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Regional Case Study

Greenhouse Gas Emission Reduction Strategies in the Transportation and Solid Waste Sector in Cilacap Regency

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Abstract
Every year, population growth in Cilacap Regency inevitably results in various impacts in various fields, including transportation and solid waste. The number of motorized vehicles in the Cilacap Regency has increased from 588,283 units in 2017 to 714,533 units in 2020. On the other hand, solid waste generation in Cilacap Regency in 2020 reached 0.22 tons per capita per year. Both activities can potentially reduce the air quality of the Cilacap Regency. One of the causes of the decline in air quality is CO_2, CH_4, and N_2O gases, which can cause global warming. This study aims to inventory and project GHG emission loads, determine mitigation strategies and design regulations related to GHG emission reduction in the transportation and solid waste sector in Cilacap Regency. The method used to inventory GHG emissions in this research is the 2006 IPCC method with Tier 1 and Tier 2 accuracy. Then it is projected for the next ten years with a Business As Usual (BAU) scenario. To determine the selected reduction strategy using SWOT and QSPM analysis. The inventory results and projected GHG emissions in the solid waste sector in 2030 are 109.29 Gg CO2e. 4 GHG emission reduction programs in the solid waste sector could reduce up to 29.49% Gg CO2-e in 2030. Then the BAU scenario GHG emissions in the transportation sector in 2030 reached 21,417 Gg CO2e. The six proposed scenarios were able to produce a percentage of GHG reduction of 7 65% in 2030 or 1,638,409 Tons of CO2e or 1,638 Gg CO2e from 2021-to 2030 with a priority strategy for reducing GHG emissions is increasing pollution buffers by building green open space and non-motorized pathways with a reduced rate of 2%.

Keywords: Green house gasses; transportation; solid waste

1. Introduction

Daily human activities always have an impact, both positive and negative. Among them is the environmental impact, one of which is human activities that produce air emission output. Air emissions from an activity have their characteristics, and gas emissions are classified as greenhouse gases (GHG). Based on the Presidential Regulation of the Republic of Indonesia Number 61 of 2011 concerning the National Action Plan for Reducing Greenhouse Gas Emissions, greenhouse gases, in the future referred to as GHGs, are gases contained in the atmosphere, both natural and anthropogenic, then absorb and re-emit infrared radiation. Six gases are classified as GHGs: CO2, CH4, N2O, HFC, PFC, and SF6 stated by the United Nations Framework Convention on Climate Change (UNFCCC). Various impacts are caused by the increasing number of greenhouse gases produced by humans, including increasing temperatures on earth or global warming.

Transportation and solid waste are the two sectors that produce GHG emissions. The transportation sector is estimated to contribute 60-70% of air pollution in urban areas (Nurdjanah, 2015). According to the projections of The Climate Action Tracker, Indonesia's total emissions (excluding LULUCF) are equivalent to 3.75 - 4% of total global emissions in 2030. One type of emission produced in the transportation sector is Greenhouse Gas Emissions. Based on KLH (2012), the types of GHG gases produced by the energy sector include CO_2, CH_4 and N_2O. Then in the solid waste sector, landfills under anaerobic conditions can produce methane gas (Anifah et al., 2021). Based on the Ministry of Environment and Forestry (2019), open burning of solid waste produces CO_2 emissions of 5,193 Gg CO_2e or 12% of total CO_2 emissions in solid waste.

Motor vehicles are one of the most significant contributors to pollution in urban areas. Motorized vehicles in Cilacap Regency always increase every year. According to data released by the Central Java Provincial Statistics Agency in 2020, the number of motorized vehicles in the Cilacap Regency is 818,330. It is the district with the 2nd highest number of motorcycles in Central Java Province (BPS, 2020). Starting from 2018, an average increase of 36,318 per year means an increase of 2.3% per year. This increase will be higher because Cilacap Regency itself is a city that is dense with industry. Industrial activities such as the mining, oil and gas and energy industries in Cilacap Regency require vehicles to support mobility. The increase in motorized vehicles is also proportional to the industrial development in Cilacap Regency (Amin, 2017).

