**Integrated Programme for Better Air Quality in Asia (IBAQ Programme)**

# CITY SOLUTIONS TOOLKIT:

# STEP-BY-STEP GUIDE FOR CITIES TO DEVELOP CLEAN AIR ACTION PLANS

## THE SITUATION

Air pollution is an issue that is influenced by different factors. Cities require a strategy to deal with the continuously changing issues and needs concerning air quality management (AQM). A process called clean air action planning can be considered as the core of AQM. Through the clean air action planning process, scientific information on the levels of air pollution, emission sources as well as local health and environmental impacts of pollution are used to provide a comprehensive understanding of the air quality status in the city. This understanding, in turn, helps the government and other stakeholders that part of the planning process to select measures that will reduce emissions from transport, industries, waste deposits, residential burning, and other sources (Clean Air Asia and UNEP, 2019a)

For a clean air action plan (CAAP) to be effective, it is important to (1) address dominant pollution sources and reduce their emissions, (2) mitigate health risks posed by pollution to vulnerable groups and/or densely populated areas, and (3) ensure that air quality and public health improvements are the overarching goals of the plan.

A step by step guide provided by this document aims to help city AQM practitioners in developing a CAAP. In this module you will find:

- Key steps your city needs to go through in developing and implementing a CAAP; and
- Considerations when working on each activity in the CAAP process.

## STAKEHOLDER ENGAGEMENT

While clean air action planning needs to be a government-led initiative, it will only be successful when stakeholder engagement and public participation are realized. Effective and successful AQM relies on stakeholder engagement, communication, and cooperation. It is important to bring together key actors who will take the lead in developing and implementing the CAAP, as well as ensure communication and cooperation between private and public entities (GIZ and Clean Air Asia, 2015). In the development of a CAAP, it is important to keep the process transparent and participatory to ensure adequate support during implementation.

Forming a Multi-stakeholder Working Group to oversee the clean air action planning process is prescribed. Representation from different agencies and their recommended roles within the

working group are summarized in the table below. Stakeholder engagement is intrinsic in clean air action planning, with various touchpoints recommended throughout the entire process.

| Institution | Roles and responsibilities |
|---|---|
| Local government<br><br>It is recommended that the following are engaged in CAAP development:<br>- Mayor or equivalent<br>- City council<br>Relevant departments such as:<br>- Environment<br>- Health<br>- Planning<br>- Engineering and public works<br>- Transportation<br>- Business permitting or licensing<br>- Public information or communication | • Lead the development and implementation of the CAAP<br>• Act as primary liaison of the technical working group, ensuring strategic and timely sharing of data and information, and alignment of set air quality targets and goals with the overall development trajectory of the city<br>• Mobilize resources and relevant AQM stakeholders to generate local air quality monitoring and emissions data to verify compliance with national standards and CAAP targets<br>• Formulate the AQM roadmap, allocate funding and set timelines for the different steps involved in developing the CAAP<br>• Formulate policies for implementation within their jurisdiction<br>• Enforce existing and newly established air quality regulations |
| National government | • Establish or update national air quality policies, standards, and guidelines, as needed<br>• Provide inter-agency administrative orders to facilitate data sharing and coordination for data collection/analysis activities, as needed<br>• Ensure appropriate financing mechanisms to support the local government in implementing the CAAP and help the latter seek funding from donors, both internal and external<br>• Ensure that CAAP development process and activities comply and align with national policies and regulations |
| Academic and research institutions | • Support the local government in air quality monitoring to understand the status and trends of air quality<br>• Support the local government to establish an emissions inventory (EI) through scientifically valid and |

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| | internationally accepted protocols, from data collection to analysis and reporting<br>• Support the local government to conduct modelling for further analysis of air quality monitoring data or EI results or for predicting future air quality trends based on EI results<br>• Share existing data or research relevant to the first three point<br>• Support technical capacity building of the local government throughout the CAAP development and implementation process |
| Private sector | • Establish environmental management systems and adopt technologies to lower environmental impacts of business operations<br>• Align corporate social responsibility programs and initiatives with the air quality objectives set by the CAAP<br>• Assist in funding CAAP development activities such as training workshops and data gathering processes |
| Non-governmental organizations and foundations | • Monitor CAAP development process<br>• Coordinate with national or local government in hiring local consultants and technical experts to support AQM work<br>• Assist in funding CAAP development activities such as training workshops and data gathering processes |
| Mass media | • Publicize important events related to CAAP development and implementation<br>• Effectively communicate air quality data and related information (e.g., policies and regulations) to city residents and businesses |
| Civil society, sectoral groups (e.g. public transport associations) and private citizens | • Participate in group discussions and stakeholder consultations<br>• Contribute to data gathering and data sharing for CAAP development |

Adapted from GIZ and Clean Air Asia (2015)

To ensure continuity of the CAAP process, it is strategic to form a smaller group from the Multi-Stakeholder Working Group who can act as the Secretariat: The Secretariat Group may be assigned the following tasks:

(a) perform project monitoring of the CAAP process: oversee the day-to-day operations, ensure milestones and outputs are completed within the timeline;

(b) manage logistical and administrative concerns relating to the entire CAAP activity; and
(c) ensure proper documentation of all meetings, workshops and decisions made.

