Challenges in Development of Mitigation Options: A Case of Bogor City

Kiki Kartikasari, Syahrina D. Anggraini, Ari Suharto
CER INDONESIA. Aryawidura Residence, Jl. Aryawidura VIII No.2, RT.01/RW.05, Tegal Gundil, Kec. Bogor Utara, Kota Bogor, Jawa Barat 16152. Indonesia

Corresponding author: syahrina@cerindonesia.org

Abstract. Regardless of increasing concern to climate change, mainstreaming the issue into a development plan has been challenging. A review at Bogor City government’s development plans reveals that a range of activities has been incorporated to reduce the City's Greenhouse Gases (GHG) emissions and these activities have also targeted major and increasing emission sources based on their emissions profile. We identified relevant activities indicated in Medium-Term City Development Plan (Rencana Pembangunan Jangka Menengah Daerah - RPJMD) and Medium-Term Sectoral Strategic Plans (Rencana Strategis - RENSTRA) for the periods of 2014–2019. We examined the emission profile and similar to other cities worldwide, energy was revealed as the largest source of emission in Bogor. Emissions from energy sector accounted for 99% of the total city emission and 36% of it come from transportation. We also examined the annual trends. In 2016, Bogor City had a population of 1,064,687, a 10% increase from year 2010. The increase was similar to their GHG emissions which showed a 13% increase in 2016 compared to the 2010’ level. The growth between these two parameters, however, was not similar. While Bogor City’s population showed a positive trend, despite at smaller rate than in previous years, emissions level in 2016 was actually less than the 2015 level. This significant emission reduction within a year might not merely be the results of mitigation action, but other factor such as economic condition. Review on Bogor City government’s Development Plan for the period of 2014–2019 showed six groups of mitigation programmes were being implemented. Some of the activities within the programmes were progressing well while others were having set back. Consultation with relevant agency’s officers revealed some operational constraints to the implementation of the mitigation activities. Bogor City has developed a Bus Rapid Transportation (BRT) system called Trans Pakuan and has improved pedestrian area to reduce individual vehicle trips. Despite enthusiasm from City Government through these programmes, the increasing trend of e-hail apps transportation was potentially constraining as their ability to cater door-to-door trip is preferable for users than using bus or walking. In the waste sector, lack of segregating habit in households contributed to problems in 3R (reduce, reuse, & recycle) stations. These findings indicate that development of mitigation options needs a comprehensive approach, including consideration of people’s habit and acceptance of the options.

1. Introduction
Initiatives to address climate change at the city level have been increasing lately. Cities are known to consume more than half of the total world's energy and contribute to more than 70% CO₂ emissions worldwide [1, 2]. In contrast, most cities are located in coastal areas and are vulnerable to climate change impacts. Like two sides of a coin, cities can be powerful agent of change and be vulnerable at the same time. Another strategic reason to start the initiatives at the city level is that cities are an
organic form of government. US Conference of Mayors in 2008 emphasised that cities have closer proximity to public or targeted issues and able to provide day-to-day services. The national government may set rules of the game, but cities are the athletes to play the game.

As Indonesia national commitment on climate change was sealed, Bogor City started working towards eco-city vision. The government introduced Bogor Green City vision while signing an MoU for knowledge sharing, promotion of technical and non-technical cooperation on environmental issues with Bogor Agriculture University on 16 June 2014. Further, on 29 August 2015, both parties started the installation of electricity use monitoring devices in a number of critical buildings. This activity was followed by a series of analysis and projection of GHG emissions.

The transition from a carbon-intensive development into a low-carbon scenario is certainly not easy, especially if suggested strategies are translated as entirely new programmes. In fact, existing development plans have already included relevant programmes to mitigating GHG emission, even though the programmes are currently not labelled as such. It is necessary to identify what the relevant activities are to mitigate GHG in current development plans and assess their operational constraints. The results will assist to sharpen the activities in future plans and/or develop necessary additional activities. This study chronologically assesses the emission profile, identify key sectors (and sub-sectors), tag existing programmes in key sectors that are relevant to mitigation of GHG emissions, and identify challenges in the implementation of the programmes.

2. Methods
This research framework is based on Boer et al. [3, 4] with a number of adjustment in scoring procedure. Arrows between boxes indicate the sequence of steps. Grey boxes indicate process taken.