The growth rate of solid waste in the Cilacap Regency continues to increase. That is proportional to the increase in population growth every year. The amount of solid waste generated in Cilacap Regency was 912.95 tons per day, and in 2020 it was 939.78 tons per day, as 2019 stated by the National Waste Management Information System (NWMI). Based on data from the Environmental Agency of Cilacap Regency, the distribution of solid waste generated in 4 landfills was 64.19% of the total solid waste generated in Cilacap Regency in 2020. According to SIPSN, some of the waste was managed by seven Recycle Temporary Waste Storage (3R TWS) with an average of Incoming solid waste is 1,971 tons per year and managed waste is 158.43 tons per year. The data shows that 13.5% of waste is processed from 3R TWS, integrated waste management, and Waste Bank sources. One of the methods of processing solid waste by the people is open burning. This method is one way of managing waste that is still widely found because it effectively eliminates waste generation and pathogenic bacteria, is cheap, easy, and does not require a lot of lands (Wahyudi, 2019).

The Government of Indonesia is making efforts to decrease GHG emissions as stated in Presidential Regulation number 61 of 2011, which contains the draft National Action Plan for Reducing Greenhouse Gases (RAN-GRK) by 26% with own business and 41% if received international assistance in 2020 (Yudi & Wimpy S, 2017). Meanwhile, the provincial level GHG emission reduction planning is regulated in Central Java Governor Regulation No. 43 of 2012 regarding Regional Action Plans for Reducing GHG in Central Java Province in 2010-2020, targeting a 9.48% in 2030.

This plan aims to carry out activities 1) inventory of land vehicles (road), 2) determine priorities for GHG emission reduction strategies and 3) draft regulations containing GHG emission mitigation programs from the land transportation sector (road) and solid waste. The method used to inventory GHG emissions in this research is the IPCC 2006 method with Tier 1 and Tier 2 accuracy. Then it is projected for the next ten years with a Business As Usual (BAU) scenario. Determining emission reduction strategy refers to the research method of Presidential Regulation no. 61 of 2011.

2. Methods

2.1. Location and Time

Planning is carried out in Cilacap Regency on GHG emissions resulting from transportation activities which are analyzed through the population of vehicle ownership and the population of vehicles on the main road. For GHG emissions of solid waste sector, the planning area covers 12 districts, that is North Cilacap, South Cilacap, Central Cilacap, Jeruk Legi, Kesugihan, Kawunganten, Kroya, Bantarsari, Sampang, Maos, Adipala and Binangun. The implementation of planning for six months, from August 23 2021-February 23, 2022.

2.2. Field Data Collection

Planning data uses primary and secondary data. Primary data collection was done through interviews, questionnaire surveys and observations. Interviews were conducted with the Environmental Agency of Cilacap Regency, Cilacap Regency Transportation Office, and waste managers or movers in the community to determine the factors influencing strategy making. The questionnaire survey was conducted to expert resource persons in the transportation and solid waste spread across the Environmental Agency of Cilacap Regency, Transportation Service, Bappeda Cilacap Regency and domestic waste management as a priority strategy determination. Field observations were carried out on several main roads in Cilacap Regency to determine the existing condition of transportation activities in the Cilacap Regency. Then observations on the waste condition are carried out at the IWPS, 3R TWS, and the Waste Bank.

2.2. Transportation Sector

The analysis of greenhouse gas emissions uses the Tier 1 and Tier 2 methods with a calculation approach based on data on the length of the trip (Vehicle Kilometer Traveled) on four types of vehicles, namely motorcycles, passenger cars, buses and trucks, to generate fuel consumption values. Emissions calculations are carried out on the complete source, line and area. The analysis of greenhouse gas emissions uses the Tier 1 and Tier 2 methods with a calculation approach based on data on the length of the trip (Vehicle Kilometer Traveled) on four types of vehicles, namely motorcycles, passenger cars, buses and trucks, to generate fuel consumption values. Emissions calculations are carried out on the complete source, line and area.