## THE CLEAN AIR ACTION PLANNING PROCESS

The general flow in conducting a Clean Air Action Plan is illustrated below :

**Plan the process → Allocate and secure resources → Propose policy and action recommendations → Monitor and evaluate implementation**

It should be noted that clean air action planning is an iterative process. Monitoring and evaluation of the plan's implementation can recommend review of the city's air quality goals and emission reduction targets, identify ways to strengthen the scientific basis of the CAAP, and look into additional policies or pollution control measures, among others. These processes will feed into the subsequent rounds of improving or updating the CAAP. The above flow is best condensed into the following steps and considerations. Take note that there are other ways to go about developing a CAAP. The following methodology provides flexibility depending on the city's capacity and AQM goals.

### STEP 1: Establish the planning process

The objectives of this step include: (1) leveling-off with concerned groups, (2) engaging stakeholders on what has to be done or is expected in conducting a CAAP; (3) building connections and the network to begin the process of planning. Recommended sub-steps are as follows:

#### A. Identify and understand stakeholders

The key considerations in the box below will be useful in mapping out the city's AQM stakeholders.

Key considerations in identifying and understanding the city's stakeholders

1. Basic questions to start with:
    - Who are the people or institutions who will need to be involved in the CAAP development or be affected by its implementation?
    - Who are the people or institutions with influence or power over it; who have an interest in its success or failure ?
    - What are the roles of the stakeholders in CAAP development?
    - Are there adjacent cities or provinces or those in the same airshed that can be engaged in the planning process?

2. Importance of CAAP to the stakeholders:

- Who are the stakeholders with high power and highly interested in the CAAP? Who are those with high power but may have little interest in the CAAP? How can their interest level be increased? These are the decision-makers who can important milestones, outputs or outcomes of the CAAP.

- What financial or strategic interest do they have in the CAAP development and outcome?
- If they are likely to oppose the activity, what risk management strategies can be employed?

3. Strategies for engaging them:

- How could they contribute or hinder the CAAP process?
- What information do they need, how often does this need to be shared and what is the best way of communicating with them?
- What is the level of input required from them? For example, the head of the city environment department needs to approve the plan before it can be adopted. On the other hand, while community groups or individuals will need to provide inputs, they do not have the authority to approve/disapprove as a single entity.
- Who influences their opinion and who else might be influenced with theirs?

Adapted from Mindtools, 2019; Clean Air Asia and UNEP, 2019a

**B. Obtain stakeholder input**

The findings, especially those under the third criteria (Strategies for engaging them) from the previous sub-step, will determine the approach for engaging the stakeholders. The following are suggested activities for this:

**Visioning workshop**

- Develops a vision for clean air in the city and confirms stakeholder commitment of stakeholders to see the CAAP process through
- Helps build acceptance among stakeholders for the CAAP measures later on

**AQM Roadmap Development Workshop**

- Opportunity for stakeholders to agree on steps to achieve their desired vision on clean air for their city

This can be performed at any stage in the AQM process, but is ideally conducted under Step 1. Assessing the city's current capacity and building a roadmap helps increase stakeholder appreciation of the importance of continuously building AQM capacity. Improving AQM capacity leads to more robust systems and practices for baselining, implementing measures, monitoring and evaluation, and governance all geared towards improving the city's air quality.

The capacity for AQM is defined into five stages: underdeveloped, developing, emerging, maturing and fully developed. The Guidance Framework for Better Air Quality in Asian Cities provides a means for cities to assess their current AQM capacity and corresponding roadmaps so they can move to the next stage. The characteristics of each

stage are defined through given indicators that generally fall into categories of data and capacity, public participation and awareness and regulatory structure and framework.

**Consultation meetings**

- Can be held at various points of the CAAP process to disseminate information, obtain input or make collective decisions

Source: Clean Air Asia and UNEP, 2019a

From 2009-2015, the German International Cooperation (GIZ), in cooperation with the ASEAN Secretariat and support from the German Federal Ministry for Economic Cooperation and Development (BMZ), implemented the project, Clean Air for Smaller Cities in the ASEAN Region (CASC). It aimed to empower smaller and medium-sized cities to develop and implement CAAPs, with the participation of civil society groups and the private sector. Iloilo City in the Philippines was one of the twelve cities in the ASEAN Region that received support from the project. The CAAP was finalized in December 2015. The following case study shows the institutional arrangement established, stakeholder roles, and engagement activities conducted to develop the Iloilo City CAAP.

