
3rd and 4th year	▪ Analyze traffic conditions such as the transportation system, traffic volume, and existing infrastructure in Kurunegala and explore candidates for sites for eco-friendly car charging stations while considering future traffic demands. ▪ On-site survey of candidates for charging station sites is conducted to analyze location conditions and select the best site. ▪ Considering the demand for eco-friendly car charging stations, the capacity of charging stations, such as the number of chargers and energy system storage facilities, is designed. ▪ Plans to build the annual charging infrastructure.
5th–10th year	▪ It gradually expands in the medium and long term to minimize blind spots for charging eco-friendly vehicles. ▪ In the long run, the effect of reducing GHG emissions will be further increased when renewable energy power generation facilities are installed in charging infrastructure.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of the project to build an eco-friendly vehicle charging infrastructure based on Kurunegala's policies, plans, and ordinances to expand eco-friendly vehicles.
Economy	▪ Budgeting is required for the establishing of the eco-friendly vehicle charging infrastructure. ▪ If the central government and Kurunegala lack resources, preparing measures to utilize the resources of international financial institutions and ODA projects is necessary.
Social	▪ When establishing a charging infrastructure for eco-friendly vehicles, we must review the contents of causing and resolving conflicts between regions.

Technology	▪ When establishing an eco-friendly vehicle charging infrastructure, TA and UDA should internalize the technology, and [Action Plan 11] should complement each other with strengthening the capabilities of the project implementers.
Environment	▪ The environmental impact of establishing an eco-friendly vehicle charging infrastructure should be minimized.
Legal	▪ Review legal procedures and conflicts with other laws regarding the establishment of eco-friendly vehicle charging infrastructure.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of securing the budget	Secure the budget for the planned installation	▪ Check the annual budget's status
Percentage of installation of eco-friendly vehicle charging infrastructure	130% charging station establishment including the existing gas stations by 2030	▪ Check the percentage of eco-friendly charging infrastructure installations

[Action plan 8] Compulsory purchase of eco-friendly vehicles for public institutions.

Period	Expected Implementation
3rd and 4th year	▪ Based on policies, plans, and ordinances to expand eco-friendly vehicles, the mandatory purchase of eco-friendly vehicles for public institutions is implemented, and the annual replacement rate is set. ▪ In the short term, hybrid vehicles are introduced independently of charging infrastructure. ▪ If the charging infrastructure for eco-friendly vehicles is not sufficient, the recommendation is to consider introducing natural gas and natural gas vehicle buses.
5th–10th year	▪ For public institutions with many vehicles or public transportation with a high fuel consumption rate, replace them with eco-friendly vehicles first. ▪ Replace all vehicles of public institutions and public facilities with eco-friendly vehicles in the mid to long term.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implement the compulsory purchase of eco-friendly vehicles for public institutions based on Kurunegala's policies, plans, and ordinances to expand eco-friendly vehicles.
Economy	▪ Budgeting is necessary for the compulsory purchase of eco-friendly vehicles for public institutions. ▪ If the central government and Kurunegala lack resources, preparing measures to utilize the resources of international financial institutions and ODA projects is necessary.
Social	▪ In the case of compulsory purchase of eco-friendly vehicles for public institutions, the details of what causes and resolves conflicts between public institutions should be reviewed.
Technology	▪ When purchasing eco-friendly vehicles for public institutions, [Action Plan 12] system operators' capacity building should be strengthened and supplemented mutually.

Environment	▪ When purchasing eco-friendly vehicles in public institutions, environmental impacts that can occur because of the disposal of existing vehicles should be minimized.
Legal	▪ Review conflicts with other laws and legal procedures for mandatory purchase of eco-friendly vehicles by public institutions.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of securing the budget	Secure the budget for the planned procurement	▪ Check the annual budget's status
Percentage of purchases made by public institutions	100% Replacement by 2030	▪ Checking the ratio of eco-friendly vehicles in public institutions

[Action plan 9] A project to support the purchase of eco-friendly vehicles.

Period	Expected Implementation
3rd and 4th year	▪ Determine the number of vehicles operated by each type of vehicle belonging to the private sector and prioritize support for eco-friendly vehicle purchase support projects by considering the fuel consumption rate of the vehicles. ▪ Set the types of vehicles to support the purchase of eco-friendly vehicles, the number of supports, and the scope of subsidies for each year. ▪ Set the annual rate of eco-friendly car replacement.
5th–10th year	▪ Provide benefits such as tax exemptions and discounts on parking fees to users who voluntarily purchase eco-friendly cars.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of the projects to support and encourage purchases of eco-friendly vehicles for based on Kurunegala's policies, plans, and ordinances to expand eco-friendly vehicles.
Economy	▪ Budgeting is necessary for the projects to support and encourage purchases of eco-friendly vehicles. ▪ If the central government and Kurunegala lack resources, preparing measures to utilize the resources of international financial institutions and ODA projects is necessary.
Social	▪ In the case of the projects to support and encourage purchases of eco-friendly vehicles, the details of what causes and resolves conflicts between owners of the traditional vehicles should be reviewed.
Technology	▪ When supporting the purchase of eco-friendly vehicles, [Action Plan 12] system operators' capacity building should be strengthened and supplemented mutually.
Environment	▪ When supporting the purchase of eco-friendly vehicles, environmental impacts that can occur because of the disposal of existing vehicles should be minimized.

Legal	▪ Review legal procedures and conflicts with other laws in support of eco-friendly vehicle purchase support projects.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of securing the budget	Secure the budget for the planned support projects	▪ Check the annual budget's status
Percentage of eco-friendly car proportion	50% replacement by 2030	▪ Check the eco-friendly vehicle registration rate

[Action plan 10] Empowering policymakers.

Period	Expected Implementation
1st and 2nd, 4th and 5th, 7th and 8th year	▪ Development and operation of training programs to strengthen the capabilities of policymakers who establish policies and plans to expand eco-friendly vehicles. ▪ The first year in which the policy and plan are established, and the fourth and seventh years in which the system and plan are directly modified and supplemented and are implemented from the beginning to the next year. ▪ Basic education on the economic, environmental, and social changes and expected effects of Kurunegala because of climate change and the introduction of eco-friendly vehicles, and policy-oriented case education for expansion and dissemination of eco-friendly vehicles in similar-income or higher-income countries.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education/training to strengthen the capabilities of policymakers based on Kurunegala's eco-friendly vehicles policies, plans, and ordinances.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the policymakers, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to transport and gender equality within the program to strengthen the capacity of the system's planners and on causing and resolving conflicts between regions.
Technology	▪ Program design and implementation techniques for strengthening the capabilities of institutional planners are necessary, and the ability to improve the system on its own should be strengthened with the assistance of experts from outside agencies. ▪ [Action plan 1], [Action plan 2], and [Action plan 5] Performance evaluations and the related systems and plans should supplement each other.

Environment	▪ Development of the capacity-building program for policymakers must minimize environmental impact.
Legal	▪ When developing the education program for policymakers, the contents of the relevant law and its relationship with other laws are specified, and the contents related to the development of the law and the institution are specified.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	To ensure the policymakers are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 11] Empowering infrastructure project implementer.

Period	Expected Implementation
3rd–8th year	▪ Training on key factors and feasibility analysis procedures to be considered when selecting an infrastructure site. ▪ Training on key elements and installation procedures to consider when installing the infrastructure. ▪ Training infrastructure installation technicians on installation know-how. ▪ Technical training for infrastructure facility management and operation.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen the capacity of the installation/construction implementer based on Kurunegala's policies, plans, and ordinances for the expansion of eco-friendly vehicles.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the installation/construction implementer, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to transport and gender equality within the program to strengthen the capacity of the installation/construction implementer and on causing and resolving conflicts between regions.
Technology	▪ Installation/construction implementers need technology to design and implement their capabilities and strengthen their ability to perform their installation and O&M with the assistance of experts from outside organizations. ▪ [Action plan 7] Must be complemented with the infrastructure installation project.
Environment	▪ Installation/construction implementer training program must be developed to include the contents that emphasize minimizing the environmental impact.
Legal	▪ Installation/construction implementer training program development must include legal procedures.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	300 individuals of installation/construction implementers attended the training program	▪ Train 50 engineers per year
Rationality of the capacity-building training module and program	Develop a reasonable capacity-building training module or program	▪ Stakeholder review workshop
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Women's employment during construction, operation, and maintenance and in transport agencies	Encourage women's employment on the site	▪ Evidence showed that contracts and tender documents for subcontractors require the recruitment of women as unskilled labor

[Action plan 12] Empowering regulation and policy operators.

Period	Expected Implementation
2nd and 3rd, 6th and 7th, 9th year	▪ Establishment of R&R for each department's support system operation. ▪ It shall be implemented in the second year before the implementation of the eco-friendly vehicle support system and in the sixth and ninth years after the modification and supplementation of the system, and the first 2 years shall be implemented in 2 years to improve the level of education. ▪ Establishment of the support system and the operation process of the support project. ▪ Support the establishment of all necessary matters and systems for the operation of the support system and support projects. ▪ Training to improve understanding of project evaluation indicators.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen the capacity of legal system operators based on Kurunegala's policies, plans, and ordinances for the expansion of eco-friendly vehicles.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the legal system operators, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ It should include information on transportation vulnerability and gender quality within the program to enhance the capacity of the system operator and information on causing and resolving conflicts between regions.
Technology	▪ Design and implementation technology of the legal system operator's capacity enhancement program is required, and the ability to improve the legal system by supporting experts from outside organizations is necessary. ▪ [Action plan 9] must be complemented with the capacity building of legal system operators.
Environment	▪ A legal system operator's training program must be developed to minimize environmental impact.

Legal	▪ When developing a legal system operator's training program, the contents of the relevant law and the relationship with other laws should be specified, and the contents of legal procedures should be included.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	Ensure the system operators are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Rationality of the capacity-building training module and program	Develop a reasonable capacity-building training module or program	▪ Stakeholder review workshop
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 13] Public awareness promotion and capacity building.

Period	Expected Implementation
3rd–10th year	▪ Development and operation of educational programs and campaigns to raise public interest in responding to climate change based on policies, plans, and ordinances for expanding eco-friendly vehicles. ▪ Education and campaigns to strengthen public awareness to cope with climate change are conducted continuously from the third year, when policies, plans, and ordinances for the expansion of eco-friendly vehicles are completed. ▪ Establish a foundation for interest in the contents through the development and operation of educational programs that help ordinary citizens understand and sympathize with the impact of climate change and the need to respond. ▪ Various activities are implemented to positively recognize the expansion of eco-friendly vehicles through education on the necessity and importance of eco-friendly vehicles.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen public awareness based on Kurunegala's policies, plans, and ordinances for the expansion of eco-friendly vehicles.
Economy	▪ Financial resources are necessary to strengthen public awareness.
Social	▪ Include information on the individuals who have less access to transport and gender equality within the program to strengthen public awareness and on causing and resolving conflicts between regions.
Technology	▪ Design and implementation skills in the general citizen's capacity-building program are required, and internal personnel who have completed the training of institutional planners, installation participants, and institutional operators should lead the training programs and campaigns.
Environment	▪ Public awareness program must be developed to include the dissemination of the importance of the minimization of the environmental impact.

Legal	▪ When developing education programs for public awareness, introduce related laws to the public.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions/campaign targeted at women and men, with a gender mainstreaming theme	Raise the awareness of gender equality among the citizens	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	4,000 citizens received the training by 2030	▪ Train 500 citizens per year
Target of the campaign participants (by women and men disaggregated data)	8,000 citizens participated in the campaign by 2030	▪ 1,000 citizens participate in the campaign per year
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training/campaign	Minimum 30% of women participating in each session/event	▪ Check attendance rate of the capacity-building program and the registration lists for the campaign

3-2. P&R System

A. Introduction

[Technology Brief in Local Context]

P&R (or incentive parking) facilities feature parking lots connected with public transportation. This combination allows commuters traveling to city centers to leave their vehicles in parking lots located outside town and transfer to a bus or rail system (rapid transit, light rail, or commuter rail) to travel into the town. Commuters leave behind their vehicles in the parking lots in the morning and retrieve the vehicles when they return after work. Transportation connecting towns and parking lots is essential for P&R systems. The traffic congestion in the town can be reduced by distributing the density of vehicles.

Few initiations were taken at different locations in Sri Lanka and in Kurunegala for P&R projects. In the Kurunegala Urban Development Plan, 11 places were identified as suitable for establishing parking areas for private vehicles; these parking areas were selected for convenience. Public transportation intersections have not been considered in urban development plans. However, several barriers have been observed, such as inadequate finances and the lack of public awareness interest in a system. The problem of inadequate parking spaces causes drivers to park vehicles on either side of main roads. This parking pattern disturbs pedestrian movement and is causes traffic congestion.

[Expected Cost and GHG Mitigation Effect]

In the "Basic Plan for Response to Climate Change in Jeollabuk-do, Republic of Korea 2018," for the P&R system, the cost was USD 16.7 million for a P&R system that links the public transportation and 7,500 parking lots. The abatement cost was 39 USD/tonCO_2eq, and the expected GHG mitigation effect was 14,232 tonCO_2eq/year. The GHG reduction factor was 2,370 kgCO_2eq/platform according to "Korea Environment Corporation, Best Practice in Local Government 2014."

B. Action Plan

Category	Action Plans	Period(year)										Implementing authority
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
Policy, plan reform and establishment	Establish KMC Public Transportation Usage Policy	■										TA, RDA, RD
	Establish KMC P&R System Implementation Plan		■									TA, RDA
	Funding for KMC P&R System Support Project		■	■	■	■	■	■	■	■	■	TA, RDA
	Monitoring and Evaluation system settlement					■			■			TA, RDA
Physical projects	Build a P&R System Infrastructure		■	■	■		■	■		■	■	TA, RDA, RD, UDA
	P&R System Operations		■	■	■	■	■	■	■	■	■	TA, RDA
Capacity Building	Capacity building of policymakers	■	■		■	■		■	■			External Expert
	Capacity building of regulation and policy operators		■	■		■	■		■			External Expert
	Public awareness promotion and capacity building		■	■	■	■	■	■	■	■	■	External Expert

[Action plan 1] Establish of KMC Public Transportation Usage Policy.

Period	Expected Implementation
1st year	▪ Establishment of policies to promote public transportation in the KMC considering national policies in the transportation sector and Kurunegala town development plan (2019). ▪ When establishing the master plan, consider how to promote public transportation, including public buses and trains, and how to build infrastructure such as P&R systems and multi-modal passenger terminals. ▪ Master plan is established including feasible and reasonable goals and implementation methods for promoting public transportation. ▪ Goals are set for promoting public transportation and building infrastructure on an annual basis in the master plan. ▪ Master plan includes a plan for, for example, ordinances, supportive regulations and policy, and financing.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Establishing polices and plans in line with the national public transportation policy direction is necessary.
Economy	▪ Financial resources are necessary to establish renewable energy policies and master plans, and cooperation with international agencies such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Establishing policies and plans that reflect the social status of public transportation use in Kurunegala and establishing policies and plans to encourage public transportation, consideration of the transportation of disadvantaged groups, and gender equality are necessary.
Technology	▪ Technology is necessary to encourage public transportation, establish plans and [Action Plan 7], and enhance and complement capabilities for policymakers.
Environment	▪ Policies and plans to encourage the use of public transportation should be fully considered for the expected

	environmental impact.
Legal	▪ Establishing a policy direction that does not conflict with other relevant laws is necessary.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of policies and plans establishment	Check the progress of policy establishment and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the policies and plans
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation is incorporated in the legal document	Preparing grounds for the performance of, e.g., ordinances, by-laws, systems in the future	▪ Confirm the contents of the legal document that indicates the future activities regarding, e.g., ordinances, by-laws, and systems
Gender mainstreaming is incorporated in the policy	Transport policy, strategies, and reforms include gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 2] Establish KMC P&R System Implementation Plan and Encouraging Citizens to Utilize.