1. Total Source

Total source analysis is based on motorized vehicle ownership data, which is then processed into fuel consumption data. The equation used is as follows:

$$\text{Fuel Comsumtion} = \frac{\overline{VKT}_{b,c\ odo} x\ N_{b.c}}{\phi\text{Fuel Comsumtion}} \quad (1)$$

Notes :

Fuel consumption	= Total fuel use (l/year)
$\overline{VKT}_{b,c\ odo}$	= VKT category b vehicles, fueled by c odometer survey (kilometer/year)
$N_{b.c}$	= number of motor vehicles category b fueled by c
ϕFuel consumption	= Fuel consumed (km/L)

2. Line Source

The line source emission calculation is based on data on the number of vehicles which get through the main and protocol roads so that the fuel consumption of each type of vehicle that gets through the road I am obtained through the value of the existing emission factor. The equation for calculating greenhouse gas emissions is:

$$\text{Emission Load} = \text{Vehicle Volume x VKT x FE}_{\text{existing}} \text{ x } 10^{-6} \quad (2)$$

Existing FE	= Existing Factor (g/km/vehicle)
VKT	= Total length of the trip (km)
Vehicle volume	= Number of vehicles (vehicles/year)

3. Area Source

The source area emission calculation is obtained from the difference between the total VKT value and the line VKT, which is converted into fuel consumption data and then processed into emission load data using equation 2. The following is the equation:

$$\text{Fuel Comsumtion} = \frac{VKT_{Total} - VKT_{line}}{\phi\text{Fuel Consumtion}} \quad (3)$$

Fuel consumption = Total fuel use (l/year)
VKTTotal = VKT at total source (km/year)
VKTline = VKT at line source (km/year)
Fuel consumption = Fuel consumed (km/L)

2.3. Strategic Priority Determination

Determining the priority of GHG emission reduction strategies was analyzed using the SWOT and QSPM methods. SWOT analysis serves as qualitative analysis to determine the factors influencing the proposed strategy. These factors were grouped into four aspects, strengths, weaknesses, opportunities and threats, then compiled into a questionnaire distributed to 8 and 5 experts in the transportation and solid waste sector. This survey aims to determine how much influence the factors have on the proposed strategy based on the rating ratings as follows:

Table 1. SWOT analysis rating

Rating	Description	Score
1	If these factors do not affect at all	Bad
2	If these factors are less influential	Worth
3	If these factors affect	Good
4	If these factors are very influential	Very good

Furthermore, the analysis continued with a quantitative analysis using QSPM. The calculation of QSPM is divided into two, namely, the calculation of the matrix to internal factors and the calculation of the matrix to the external. The QSPM assessment is in the form of an assessment of the weight, rating value and score value results. The following formula is used in the QSPM analysis:

$$\text{Weight result} = \frac{Factor\ Value}{Internal\ Factor\ Value} \quad (4)$$

$$\text{Rating Result} = \frac{Factor\ Value}{number\ of\ the\ respondent} \quad (5)$$

$$\text{Score result} = \text{Weight result x Rating result} \quad (6)$$

3. Result and Discussion

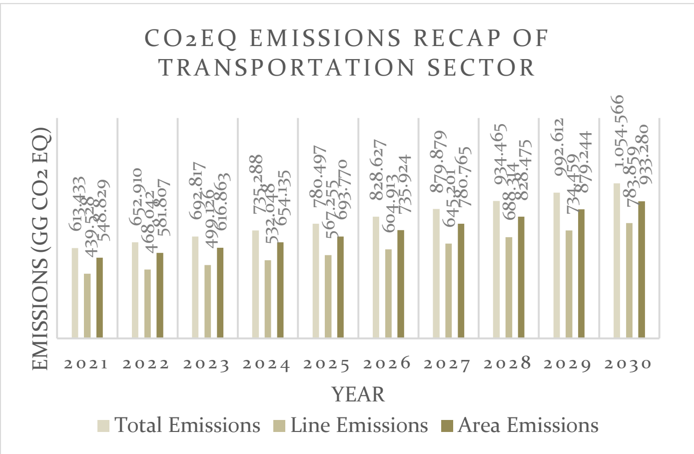
3.1. Solid Waste Sector and Transportation's Potential GHG Emissions

The potential for GHG emissions is analyzed from several data sources, namely the global vehicle population and the number of vehicle traffic counting for vehicles that pass through the primary and protocol roads in the Cilacap Regency. Global vehicle population data were obtained from the UPPD of Cilacap Regency, while the traffic counting data were obtained from the Department of Transportation of Cilacap Regency. According to data from the UPPD of Cilacap Regency, each type of land vehicle (road) in the district always experiences an increase. The data shows that the vehicle population of 4 types of vehicles (passenger cars, motorcycles, buses and trucks) in 2017 was 588,283 units, an increase until 2020 the population became 714,533 units. Traffic counting is taken from the number of vehicles that pass 35 roads.