CASE STUDY: Stakeholder engagement in Iloilo City, Philippines' CAAP development

To institutionalize CAAP development and ensure sustainability, a CAAP working group was formed for the city. The members and their respective roles are shown below:
National government: Environmental Management Bureau, Department of Environment and Environmental Resources Region VI (DENR-EMB), Air Quality Division

| Institution | Office or organization | Role |
|---|---|---|
| **National government** | • Environmental Management Bureau, Department of Environment and Environmental Resources Region VI (DENR-EMB), Air Quality Division | • Ensured CAAP is aligned or in compliance with national policies and regulations |
| **Local government** | • Iloilo City Environment and Natural Resources Office | • Led CAAP development as agency mandated to perform air quality management in the city |
| | • Iloilo City Traffic Management Unit<br>• The Association of Barangay (village) Captains of Iloilo City | • Provided input in selecting control measures relevant to their work and supported their implementation |

| | | |
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| | • Iloilo City Mayor<br>• Members of Iloilo City Council | • Developed and enacted policies to support the CAAP |
| **Academia** | • Experts from national universities – Ateneo de Manila University and De La Salle University<br>• Experts from universities in Iloilo City – University of the Philippines Visayas, Central Philippine University and University of San Agustin | • Performed air quality monitoring, emissions inventory and preliminary health data assessment |
| **Non-governmental organizations** | • German International Cooperation (lead implementing organization of the Clean Air for Smaller Cities in the ASEAN Region project on behalf of the German government) | • Provided funding for the entire planning process<br>• Conducted technical review of the emission inventory and CAAP reports |
| | • Clean Air Asia (regional implementing partner and national coordinator) | • Performed overall coordination and progress tracking to support project implementation |

Several workshops were held including visioning, review of air quality data, AQM roadmap development, identification of measures and CAAP dissemination.

1) A visioning workshop was facilitated in Iloilo City in November 2010. This allowed for participants to contribute to the vision of Iloilo City's air quality future. The vision produced from the workshop was summarized as: "A progressive city with clean air, blue skies, and community committed to sustained development."
2) A second workshop was organized for stakeholders to understand the city's air quality. During this workshop, the method and initial results of air quality monitoring and emissions inventory (undertaken in preparation for the CAAP) were presented. Stakeholders were asked to validate the data collected and provide feedback on results that were unexpected or contrary to their experience.
3) The AQM roadmap development workshop entailed a review of available air quality data in the city, remaining data gaps, on-hand resources for preparing the CAAP, stakeholder roles and timeline. The final output was a workplan for CAAP development.
4) During the course of CAAP preparation, stakeholders met again to identify measures to mitigate existing sources of air pollution identified in the emissions inventory. The discussions also included what strategies should be implemented by the city to prevent or counter negative environmental effects brough by continued economic development. The stakeholders wanted to focus on improving existing policies, as this was less resource-

intensive, before moving on to implementation of new measures. The measures identified by stakeholders, which were captured in the CAAP, were a mix of both local and national interventions.

5) Finally, upon completion of the CAAP, a dissemination workshop was held to explain the entire CAAP document, from the air quality data collected which informed the plan until the measures for the stationary, area and mobile sources present in the city. An output of the CAAP was a plan for operationalizing the priority measures, including stakeholder roles for implementation, timeline, budget source and costing.

The sustainability of the Iloilo City's CAAP relied on stakeholder involvement. Under the plan, a multi-sectoral stakeholder committee was enacted to monitor its implementation. The committee body included the Department of Environment and Natural Resources (national environmental agency), local universities, public transportation groups, NGOs, and private sector. The committee was tasked to review the implementation progress quarterly. The group was also responsible for continuing community engagement and coordination with local stakeholders

Source: GIZ and Clean Air Asia, 2015; GIZ, 2010 as cited in Clean Air Asia and UNEP, 2019a

**C. Mobilize resources**

During this step, members of the working group identify what kind and how much resources are needed to undertake them. The following are recommended guide questions for this step:

| Financial resources | Human resources | Goods | Services |
|---|---|---|---|
| • Can the city allocate budget for clean air action planning?<br>• If additional funds are needed, where can we source them? (see table above)<br>• How we do we maximize existing resources (e.g. use city hall as meeting venue, dovetailing with other projects)? | • Who from existing staff will be involved in the process?<br>• How many do we need in the process?<br>• Are the necessary skills for the process available?<br>• If not, how do we obtain them?<br>• What are the capacity building needs of existing staff? | • What equipment is most appropriate for our needs?<br>• Is equipment maintenance needed? Who will do this?<br>• Are consumables available?<br>• What skills are needed to operate and maintain the equipment? | • What expertise or skills are needed in the process (consider needs identified for Financial resources, Human resources and Goods)?<br>• What capacity building activities are needed to support this? |

Source: Clean Air Asia and UNEP, 2019a

Clean Air Asia together with the Institute for Global Environment Strategies and Asia Centre for Air Pollution Research implements the project entitled Integrated Programme for Better Air Quality in Asia (IBAQ) funded by the Ministry of Environment, Japan. It aims to improve air quality and contribute to more livable and healthy cities in Asia with a focus on cities with high impact potential and potential for leveraging wider change. Marikina City, Philippines was among the cities in Asia who received technical assistance towards the development of a CAAP. Aside from support given by the IBAQ Programme, the city obtained air quality monitoring equipment on-loan from private sector companies. The case study provides a summary of the resources utilized in completing the city's CAAP.