Period	Expected Implementation
2nd year	▪ The P&R system incentive system is established based on Kurunegala's plan to encourage public transportation. ▪ The use of the P&R system is encouraged by applying the discount rate differently, depending on parking fees, public transportation fees, tax exemptions, and traffic congestion. ▪ The government establishes a system that highlights the economic benefits of using public transportation by applying a high discount rate for long-term users and considers penalizing nonusers, for example, collecting traffic congestion fees to secure the P&R system users.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Enact a legal system in line with Kurunegala's policy and a plan to encourage public transportation utilization.
Economy	▪ Use local authority level budgeting to encouraging the plan for utilizing the P&R system.
Social	▪ Prepare an ordinance that reflects the social status of P&R system in Kurunegala. ▪ Prepare the encouraging plan for utilizing P&R system while considering the individuals who have less access to transport and gender equality.
Technology	▪ Technology for encouraging a plan for utilizing P&R should complement each other with [Action Plan 8]
Environment	▪ The environmental impact of the encouraging plan for utilizing the P&R system scheme should be fully considered.
Legal	▪ Enact an ordinance that does not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of ordinances/by-laws establishment	Check the progress of ordinances/by-laws and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the ordinances or by-laws
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation is incorporated in the legal document	Prepare the basis for the future supportive system or plans, subsidies, strengthening the capabilities of stakeholders, and so forth.	▪ Confirmation of future performance, e.g., supportive system or plans, subsidies, and strengthening stakeholder capabilities
Gender mainstreaming is incorporated in the ordinances/by-laws	Ordinances and by-laws include gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 3] Funding for the KMC P&R System Support Project.

Period	Expected Implementation
2nd–10th year	▪ Calculate the estimated input cost and annual budget for achieving the goals according to the policy and plan to encourage the use of public transportation in Kurunegala. ▪ Investigate and apply for support for financial support and ODA projects for international financial institutions that can be linked to P&R systems. ▪ Request that the Sri Lankan central government raise funds and attract investment from domestic and foreign private sectors to secure funds for the project. The private sector's business model can be either build-transfer-operation or build-own-transfer, to charging a user fee to gain the return on its facilities.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ A plan to raise funds in accordance with Kurunegala's plan to encourage public transportation is necessary. ▪ Completing the legal basis for the private sector's investment is necessary.
Economy	▪ A budget is necessary to finance Kurunegala's P&R system. ▪ If there is no central government budget, support may not be available.
Social	▪ When applying for a project funded by an international financial organization, the project's design must integrate poverty- and gender-inclusive components. ▪ Creating a favorable social atmosphere for private sector investment is necessary.
Technology	▪ Technology must be prepared to support the international financial institution funding project and the ODA project, and the preparation of a proposal is required. ▪ Technology is necessary to raise funds, and [Action Plan 8] should be complemented and strengthened by the system operator.

Environment	▪ When financing an international financial institution support project, the environmental impact of the project should be fully considered.
Legal	▪ Enactment of ordinances that do not conflict with other systems is necessary when financing is provided. ▪ Investment in the private sector should not conflict with other laws, and legal assistance should be reviewed.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of budgeting and funding planning	Check the progress of securing budget or funds by each year	▪ Official letter or document of the annual budget's plan by local authority level ▪ Progress reports from the officer-in-charge
Budget allocation from the central government	Check the progress of the supportive action/plans from the central level	▪ Budget allocation request for central government
Funding proposal for international organizations	Propose funding projects that cannot be secured by national level budgeting	▪ Review of the status of composing, e.g., funding proposals and concept notes
Private sector investment	Establish the atmosphere and system for the private sector to invest by 2030	▪ Review of the atmosphere and system for the private sector to invest through stakeholder and expert review workshop

[Action plan 4] Monitoring and Evaluation system settlement

Period	Expected Implementation
5th year, 8th year	▪ Project performance evaluation indicators are set for each action plan, from revisions of ordinances established in the master plan, the provision of supportive regulations and policy, and project financial resources to project execution and capacity building. ▪ When setting the project performance evaluation index or indicator, use a quantitative index or indicator to evaluate whether the goal is achieved. ▪ Based on the results of the project evaluation, improvement and supplementary items are derived, and the action plan is revised by reflecting them in the next action plan or next year's project.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Performance evaluation based on Kurunegala's plan to encourage public transportation shall be conducted. ▪ When revising the legal basis and plan related to public transportation, it should be based on the existing plans and ordinances.
Economy	▪ Budgeting is necessary to supplement modifications such as performance evaluation, systems, and plans.
Social	▪ Social status should be reflected when supplementing revisions of performance evaluation, systems and plans.
Technology	▪ Technology is necessary to modify and supplement performance evaluation and related systems and plans and complement each other with [Action Plan 7] and [Action Plan 8].
Environment	▪ The environmental impact that can occur when supplementing modifications such as performance evaluation and related systems and plans should be fully considered.
Legal	▪ When supplementing modifications such as performance evaluation and related systems and plans, they should not conflict with other laws.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of planning and legal basis	Review and confirm the needs of the modification(revision)	▪ Survey and analysis of the result of the performance evaluation and the impact on the social changes
Track the monitoring and evaluation indicators of each action plan	Monitor and evaluate the achievements and failures of each action and then reflect that information in the future roadmap	▪ Compose the logical framework and matrix for monitoring and evaluation
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Feasibility of the implementation of the legal system	Establish feasible objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Number and percentage of jobs generated by the project for women and men	Increase employment and enterprise opportunities for women and men to mainstream gender equality in the transportation sector	▪ Sex-disaggregated statistical data from the related authority

Number and percentage of women and men employed, by type of job and pay rates, and proportion of women employed in unskilled, technical, management, and supervisory roles		
Evidence of the type of incentives designed to recruit women, increase their capacity, and provide career development in the transportation sector and with service providers		
Evidence that climate finance facilities include special windows for funding activities with women's groups and gender-sensitive guidelines for all funded activities and employ women and men in fund management	Equal access for women to small grants for climate change projects	▪ Check the guidelines/action plans prepared by the government ▪ Sex-disaggregated statistical data from the related authority

[Action plan 5] Build a P&R System Infrastructure.

Period	Expected Implementation
2nd–4th year	▪ Based on the plan to encourage the use of public transportation, the analysis of traffic conditions will consider connecting and integrating with other means of transportation, including the transportation system, traffic flow, and parking demand in areas adjacent to the transportation network. ▪ The most effective site is selected through an on-site survey of the site subject to the P&R system infrastructure. Capacity is designed considering the number of parking spaces, areas, and floors, and bus and taxi rides are established to connect with other adjacent transportation methods.
6th and 7th, 9th and 10th year	▪ Location of the P&R system infrastructure deployment may change during performance evaluation and plan modification; thus, it is excluded from the fifth and eighth years. ▪ Problems are derived through the operation of short-term facilities, improvements are identified, and subsequent projects are reflected.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of P&R system infrastructure construction projects based on policies, plans, and ordinances to encourage public transportation in Kurunegala are necessary.
Economy	▪ Budgeting is required to establish P&R system. ▪ If the central government and Kurunegala lack resources, preparing measures to utilize the resources of international financial institutions and ODA projects is necessary.
Social	▪ When establishing P&R system in public institutions, the contents of causing and resolving conflicts between public institutions should be reviewed.

Technology	▪ When establishing the P&R system infrastructure, TA, RDA, RD, and UDA should internalize the technology, and [Action Plan 8] should complement each other with strengthening the capabilities of the operator.
Environment	▪ Minimize the environmental impact of building a P&R system infrastructure.
Legal	▪ Review legal procedures and conflicts with other laws due to establishing the P&R system.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of securing the budget	Secure the budget for the planned construction	▪ Check the annual budget's status
Status of users of P&R system	10% increase in the number of individuals using P&R system every year	▪ Check the number of individuals using the P&R system
Progress of P&R system establishment	100% deployment of more than one transit area by 2030	▪ Check the progress of P&R system establishment through officer-in-charge's report and project implementer's report

[Action plan 6] P&R System Operations.

Period	Expected Implementation
2nd–10th year	▪ Based on policies and plans to encourage the use of public transportation, operates the P&R system, and establishes goals for annual expansion. ▪ P&R system infrastructure deployment begins in the second year of completion and continues to be implemented. ▪ Designing a 24-hour operation through the introduction of an unmanned payment system(auto-programmed), and considering methods such as applying different discount rates depending on traffic volume and congestion time, are necessary.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Operation of the P&R system based on Kurunegala's policies and plans to encourage public transportation.
Economy	▪ Budgeting is required for the operation of the P&R system.
Social	▪ While operating the P&R system, the contents of causing and resolving conflicts between public institutions should be reviewed.
Technology	▪ Technologies such as process and R&R establishment are necessary for the operation of the P&R system, and [Action Plan 8] should be complemented with the enhancement of the capabilities of the system operator.
Environment	▪ When operating the P&R system, the environmental impact should be minimized, and projects with a large environmental impact should not be supported.
Legal	▪ Reviewing conflicts with other laws and legal procedures because of the operation of the P&R system is

	necessary.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
User's pattern of utilizing P&R system	Collect data such as P&R system usage time	▪ Collection of hours of use for P&R system users
Status of users of P&R system	10% increase in the number of individuals using the P&R system per year	▪ Check the number of individuals using the P&R system
Number of public transportation passengers	50% increase in 2030 compared with 2021	▪ Check the number of public transportation passengers

[Action plan 7] Capacity building of policymakers.

Period	Expected Implementation
1st and 2nd, 4th and 5th, 7th and 8th year	▪ Development and operation of training programs to strengthen the capabilities of policymakers who establish policies and plans to encourage public transportation. ▪ The first year in which the policy and plan are established, and the fourth and seventh years in which the system and plan are directly modified and supplemented and are implemented from the beginning to the next year. ▪ Basic education on the economic, environmental, and social changes and expected effects of Kurunegala because of climate change and the introduction of the P&R system, and policy-oriented case education for encouraging public transportation in similar-income or higher-income countries.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education/training to strengthen the capabilities of policymakers based on policies, plans, and ordinances to encourage the use of public transportation in Kurunegala.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the policymakers, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to transport and gender equality within the program to strengthen the capacity of the system's planners and on causing and resolving conflicts between regions.
Technology	▪ Program design and implementation techniques for strengthening the capabilities of institutional planners are necessary, and the ability to improve the system on its own should be strengthened with the assistance of experts from outside agencies. ▪ [Action plan 1] and [Action plan 4] should be complemented.
Environment	▪ Development of the drafting program must minimize environmental impact.

Legal	▪ When developing the education program for policymakers, the contents of the relevant law and its relationship with other laws are specified, and the contents related to the development of the law and the institution are specified.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	To ensure the policymakers are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 8] Capacity building of regulation and policy operators.

Period	Expected Implementation
2nd and 3rd, 6th and 7th, 9th year	▪ Establish R&R and operate a support system for each department or division. ▪ Establish a support system and operation process for support projects. ▪ Assist in establishing supportive regulations and policy and all necessary matters during the implementation. ▪ Implement training to improve understanding of project evaluation indicators.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education/training to strengthen the capabilities of system operators based on policies, plans, and ordinances to encourage the use of public transportation in Kurunegala.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the legal system operators, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Include information on the individuals who have less access to transport and gender equality within the program to strengthen the capacity of the legal system operators and on causing and resolving conflicts between regions.
Technology	▪ Design and implementation technology of the legal system operator's capacity enhancement program is required, and the ability to improve the legal system by supporting experts from outside organizations is necessary. ▪ [Action plan 6] Must be complemented with the P&R system operation.
Environment	▪ Legal system operator's training program must be developed to include the content of the importance of minimizing environmental impact.
Legal	▪ When developing a legal system operator's training program, the contents of the relevant law and the relationship with other laws should be specified, and the contents of legal procedures should be included.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	Ensure the system operators are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Rationality of the capacity-building training module and program	Develop a reasonable capacity-building training module or program	▪ Stakeholder review workshop
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 9] Public awareness promotion and capacity building.

Period	Expected Implementation
2nd–10th year	▪ Development and operation of educational programs and campaigns to raise public interest in responding to climate change based on policies, plans, and ordinances for encouraging the public transport. ▪ Education and campaigns to strengthen public awareness to cope with climate change are conducted continuously from the third year, when policies, plans, and ordinances for encouraging the public transport are completed. ▪ Establish a foundation for interest in the contents through the development and operation of educational programs that help ordinary citizens understand and sympathize with the impact of climate change and the need to respond. ▪ Various activities are implemented to positively recognize the necessity and importance of utilizing public transport.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen public awareness based on Kurunegala's policies, plans, and ordinances for encouraging the public transport.
Economy	▪ Financial resources are necessary to strengthen public awareness.
Social	▪ Include information on the individuals who have less access to transport and gender equality within the program to strengthen public awareness and on causing and resolving conflicts between regions.
Technology	▪ Design and implementation skills in the general citizen's capacity-building program are required, and internal personnel who have completed the training of policymakers and legal system operators should be the leaders.
Environment	▪ Public awareness program must be developed to include the dissemination of the importance of the minimization of the environmental impact
Legal	▪ When developing education programs for public awareness, introduce related laws to the public.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions/campaign targeted at women and men, with a gender mainstreaming theme	Raise the awareness of gender equality among the citizens	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	4,000 citizens received the training by 2030	▪ Train 500 citizens per year
Target of the campaign participants (by women and men disaggregated data)	8,000 citizens participated in the campaign by 2030	▪ 1,000 citizens participate in the campaign per year
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training/campaign	Minimum 30% of women participating in each session/event	▪ Check attendance rate of the capacity-building program and the registration lists for the campaign

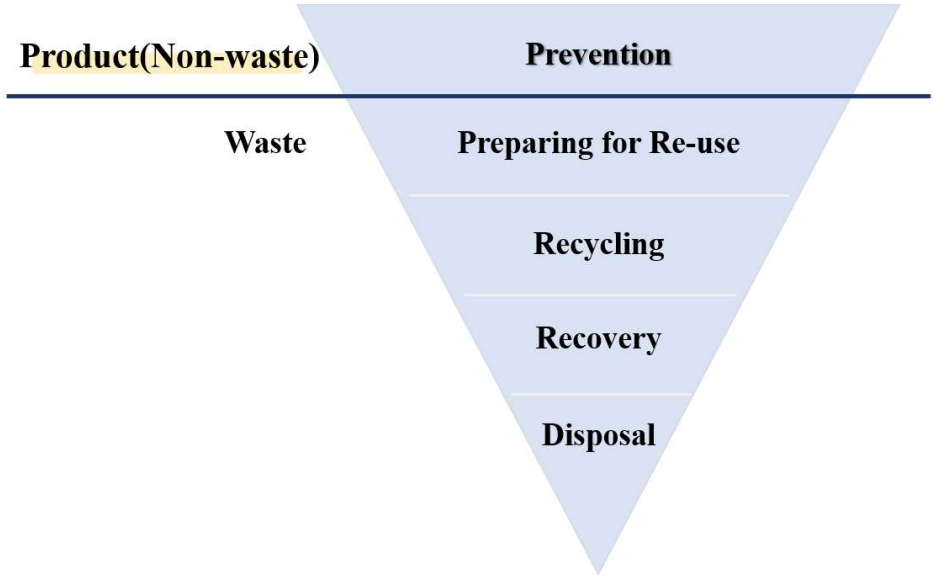
VI. Waste Sector Roadmap and Action Plans

1. Introduction

Enhancing any waste management system requires a gradual approach, changes should be introduced incrementally, and the sector should be allowed to improve and grow naturally without outsized interventions. The first and basic objective of any waste management system is to provide professional collection and disposal services to its constituencies, including at least full collection coverage in urban areas, substantial or full coverage in rural areas, and sound environmental practices at disposal sites. As a general rule, investing in more sophisticated infrastructure and technologies should be considered only after the basic level of service provision for the population is available. Once full collection coverage and environmentally sound disposal practices are in place, and when affordability allows it, waste separation and recycling should be considered the next step up in the gradual upgrade of the sector. Waste reuse, recycling, and recovery are policy choices that result in essential environmental benefits; however, in financial terms, they increase the cost of the waste management system. Therefore, moving up the "waste hierarchy" should be done only when sufficient resources are available to finance the increased costs that are incurred with such improvements[1].