Figure 1. Framework to assess potential mitigation options.
3. Results

3.1. Emission Profile

The Government of Bogor City has regularly been conducting GHG inventory since 2014 [5, 6]. In addition, a number of organisations, e.g.ICLEI [7, 8], also studied the city emission of the period 2010–2013. Summary of the results is depicted in Figure 2 below. Sectors covered in the inventory are energy, waste, industry and agriculture.

Figure 2. Bogor City’s GHG emissions during the period of 2010–2016.

In convergence with other cities worldwide, energy has shared the largest contribution to GHG emissions in Bogor. More than 95% of the total emission comes from this sector. Looking further into the energy sector, the increasing trend is prominent in transportation sub-sector (Figure 3). However, as the population is rapidly increasing, the emissions from waste sector indicated an alarming trend of an increase too. Domestic wastewater treatment needs serious attention as this sub-sector contributed more than three times higher emissions compared to other sub-sectors such as solid waste, incineration or composting (Figure 4).

Figure 3. GHG emissions in energy sector 2010–2016.
The identification and tagging of existing programmes relevant to climate change mitigation resulted in an interesting figure. As indicated in Table 1 below, the issue of climate change is highly addressed by Transportation Agency (Dinas Perhubungan). This has been well corresponding with the emission profile that indicate transportation as a key sub-sector. However, only about 13.5% among the 89 programmes or activities were categorised as high priority. Meaning that the programmes are directly cutting the emissions as well as necessary towards achieving Sustainable Development Goals (SDG). The remaining portion of the programmes are categorised as medium to low priority, because the programmes only had indirect benefits to emission reductions and/or are less relevant to SDGs.

Table 1. Development plan documents assessed.

| Document                          | No. of Programme/Activity | Proportion of Each Priority Class (%) |
|-----------------------------------|----------------------------|---------------------------------------|
| RPJMD                             | 315                        | 10.8  6.8  79.6                       |
| Renstra BAPPEDA (Development and Planning) | 55                        | 1.8  12.7  85.5                       |
| Renstra Dinas Perhubungan (Transportation) | 89                        | 13.5  22.5  64.0                      |
| Renstra Dinas Lingkungan Hidup (Environment) | 48                        | 28.6  36.7  32.7                      |
| Renstra Dinas PERUMKIM (Housing and Settlement) | 45                        | 15.6  31.1  53.3                      |

The interviews with government officials have revealed that private vehicles (e.g. car, motorcycle) apparently dominated the roads in Bogor. Mitigation options in transportation were ideally focused on reducing use of private vehicles. However, despite the number is excessively beyond the demand, public transportation remains critical for GHG mitigation as it cause traffic jams in Bogor due to its reckless driving style. In 2017 there were more than 3,400 units of Angkot (minibus type of public transportation) serving about 30 routes. Traffic congestion as such increased the GHG emissions and degraded ambient of air quality. Therefore the main programmes in transportation were designed to manage both the potential emissions from private and public vehicles as follows:

- Conversion of 796 Angkot into 252 medium-sized bus,
- Compulsory conversion into biofuel for public transportation,
- On and off-street parking management, including high tariff charges for private vehicles,
• Expansion of combined pedestrian - bike lane from 0.5 km to 24.8 km within the central area of Bogor to promote walking or cycling as a mean of transport within shorter distance.

Following the significant contribution from energy (sub-sector: transportation), emission from waste sector was also highlighted. Mitigation related programmes in solid waste management are including:

• Development of waste banks, composter and 3R (reduce, reuse, recycle) stations. Currently, there are 233 community-based waste banks, 1 waste bank operated by government officers, and 26 recycling stations for 3R programme

• Development of new wastewater treatment plants (Instalasi Pengelolaan Air Limbah - IPAL)

• Relocation of final disposal site. The provincial government of West Java has developed a regional landfill in Nambo, which will collect waste from Bogor City, Depok City and Bogor District. The operation is scheduled to start in 2020. Disposal quota allocated for Bogor City is 500 tonne per day. Instead of open dumping as in current disposal site, Nambo site is designed as a semi-landfill disposal site. This is expected to reduce the emissions

Detailed list of programmes and activities related to climate change mitigation from each sector is presented below in Table 2.