**CASE STUDY: Resource mobilization for Marikina City, Philippines' CAAP formulation**

| Financial resources | Human resources | Goods | Services |
|---|---|---|---|
| Bilateral funding supported the CAAP development through a project.<br><br>Details:<br>• Clean Air Asia engaged consultants (including De La Salle University and a private surveyor team), to conduct emissions inventory; covered workshops and meetings costs. | Non-government organization implemented the project in collaboration with the city government.<br><br>Details:<br>• Clean Air Asia was in-charge of overall project implementation, project management, documentation and CAAP report preparation.<br>• Marikina City Environmental Management Office (CEMO) staff were in-charge of logistics for driving the electric vehicle with the mobile sensor around the city; performed household and commercial establishment surveys | Private sector provided on-loan air quality monitoring and related equipment.<br><br>Details:<br>• The stationary and mobile air quality monitoring equipment used were on-loan from First Philippine Holdings Corporation.<br>• Electric vehicle which housed the mobile monitoring sensor was on-loan from Mitsubishi Motors Philippines Corporation / Department of Environment and Natural Resources. | Non-government organization and university provided technical expertise and capacity building support.<br><br>Details:<br>• Clean Air Asia provided technical expertise and capacity building for AQM assessment, air quality monitoring, health impacts mapping, and CAAP development; co-organized stakeholder engagement activities with Marikina CEMO.<br>• De La Salle University provided |

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| | for the emissions inventory; co-organized and hosted stakeholder engagement activities with Clean Air Asia; coordinated with other city departments for data needed in the CAAP | | technical expertise for the emissions inventory. |

**STEP 2: Establish baselines**

After the planning process is established, the magnitude of the city's air pollution problem needs to be understood. This step is crucial in ensuring that the pollution reduction measures in the CAAP target the most critical pollutants, pollution sources and/or areas within the city. The following are the main activities (also called as AQM areas) under this step and the corresponding questions these activities can help answer:

| AQM area | Questions that can be answered by the activities |
|---|---|
| **Air quality monitoring**<br>**(Refer to modules on Ambient Air Quality Monitoring and Standards of the Toolkit)** | - Do air quality levels comply with national ambient air quality standards and WHO guidelines?<br>- Which pollutants are exceeding national standards and WHO guidelines?<br>- What air quality targets should the city set?<br>- What are the air quality trends in the city (e.g. peak hours, peak days, seasonal effects, long-term increasing or decreasing trend)?<br>- Where are the hotspots and priority areas for emission reduction |
| **Emissions inventory and source apportionment**<br>**(Refer to modules on Emissions Inventory and Modeling of the Toolkit)** | - What are the emission sources in the city and where are they located?<br>- What is the emission contribution of each emission source?<br>- What are the emission reduction targets that the city should set?<br>- What are the dominant emission sources that should be prioritized in the CAAP? |
| **Health and environmental impact assessment**<br>**(Refer to modules on Health and other impacts of the Toolkit)** | - What are the impacts of air pollution to public health in terms of incidence of related diseases and deaths<br>- Based on the incidence rates above, which areas in the city should we prioritize for air quality improvement? |

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| **Identification of indicators of economic growth, energy use and population growth, and their future projections** | - What other important developments and trends are taking place in the city that may not be captured by air quality monitoring, emissions inventory or health impact assessment but need to be considered in identifying pollution control strategies and measures?<br>*These may include population trends, rates of urbanization and motorization, expected future large-scale infrastructure developments and others. |

Source: Clean Air Asia and UNEP, 2019a

A common challenge encountered by cities in developing a CAAP is the lack of resources for intensive data collection and baselining. It is important that this does not become a major hindrance for developing a CAAP. There are potential solutions to address this issue, e.g. utilizing data from other reliable sources such as the national government or academic institutions or performing rapid assessment techniques. The table below shows examples of solutions to address this and the general approach for maximizing available resources in data collection and consolidation (Clean Air Asia and UNEP, 2019a).

| Data Limitations | Potential solutions |
|---|---|
| **Minimal to no local ambient air quality monitoring** | • Identify pollutant of concern from ad hoc available data/literature/national or regional air quality monitoring initiatives<br>• Partner with local universities or research institutions to obtain data generated from previous studies or to pool resources for air quality monitoring activities<br>• Focus efforts on establishing continuous monitoring in strategic sites; explore feasibility of time-series analysis<br>• Employ low-cost monitoring in strategic sites to generate initial data |
| **No emissions inventory or source apportionment** | • Refer to available work by local universities or research institutions<br>• Employ quick assessments and modeling using available tools (e.g., IVT for transport)<br>• Refer to regional emissions inventory case studies for emission factors and activity data that may be adapted<br>• Explore possibility of conducting rapid assessment using national or proxy data |

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| **No health risk or impact assessment studies available** | • Employ quick assessments using available tools such as BenMAP<br>• Do a spatial mapping of mortality and morbidity rates or air pollution-related diseases to see which areas have the highest incidence rates |
| **No local data available on indicators of economic growth, energy use and population growth and future projections** | • Refer to national statistics and employ projection tools/web databases |

Source: Clean Air Asia and UNEP, 2019a

The following case study illustrates the data collection and baselining activities carried out in formulating Marikina City, Philippines' CAAP. It shows how the data was applied to understand the city's air quality status and identify the control measures in the CAAP.