In this roadmap, the scope of "waste management" covers all stages of waste generation, recycling, intermediate treatment, and final treatment for all areas of Kurunegala.

[1] "Municipal Solid Waste Management – A roadmap for reform for policymakers," World Bank



[Waste Management Hierarchy]

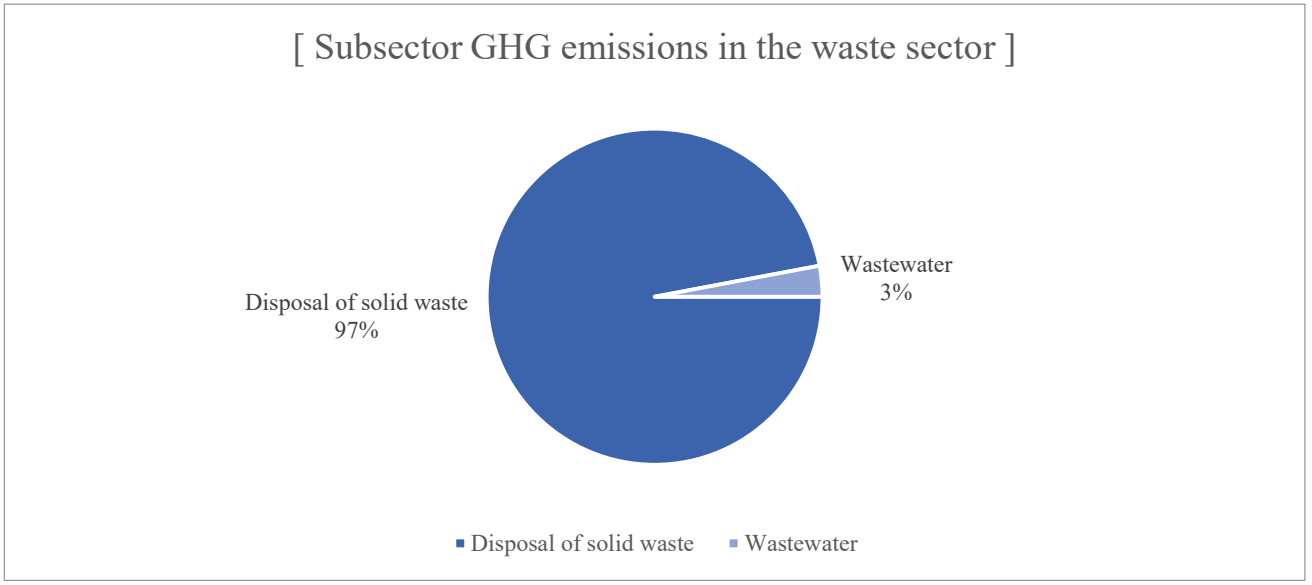
** Source: http://ec.europa.eu/environment/waste/framework/*

The roadmap for climate technology implementation in the waste sector of Kurunegala is composed of the following technologies, and the overall implementation roadmap is shown in the table below:

- Organic composting
- IoT-based recycling system
- Energy generation by incineration of MSW

[Emission Trend of the Waste Sector]

The feature of GHG emissions in waste sector differs from the features of other sectors since the reason of GHG generation is not the consumption of fossil fuel and electricity but the generation of solid waste and wastewater. The 97% of GHG emissions in waste sector comes from the subsector of disposal of solid waste. Only the 3% of GHG emissions in waste sector is allocated in the treatment of wastewater.



2. Waste Sector Roadmap

Category	Type of actions	Period			Implementing Authority
		Short term	Mid term	Long term	
Policy, plan reform and establishment	Designate and empower a professional institutional local authority for waste management for policy development and reform (MSW, IoT, Composting)	■			Chief Commissioner of KMC
	Regional level action plan built on the national plan and strategy (MSW, IoT, Composting)	■	■		Legal and technical division of KMC
	Monitoring and evaluation guideline on the strategy, plans, and the physical projects process and operation (MSW, IoT, Composting)	■	■		Legal and technical division of KMC
Physical projects	Public investment project (MSW, IoT, Composting)		■	■	Technical division
	Obligatory project for the public sector	■	■		Technical and legal division
	Private investment project			■	Technical division
Capacity Building	Capacity building of decisionmaker (policymaker)	■	■	■	Administrative and HR division
	Capacity building of the manpower on the project designing, implementation level	■	■	■	Technical division
	Capacity building of the operation and management human resources	■	■	■	Technical division
	Enhancing Public awareness	■	■	■	Planning division

3. Action Plan per Climate Technology

3-1. Organic Composting

A. Introduction

[Technology Brief in Local Context]

Composting is the decomposition and stabilization of food waste, which is biodegradable organic solid waste, through microorganisms to make fertilizers that supply nutrients necessary for the growth of crops.

Currently, the solid waste collected by the Kurunegala MC (Municipality Council) and the Kurunegala PS (Pradeshiya Sabha) is transferred to the Sundarapola final disposal site located in the Kurunegala PS. The Sundarapola final disposal site began operation in 1920. The area of the Sundarapola site is 12.5 acres, of which approximately 4 acres is covered by the open dump. The discharged solid waste amount is approximately 38 ton/day from the Kurunegala MC, approximately 10 ton/day from the Kurunegala PS, and approximately 48 ton/day in total. On August 18, 2019, a screw-type composting machine was installed at the Sundarapola waste disposal site, with a capacity of 50 Mt/day. The main raw material of the compost is organic domestic garbage collected by separate collection, introduced to households in 2010. However, the plant is not running at its full capacity because of technical operational problems. The plant process 3–7 Mt of wastes per day.

[Expected Cost and GHG Mitigation Effect]

In the “CDM Project, Omdurman Landfill Municipal Solid Waste Composting Project, 2014,” the type of composting was the windrow type. The processing capacity was 80 tons of organic waste per day, at the cost of USD 1,180,000. The abatement cost was 20 USD/tonCO_2eq, and the GHG mitigation effect was 0.11 tonCO_2eq/year/ton-waste.

B. Action Plan

Category	Action Plans	Period(year)										Implementing authority
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
Policy, plan reform and establishment	Amend the existing waste management ordinances/by-laws	■	■	■		■					■	Legal and technical department in KMC
	Develop the guidelines of MSW management implementation		■	■		■					■	Technical department in KMC
	Delegate the professional local authority for the integrated waste management and operation	■				■					■	Chief Commissioner of KMC
Physical projects	Composting facilities' establishment and operation at the Sundarapola dump site	■	■			■					■	Technical department in KMC
	Establishment of an integrated waste management system for Kurunegala		■	■	■	■	■	■	■	■	■	Technical department in KMC
Capacity Building	Institutional capacity building of professional management of MSW	■	■	■		■		■		■	■	Administrative and HR department in KMC
	Public awareness promotion of waste disposal and social inclusion	■	■	■	■	■	■	■	■	■	■	Planning department in KMC
	Technical capacity enhancement of composting site workers	■	■	■		■		■		■	■	Technical department in KMC

[Action plan 1] Amend the existing waste management ordinances/by-laws.

Period	Expected Implementation
1st and 2nd year	▪ Along with delegating the authority to professional local institutions and personnel, the members of the legal and technical division of the KMC should conduct assessments if the current ordinances/by-laws, regulations, and general practices of waste management in Kurunegala need it. ▪ Prepare amendment of existing waste management ordinances/by-laws. ▪ Support the gender mainstreaming in this sector by inputting the measures to create opportunities for women within the new waste management system. ▪ Gazette and actual implementation of the amended ordinances/by-laws and regulation will occur (2nd year).
3rd year	▪ Establish evaluation indicators for each action plan, based on the revision of ordinances established by the Master Plan, and funding support systems and projects to execute those projects and strengthen capabilities. ▪ Assess achievement of goals with quantitative indicators when establishing assessment indicators for project performance.
5th year	▪ Project evaluation is conducted in the last year of the short-term, medium-term, and long-term periods set by the action plan. If necessary, the annual target is set for evaluation.
10th year	▪ Improvements and supplements are derived according to the results of the project evaluation, and the action plan is modified by reflecting them in the next roadmap.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Ordinances/by-laws of composting shall complement each other and other types of waste disposal ordinances/by-laws and as a whole, waste management ordinances/by-laws.
Economy	▪ Local/national authority level budgeting is required to enact the Kurunegala municipal ordinance on composting. ▪ Policymakers should consider the cost and benefits, incentives, and household-wise affordability for the operating fee of municipal services, and polluter-pays principles when amending the ordinances/by-laws.
Social	▪ The ordinance should reflect the social status of composting in Kurunegala. ▪ Policymakers should incorporate the aspects of encouraging citizens' participation and mobilization for composting.
Technology	▪ Cooperation with technical experts is necessary to incorporate the practical and effective ordinances/by-laws upon the situation analysis of the current technology level in Kurunegala.
Environment	▪ The environmental impact of the performance included in the composting ordinance should be fully considered.
Legal	▪ Enact an ordinance that does not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of ordinances/by-laws establishment	Check the progress of ordinances/by-laws and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the ordinances or by-laws
Rationality of the objectives and	Establish reasonable objectives and methods	▪ Stakeholder review workshop

implementation methods	of actual implementation	▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation is incorporated in the legal document	Prepare the basis for the future supportive system or plans, subsidies, strengthening the capabilities of stakeholders, and so forth.	▪ Confirmation of future performance, e.g., supportive system or plans, subsidies, and strengthening stakeholder capabilities
Gender mainstreaming is incorporated in the ordinances/by-laws	Ordinances and by-laws include gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 2] Develop the guidelines of the MSW management implementation.

Period	Expected Implementation
2nd and 3rd year	▪ After the assessment from "Action plan 1" in the 1st year, based on the assessment, new MSW waste management guideline is circulated.
5th year	▪ Project evaluation is conducted in the last year of the short-term, medium-term, and long-term periods set by the action plan. If necessary, the annual target is set for evaluation.
10th year	▪ Improvements and supplements are derived according to the results of the project evaluation, and the action plan is modified by reflecting them in the next roadmap.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ The MSW guidelines, including those on composting, should follow the direction of the ordinances/by-laws on waste management by Kurunegala.
Economy	▪ Guidelines should include the aspects of the cost and benefit and the incentive for each activity so that an effective set up of the fee based on the polluter pays, affordability from the household level, and operation cost recovery can occur.
Social	▪ The general guidelines should include the public's responsibility for the specified waste treatment method for the household level.
Technology	▪ Cooperation with technical experts is necessary to incorporate the practical, effective guidelines based on the situation analysis of the current technology level in Kurunegala.
Environment	▪ The environmental impact of the performance included in the composting guidelines should be fully considered.
Legal	▪ Enact an ordinance that does not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of guidelines establishment	Check the progress of guidelines and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the guidelines
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the guidelines include the activities both for the general citizen and for the operational/governmental level	Prepare the basis for the monitoring and evaluation indicators for the local authority and the waste disposal for the general citizens	▪ Stakeholder review workshop ▪ Public survey on citizens' awareness of the waste disposal/treatment
Gender mainstreaming is incorporated in the guidelines	Waste management guidelines include gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 3] Delegate the professional local authority for integrated waste management and its operation

Period	Expected Implementation
1st year	▪ If designating a technical function to personnel with insufficient technical knowledge and management skills, hire local consultants to train the designated personnel or division in the local authority. ▪ Allocate satisfactory roles and responsibilities such as policy establishment; financing planning for waste management; preparation of regional standards and guidelines; setting up of a waste information database; monitoring and enforcement, especially of the "Polluter pays principle;" and coordination and consultation with stakeholders.
5th year	▪ Project evaluation is conducted in the last year of the short-term, medium-term, and long-term periods set by the action plan, and if necessary, the annual target is set for evaluation.
10th year	▪ Improvements and supplements are derived according to the results of the project evaluation, and the action plan is modified by reflecting them in the next roadmap.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ The delegation should be from the final decisionmaker level according to Kurunegala's official organization hierarchy.
Economy	▪ The delegation should reflect the cost-effectiveness of delegation in terms of the human resource cost, training cost, and number of officials to be delegated and their workload based on resource management methodology.
Social	▪ Local authority/personnel must be designated who reflect the social atmosphere toward the composting and the other waste disposal/treatment.
Technology	▪ The designated authority/personnel should be well aware of the composting technology.
Environment	▪ The designated authority/personnel should be well aware of the environmental impact from the composting and

	how to manage it.
Legal	▪ The designation shall be in the official procedure according to the KMC's procedure.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Designation of the local authority/personnel	Check the progress of the designation and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Performance evaluation on the designated local authority/personnel	Effectively run the incentives/penalties according to an individual's R&R	▪ Format the performance evaluation sheet with qualitative and quantitative indicators
Official takeover/handover after the termination of an individual's designation period	In the case of a sudden change in the local authority/personnel, systematically form the takeover/handover procedure to avoid this confusing situation in the future	▪ Format the handover/takeover document ▪ Organize the official approval procedure for the handover
Number and percentage of male and female civil servants, including those in state-owned enterprises and local government administration who will be part of the designated local authority	Progress made toward gender parity in civil service employment	▪ Administrative date for the HR of the local authority

[Action plan 4] Composting facilities' establishment and operation at the Sundarapola dump site.