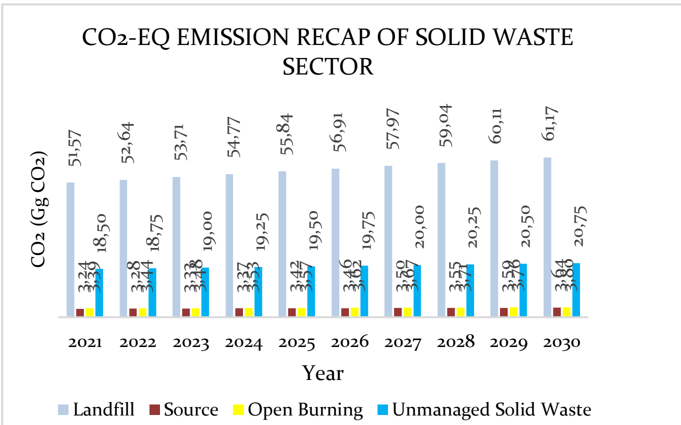
The results of the vehicle projection from 2021-to 2030 will reach 819,100 units with the number of passenger cars, motorcycles, buses and trucks, respectively, namely 98,671 units, 696,521 units, 996 units and 22,911 units. Then for traffic counting projections, the volume of 4 types of passenger cars, motorbikes, buses and trucks is obtained, namely 80,607,749 units, 226,874,936 units, 1,679,015 units and 7,146,623 units. The number of traffic counting vehicle volumes has a higher value because the projection is made on all vehicles that pass 35 roads, both numbered for vehicles in the city and those without vehicle numbers. Emissions calculation uses a bottom-up approach by estimating the calculation of all individual source emissions to obtain local emissions. This study uses data on the number of vehicles and VKT (Vehicle Kilometer Traveler) or the length of the trip per year, which is then processed into emission load data. Calculation results can be seen in Figure 1. image below.

Potential GHG emissions in the solid waste sector are analyzed using the IPCC Tier 1, projected with a Business As Usual (BAU) scenario from 2021 to 2030. Emissions are calculated from 4 categories of waste based on the distribution of processing in 12 sub-districts which are the service coverage of the landfill. Tritih Lor in Cilacap Regency. That is because the complete data for calculating Tier 1 GHG emissions is only available at the British Lor Landfill. In calculating GHG emissions in the solid waste, the sector needs to know the total of solid waste generated for each distribution projected on a BAU basis. The distribution of solid waste data in Cilacap is based on Jakstrada in the Regulation of the Cilacap Regent No. 233 of 2018. Because the BAU scenario is projected so that the distribution percentage is fixed every year, namely landfill waste of 64.19%, waste that is processed at source is 13.5%. Unmanaged waste is 22.31% to MEMR (2012), namely The BAU scenario assumes that there is no policy intervention whatsoever.

The quantity of solid waste generated and GHG emissions category calculated according to the formula in the IPCC 2019. Figure 1. image b shows the GHG emissions of the waste sector, which have been converted into CO2-eq. It is known that the number of GHG emissions increases yearly, with the most significant emissions generated by the waste in the landfill. In contrast, the most negligible emissions are generated by the waste in source management. That is because the amount of waste generated in the landfill is the largest than others. The emissions produced by unmanaged waste are high even though the distribution is only 22.31%, so it was necessary to take action against unmanaged waste.



(a)



(b)

Figure 1. Transportation emissions grafic (a) and waste emissions grafic (b)

3.2. GHG Emissions Reduction Strategy Priority for Transportation and Waste Sector

Taking GHG Emissions mitigation strategy needs to consider the factors that can affect the selected strategy. Factors from the research area have been determined previously and then analyzed by SWOT analysis to determine the value of the planned program to the existing factors. The planned strategy was obtained through analysis from various sources such as mitigation strategy design data from the Environment Agency, Cilacap Regency RPJPD, Cilacap Regency RPJMD and related documents such as RAN-GRK and RAD-GRK at the provincial level; besides that, it was also obtained through interviews with staff Traffic Division of the Cilacap Regency Transportation Service and waste management figures. After obtaining a SWOT analysis of the chosen strategy, the values given by the respondents were processed using a quantitative technique, namely QSPM, to determine the position of the strategy's quadrant (I, II, III, IV). Based on the QSPM calculation, the quadratic coordinates are obtained as in Table 2.