CASE STUDY: Baseline assessment for Marikina City, Philippines' CAAP development

**1. Air quality monitoring**

| Description | Findings |
|---|---|
| Official air quality monitoring data available from the Department of Environment and Natural Resources – Environmental Management Bureau was available from a manual monitoring for total suspended particulates (TSP) and $PM_{10}$ in Marikina Sports Complex.<br><br>Information obtained include annual average TSP and $PM_{10}$ concentrations. Annual TSP (measured from 2010 to 2015) has consistently been exceeded except in 2014. Annual $PM_{10}$ average (collected from 2012 to 2017) was only met in 2014 and 2017.<br><br>Given the limited availability of high-resolution air quality data in Marikina, additional stationary and mobile monitoring were performed for the city. The stationary monitor was installed in CEMO, to serve as the reference instrument for the air quality | The $PM_{10}$ levels in the city measured from the stationary and mobile air quality monitoring suggest that the air quality in Marikina City can have impacts to the health of its citizens as these are above the WHO AQG values.<br><br>The $PM_{10}$ daily average value for the sampling period was higher than the World Health Organization's (WHO) air quality guideline (AQG) but met the Philippine National Ambient Air Quality Guideline Value (NAAQGV). For the $PM_{2.5}$ levels, the daily average was also higher than the WHO AQG value but meets national standards. Trends were also noted in terms of temporal variation of hourly-averaged $PM_{10}$ and $PM_{2.5}$ throughout the day, the daily variation throughout the week, and the variation of monthly averages. These were correlated with meteorological |

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| monitoring in Marikina, the instrument was deployed from July to October 2018 for a total of 48 days. It measured concentrations of $PM_{10}$, $PM_{2.5}$, nitrogen oxides, ozone, and meteorological parameters.<br><br>One of the most unique components of the air quality monitoring performed in Marikina City is the use of the mobile monitoring platform. Within a period of seven weeks, mobile measurements of $PM_{10}$ and $PM_{2.5}$ were performed throughout the city in two pre-defined routes: one which covers major roads and boundaries of Marikina City, and the other, which covers two residential neighborhoods in detail. The mobile monitoring data was compared with readings from a reference instrument to ensure data quality. | data and vehicle activity within the vicinity of the monitoring station.<br><br>For the mobile monitoring, a visual representation of the results was generated (see map below). In the map, the redder road segments have the highest concentrations and are described as 'hotspot' areas that must be prioritized for pollution source and risk management. The road segments with the highest concentrations are found in the areas of Fortune, JP Rizal, and Sumulong, which are considered as major roads.<br><br>Results also showed that $PM_{2.5}$ values are higher during specific days of the week (weekends) and at specific times of the day (morning and evening rush hours). |

**2. Emissions inventory**

| Description | Findings |
|---|---|
| The DENR EMB published a national emissions inventory every three years, the last of which was in 2015. In the National Capital Region (NCR) where Marikina City is part of, 88% of the emissions is attributed to mobile sources. Area and point sources account for 2% and 10%, respectively.<br><br>No prior EI has been prepared for Marikina City. A bottom-up approach was employed for this purpose, where the activity data was collected through a survey complemented by a mobile application.<br><br>The EI covered point (factories and industrial facilities), area (residential and commercial establishment activities), and mobile (on-road vehicles) sources. The scope of the inventory | Mobile source is the major source of air pollution in the city, followed by area and point sources respectively. Mobile sources account for majority of the CO, $PM_{10}$, and $NO_X$ emissions, while area source for NMVOC and point source for $SO_X$ emissions. |

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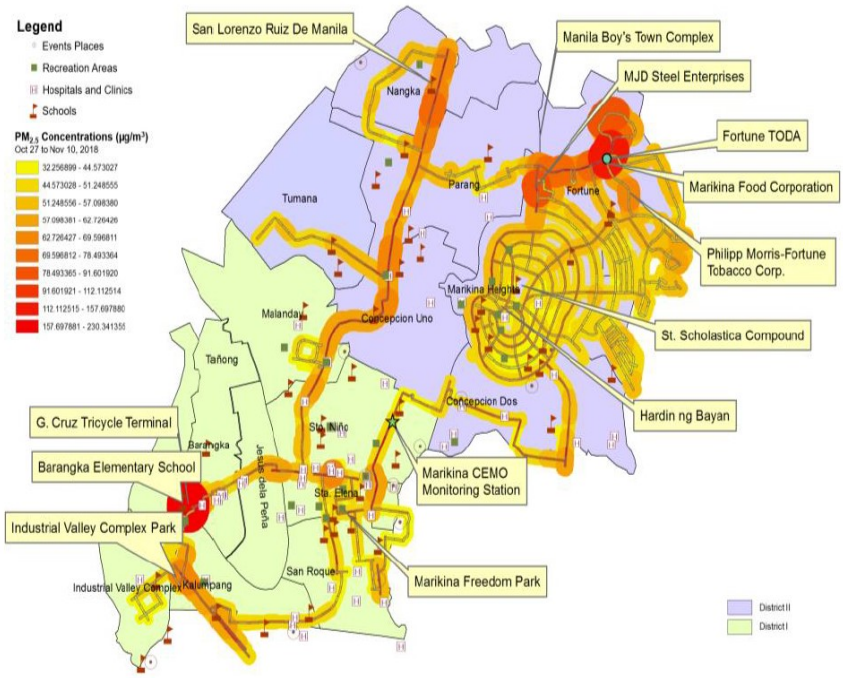
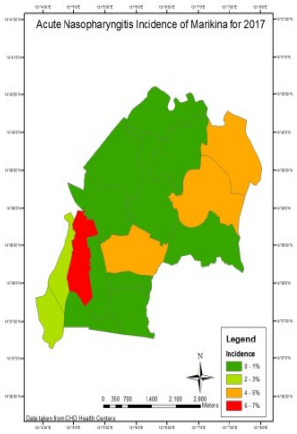
|---|---|
| included criteria pollutants: $PM_{10}$, CO, $SO_X$, $NO_X$, as well as non-methane volatile organic compounds (NMVOC). | |