Period	Expected Implementation
1st year	▪ A feasibility survey on the waste management system in Kurunegala is recommended. Especially for the composting technology, through the consultancy from the external technical consultant, locally appropriate composting technology should be promoted after the feasibility survey. ▪ Subsequently, the designated local authority works on the administrative process and planning of the actual implementation and maintenance.
2nd year	▪ In the first half of the year, after receiving the result of the feasibility survey on-site, the local authority hires the project implementer either from domestic or from international sources to renovate or newly establish composting machines at the Sundarapola dump site. ▪ For the remaining year, the local authority and the project implementer work together to draw out the operation data to monitor the actual operation.
5th year	▪ Project evaluation is conducted in the last year of the short-term, medium-term, and long-term periods set by the action plan, and if necessary, the annual target is set for evaluation.
10th year	▪ Improvements and supplements are derived according to the results of the project evaluation, and the action plan is modified by reflecting them in the next roadmap for advanced technology integration in waste sector.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ The establishment of composting technology should follow the ordinances/by-laws and guidelines for the composting technology of Kurunegala.
Economy	▪ When introducing/expanding the composting machines, analyze the cost of the introduction and how to generate the benefit utilizing the composting technology. ▪ Connect with a certain farm or plant industry to generate economic activities from the operating of the composting machines.
Social	▪ Educate/disseminate the waste sorting method to the public to ensure the social norm is formed and the actual behavior change of the citizens.
Technology	▪ Technical experts should advise on the composting technology that can be feasible for Kurunegala's waste treatment characteristics.
Environment	▪ The technology expected to be deployed should minimize the environmental impact and contribute to GHG reduction.
Legal	▪ The introduction/expansion of composting technology that does not conflict with other relevant laws and Kurunegala's ordinances is necessary.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status and results of feasibility review	Check the progress of the feasibility review and implementation results	▪ Review the feasibility review status and results through stakeholder and experts' workshop ▪ Progress reports from the officer-in-charge
Status of securing the budget	Secure the budget for the planned construction	▪ Check the annual budget's status
Establishment of new composting technology	100% establishment by 2024	▪ Check the progress through officer-in-charge's report and project implementer's report
O&M monitoring and evaluation	Check whether the technology is satisfactory and operates well at the site	▪ Develop data tracking tools for quantitative monitoring and evaluation

[Action plan 5] Establishment of an integrated waste management system for Kurunegala

Period	Expected Implementation
2nd–5th year	▪ In line with the establishment and operation of the composting facility, local authority shall introduce related waste management infrastructure to the site based on the assessment performed in the 1st year of "Action plan 1." ▪ As well as physical project, upgrading the waste collection and disposal practice of the KMC as a public service is necessary. ▪ Set up the monitoring and evaluation plan.
5th–10th year	▪ Once the essential infrastructure is in place, integrate the service of waste management, such as collecting and disposal, with established infrastructure for the first half of the year. ▪ The local authority shall monitor and evaluate the compatibility of each infrastructure and service then verify the affordability of the KMC to move up to the upper level of the waste hierarchy.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Policymakers ensure the incorporation of MSW disposal/treatment ordinances/guidelines is well established. ▪ Composting technology should be operated as a part of the integrated waste management system in Kurunegala.
Economy	▪ When integrating the MSW system, policymakers should consider the cost-benefit of the construction, operation, and management for cost assessment and setting the system. ▪ Policymakers should consider sustainability in terms of the operation fee so that sufficient financing is available regardless of the sources.
Social	▪ Establish a technical working group or regular stakeholder meeting for the integrated waste management system

	operation and include the public. ▪ The local authority should consider the NIMBY (Not In My Back Yard) phenomenon.
Technology	▪ Establish satisfactory infrastructure before integrating the different systems under the one system. ▪ A comprehensive waste management assessment or feasibility study should be conducted before the integration and move up to the next level of the waste hierarchy.
Environment	▪ The technology expected to be deployed should minimize the environmental impact and contribute to GHG reduction.
Legal	▪ The integrated waste management technology should be deployed that does not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of basic infrastructure's establishment	Check whether satisfactory infrastructure has been provided before the integration	▪ Review the feasibility review status and results through stakeholder and experts' workshop ▪ Progress reports from the officer-in-charge
Status of securing the budget	Secure the budget for the planned construction	▪ Check the annual budget's status
Establishment of integrated waste management system in Kurunegala	Gradually establish each component until 2026	▪ Check the progress of system establishment through officer-in-charge's report and project implementer's report

O&M monitoring and evaluation	Check whether the technology is satisfactory and operates well at the site	▪ Develop data tracking tools for quantitative monitoring and evaluation

[Action plan 6] Institutional capacity building of professional management of MSW

Period	Expected Implementation
1 and 2nd year	▪ Establish technical guidelines for the person in charge of MSW management in various sectors. ▪ Hire a local consultancy to train the responsible division or personnel on waste management. The training should include technical training, administrative and managing skills training, facilitating training, advanced cost assessment and fee setting training, and financial sourcing training. ▪ Inter-municipal facilitation and cooperation regarding waste management facilities also should be considered if necessary.
2 and 3rd year	▪ Design the incentive program or KPI for the staffs in charge of waste management. ▪ In addition to KPI for the personnel, set the waste management index or indicator to quantitively monitor the performance of the waste management.
5, 7, 9th year	▪ Continuous monitoring and regulatory frameworks are established during the 2nd year, and the actual implementation starts in the 3rd year. The local authority shall monitor and evaluate to collect annual data and then reflect the lessons learned in the upcoming year's planning. ▪ Evaluate the capacity level annually and reflect the lessons learned in the upcoming decade's new planning.
10th year	▪ Conduct the final evaluation of the action plan and then plan for the next decade.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education/training to strengthen the capabilities of policymakers based on policies, plans, and ordinances of waste management including composting in Kurunegala.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the policymakers.
Social	▪ Include training on how to manage the NIMBY phenomenon from the public.
Technology	▪ Program design and implementation techniques for strengthening the capabilities of institutional planners are necessary, and the ability to improve the system on its own should be strengthened with the assistance of experts from outside agencies.
Environment	▪ Development of the drafting program must minimize environmental impact.
Legal	▪ When developing the education program for policymakers, the contents of the relevant law and its relationship with other laws are specified, and the contents related to the development of the law and the institution are specified.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	To ensure the policymakers are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents

Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 7] Public awareness promotion of waste disposal and social inclusion.

Period	Expected Implementation
1 and 2nd year	▪ Amend the current waste management policy and regulation, including the public's responsibilities and engagement. ▪ Involve the public as a stakeholder in the planning and engage them in the monitoring and evaluation of the current operation of the technology.
2 and 3rd year	▪ Because of the introduction of the new facilities, the TFT or communication centers must be organized to receive and actively respond to the reports and suggestions from affected citizens. One-way communication for public awareness and inclusion and two-way communication targeting specific groups to receive certain responses are necessary. ▪ A monitoring and evaluation process on public awareness and social inclusion should be established.
4th–10th year	▪ The local authority shall establish the public awareness program on waste generation minimization and waste separation at source and secure the budget for the continuous campaign and related project on public awareness. ▪ Continuous monitoring and regulatory frameworks are established during the 2nd year, and the actual implementation starts in the 3rd year. The local authority shall monitor and evaluate to collect annual data and then reflect the lessons learned in the upcoming year's planning.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen public awareness based on Kurunegala's policies, plans, and ordinances for waste management including composting.
Economy	▪ Financial resources are necessary to strengthen public awareness.
Social	▪ Include information on the needs of the integrated waste management system and the treatment facilities at the municipal level to reduce the NIMBY phenomenon.
Technology	▪ Design and implementation skills in the general citizen's capacity-building program are required, and internal personnel who have completed the training of policymakers and legal system operators should lead the training programs and campaigns.
Environment	▪ Public awareness program must be developed to include the dissemination of the importance of the minimization of the environmental impact
Legal	▪ When developing education programs for public awareness, introduce related laws to the public.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions/campaign targeted at women and men, with a gender mainstreaming theme	Raise the awareness of gender equality among the citizens	▪ Stakeholder review workshop to check the module's contents

Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	4,000 citizens received the training by 2030	▪ Train 500 citizens per year
Target of the campaign participants (by women and men disaggregated data)	8,000 citizens participated in the campaign by 2030	▪ 1,000 citizens participate in the campaign per year
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training/campaign	Minimum 30% of women participating in each session/event	▪ Check attendance rate of the capacity-building program and the registration lists for the campaign

[Action plan 8] Technical capacity enhancement of composting site workers.

Period	Expected Implementation
1 and 2nd year	▪ Conduct a baseline survey such as the KAP* with the composting site workers. ▪ Use the survey results to set the monitoring and evaluation plan to track the technical capacity and behavior change with quantitative and qualitative indicators. ▪ Conduct the technical capacity training through local experts on composting and the professional from the machine seller.
2 and 3rd year	▪ Establish regular meetings for needs assessment between the designated local authority and waste sector workers. ▪ Use the assessment results to design the incentives or drivers to drive the final behavior change and responsibility of the waste sector workers.
5th, 7th, 9th year	▪ Continuous monitoring and regulatory frameworks are established during the 2nd year, and the actual implementation starts in the 3rd year. The local authority shall monitor and evaluate to collect annual data and then reflect the lessons learned in the upcoming year's planning. ▪ Evaluate the capacity level annually and reflect the lessons learned in the upcoming decade's new planning.
10th year	▪ Conduct the final evaluation of the action plan and then plan for the next decade.

➢ **KAP** measures the extent of a known situation, confirms or disproves a hypothesis, and provides new tangents of a situation's reality. It also reveals misconceptions or misunderstandings that may represent obstacles to the activities that we want to implement and potential barriers to behavior change. Therefore, it contributes to establishing the baseline (reference value) for use in future assessments and helps measure the effectiveness of technical training activities' ability to change behaviors.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen the capacity of the installation/construction implementer based on Kurunegala's policies, plans, and ordinances for waste treatment including composting.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the installation/construction implementer, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Need to provide incentives or obligatory program to the on-site worker so that can encourage workers to participate in the capacity-building program.
Technology	▪ On-site workers need technology to design and implement their capabilities and strengthen their ability to perform their installation and O&M with the assistance of experts from outside organizations.
Environment	▪ On-site workers' training program must be developed to include the contents that emphasize minimizing the environmental impact.
Legal	▪ On-site workers' training program development must include legal procedures.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	300 individuals of installation/construction implementers attended the training program	▪ Train 50 engineers per year

Rationality of the capacity-building training module and program	Develop a reasonable capacity-building training module or program	▪ Stakeholder review workshop
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Women's employment during construction, operation, and maintenance and in waste management agencies	Encourage women's employment on the site	▪ Evidence showed that contracts and tender documents for subcontractors require the recruitment of women as unskilled labor

3-2. IoT-based Recycling System

A. Introduction

[Technology Brief in the Local Context]

While the user accurately sorts wastes in the separation bin, the data on the status regarding how much the bin is filled is collected and transmitted to the data monitoring center through the network. The center calls for waste collections of trash cans filled with waste. Compensation is provided to the users that recycle the waste by waste types. The compensation is based on the amount of waste recycled, and by using smartphone applications, the user can access this information. A waste management system with IoT makes it possible to manage and collect waste efficiently. The labor and costs for collecting wastes are expected to be as much as 80% less than the original by introducing the technology.

Four Local Authorities (LAs) in Sri Lanka are successfully incorporating this technology to streamline their waste collection process. However, the Western Province Waste Management Authority plans to use this technology in all the local authorities in the Western Province. These successful projects inspire other LAs to adopt this technology. Infrastructure could be purchased and installed with local experts, and LAs are willing to adopt this type of technology into their waste management process. Additionally, skill development in garbage collectors and LA personnel directly involved in waste management ensures the successful continuation of the project.

[Expected Cost and GHG Mitigation Effect]

The cost of the IoT-based waste collection system of Jeju Island, Republic of Korea, is USD 2,100,000. The GHG mitigation effect is up to a 40% reduction of the use of waste collection vehicles.

B. Action Plan

Category	Action Plans	Period(year)										Implementing authority
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
Policy, plan reform and establishment	Amend the existing waste management ordinances/by-laws and regulation	■	■	■		■					■	Legal and technical department in KMC
	Develop the guidelines of the MSW management implementation		■	■		■					■	Technical department in KMC
	Delegate the professional local authority for the integrated waste management and operation	■				■					■	~~Chief~~ Commissioner of KMC
Physical projects	Conduct a baseline survey and construct basic infrastructure for introducing the system	■	■	■	■							Technical department in KMC
	Implement a pilot project in the selected residential area		■	■								Technical department in KMC
	Scale-up to the overall Kurunegala boundary			■	■	■	■	■	■	■	■	Technical department in KMC
Capacity Building	Institutional capacity building of professional management of MSW	■	■	■		■		■		■	■	Administrative and HR department
	Public awareness promotion of waste disposal and social inclusion	■	■	■	■	■	■	■	■	■	■	Planning department in KMC
	Technical capacity enhancement of waste collecting and disposal site workers	■	■	■		■		■		■	■	Technical department in KMC

[Action plan 1] Amend the existing waste management ordinances/by-laws and regulation

Period	Expected Implementation
1 and 2nd year	▪ Delegate the authority to professional local institutions and personnel. The legal and technical division of the KMC should assess the current policy, regulations, and general practices of waste management in Kurunegala. ▪ This system has been successfully launched in the Western Province of Sri Lanka; thus, benchmark the Western Province Waste Management Authority's roadmap and action plan for introducing the IoT-based recycling system. ▪ Support gender mainstreaming in this sector by inputting the measures to create opportunities for women within the new waste management system. ▪ Gazette and actual implementation of the amended policy and regulation will occur (2nd year).
3rd year	▪ Establishment of evaluation indicators for each action plan, from the revision of ordinances established by the master plan, funding support systems and projects for the execution of projects and strengthening capabilities. ▪ Assessment of achievement of goals with quantitative indicators when establishing assessment indicators for project performance.
5th year	▪ Project evaluation is conducted in the last year of the short-, medium-, and long-term periods set by the action plan, and if necessary, the annual target is set for evaluation.
10th year	▪ Improvements and supplements are derived according to the results of the project evaluation, and the action plan is modified by reflecting them in the next roadmap.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ The ordinances/by-laws of the recycling system shall be complementary to each other and other types of waste disposal ordinances/by-laws and as a whole, waste management ordinances/by-laws.
Economy	▪ Local/national authority level budgeting is required to enact the Kurunegala municipal ordinance on recycling. ▪ Policymakers should consider the cost and benefits, incentives, and household-wise affordability for the operating fee of municipal services, and polluter-pays principles when amending the ordinances/by-laws.
Social	▪ Prepare an ordinance that reflects the social status of recycling in Kurunegala. ▪ Policymakers should incorporate the aspects of encouraging citizens' participation and mobilization for recycling.
Technology	▪ Cooperate with technical experts to incorporate the practical and effective ordinances/by-laws after the situation analysis of the current technology level in Kurunegala.
Environment	▪ The environmental impact of the performance included in the composting ordinance should be fully considered.
Legal	▪ Enact an ordinance that does not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of ordinances/by-laws establishment	Check the progress of ordinances/by-laws and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the ordinances or by-laws
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-

		in-charge
Whether the basis for the future implementation is incorporated in the legal document	Prepare the basis for the future supportive system or plans, subsidies, strengthening the capabilities of stakeholders, and so forth.	▪ Confirmation of future performance, e.g., supportive system or plans, subsidies, and strengthening stakeholder capabilities
Gender mainstreaming is incorporated in the ordinances/by-laws	Ordinances and by-laws include gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 2] Develop the guidelines of the MSW management implementation.

Period	Expected Implementation
2 and 3rd year	▪ On the basis of the assessment from "Action plan 1" in the first year, publish and circulate the new MSW waste management guideline.
5th year	▪ Project evaluation is conducted in the last year of the short-term, medium-term, and long-term periods set by the action plan, and if necessary, the annual target is set for evaluation.
10th year	▪ Improvements and supplements are derived according to the results of the project evaluation, and the action plan is modified by reflecting them in the next roadmap.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ The MSW guidelines including recycling shall follow the direction of the ordinances/by-laws on waste management by Kurunegala.
Economy	▪ Guidelines should include the aspects of costs and benefits and the incentive for each activity, to effectively set up the fee based on the polluter pays, affordability from the household level, and operation cost recovery.
Social	▪ The general guidelines should include the public's responsibility and the specified waste sorting methodology.
Technology	▪ Cooperate with technical experts to incorporate the practical and effective guidelines after the situation analysis of the current technology level in Kurunegala.
Environment	▪ The environmental impact of the performance included in the composting guidelines should be fully considered.
Legal	▪ Enact an ordinance that does not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of guidelines establishment	Check the progress of guidelines and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the guidelines
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the guidelines include the activities both for the general citizen and for the operational/governmental level	Prepare the basis for the monitoring and evaluation indicators for the local authority and the waste disposal for the general citizens	▪ Stakeholder review workshop ▪ Public survey on citizens' awareness of the waste disposal/treatment
Gender mainstreaming is incorporated in the guidelines	Waste management guidelines include gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 3] Delegate the professional local authority for the integrated waste management and operation

Period	Expected Implementation
1st year	▪ If designating a technical function to personnel with insufficient technical knowledge and management skills, hire local consultants to train the designated personnel or division in the local authority. ▪ Allocate satisfactory roles and responsibilities such as policy establishment; financing planning on the waste management; preparation of regional standards and guidelines; setting up of waste information database; monitoring and enforcement, especially of the "Polluter pays principle;" and coordination and consultation with stakeholders.
5th year	▪ Project evaluation is conducted in the last year of the short-term, medium-term, and long-term periods set by the action plan, and if necessary, the annual target is set for evaluation.
10th year	▪ Improvements and supplements are derived according to the results of the project evaluation, and the action plan is modified by reflecting them in the next roadmap.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ The delegation should be from the final decisionmaker level according to Kurunegala's official organization hierarchy.
Economy	▪ The delegation should reflect the cost-effectiveness of delegation in terms of the human resource cost, training cost, and number of officials to be delegated and their workload based on resource management methodology.
Social	▪ Designate local authority/personnel who can effectively reflect the social atmosphere toward the recycling and waste sorting practices.
Technology	▪ The designated authority/personnel should be well aware of the IoT-based recycling technology.
Environment	▪ The designated authority/personnel should be well aware of the environmental impact, from introducing IoT-

	based technology and how to manage it.
Legal	▪ The designation shall be in the official procedure according to the KMC's procedure.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Designation of the local authority/personnel	Check the progress of the designation and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Performance evaluation on the designated local authority/personnel	Effectively run the incentives/penalties according to an individual's R&R	▪ Format the performance evaluation sheet with qualitative and quantitative indicators
Official takeover/handover after the termination of an individual's designation period	In the case of a sudden change in the local authority/personnel, systematically form the takeover/handover procedure to avoid this confusing situation in the future	▪ Format the handover/takeover document ▪ Organize the official approval procedure for the handover
Number and percentage of male and female civil servants, including those in state-owned enterprises and local government administration who will be part of the designated local authority	Progress made toward gender parity in civil service employment	▪ Administrative date for the HR of the local authority

[Action plan 4] Conduct a baseline survey and construct basic infrastructure for introducing the system.