Table 2. Climate change mitigation related activities in Bogor City's Development Plans 2014 – 2019.

| No. | Programme | Activities | Responsible agency |
|-----|-----------|------------|---------------------|
| 1   | Policy umbrella for climate change-related programmes | Implementation of mitigation and adaptation actions | Development Planning Agency |
|     |           | Monitoring and evaluation of mitigation and adaptation actions | |
|     |           | Environmental pollution and damage control | Environmental Agency |
|     |           | Vulnerability analysis to support identification of relevant adaptation options | Local agency for disaster management (Badan Penanggulangan Bencana Daerah - BPBD) |
|     |           | Establishment of climate change working group to support implementation of mitigation and adaptation actions | Development Planning Agency |
| 2   | Energy efficiency | at household level | Settlement Agency |
|     |           | at commercial facilities | Public Works and Housing Agency |
|     |           | at government facilities | |
| 3   | Transportation | Conversion to BRT | Transportation Agency |
| No. | Programme                        | Activities                                                                 | Responsible agency                        |
|-----|----------------------------------|---------------------------------------------------------------------------|-------------------------------------------|
| 1   | Conversion to cleaner fuel       |                                                                           |                                           |
|     |                                  | Parking policies, e.g. high parking tariff and no street parking policy to encourage people in using public instead of private transportation |                                           |
|     |                                  | Improvement and development of pedestrian and bike lane to encourage shifting from using motorised transportation for short trips | Public Works and Housing Agency           |
| 4   | Low emission agriculture         | Climate smart agriculture, Low emission animal husbandry                  | Agricultural Agency                       |
| 5   | Improvement of green spaces      | Quantity (development of new green spaces)                                | Gardening Agency                          |
|     |                                  | Quality (replanting and rehabilitation of existing green spaces with hardwood trees) |                                           |
| 6   | Waste management                 | 3R and Waste Bank, Relocation of final disposal site, Composter, Development of new IPAL facilities to cover more areas without onsite wastewater management facilities | Environmental Agency                     |

3.2. **Operational Constraints of Existing Mitigation Actions**

Results of assessment to emission profile and tagging of relevant programmes were presented in a series of consultations with Bogor government officials. Further, key issues were then consulted through one-on-one interview with related agency. Despite the lack of strategic policy at city level to translate climate change into longer-term development plans, mitigation-related programmes are relatively supported in the policy context. As most programmes were also parts of the national initiatives, budgets for key components are secured. However, the constraints are persistent at the operational context.

Challenges in the implementation of mitigation programmes in transportation were dominantly concerning habits. Walking or cycling is not a preferable mean of transportation for most of Bogor residents. Humid tropical weather makes walking or cycling uncomfortable. The second issue on habit was the undisciplined parking. Most people tent to park the vehicles as close as possible to their destination, which caused roadblocks, especially on busy main roads.

Transportation agency has been working intensively in conversion of *Angkot* into BRT and aiming this as the first inner city travel option for Bogor residents. Bogor has currently established one route (corridor) of BRT and planned to expand the service into five corridors as detailed in Table 3. However this optimistic scenario has been faced with unexpected constraints. During the last 2 years, e-hailing taxi apps have been rapidly increasing both in number and popularity. Services are available for both car (group traveller) and motorbike (single traveller). Unlike the BRT that requires traveller to walk or use other means of transport to the bus stop, e-hailed taxis are able to serve door-to-door which provides maximum comfort for travellers.
Table 3. Conversion to BRT planning.

| Corridor 2                      | Corridor 3                      | Corridor 4                      | Corridor 5                      |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Current route                   | Terminal Bubulak - Baranangsiang| Terminal Bubulak - Ciawi       | Villa Bogor Indah, POMAD, Warung Jambu |
| Conversion ratio*               | 3:2 consecutively followed by 2:1 | 3:1                             | 3:2 consecutively followed by 2:1 |
| Number of Angkot converted into Bus (unit) | 243                             | 243                             | 180                             |
| Timeline                        | by Dec 2018                      | Sep – Dec 2018                   | 2019 – 2020                     |
|                                 | 60 Angkots are converted into 40 unit medium-sized bus | 90 Angkots are converted into 30 unit medium-sized bus | 180 Angkots are converted into 120 unit medium-sized bus |
|                                 | 2019–2020 (for every 3–4 months) | 2019–2020                       | 2019                            |
|                                 | 30 Angkots are converted into 20 unit bus, So the conversion is expected to be completed by the first quarter of 2020 | 153 Angkots are converted into 51 medium-sized bus | 120 medium-sized bus are converted into 60 unit bus |

*) Conversion ratio is based on GIZ [9] study, taking into consideration the average of head way, distance, travel time and other relevant variables.