Table 2. Quadrant positioning

No	Strategy	IFAS Coordinates	EFAS Coordinates	Quadrant
Transportation Sector				
1	Provision and improvement of an integrated and centralized traffic system through the Intelligent Transport System	0.016	-0.02	II
2	Application of BRT (Bus Rapid Transit)/Semi BRT to change people's interest from private transportation to public transportation	-0.03	-0.02	IV
3	Expansion of parking tax implementation/ Parking management	0	0.003	I
4	Rejuvenation of public transport to increase vehicle efficiency and reduce emissions	-0.014	0.002	III
5	Increasing green open space and non-motorized lanes as a pollution buffer from transportation and traffic activities in the Cilacap Regency urban area	0.047	0.021	I
6	Improvements and improvements to urban planning by increasing ANDALALIN to control the spread of building activities	-0.007	0.54	III
Solid Waste Sector				
1	Accommodating community aspirations related to solid waste services, which are the rights of the community through the local government and channelled directly to the relevant agency.	0.127	-0.069	IV
2	Improving 3R treatment for solid waste management at the source	0.088	-0.035	IV
3	Increased coverage of waste transportation services to Tritih Lor Landfill in the Cilacap Regency area.	0.114	-0.039	IV
4	Optimization of available waste facilities such as integrated waste management, 3R TWS and Waste Bank	0.192	0.016	I

3.2.1. GHG Emissions Reduction Strategy Priority for Transportation and Waste Sector

The determination of strategic priorities must also pay attention to other aspects, including the existence of a program implementation budget and the percentage reduction value. Based on RKPD data and several interviews, there is no definite budget yet to realize these programs because these strategies are the design of establishing the Strategic Plan and RAD-GRK of Cilacap Regency. The available funding for GHG emission control in Cilacap Regency only includes financing for preparing action plan documents, Proklim guidance and assistance funds and green open space development funds. Based on these data, only 1 of the proposed strategies already has funding of Rp. 200,000,000, namely the development of green open space. In addition, the percentage reduction due to the scenario also needs to be considered. Based on the result, the reduction value from the strategy (1 to 6) in 2030 is 3.2%, 0.16%, 1.91%, 0.13%, 2.10%, and 0.15%. With this analysis, the priority strategies for GHG emission mitigation in Cilacap Regency are 1) Increased green space, 2) Parking management expansion and improvement, 3) traffic system improvement through the implementation of (the Intelligent Transport

System) ITS, 4) urban planning improvement and improvement using Andalalin, 5) rejuvenation of public transport and the last 6) implementation of BRT.

These strategies then need to be made into technical planning for program implementation. This technical planning outline contains program objectives, implementation locations and program implementation times. Following are the planning techniques for each strategy:

1. Increased RTH

   Based on the Cilacap Regency RKPD document, the target for achieving green open space development in 2022-2023 is 21%. In the 2012-2017 RPJMD document for Cilacap Regency, the target for achieving green open space in 2017 is 20%, but the target is only around 15.74%. Then the target is continued through the 2017-2022 RPJMD, where the green open space target in 2022 is 21%, but the achievement is only 18.18%. This plan's goal for achieving green open space until 2030 is 21%. The goal of increasing green open space every year is 0.23%. This planning focuses on providing a green line for roads or shade trees or as a line source GHG emission reduction. The type of plant used is the Angsana plant which is planted along roads in the city area and arterial roads. Based on the research of Hermana (2003), 1 Angsana tree stand can absorb CO_2 gas as much as 4,620 ppm. The RTH planning map is shown in Figure 2. (a).

2. Expansion and Improvement of Parking Management

   Parking management is a technique that changes location, supply and demand to achieve better and more efficient use of parking infrastructure. The need for parking spaces is emphasized to reach 10-30% to create a reduction in the number of vehicles and the efficiency of parking spaces (Lestari, 20217). Based on observations in several places in Cilacap Regency, the provision of parking in commercial places such as markets and supermarkets is still not good. In addition, in some administrative offices, vehicle parking still uses the shoulder of the road. So in this plan, the emphasis is on providing parking lots in commercial places with a target of increasing by 2% per year starting from 2021-to 2030. The map for planning the parking area expansion is shown in Figure 2. (b).