Period	Expected Implementation
1st year	▪ A feasibility survey on the waste management system in Kurunegala is recommended, especially for the IoT-based recycling and garbage collection system, for which essential infrastructure is necessary. ▪ Then, the designated local authority works on the administrative process and planning of the actual implementation and maintenance.
2 and 3rd year	▪ After obtaining the result of the feasibility survey on-site, the local authority hires the project implementer either from domestic or from international sources to renovate or newly establish the basic infrastructure. ▪ Planning for the pilot project occurs after the construction. ▪ During the period, the local authority and the project implementer work together to draw out the operation data to monitor the actual operation.
4th year	▪ Evaluations from stakeholders and sector experts are necessary on the readiness of the infrastructure for introducing the system as the next step. ▪ Planning of the scale-up scenario for Kurunegala is conducted.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Establishing the IoT-based recycling system should follow the ordinances/by-laws and guidelines for the recycling and waste sorting practices of Kurunegala.
Economy	▪ When constructing the basic infrastructures for the IoT system, analyze the cost of the introduction and how to generate the benefit utilizing the technology. ▪ Connect with certain private companies to develop the business model of the IoT-based recycling system.
Social	▪ Educate/disseminate the waste sorting method to the public to ensure that social norms and actual behavior changes form.
Technology	▪ Technical experts should be advisors on the basic infrastructure feasible for Kurunegala's introduction of a IoT-based recycling system.
Environment	▪ The technology expected to be deployed should minimize the environmental impact and contribute to GHG reduction.
Legal	▪ Constructing the basic infrastructure should occur and not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status and results of baseline survey review	Check the progress of the baseline survey review and implementation results	▪ Review the baseline survey status and results through stakeholder and experts' workshop ▪ Progress reports from the officer-in-charge
Status of securing the budget	Secure the budget for the planned construction	▪ Check the annual budget's status
Establishment of basic infrastructure for the IoT system	To integrate the system with other treatment facilities	▪ Check the progress through officer-in-charge's report and project implementer's report
O&M monitoring and evaluation	Check whether the technology is satisfactory and operates well at the site	▪ Develop data tracking tools for quantitative monitoring and evaluation

[Action plan 5] Implement a pilot project in the selected residential area.

Period	Expected Implementation
2 and 3rd year	▪ In the last year of basic infrastructure construction, the local authority hires the project implementer either from domestic or from international sources to introduce and operate the IoT-based recycling and garbage collection system. ▪ At the end of the year, the local authority begins the actual planning of the scale-up of the project for the overall boundary of Kurunegala.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ The establishment of IoT-based recycling system should follow the ordinances/by-laws and guidelines for the recycling and waste sorting practices of Kurunegala.
Economy	▪ When introducing the IoT system, analyze the cost of the introduction and how to generate the benefits of utilizing the technology. ▪ Connect with certain private companies to develop the business model of the IoT-based recycling system.
Social	▪ Educate/disseminate the waste sorting method to the public to ensure that social norms and actual behavior changes form.
Technology	▪ Technical experts should provide advice as to which IoT system will be most suitable for Kurunegala's current status.
Environment	▪ The technology expected to be deployed should minimize the environmental impact and contribute to GHG reduction.
Legal	▪ The IoT system's operation should not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of securing the budget	Secure the budget for the planned construction	▪ Check the annual budget's status
Introducing the IoT system for certain area	Check the feasibility of the system	▪ Check the progress through officer-in-charge's report and project implementer's report
O&M monitoring and evaluation	Check whether the technology is satisfactory and operates well at the site	▪ Develop data tracking tools for quantitative monitoring and evaluation

[Action plan 6] Scale-up to the overall Kurunegala boundary.

Period	Expected Implementation
3rd and 4th year	▪ For the extension of "Action plan 5," the local authority will work on the administrative process and planning of the actual implementation and maintenance. ▪ The designated local authority will begin to scale-up to the overall area of Kurunegala.
5th–10th year	▪ Continuous monitoring and evaluations on the operating status of the project should be conducted; then, the lessons learned should be reflected in the upcoming year's planning.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ The establishment of IoT-based recycling system should follow the ordinances/by-laws and guidelines for the recycling and waste sorting practices of Kurunegala.
Economy	▪ When scaling up the IoT system, it is crucial to analyze and finance the cost of the operation and management throughout the Kurunegala. ▪ Connect with certain private companies to develop the business model of the IoT-based recycling system.
Social	▪ Educate/disseminate the waste sorting method to the public to ensure that social norms and actual behavior changes form.
Technology	▪ The technical experts should advise on the scaling up timing and methodology for Kurunegala.
Environment	▪ The expected technology should minimize the environmental impact and contribute to GHG reduction.
Legal	▪ Scaling up the IoT system should not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of securing the budget	Secure the budget for the planned construction	▪ Check the annual budget's status
Scaling up to the regional area	Disseminate the practices and technology to the remaining area of Kurunegala	▪ Check the progress through officer-in-charge's report and project implementer's report
O&M monitoring and evaluation	Check whether the technology is satisfactory and operates well at the site	▪ Develop data tracking tools for quantitative monitoring and evaluation

[Action plan 7] Institutional capacity building of professional management of MSW

Period	Expected Implementation
1 and 2nd year	▪ Establish technical guidelines for the person in charge of MSW management in various sectors. ▪ Hire a local consultancy to train the responsible division or personnel on waste management. The training should include technical training, administrative and managing skills training, facilitating training, advanced cost assessment and fee setting training, and financial sourcing training. ▪ Inter-municipal facilitation and cooperation regarding waste management facilities also should be considered if necessary.
2nd and 3rd year	▪ Design the incentive program or KPI for the staffs in charge of waste management. ▪ In addition to KPI for the personnel, set the waste management index or indicator to quantitively monitor the performance of the waste management.
5th, 7th, 9th year	▪ Continuous monitoring and regulatory frameworks are established during the 2nd year, and the actual implementation starts in the 3rd year. The local authority shall monitor and evaluate to collect annual data and then reflect the lessons learned in the upcoming year's planning. ▪ Evaluate the capacity level annually and reflect the lessons learned in the upcoming decade's new planning.
10th year	▪ Conduct the final evaluation of the action plan and then plan for the next decade.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education/training to strengthen the capabilities of policymakers based on policies, plans, and ordinances of waste management including recycling in Kurunegala.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the policymakers.
Social	▪ Include training on how to encourage system operators and citizens to actively utilize the system.
Technology	▪ Program design and implementation techniques for strengthening the capabilities of institutional planners are necessary, and the ability to improve the system on its own should be strengthened with the assistance of experts from outside agencies.
Environment	▪ Development of the drafting program must minimize environmental impact.
Legal	▪ When developing the education program for policymakers, the contents of the relevant law and its relationship with other laws are specified, and the contents related to the development of the law and the institution are specified.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	To ensure the policymakers are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 8] Public awareness promotion of waste disposal and social inclusion.

Period	Expected Implementation
1 and 2nd year	▪ Amend the current waste management policy and regulation, including the public's responsibilities and engagement. ▪ Involve the public as a stakeholder in the planning and engage them in the monitoring and evaluation of the current operation of the technology.
2 and 3rd year	▪ Because of the introduction of the new facilities, the TFT or communication centers must be organized to receive and actively respond to the reports and suggestions from affected citizens. One-way communication for public awareness and inclusion and two-way communication targeting specific groups to receive certain responses are necessary. ▪ Adding to the public awareness program, the local authority shall reflect the public's behavior when establishing the mobile app so that the user-friendly app will enable citizens to use it easily and frequently. ▪ A monitoring and evaluation process on public awareness and social inclusion should be established.
4th–10th year	▪ The local authority shall establish the public awareness program on waste generation minimization and waste separation at source and secure the budget for the continuous campaign and related project on public awareness. ▪ Continuous monitoring and regulatory frameworks are established during the 2nd year, and the actual implementation starts in the 3rd year. The local authority shall monitor and evaluate to collect annual data and then reflect the lessons learned in the upcoming year's planning.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen public awareness based on Kurunegala's policies, plans, and ordinances for waste management including recycling.
Economy	▪ Financial resources are necessary to strengthen public awareness.
Social	▪ Include information of the availability and convenient characteristics of IoT-based recycling system.
Technology	▪ Design and implementation skills in the general citizen's capacity-building program are required, and internal personnel who have completed the training of policymakers and legal system operators should lead the training programs and campaigns.
Environment	▪ Public awareness program must be developed to include the dissemination of the importance of the minimization of the environmental impact
Legal	▪ When developing education programs for public awareness, introduce related laws to the public.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions/campaign targeted at women and men, with a gender mainstreaming theme	Raise the awareness of gender equality among the citizens	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	4,000 citizens received the training by 2030	▪ Train 500 citizens per year
Target of the campaign participants (by women and men disaggregated data)	8,000 citizens participated in the campaign by 2030	▪ 1,000 citizens participate in the campaign per year
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training/campaign	Minimum 30% of women participating in each session/event	▪ Check attendance rate of the capacity-building program and the registration lists for the campaign

[Action plan 9] Technical capacity enhancement of waste collecting and disposal site workers

Period	Expected Implementation
1 and 2nd year	▪ Conduct a baseline survey such as the KAP* with the waste collecting and disposal site workers. ▪ Use the survey results to set the monitoring and evaluation plan to track the technical capacity and behavior change with quantitative and qualitative indicators. ▪ Conduct technical capacity training through local experts on waste treatment.
2 and 3rd year	▪ Establish regular meetings for needs assessment between the designated local authority and waste sector workers. ▪ Use the assessment results to design the incentives or drivers to drive the final behavior change and responsibility of the waste sector workers.
5th, 7th, 9th year	▪ Continuous monitoring and regulatory frameworks are established during the 2nd year, and the actual implementation starts in the 3rd year. The local authority shall monitor and evaluate to collect annual data and then reflect the lessons learned in the upcoming year's planning. ▪ Evaluate the capacity level annually and reflect the lessons learned in the upcoming decade's new planning.
10th year	▪ Conduct the final evaluation of the action plan and then plan for the next decade.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen the capacity of waste collecting and disposal site workers based on Kurunegala's policies, plans, and ordinances for waste treatment including recycling.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the waste sector workers, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Need to provide incentives or obligatory program to the on-site worker so that can encourage workers to participate in the capacity-building program.
Technology	▪ On-site workers need technology to design and implement their capabilities and strengthen their ability to perform their installation and O&M with the assistance of experts from outside organizations.
Environment	▪ On-site workers' training program must be developed to include the contents that emphasize minimizing the environmental impact.
Legal	▪ On-site workers' training program development must include legal procedures.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	300 individuals of installation/construction implementers attended the training program	▪ Train 50 engineers per year
Rationality of the capacity-building training module and program	Develop a reasonable capacity-building training module or program	▪ Stakeholder review workshop
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Women's employment during construction, operation, and maintenance and in waste management agencies	Encourage women's employment on the site	▪ Evidence showed that contracts and tender documents for subcontractors require the recruitment of women as unskilled labor

3-3. Energy generation by incineration of MSW

A. Introduction

[Technology Brief in Local Context]

Incineration of solid waste can treat a large amount of waste within a short time and leaves behind a small amount of ash; thus, the remains can be treated or buried in the landfill. The other feature of waste incineration is that it generates electricity by utilizing waste heat from the process of incinerating the waste and thus could reduce the consumption of fossil fuels to generate electricity.

Sri Lanka is constructing a new waste to energy (WtE) plant at Kerawalapitiya in Wattala DS division of Gampaha District, 12 km north of the Colombo City center. The WtE project will be implemented by Western Power Company, owned by Aitken Spence Ltd. The project shall generate electricity from MSWs and add a net 10 MW of electricity to the national grid. The power plant will use MSW as fuel. The daily availability of MSW will be approximately 600–800 tons. The Colombo Municipal Council (CMC) will collect MSW at the plant site daily; thereby, the necessity for the CMC to dump the MSW elsewhere will not arise. The operational period of the project will be 20 years. Further, the company has been granted 10 acres of flat land through a land lease agreement for a period of 30 years on which to locate the project.

[Expected Cost and GHG Mitigation Effect]

In the "CDM project, Municipal Solid Waste to Energy Project by Western Power Company Ltd, 2012 in Sri Lanka," the total cost is USD 36,800,000, which is 3,071,000 USD/MW. The abatement cost is 13 USD/tonCO_2eq, and the GHG mitigation effect is 139,829 tonCO_2eq/year, which is 11,652 tonCO_2eq/year/MW.

B. Action Plan

Category	Action Plans	Period(year)										Implementing authority
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
Policy, plan reform and establishment	Amend the existing waste management ordinances/by-laws	■	■	■		■					■	Legal and technical department in KMC
	Develop the guidelines of the MSW management implementation		■	■		■					■	Technical department in KMC
	Delegate the professional local authority for the integrated waste management and operation	■				■					■	Chief Commissioner of KMC
Physical projects	WtE incinerator setup in Kurunegala	■	■			■					■	Technical department in KMC
	Establishment of an integrated waste management system for Kurunegala		■	■	■	■	■	■	■	■	■	Technical department in KMC
Capacity Building	Institutional capacity building of professional management of MSW	■	■	■		■		■		■	■	Administrative and HR department in KMC
	Public awareness promotion of waste disposal and social inclusion	■	■	■	■	■	■	■	■	■	■	Planning department in KMC
	Technical capacity enhancement of incinerator workers	■	■	■		■		■		■	■	Technical department in KMC

[Action plan 1] Amend the existing waste management ordinances/by-laws.