### 3. Preliminary analysis of air pollution-related health incidences

| Description | Findings |
|---|---|
| The incidence (morbidity) of air pollution-related diseases Acute Bronchitis, Nasopharyngitis, and Primary Hypertension in Marikina City were obtained from the City Health Office. These were recorded for each barangay (neighborhood). The data was mapped using the BenMAP Community Edition software to visualize which areas had the highest incidences per disease. | Official data from the City Health Office (2017) reflected that lung and cardiovascular diseases are the top two leading causes of morbidity and mortality in the city. It was found that Barangay Tañong had the highest incidence rate for acute nasopharyngitis in the two-year period, followed by Marikina Heights, Nangka, IVC, and Kalumpang in 2016, and Marikina Heights, Fortune, and Sto. Niño in 2017. These information were used in identifying the priority barangays for emission and exposure reduction efforts. |



The map above shows the results of the mobile air quality monitoring, identified pollution sources, as well as areas with vulnerable populations such as children, elderly and health-compromised individuals (i.e. schools, hospitals, clinics, recreation areas, and parks where the general population frequently spend time in). The following observations were noted:

- In the identified hotspot road segments found in Barangay Fortune, several industries (Philip Morris-Fortune Tobacco Corp., MJD Steel Enterprises and Marikina Food Corp.) can be found in the vicinity. In almost the exact location of the road segment with the highest concentration, the Fortune public tricycle terminal can be found.
- In the JP Rizal road with high concentrations of $PM_{2.5}$, several schools can be found, including the San Lorenzo Ruiz de Manila.
- In the identified hotspot in Sumulong, there is a tricycle terminal, and Barangka Elementary School.

These kinds of information as well as quantitative results of the activities above were important for establishing a data-driven approach for reducing air pollutants. In the plan, $PM_{10}$ was designated as a priority pollutant due to health impacts associated with particulate matter. This resulted to jeepneys and light-duty vehicles being priority pollution sources due to their significant $PM_{10}$ contributions.

Moreover, spatial mapping results indicated that route planning and traffic flow management can help reduce exposure of people, especially of vulnerable population, to air pollution. One of the main hotspots is within the vicinity of Barangka Elementary School (see large red dot in the lower left portion of the map). To lessen the exposure of students in the school to vehicle emissions, the city may consider moving G. Cruz Tricycle Terminal or re-routing the vehicles in this area to reduce build-up of vehicles.