3. Improved Traffic System with ITS

   In this plan, the type of ITS suitable to be established in Cilacap Regency is the Advance Traffic Management System (ATMs), with the technology used being ATCS. This system collects data from various sources in the field, such as using loop detectors on roadsides and CCTV at intersections. The function of this tool is to provide real-time information so that if there is a problem with traffic flow, handling can be done quickly through traffic light settings and Variable Message Sign (VMS). Its application is carried out on main roads in Cilacap City or roads with the potential for vehicle accumulation. ITS implementation can be started with the placement of ATCS technology in the centre of Cilacap City and arterial roads. Then the development will be carried out throughout the Cilacap Regency in stages. As for the monitoring system, it will be carried out by the Cilacap Regency Transportation Agency. Program planning time is from 2021-to 2030. The following map of ITS technology placement planning can be seen in Figure 2. (c).

4. Improvements and Improvements to City Planning with Andalalin

   The Andalalin document contains an assessment of the effects that can be caused by increased traffic activity due to the development of the area on the transportation network. Andalalin serves to anticipate the occurrence of an enormous traffic influence on the transportation network around the area.

5. Rejuvenation of Public Transport

   Planning for implementing public transport rejuvenation will be carried out on the number of vehicles that have exceeded the vehicle age limit, which refers to the Cilacap Regency Regional Regulation No. 1 of 2020 for seven years. Before implementing the program, it is necessary to conduct regular socialization with the owners of special vehicle services by the relevant agency. Then to strengthen the program, it is necessary to have policies and actions that continuously monitor its implementation. Monitoring can be done by conducting random and periodic raids and applying the KIR Test and Route Permit.

6. Implementation of BRT

One of the solutions to control GHG emissions in the transportation sector is the implementation of BRT (Bus Rapid Transit)/Semi BRT as a substitute for private transportation to public transportation. According to the explanation from the Dishub staff, Cilacap Regency already has a BTS (Bus by The Service) Purwokerto-Kroya program plan implemented by the APBN. If BRT is implemented in Cilacap City can be started from Kroya-Cilacap City to continue the planned route. The BRT planning path can be seen in Figure 2. (d).

In implementing BRT, several aspects must be considered, namely 1 round of performance calculation and infrastructure analysis. Calculating the performance of 1 round includes circulation time, waiting time and the number of vehicles required. Based on the calculations that have been made previously, the circulation time is 116,955 minutes, the waiting time is about 4-5 minutes, and the number of fleets needed in one round is 12 units. Then the infrastructure analysis includes tariffs, bus stops and pools.