In supporting the programme for conversion into greener fuel, Bogor City has developed three natural gas-based fuel stations. However, only one station is currently operating. The other two stations are currently not operating as the equipments were stolen right after the opening ceremony. The city government has been approaching other gas companies to run the business but no promising result. Another issue in the fuel conversion programme was the unsuitable fuel converters. A number of car owners have been complaining about this issue. The programme was apparently translated from the national government programme on conversion into biofuel. National government provides the equipment and the city government is expected to support other components, such as the development of fuel station. Yet, as the dominant vehicle types in an area, distributed equipment from national government does not always meet the specific needs of the area. These operational issues in the transportation sector are presently deadlocked.

The second key concern in Bogor GHG mitigation is the Solid Waste Management (SWM). The rapidly increasing population in the city has made the potential emissions from this sector alarming. Bogor solid waste is dominated by organic waste, of which 66% are food waste, as the culinary business is known as the most popular industry in the city. About 80% of waste management budget is currently allocated for transportation fuel and labour and this has caused another constraint in the city’s ability to expand or modify their current waste management programme as their budgets for this allocation were inflexible. Despite the existing solid market to absorb recycled products such as paper, only around 4% of the total solid waste was currently segregated. This was due to a lack of awareness for segregation at the household level. Campaigns have organised up to community level, but adoption of the segregation process remains slow as it sometimes considered as a nuisance or additional burden.
for the households. Households in Indonesia have typically only one general waste bin in the kitchen to accommodate all types of waste.

There was also no dedicated station or system to collect used electronic devices, which took up a considerable portion among solid wastes. As a result, organic wastes were partly contaminated by hazardous contents. Currently, the market for organic fertilisers produced from composting station is limited to decorative plantation nursery because the fertilisers are still Pb-contaminated. Once the segregation is better arranged, we may expand the market into food crop farming as the composting programme has apparently large enough resources from the food waste. Last operational constraint in main SWM programmes was the transportation of residues to Nambo—the new final disposal site. Nambo is located further than the existing final disposal site, and also only accessible via highways. This means the transporting vehicles need to follow a set of rule in the highway, including no-leachate transport. Extra-large budgets were required to provide new-standardised vehicles and to cover higher transportation costs.

The efforts to reduce the amount of waste processed in disposal site include installation of biodigester in traditional markets and pilot incineration programme located in the Environmental Agency office. Unfortunately, both attempts were short-lived, mostly due to the nature of wastes in Bogor City which primarily are wet. Higher energy, means more fuel were required to process the wastes and thus cost for operation of both biodigester and incineration was considered inefficient.

4. Conclusion and recommendation
The economic and social transitions from a carbon-intensive development to low carbon scenarios are definitely complicated. Regardless of the implementation of low-carbon programmes, redesign of infrastructure, or technology shift, major changes in cities emission reduction might only appear in the coming decades. It is necessary to have preliminary research concerning supporting and hindering habits/lifestyle and other local characteristics prior to the identification of mitigation programmes. This will increase acceptance and adoption of the programs. Early education on green lifestyle, such as introduction of climate-change related topics into school curricula, is also important to support the long-term commitment to low carbon society.

Reference
[1] C40 cities. 2018. Infographic: Addressing climate change begins in the City. Available online at: https://www.c40.org/why_cities. Accessed on 18 January 2019.
[2] IEA (International Energy Agency). 2008. World Energy Outlook 2008. Paris. International Energy Agency.
[3] Boer, R, Dharmawan, IWS, Ardiansyah, M, dan Ridwan, M. 2017. Modul tagging program dan penentuan lokasi aksi mitigasi.
[4] Boer, R, Dharmawan, IWS dan Ridwan, M. 2017. Four key steps for mainstreaming climate change mitigation into local development plan. Green development policy brief.
[5] Dinas Lingkungan Hidup Kota Bogor. 2017. Laporan Akhir Perhitungan Emisi Gas Rumah Kaca Kota Bogor.
[6] Badan Perencanaan Pembangunan Daerah Kota Bogor. 2014. Laporan Akhir Penyusunan Layanan Persampahan Kota Bogor. Bogor.
[7] ICLEI. 2014. City of Bogor, Indonesia: building disaster resilience through better understanding of urban systems and climate change.
[8] ICLEI. 2016. Regional action plan on climate change adaptation.
[9] GIZ. 2014. Sustainable Urban Transportation Improvement Project (SUTIP). Project Report.