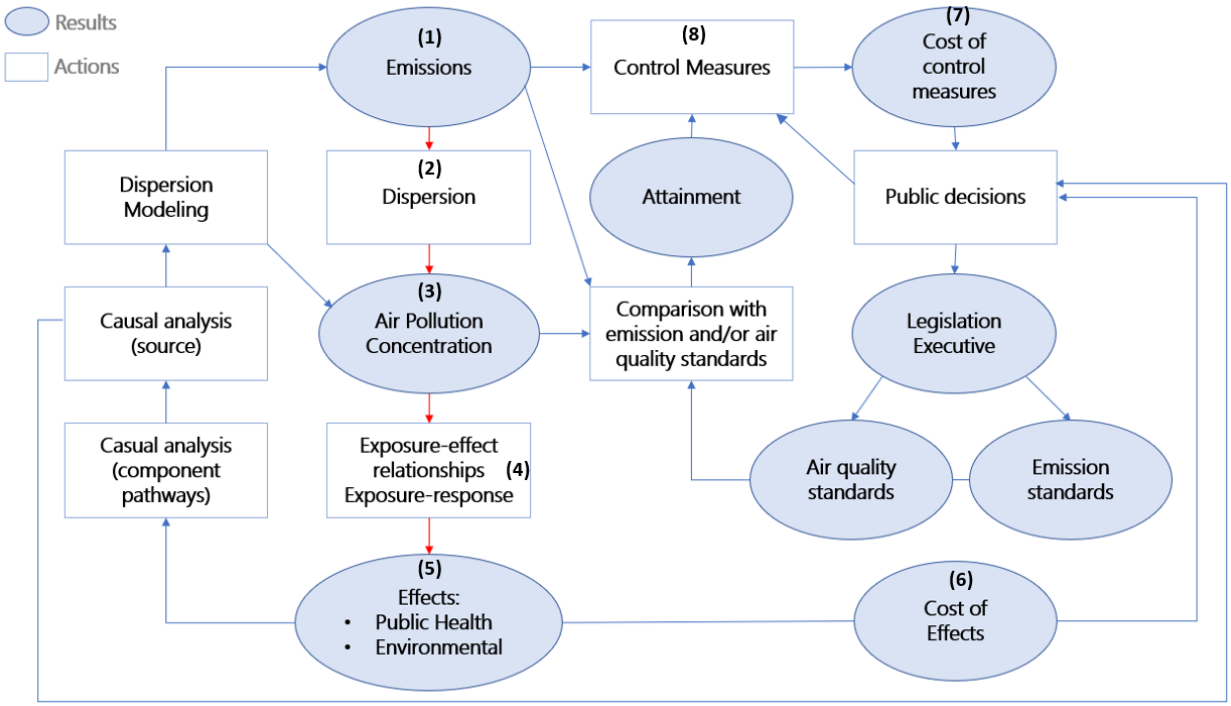
These are just examples of some of the control measures demonstrating how the baselining is important in the prioritization of measures and their subsequent evaluation.

Source: Clean Air Asia, 2019 as cited in Clean Air Asia and UNEP, 2019

**STEP 3: Target setting, selecting appropriate control measures, and planning for operationalization**

There are five sub-steps that the Working Group must consider in carrying this out. In a nutshell, Step 3 applies what has been learned from the baseline assessment in formulating strategies and actions to improve air quality as well as protect public health and the environment.

**Step 3.1: Set air quality management targets**




Adapted from Clean Air Asia and UNEP, 2019b

In a fully-development AQM system, setting of air quality targets follows the process shown above:

- An emissions inventory (refer to 1 in the flowchart) or, in some cases, source apportionment is performed to determine emission concentrations produced by all pollution sources in the city.
- The emissions inventory data is used as input for dispersion modeling (refer to 2). Dispersion models, as can be deduced by their name, simulate the process of atmospheric dispersion, which mixes the pollutant with the existing air. This results in estimated pollutant concentrations (refer to 3) at any point in time or space – which can serve as replacement for air quality monitoring data.
- These can then be used for estimating the health and environmental impacts of air pollution (refer to 5) based on models of exposure-effects relationship between air pollution levels and human health (refer to 4).
- Cost-benefit analysis which quantifies and weighs the cost of pollution control measures (refer to 7) against the benefits of improving air quality (6) (in terms of avoided lives lost, disability adjusted life years, economic gains, etc.) will then inform public decision on various levels including which control measures (refer to 8) to take to reduce air pollution.

The approach described above can be flexible, depending on the city's current AQM capacity. The following are options that can be taken in the absence of the elements discussed above:

<u>Option 1: Set air quality targets (air quality monitoring data-based)</u>

While there is no perfectly 'safe' amount of exposure for most pollutants, the goal of AQM is to reduce overall acute and chronic health risks through reductions in ambient air pollutant concentrations (GIZ and Clean Air Asia, 2015). This means that the CAAP should identify air quality goals and/or emission targets. In identifying their air quality goals, cities would usually aim to achieve their national ambient air quality standard. It is recommended that WHO Air Quality Guideline (AQG) values or interim targets also be considered in target setting (Clean Air Asia and UNEP, 2019a). Cities can use their existing air quality monitoring data as baseline. Cities can then continue to monitor for compliance to national standards or WHO guidelines values; or whether air quality trends show a generally decreasing trend throughout the implementation of the control measures.

In January 2012, the Hong Kong, China announced its intention to adopt a new set of Air Quality Objectives (AQO) which makes reference to the WHO AQG and its interim targets, with a view of the new AQO coming into effect in 2014 subject to the passage of the relevant legislation. An Amendment Bill to amend the Air Pollution Control Ordinance was submitted to the Legislative Council in February 2013 to tighten the AQO, with a provision that the AQO shall be reviewed at least once every 5 years after the commencement of the new AQO (Clean Air Asia and UNEP, 2019a).