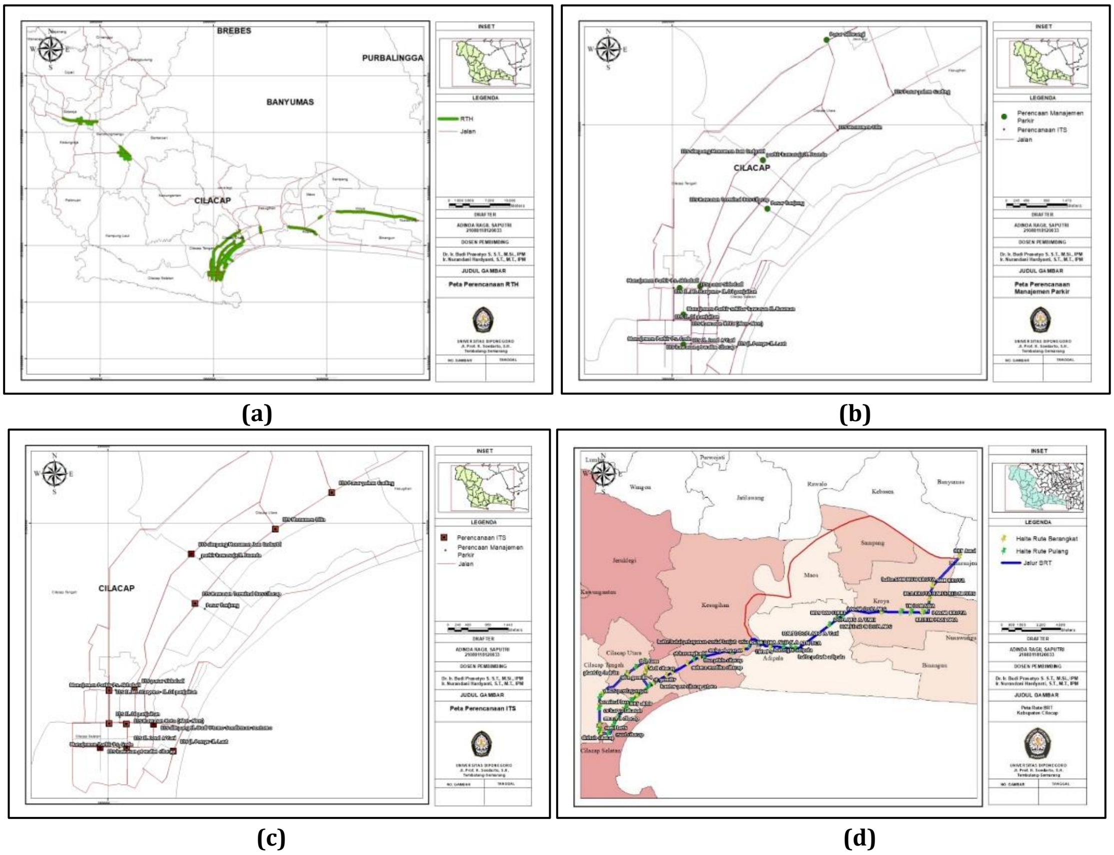


Figure 2 (a) Green open space planning map, (b) Map of parking area expansion, (c) Distribution Map of ATCS Installation Locations, (d) BRT path map

3.2.2. Solid Waste Sector Emission Reduction Strategy

These strategies then need to be made into technical planning for program implementation. From these four programs, three implementation scenarios were formed by the Pergub Kab. Cilacap No. 233 of 2018 to calculate the potential for reducing the resulting GHG emissions. The scenarios are:

a. Scenario 1: Improved 3R Waste Management and Improved Landfill Services

Currently, solid waste management at the source is still based on sorting and recycling on a small scale. From the results of domestic solid waste sampling, the type of waste burned is generally plastic waste. In Cilacap Regency itself, plastic is still commonly used as a container for shopping at markets, minimarkets, and supermarkets. Therefore, as a form of reducing activity, regulations are made to bring environmentally friendly shopping bags from home, and if goods are purchased in large quantities, they can use cardboard. Reuse activities are carried out by reusing items that are not used without modifying them. Furthermore, recycling is carried out more deeply by paying attention to its economic value in the Waste Bank. This activity needs to be supported by campaigns in the community in collaboration between environmental services and the local government.

b. Scenario 2: Optimizing Available Waste Facilities and Improving Landfill Services

Optimization of facilities in waste management at sources such as integrated waste dumps, Recycle Temporary Waste Storage (3R TWS) and Waste Banks, namely by developing and routinely managing solid waste by composting for organic waste. Currently, waste management activities at these facilities generally revolve around small-scale sorting and recycling. The Environment Agency has given composting equipment to several waste banks, but it was not used in the end. Therefore, it is necessary to carry out further activities related to providing facilities in the form of a composting device to solid waste management facilities at that source and follow up with monitoring evaluations regularly every month.

c. Scenario 3: Combine Scenario 1 and Scenario 2

The programs in Scenario 1 and Scenario 2 are combined. In this scenario, there are three programs: Improving Landfill services, Optimizing available solid waste treatment facilities, especially biological treatment, and increasing 3R waste management. The percentage of solid waste processing distribution is according to the Regulation of the Cilacap Regent No. 233 of 2018. The activities carried out are the same as in scenarios 1 and 2, only differing in the percentage distribution of each processing. The following is the result of calculating GHG emissions in a combination of scenario one and scenario 2.

Table 3 compares GHG emissions in the solid waste sector between the BAU scenario, scenario 1, scenario 2, and combined scenarios 1 & 2 in CO_2-eq each year. The result shows the most prominent emission reduction occurred in scenario 1, namely in 2030, which reached a decrease of 29.49% from the BAU scenario. That is because scenario 1 uses a 3R strategy to increase solid waste management. 3R processing does not produce GHG emissions. That processing at the source produces small GHG emissions compared to scenario two and a combination of scenarios 1 and 2.