Period	Expected Implementation
1 and 2nd year	▪ Delegate the authority to professional local institutions and personnel. The legal and technical division of the KMC assesses the current policy, regulations, and general practices of waste management in Kurunegala. ▪ Prepare amendment of existing waste management policy and regulation. ▪ Support gender mainstreaming in this sector by inputting the measures to create opportunities for women within the new waste management system. ▪ Publishing and actual implementation of the amended policy and regulation will occur (2nd year).
3rd year	▪ Establishment of evaluation indicators for each action plan, from the revision of ordinances established by the master plan, funding support systems and projects for the execution of projects and strengthening capabilities. ▪ Assessment of achievement of goals with quantitative indicators when establishing assessment indicators for project performance.
5th year	▪ Project evaluation is conducted in the last year of the short-term, medium-term, and long-term periods set by the action plan, and if necessary, the annual target is set for evaluation.
10th year	▪ Improvements and supplements are derived according to the results of the project evaluation, and the action plan is modified by reflecting them in the next roadmap.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ The ordinances/by-laws of WtE shall be complementary to each other with other types of waste disposal ordinances/by-laws as a whole waste management ordinances/by-laws.
Economy	▪ Local/national authority level budgeting is required to enact the Kurunegala municipal ordinance on WtE. ▪ Policymakers should consider the cost and benefits, incentives, and household-wise affordability for the operating fee of municipal services, and polluter-pays principles when amending the ordinances/by-laws.
Social	▪ Prepare an ordinance that reflects the social status of incinerators in Kurunegala. ▪ Policymakers should incorporate the aspects of encouraging citizens' participation and mobilization for WtE.
Technology	▪ Cooperate with technical experts to incorporate the practical and effective ordinances/by-laws after the situation analysis of the current technology level in Kurunegala.
Environment	▪ The environmental impact of the performance included in the WtE ordinance should be fully considered.
Legal	▪ Enact an ordinance that does not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of ordinances/by-laws establishment	Check the progress of ordinances/by-laws and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the ordinances or by-laws
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the basis for the future implementation is incorporated in the legal document	Prepare the basis for the future supportive system or plans, subsidies, strengthening the capabilities of stakeholders, and so forth.	▪ Confirmation of future performance, e.g., supportive system or plans, subsidies, and strengthening stakeholder capabilities
Gender mainstreaming is incorporated in the ordinances/by-laws	Ordinances and by-laws include gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 2] Develop the guidelines of the MSW management implementation.

Period	Expected Implementation
2 and 3rd year	▪ On the basis of the assessment from "Action plan 1" in the first year, publish and circulate the new MSW waste management guideline.
5th year	▪ Project evaluation is conducted in the last year of the short-term, medium-term, and long-term periods set by the action plan, and if necessary, the annual target is set for evaluation.
10th year	▪ Improvements and supplements are derived according to the results of the project evaluation, and the action plan is modified by reflecting them in the next roadmap.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ The MSW guidelines, including those for incinerators, shall follow the direction of the ordinances/by-laws on waste management by Kurunegala.
Economy	▪ Guidelines should include the aspects of costs and benefits and the incentive for each activity, to effectively set up the fee based on the polluter pays, affordability from the household level, and operation cost recovery.
Social	▪ The general guidelines should include the public's responsibility, with specified waste treatment methods for the household level.
Technology	▪ Cooperate with technical experts to incorporate the practical and effective guidelines after the situation analysis of the current technology level in Kurunegala.
Environment	▪ The environmental impact of the performance included in the incinerators' guidelines should be fully considered.
Legal	▪ Enact an ordinance that does not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of guidelines establishment	Check the progress of guidelines and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge ▪ Official publication and circulation of the guidelines
Rationality of the objectives and implementation methods	Establish reasonable objectives and methods of actual implementation	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Whether the guidelines include the activities both for the general citizen and for the operational/governmental level	Prepare the basis for the monitoring and evaluation indicators for the local authority and the waste disposal for the general citizens	▪ Stakeholder review workshop ▪ Public survey on citizens' awareness of the waste disposal/treatment
Gender mainstreaming is incorporated in the guidelines	Waste management guidelines include gender equality objectives based on gender analysis of need, demand, and supply	▪ Training for policymakers on the gender mainstreaming ▪ Check the final version of legal documents to identify whether gender equality is incorporated successfully

[Action plan 3] Delegate the professional local authority for the integrated waste management and operation.

Period	Expected Implementation
1st year	▪ If designating a technical function to personnel with insufficient technical knowledge and management skills, hire local consultants to train the designated personnel or division in the local authority. ▪ Allocate satisfactory roles and responsibilities such as policy establishment; financing planning on the waste management; preparation of regional standards and guidelines; setting up of waste information database; monitoring and enforcement, especially of the "Polluter pays principle;" and coordination and consultation with stakeholders.
5th year	▪ Project evaluation is conducted in the last year of the short-term, medium-term, and long-term periods set by the action plan, and if necessary, the annual target is set for evaluation.
10th year	▪ Improvements and supplements are derived according to the results of the project evaluation, and the action plan is modified by reflecting them in the next roadmap.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ The delegation should be from the final decisionmaker level according to Kurunegala's official organization hierarchy.
Economy	▪ The delegation should reflect the cost-effectiveness of delegation in terms of the human resource cost, training cost, and number of officials to be delegated and their workload based on resource management methodology.
Social	▪ Designate local authority/personnel who can effectively reflect the social atmosphere toward the incinerating and the other waste disposal/treatment.
Technology	▪ The designated authority/personnel should be well aware of the incinerating technology.
Environment	▪ The designated authority/personnel should be well aware of the environmental impact from the incinerating and

	how to manage it.
Legal	▪ The designation shall be in the official procedure according to the KMC's procedure.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Designation of the local authority/personnel	Check the progress of the designation and the availability at the end of the expected implementing year	▪ Stakeholder review workshop ▪ Progress reports from the officer-in-charge
Performance evaluation on the designated local authority/personnel	Effectively run the incentives/penalties according to an individual's R&R	▪ Format the performance evaluation sheet with qualitative and quantitative indicators
Official takeover/handover after the termination of an individual's designation period	In the case of a sudden change in the local authority/personnel, systematically form the takeover/handover procedure to avoid this confusing situation in the future	▪ Format the handover/takeover document ▪ Organize the official approval procedure for the handover
Number and percentage of male and female civil servants, including those in state-owned enterprises and local government administration who will be part of the designated local authority	Progress made toward gender parity in civil service employment	▪ Administrative date for the HR of the local authority

[Action plan 4] WtE incinerator setup in Kurunegala.

Period	Expected Implementation
1st year	▪ A feasibility survey on the waste management system in Kurunegala is recommended. ▪ After the general feasibility survey on the waste management system, the local authority will analyze the proper types of incinerators for WtE. ▪ Then, the designated local authority works on the administrative process and planning of the actual implementation and maintenance.
2nd year	▪ After obtaining the result of the feasibility survey on-site, the local authority hires the project implementer either from domestic or from international sources to install incinerators. ▪ Evaluations from the stakeholders and sector experts on the effectiveness of the incinerators are collected and the results used in planning for the upcoming years.
5th year	▪ Project evaluation is conducted in the last year of the short-term, medium-term, and long-term periods set by the action plan, and if necessary, the annual target is set for evaluation.
10th year	▪ Improvements and supplements are derived according to the results of the project evaluation, and the action plan is modified by reflecting them in the next roadmap for advanced technology integration in the waste sector.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ The establishment of WtE technology should follow the ordinances/by-laws and guidelines for the incinerating technology of Kurunegala.
Economy	▪ When introducing the incinerators, analyze the cost of the introduction and how to generate the benefit utilizing the WtE technology.
Social	▪ Educate/disseminate the waste treatment and sorting method to the public to ensure social norms and actual behavior changes are formed.
Technology	▪ Technical experts should recommend which incinerating technology is feasible for the Kurunegala's waste treatment characteristics.
Environment	▪ The technology expected to be deployed should minimize the environmental impact and contribute to GHG reduction.
Legal	▪ The introduction/expansion of composting technology that does not conflict with other relevant laws and Kurunegala's ordinances is necessary.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status and results of feasibility review	Check the progress of the feasibility review and implementation results	▪ Review the feasibility review status and results through stakeholder and experts' workshop ▪ Progress reports from the officer-in-charge
Status of securing the budget	Secure the budget for the planned construction	▪ Check the annual budget's status
Establishment of incinerating technology	100% establishment by 2026	▪ Check the progress through officer-in-charge's report and project implementer's report
O&M monitoring and evaluation	Check whether the technology is satisfactory and operates well at the site	▪ Develop data tracking tools for quantitative monitoring and evaluation

[Action plan 5] Establishment of an integrated waste management system for Kurunegala.

Period	Expected Implementation
2nd–5th year	▪ In line with the establishment and operation of the incinerators, the local authority shall introduce related waste management infrastructure to the site based on the assessment performed in the 1st year of "Action plan 1." ▪ As well as physical project, it is necessary to upgrade the waste collection and disposal practice of the KMC as a public service. ▪ Setting up the monitoring and evaluation plan
5th–10th year	▪ Once the essential infrastructure is in place, integrating the service of the waste management such as collecting and disposal with established infrastructure for the first half of the year is necessary. ▪ The local authority shall monitor and evaluate the compatibility of each infrastructure and service and then verify the affordability of the KMC to move up to the upper level of the waste hierarchy.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Policymakers ensure that the incorporation of MSW disposal/treatment ordinances/by-laws/guidelines is well established. ▪ Incinerating technology should be operated as a part of the integrated waste management system in Kurunegala.
Economy	▪ When integrating the MSW system, policymakers should consider the costs and benefits of the construction, operation, and management for the cost assessment and setting the system. ▪ Policymakers should consider sustainability in terms of the operation fee so that sufficient financing is available regardless of the sources.

Social	▪ Establish a technical working group or regular stakeholder meeting for the integrated waste management system operation including the public. ▪ The local authority should consider the NIMBY phenomenon.
Technology	▪ Establish satisfactory infrastructure before integrating the different systems under the one system. ▪ A comprehensive waste management assessment or feasibility study should be conducted before the integration and move up to the next level of the waste hierarchy.
Environment	▪ The technology expected to be deployed should minimize the environmental impact and contribute to GHG reduction.
Legal	▪ The integrated waste management technology should be deployed that does not conflict with other relevant laws and Kurunegala's ordinances.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of basic infrastructure's establishment	Check whether satisfactory infrastructure has been provided before the integration	▪ Review the feasibility review status and results through stakeholder and experts' workshop ▪ Progress reports from the officer-in-charge
Status of securing the budget	Secure the budget for the planned construction	▪ Check the annual budget's status

Establishment of integrated waste management system in Kurunegala	Gradually establish each component until 2026	▪ Check the progress of system establishment through officer-in-charge's report and project implementer's report
O&M monitoring and evaluation	Check whether the technology is satisfactory and operates well at the site	▪ Develop data tracking tools for quantitative monitoring and evaluation

[Action plan 6] Institutional capacity building of professional management of MSW

Period	Expected Implementation
1 and 2nd year	▪ Establish technical guidelines for the person in charge of MSW management in various sectors. ▪ Hire a local consultancy to train the responsible division or personnel on waste management. The training should include technical training, administrative and managing skills training, facilitating training, advanced cost assessment and fee setting training, and financial sourcing training. ▪ Inter-municipal facilitation and cooperation regarding waste management facilities also should be considered if necessary.
2 and 3rd year	▪ Design the incentive program or KPI for the staffs in charge of waste management. ▪ In addition to KPI for the personnel, set the waste management index or indicator to quantitively monitor the performance of the waste management.
5th, 7th, 9th year	▪ Continuous monitoring and regulatory frameworks are established during the 2nd year, and the actual implementation starts in the 3rd year. The local authority shall monitor and evaluate to collect annual data and then reflect the lessons learned in the upcoming year's planning. ▪ Evaluate the capacity level annually and reflect the lessons learned in the upcoming decade's new planning.
10th year	▪ Conduct the final evaluation of the action plan and then plan for the next decade.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education/training to strengthen the capabilities of policymakers based on policies, plans, and ordinances of waste management including incinerating in Kurunegala.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the policymakers.
Social	▪ Include training on how to manage the NIMBY phenomenon.
Technology	▪ Program design and implementation techniques for strengthening the capabilities of institutional planners are necessary, and the ability to improve the system on its own should be strengthened with the assistance of experts from outside agencies.
Environment	▪ Development of the drafting program must minimize environmental impact.
Legal	▪ When developing the education program for policymakers, the contents of the relevant law and its relationship with other laws are specified, and the contents related to the development of the law and the institution are specified.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions targeted at women and men, with a gender mainstreaming theme	To ensure the policymakers are aware of the norm of gender mainstreaming	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	100% training for policymakers	▪ Number of public officials subject to capacity-building training
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training workshop	Minimum 30% of women participating in each session	▪ Check attendance rate in the capacity-building program reports

[Action plan 7] Public awareness promotion of waste disposal and social inclusion.

Period	Expected Implementation
1 and 2nd year	▪ Amend the current waste management policy and regulation, including the public's responsibilities and engagement. ▪ Involve the public as a stakeholder in the planning and engage them in the monitoring and evaluation of the current operation of the technology.
2 and 3rd year	▪ Because of the introduction of the new facilities, the TFT or communication centers must be organized to receive and actively respond to the reports and suggestions from affected citizens. One-way communication for public awareness and inclusion and two-way communication targeting specific groups to receive certain responses are necessary. ▪ A monitoring and evaluation process on public awareness and social inclusion should be established.
4th–10th year	▪ The local authority shall establish the public awareness program on waste generation minimization and waste separation at source and secure the budget for the continuous campaign and related project on public awareness. ▪ Continuous monitoring and regulatory frameworks are established during the 2nd year, and the actual implementation starts in the 3rd year. The local authority shall monitor and evaluate to collect annual data and then reflect the lessons learned in the upcoming year's planning.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen public awareness based on Kurunegala's policies, plans, and ordinances for waste management including incinerating
Economy	▪ Financial resources are necessary to strengthen public awareness.
Social	▪ Include information on the needs of the integrated waste management system and the treatment facilities at the municipal level to reduce the NIMBY phenomenon.
Technology	▪ Design and implementation skills in the general citizen's capacity-building program are required, and internal personnel who have completed the training of policymakers and legal system operators should lead the training programs and campaigns.
Environment	▪ Public awareness program must be developed to include the dissemination of the importance of the minimization of the environmental impact
Legal	▪ When developing education programs for public awareness, introduce related laws to the public.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Number of training sessions/campaign targeted at women and men, with a gender mainstreaming theme	Raise the awareness of gender equality among the citizens	▪ Stakeholder review workshop to check the module's contents
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	4,000 citizens received the training by 2030	▪ Train 500 citizens per year
Target of the campaign participants (by women and men disaggregated data)	8,000 citizens participated in the campaign by 2030	▪ 1,000 citizens participate in the campaign per year
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Ratio of women participating in the training/campaign	Minimum 30% of women participating in each session/event	▪ Check attendance rate of the capacity-building program and the registration lists for the campaign

[Action plan 8] Technical capacity enhancement of incinerator workers.

Period	Expected Implementation
1 and 2nd year	▪ Conduct a baseline survey such as the KAP* with the waste workers at the collecting and disposal site. ▪ Use the survey results to set the monitoring and evaluation plan to track the technical capacity and behavior change with quantitative and qualitative indicators. ▪ For the second half of the year, conduct technical capacity training through local experts on incinerator operation and management.
2 and 3rd year	▪ Establish regular meetings for needs assessment between the designated local authority and waste sector workers. ▪ Use the assessment results to design the incentives or drivers to drive the final behavior change and responsibility of the waste sector workers.
5th, 7th, 9th year	▪ Continuous monitoring and regulatory frameworks are established during the 2nd year, and the actual implementation starts in the 3rd year. The local authority shall monitor and evaluate to collect annual data and then reflect the lessons learned in the upcoming year's planning. ▪ Evaluate the capacity level annually and reflect the lessons learned in the upcoming decade's new planning.
10th year	▪ Conduct the final evaluation of the action plan and then plan for the next decade.

➢ **Barrier and Consideration**

Category	Contents
Policy	▪ Implementation of education to strengthen the capacity of the installation/construction implementer based on Kurunegala's policies, plans, and ordinances for waste treatment including incinerating.
Economy	▪ Financial resources are necessary to strengthen the capabilities of the installation/construction implementer, and cooperation with financial support institutions such as KEITI, KOICA, GCF, and CTCN is necessary.
Social	▪ Need to provide incentives or obligatory program to the on-site worker so that can encourage workers to participate in the capacity-building program.
Technology	▪ On-site workers need technology to design and implement their capabilities and strengthen their ability to perform their installation and O&M with the assistance of experts from outside organizations.
Environment	▪ On-site workers' training program must be developed to include the contents that emphasize minimizing the environmental impact.
Legal	▪ On-site workers' training program development must include legal procedures.