Table 3. Comparison between every scenarios

Year	BAU Scenario (Gg CO_2/year)	Scenario 1 (Gg CO_2/year)	Scenario 2 (Gg CO_2/year)	Combine from Scenario 1 & 2 (Gg CO_2 /year)
2021	94,40	66,20	66,86	64,13
2022	95,74	75,32	79,83	60,66
2023	97,51	73,94	79,30	69,39
2024	99,20	72,47	78,72	68,12
2025	100,86	73,81	80,14	66,77
2026	102,55	72,23	79,48	67,98
2027	104,23	70,59	78,77	66,53
2028	105,92	68,87	78,00	65,02
2029	107,61	67,07	77,18	63,44
2030	109,29	65,20	76,31	61,80

3.2. Regulatory Draft

According to the analysis of the inventory calculation and strategic priorities, a draft regulation is made containing a strategy for reducing GHG emissions from the transportation and solid waste sector in Cilacap Regency. Preparing the draft regulation is carried out by considering the arrangement of the regulations as a reference. This draft regulation will contain an explanation regarding the definition, rights, obligations and discussion of the selected strategy for the priority analysis that has been carried out. The regulations, strategies and various programs that have been determined will be implemented based on the Cilacap Regency RTRW planning with the assumption of planning in 2020 with a period of 10 years of implementation, namely 2021-2030. In general, the preparation of regulations is shown in table 4.

Table 4 Regulatory draft

Chapter	Contents	Description
Chapter I	General terms and scope	2 Article (Definition and Scope)
Chapter II	Principles and goals	1 Article
Chapter III	Programs from the transportation sector GHG emission reduction strategy	1 Article
Chapter IV	Period of implementation of the Mitigation Program	2 Article (Scope of Planning and Review)
Chapter V	Rights and obligations for regional agencies, and communities, as well as discussion of sanctions for violators' actions	4 Article (Local Government Obligations, Community Obligations and Rights and Sanctions)

4. Conclusions

In the calculation results of GHG emission inventory using the BAU scenario, it is found that the accumulated GHG emission load from VKT sources is 8,165 Gg CO2e, the VKT Line source emission load is 5,962.7 Gg CO2e, and the number of GHG emissions resulting from source VKT Area is 7,253 Gg CO2e. Then the solid waste sector results in Landfills producing CO2 of 61.17 Gg CO2/year, Source management (Composting) produces CO2 emissions of 3.635 Gg CO2/year, open burning produces CO2 emissions of 3.804 Gg CO2/year, and unmanaged waste produce CO2 emissions of 20.75 Gg CO2/year. Based on the results of the analysis, it was found that the priority strategies are considered effective and efficient enough to reduce GHG emissions in Cilacap Regency through consideration of the quadrant position, the availability of funding, the percentage level of strategy reduction and the percentage value of GHG emission reduction targets at the national, provincial or regional levels.

The order of priority for the transportation sector strategy is as follows: implementation of pollution buffers, improvement of parking management, implementation of ITS, improvement and improvement of traffic management, implementation of rejuvenation of public transportation, and implementation of Bus Rapid Transit. These six strategies resulted in a 7.65% reduction in GHG emissions in 2030. According to the percentage analysis, the reduction reduced the emission load of 1,638,409 Tons of CO2e or 1,638 Gg CO2e from 2021-to 2030.

Four programs are planned to reduce GHG emissions in the Cilacap Regency Waste Sector based on a SWOT survey by expert resource persons. Three kinds of scenarios were made by the Cilacap Regional Regulation No. 233. In 2018, with the first scenario, namely the implementation of program two and program 3, a reduction in CO2-e emissions of 29.49% was obtained. The second scenario, namely the implementation of program three and program 4, obtained a reduction in CO2-e emissions of 17.48%. Then combined the two scenarios and obtained a reduction in CO2-eq emissions of 27.57%. A draft regulation related to the GHG emission reduction strategy for the transportation sector in Cilacap Regency contains five chapters, ten articles containing general provisions, principles and objectives, emission reduction programs, timeframe and obligations for relevant local agencies for the community.

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