➢ **Recommended Monitoring and Evaluation Methodology**

Indicator/Index category	Objective	Methodology
Status of capacity-building program/module development	Check the progress of the development of the capacity-building program/module.	▪ Stakeholder review workshop
Participant's attendance percentage (by women and men disaggregated data)	80% of more participate in capacity-building training	▪ Check attendance rate in the capacity-building program reports
Target of the capacity-building training (by women and men disaggregated data)	300 individuals of installation/construction implementers attended the training program	▪ Train 50 engineers per year
Rationality of the capacity-building training module and program	Develop a reasonable capacity-building training module or program	▪ Stakeholder review workshop
Result of the capacity-building training	70% or more outstanding as a result of the final evaluation	▪ Quantitative and qualitative evaluations are conducted after capacity-building training
Women's employment during construction, operation, and maintenance and in waste management agencies	Encourage women's employment on the site	▪ Evidence showed that contracts and tender documents for subcontractors require the recruitment of women as unskilled labor

VII. Way Forward

The roadmap has been developed based on each timeline—a short-, mid-, and long-term period—and according to each action plan per technology from the energy, transportation, and waste sectors in Kurunegala. Developing the roadmap demonstrated that the most important action is to build the operational capacity of the government and the local authority to manage, design, and operate the system at its own level. The financial scheme or the budget per each action was not evaluated in this roadmap because of the limited access to the information. However, the financial support scheme and the budgeting per each organization also should be evaluated and enhanced, especially for annual budget planning.

The public awareness of each sector and technology is also relevant to future implementation; therefore, policymakers should consider efficient means of outreach to promote household-level awareness on the specific technology and policy. The local authority should provide the contents of its commitment to a certain sector or technology to the public as well.

To evaluate the effectiveness of the action plan, the local authority should develop quantifiable indicators to track the progress in a systematic approach. To pursue the systematic evaluation system, the local authority and the related stakeholders should manage the data and establish the data-sharing mechanism with a certain role designation for each stakeholder or authority.

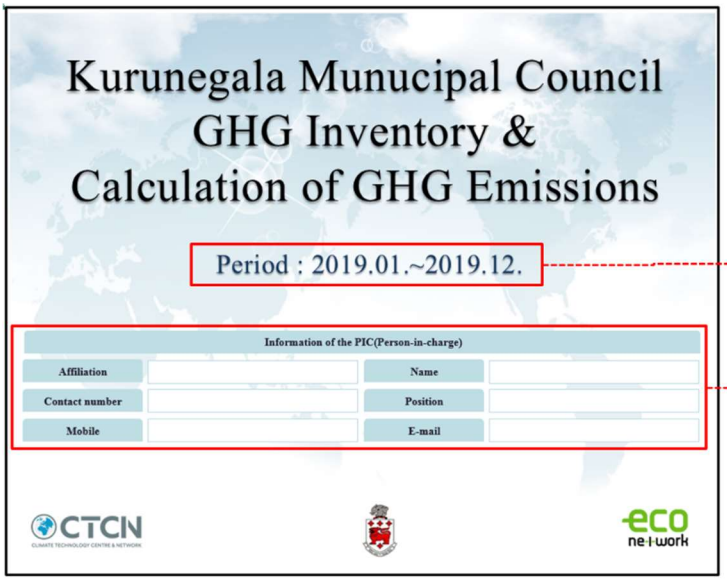
Finally, the roadmap should be reviewed periodically by each stakeholder to reflect the state-of-the-art system, technology, and social norms, because Kurunegala is becoming Greater Kurunegala according to its urban development plan, whose duration ends in 2030.

ANNEX A. GUIDELINES FOR THE KURUNEGALA GHG INVENTORY

To facilitate the establishment of a GHG inventory and calculation of GHG emissions of Kurunegala, the "Tool of establishing greenhouse gases inventory and calculation of greenhouse gases emissions of Kurunegala" is composed and delivered as a basic template. The Tool is composed as a guide on how to gather the fundamental data of the city and identify the GHG emission activities within the city boundary. The tool also presents which GHG calculation methodologies are applied. The objective of the tool is to identify the emission sources of GHGs and calculate the amounts of GHG emissions in the jurisdiction of local governments.

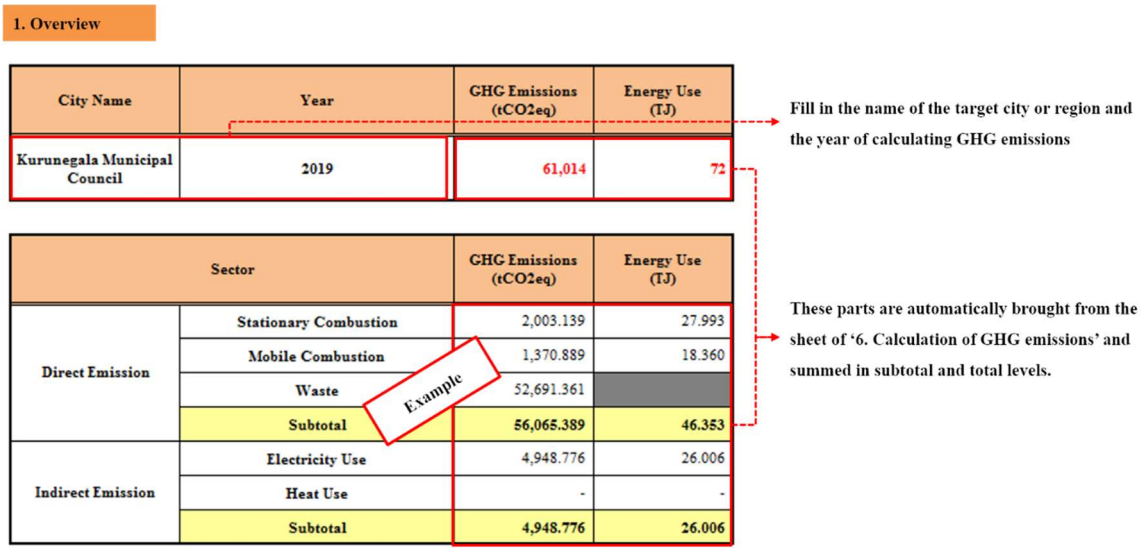
The jurisdiction of local governments is considered; as such, the geographical boundary is limited to the region governed and affected by the administrative authority of local governments. The activity data for calculating the amounts of GHG emissions is recommended to collect annual data of each GHG emission source. The data collection boundary is divided into two parts. One part is the direct GHG emission sources, which emits GHGs directly by consuming fossil fuels or producing the products. In accordance with the 2006 IPCC (Intergovernmental Panel on Climate Change) Guidelines, the GHG emission sources can be classified into four parts. However, because of the difficulties of data collection, only the energy sector and waste sector are considered in the tool and, "Agriculture, forestry and other land use" and "Industrial Processes and Product Use" sectors are excluded from the data collection boundary. The second part is the indirect GHG emission sources, which do not emit GHGs but cause the consumption of fossil fuels. Electricity or heat energy consumption are examples of indirect GHG emission sources.

The tool comprises six sections. The first sheet of the tool is the cover page. Input the target period of collecting the data, calculate the amounts of GHG emissions, and designate the person in charge of managing the tool.



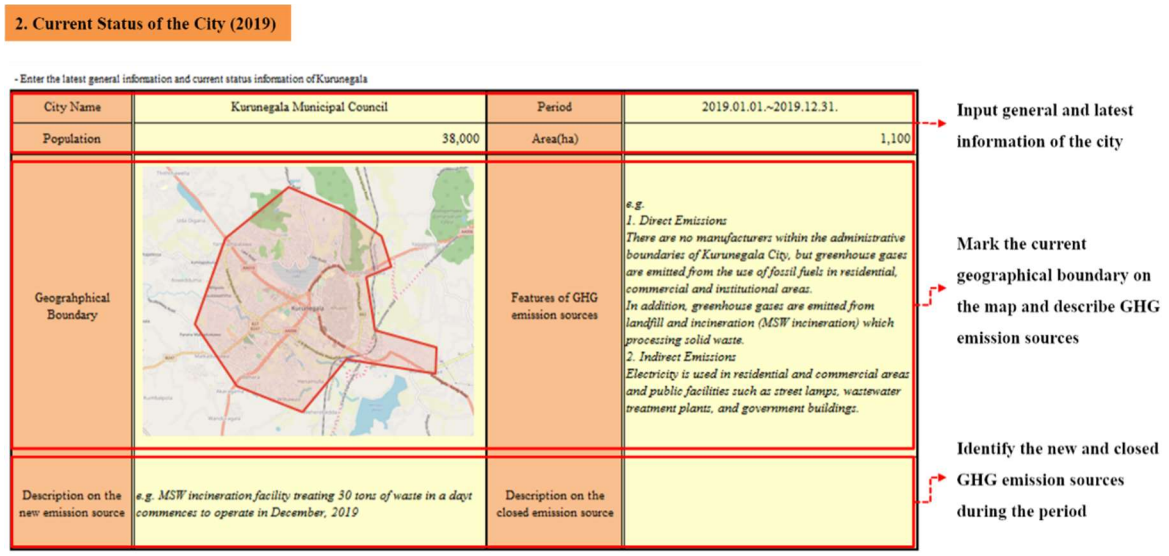
[Cover page]

The first section is the "Overview." The amounts of total GHG emissions of the city and the classified GHG emissions of each emission source are summarized and presented in the table. All numbers related to GHG emissions and energy use are automatically brought from the following sheets.



[Overview]

The second section is "Current status of the city." It contains the latest general information and the current status of the city. In the geographical boundary cell, there is the map that marks the administrative boundary that the authority of the local government has reached. In the cell "features of greenhouse gas emission sources," respondents describe the direct and indirect GHG emission sources. To systematically manage the GHG emission sources, first, the respondent must identify the newly discovered emission sources and closed emission sources in the year. These records should be retained to compare them with the greenhouse inventory of other years. The details of the emission sources, such as installation and closure dates or locations or capacities of plants, should be mentioned and written about in this section.



[Current status of the city]

Next, the GHG inventory of the city is defined. But first, the criteria for classifying the GHG inventory is presented (Table 1 of Annex 1 in the tool). The "Guidelines for Local Government GHG Inventories" of the Korean Environmental Corporation suggest that the GHG inventory can be classified into Scopes 1 and 2. In the case that GHGs are directly emitted from the consumption of energy such as fossil fuels, it is defined as Scope 1. In the case that GHGs are not directly emitted from the consumption of energy such as electricity or heat energy, it is defined as Scope 2. Scopes 1 and 2 can be classified as Scope capital "A" and Scope capital "B." Scope capital "A" means the GHG emission sources, such as

landfills or wastewater treatment plants, managed by local governments. Scope capital "A" can be classified into Scope small "a" and Scope small "b" by whether the GHG emission sources are directly managed by local governments. Scope capital "B" means the GHG emission sources are not managed by the local governments but by central governments or other agents, such as railways. In general, GHG emission sources in the boundary of Scope capital "B" are excluded from the boundary of local governments. However, these emission sources can be included in the boundary and calculated with the GHG emission sources of Scope capital "A" to prepare for providing the fundamental data and information to the national GHG inventory.

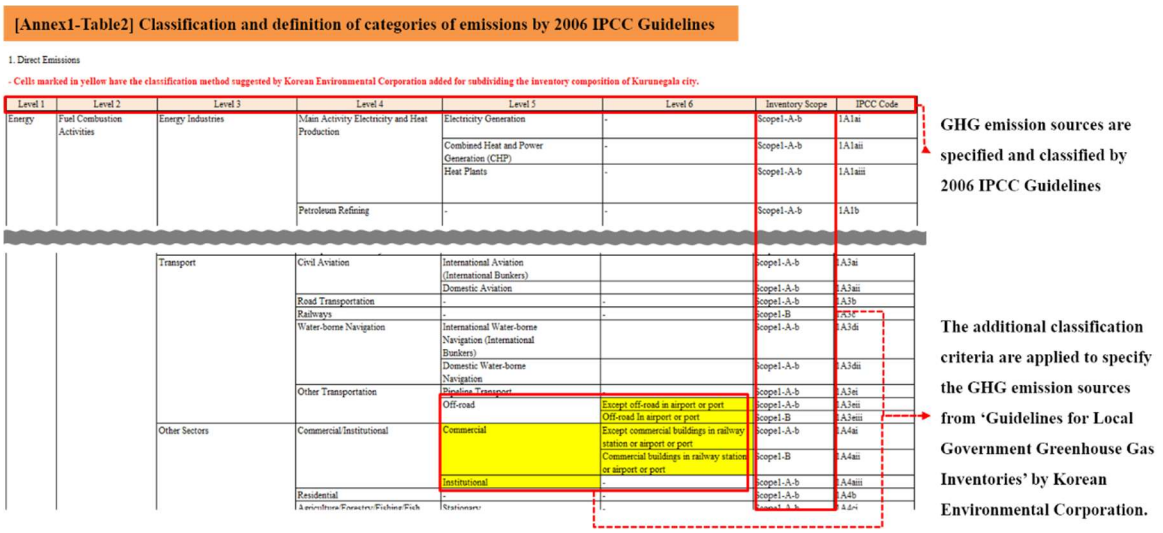
[Annex1-Table1] Inventory scope setting

Level 1	Level 2	Level 3
Scope 1 (Direct Emission)	Scope 1-A (Inventory included for local government management)	Scope 1-A-a (Direct management)
		Scope 1-A-b (Indirect management)
	Scope 1-B (Excluded from inventory due to non-local government management)	-
Scope 2 (Indirect Emission)	Scope 2-A (Inventory included for local government management)	Scope 2-A-a (Direct management)
		Scope 2-A-b (Indirect management)
	Scope 2-B (Excluded from inventory due to non-local government management)	-

[Inventory scope setting]

To match the GHG inventory of the national level, the classification criteria of GHG inventory of the local governments must follow one of the 2006 IPCC Guidelines. The category of the direct GHG emissions in Table 2 of Annex 1 of the tool is combined with the 2006 IPCC Guidelines and Guidelines for Local Government GHG Inventories from the Korean Environmental Corporation. Basically, for the inventory categories, the IPCC Guidelines classify the emission categories by sector at six levels: "energy," "industrial processes and product use," "agriculture, forestry, and other land use," and "waste." However, the energy and waste sectors are only considered in the boundary of the identification of GHG emission sources in the tool, because of the restriction of data

collecting. The guidelines from the Korean Environmental Corporation present the criteria to match each level-6 emission category with the inventory scope that defines which emission sources should be included in the boundary of local governments. Additionally, the "Guidelines from Korean Environmental Corporation" suggest the classifications of an off-road category and commercial/institutional area into a more specific level. Because the classification presented in the table is merely basic categories, the respondent is instructed to edit and amend the greenhouse inventory by its own purpose. The category for the indirect GHG emissions is not presented in the 2006 IPCC Guidelines but referred to in the Guidelines established by the Korean Environmental Corporation. The classification levels are identical to those aforementioned: six levels and the inventory scope has the same meaning.



[Annex1-Table2] Classification and definition of categories of emissions by 2006 IPCC Guidelines

1. Direct Emissions

- Cells marked in yellow have the classification method suggested by Korean Environmental Corporation added for subdividing the inventory composition of Kurunegala city.

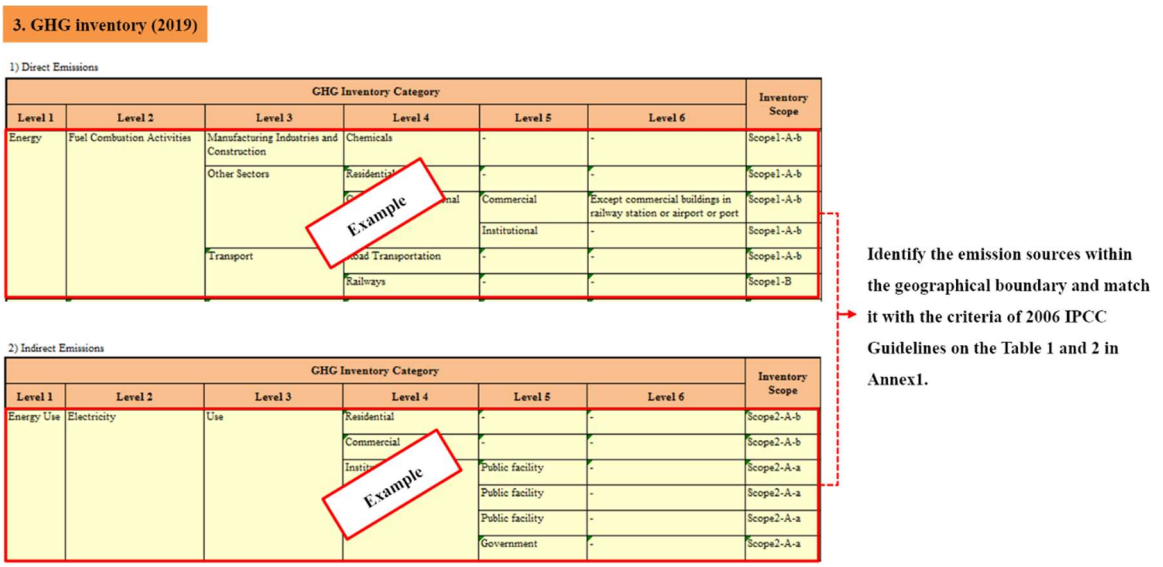
Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Inventory Scope	IPCC Code
Energy	Fuel Combustion Activities	Energy Industries	Main Activity Electricity and Heat Production	Electricity Generation	-	Scope1-A-b	1A1ai
				Combined Heat and Power Generation (CHP)	-	Scope1-A-b	1A1aii
				Heat Plants	-	Scope1-A-b	1A1aiii
			Petroleum Refining	-	-	Scope1-A-b	1A1b
		Transport	Civil Aviation	International Aviation (International Bunkers)		Scope1-A-b	1A3ai
				Domestic Aviation		Scope1-A-b	1A3aii
			Road Transportation	-	-	Scope1-A-b	1A3b
			Railways	-	-	Scope1-B	1A3c
			Water-borne Navigation	International Water-borne Navigation (International Bunkers)		Scope1-A-b	1A3di
				Domestic Water-borne Navigation		Scope1-A-b	1A3dii
			Other Transportation	Pipeline Transport		Scope1-A-b	1A3ei
				Off-road	Except off-road in airport or port	Scope1-A-b	1A3eii
					Off-road in airport or port	Scope1-B	1A3eiii
		Other Sectors	Commercial/Institutional	Commercial	Except commercial buildings in railway station or airport or port	Scope1-A-b	1A4ai
					Commercial buildings in railway station or airport or port	Scope1-B	1A4aii
				Institutional	-	Scope1-A-b	1A4aiii
			Residential	-	-	Scope1-A-b	1A4b
			Agriculture/Forestry/Fishing/Fish	Stationary	-	-	1A4ci

GHG emission sources are specified and classified by 2006 IPCC Guidelines

The additional classification criteria are applied to specify the GHG emission sources from 'Guidelines for Local Government Greenhouse Gas Inventories' by Korean Environmental Corporation.

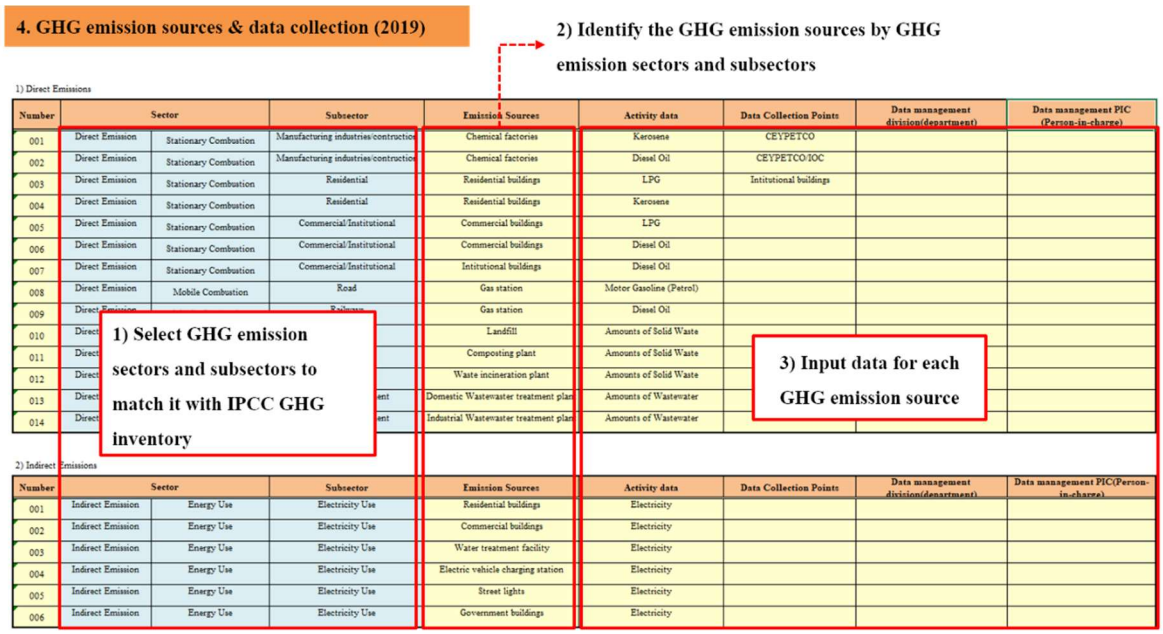
[Classification and definition of categories of emissions on the basis of the 2006 IPCC Guidelines]

The third section is "GHG inventory." According to the tool in Tables 1 and 2 of Annex 1, the respondent identifies all direct and indirect GHG emission sources within the boundaries of the city, matches those with the IPCC Inventory category, and arranges the GHG emission sources by sectors and emission types.



[GHG Inventory]

The fourth section is "GHG emission sources and data management." The respondent sets the GHG emission sources and designates the individual and department that collects and manages the activity data: first, in the blue area, sectors and subsectors are selected by the identified GHG emission sources; second, in the yellow area, the actual greenhouse emission source is input; and third, the information of focal points is input to collect and manage the activity data.

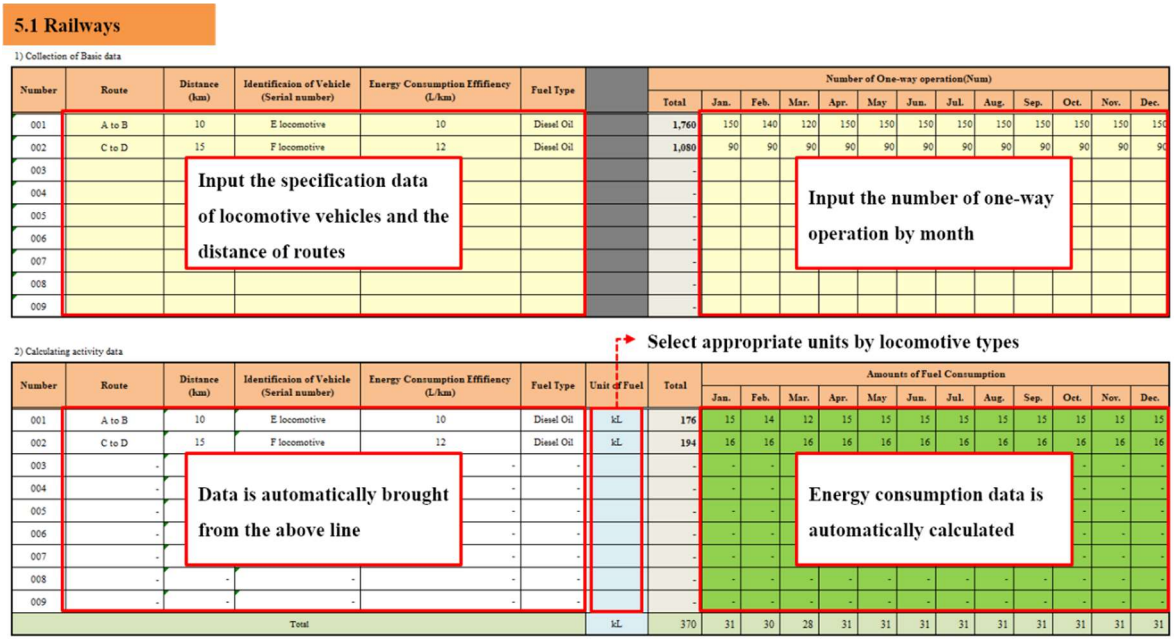


[GHG emission sources and data collection]

The fifth section is "Collection of activity data." On this sheet, the activity data and units are entered. The activity data for railways and the waste sector are entered on individual sheets because different methodologies must be applied for calculating the amounts of GHG emissions. In this section, the data area without color is the area to input the data automatically from the prior sheet, in which the data was initially input. In the yellow data area, the monthly activity data by each greenhouse emission source are input.

[Collection of activity data]

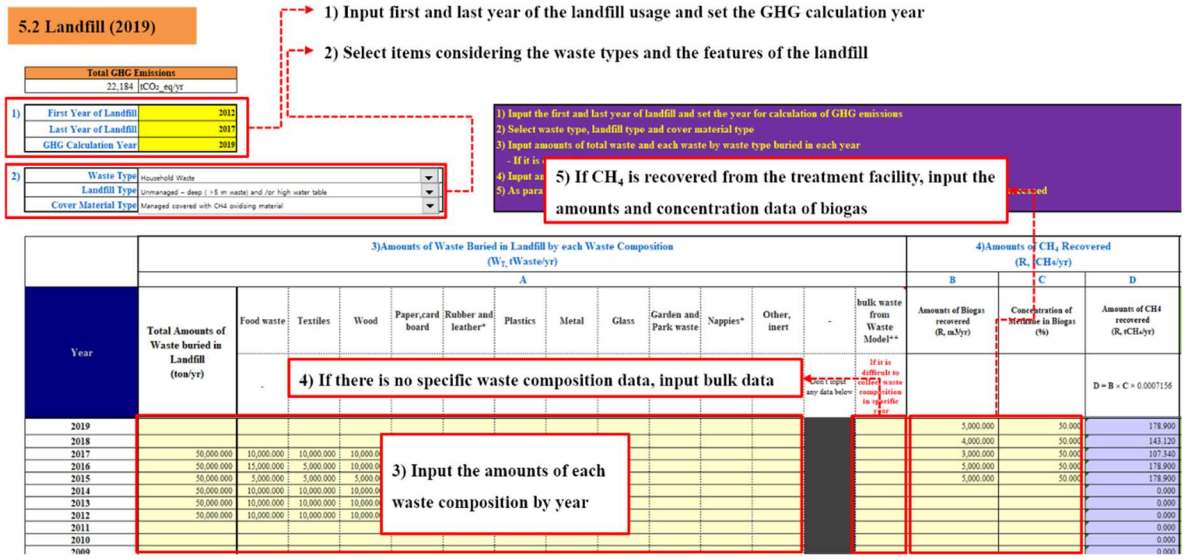
For the railway sector, there are descriptions of the sheets for collecting the activity data of railways. Regarding the railway sector, if separating the activity data of railways running in the geographical boundary of the city from the whole consumption of fossil fuels in the railway sector is difficult, the activity data can be quantified by the methodology to yield the amounts of fossil fuel consumption based on the travel distance and fuel efficiencies of the locomotive vehicle. First, in the yellow data area, the respondent identifies the routes in the city boundary and inputs the distance of the routes, the fuel consumption efficiency of each vehicle, and the number of one-way operations by month. Second, the fuel type and its unit are selected. Third, monthly energy consumption data is estimated by the formulas previously entered in the green data area.



[Data collection for railway sector]

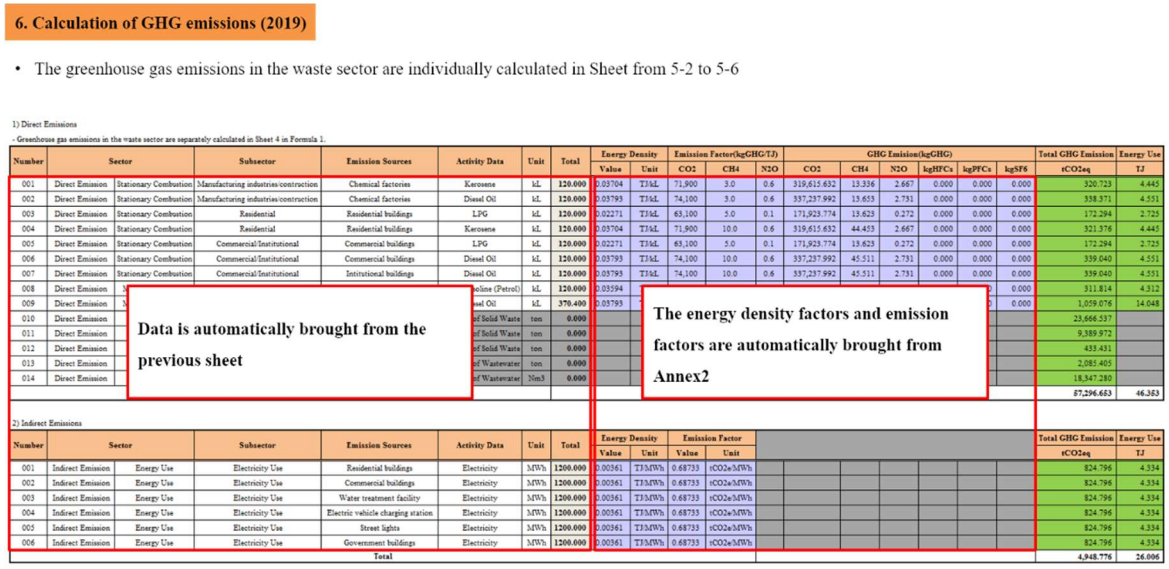
The data collection and GHG calculation sheets for the waste sector are divided into four parts—landfill, biological treatment, incineration, and wastewater treatment—by the waste treatment methods. Because each part has a similar structure, the explanation for the landfill area is the only explanation presented.

First, the respondent designates the initial year and the last year of the landfill and sets the year for calculating the amounts of GHG emissions. Second, waste types, landfill types, and cover material types of the landfill are selected in consideration of the features of the landfill. Each item of the drop box can be observed in Annex 3 of the tool. Third, the amounts of each waste composition are input by year, and the aggregation of each amount of waste composition is checked that it matches with the total amounts of waste buried in the year. If collecting the data of the separated waste amounts is difficult, the amounts of bulk waste are input instead of the amounts of waste composition. However, the bulk data can be used only if the factor of degradable organic carbon is prepared. Finally, the amounts and concentration data of biogas are input if methane gas is recovered from the wastewater treatment facility. The total amounts of the GHG emission from the landfill area is calculated when all data are entered.



[Data collection and GHG calculation for the landfill sector]

The sixth section is "Calculation of greenhouse gas emission." The amounts of each GHG emission source are automatically calculated with the energy density and the GHG emission factors of each energy type. The data area with no color is automatically input from the prior sheet. The data area with purple color is automatically input from Annex 2 of the tool.



[Calculation of GHG emissions]

The “Tool of establishing greenhouse gases inventory and calculation of greenhouse gas emissions of Kurunegala” is a basic template to present how to collect and manage the data and calculate GHG emissions by referring to the 2006 IPCC Guidelines. Therefore, the forms and contents of the tool are edited and amended to adjust the template to the actual field while considering the features of Sri Lanka and its local areas.