**Example: Hong Kong, China health-based Air Quality Objectives**

| **Pollutant** | **Average time** | **Existing AQO** | **WHO AQGs** | | | | **No. of exceedances proposed** |
|---|---|---|---|---|---|---|---|
| | | | IT-1 | IT-2 | IT-3 | AQG | |
| **$SO_2$** | 10-min | - | - | | | 500 | 3 |
| | 24-hr | 350 | 125 | 50 | | 20 | 3 |
| **$PM_{10}$** | 24-hr | 180 | 150 | 100 | 75 | 50 | 9 |
| | Annual | 55 | 70 | 50 | 30 | 20 | N/A |
| **$PM_{2.5}$** | 24-hr | - | 75 | 50 | 37.5 | 25 | 9 |
| | Annual | - | 35 | 25 | 15 | 10 | N/A |
| **$NO_2$** | 1-hr | 300 | - | | | 200 | 18 |
| | Annual | 80 | - | | | 40 | N/A |
| **O3** | 8-hr | 240 (1 hr) | 160 | | | 100 | 9 |
| **CO** | 1-hr | 30,000 | - | | | 30,000 | 0 |
| | 8-hr | 10,000 | - | | | 10,000 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| **Pb** | Annual | 1.5 (3-month) | - | 0.5 | N/A |

Source: Hong Kong, China Environment Bureau,2013)

Option 2: Set emission reduction targets (emissions inventory-based)

Cities can define a target emission reduction within a specific period of time. This can be for a specific pollutant (e.g. reduce 2018 $PM_{10}$ concentrations by 20% by 2025) and then later on disaggregated per sector or pollution source (e.g. reduce 2018 $PM_{10}$ concentrations produced by vehicles by 10% by 2025).

Option 2A: Use your country's greenhouse gas emission targets as a starting point

Cities can opt to adopt national targets which can be in the form of Intended Nationally Determined Contributions (INDC) or Nationally-Determined Contributions (NDC). INDCs are comprised of proposed climate actions and reduction targets communicated by countries ahead of the COP21 (or the 21st Conference of the Parties to the UN Framework Convention on Climate Change Paris Agreement) being finalized. A country's INDC is converted to an NDC when it formally joins the Paris Agreement by submitting an instrument of ratification, acceptance, approval or accession, unless a country decides otherwise. While the emission targets are in tonnes of carbon dioxide equivalent, the control measures for reducing them are generally expected to contribute to air quality improvements due to co-benefits.

Option 2B: Alternatively, there are tools that can be used in estimating emission reduction of control measures in terms of both GHGs and air pollutants. These can be used so that the basis for setting emission reduction targets would not just be from a climate perspective, but consider air quality improvements and other associated benefits from the on-set. This is a recommended approach to maximize co-benefits or the total benefits resulting from air pollution reduction measures or strategies. Co-benefits include GHG emission reduction, economic savings, improved mobility (for transportation solutions) etc. For more information, please refer to the Co-Benefits Module. It has a list of tools that can be applied for this purpose.

Option 3: Look at incidence rates of air pollution-related diseases

This final option is not airtight since known air pollution-related diseases such as lung cancer, stroke, heart attack etc. may be caused by other factors such as genetic predisposition or lifestyle. However, this option is included to highlight that the ultimate goal of air quality improvement is to improve people's health. In turning to this option, it may be good for the city to first review if incident rates of air pollution-related are consistently increasing or if these are among the city's top leading causes of mortality, morbidity or hospital admissions. Based on these data and other supporting information (such as air quality levels being non-compliant with national standards, citizen complaints on air pollution-related issues, etc.), the government may use as a decrease in incidence rates as a

secondary indicator, with Option 1 or 2 (as primary indicators) for a more scientific approach to target-setting.

**Step 3.2: Select appropriate control measures**

Control measures for a city CAAP commonly target transportation, industry, small-medium enterprise, open burning (of municipal solid waste and agricultural residues) and household air pollution (from cooking and heating). For each of these sectoral categories, it is a good practice to identify measures for short term (3-5 years), medium-term (6-10 years) and long-term (11-20 years).

The Air Pollution in Asia and the Pacific: Science-based Solutions report identifies 25 clean air measures to positively impact human health, crop yields, climate change and socio-economic development, as well as contribute to the achievement of the SDGs. It aims to support efforts to air pollution and mitigate climate change in Asia and the Pacific by proposing cost-effective options suited to the countries of the region (Clean Air Asia and UNEP, 2019). Cities may refer to this report as guidance in selecting the control measures.

| **Asia-wide application of conventional measures** | |
|---|---|
| *Post-combustion controls | State of the art end-of-pipe measures to reduce sulfur dioxide, nitrogen oxides and PM emissions at power stations and in industry |
| *Industrial process emissions | Advanced emission standards for, e.g., iron and steel plants, cement factories, glass production, chemical industry, etc. |
| *Emission standards for road vehicles | Strengthening all emission standards; special focus on regulation of diesel light- and heavy-duty vehicles |
| Vehicle inspection and maintenance | Enforcement of mandatory checks and repairs for vehicles |
| Road dust | Road paving and cleaning |
| **'Next generation' Asia-specific air quality measures that are not yet major components of clean air policies in many parts of the Asia Pacific** | |
| Agricultural crop residues | Management of agricultural residues including strict enforcement of ban of open burning |
| Residential waste burning | Strict enforcement of ban of open burning of household waste |
| **Prevention of forest and peat fires | Prevention of forest and peat fires |
| **Livestock manure management | Covered storage and efficient application of manure, anaerobic digestion |
| **Nitrogen fertilizer application | Efficient application, urease inhibitors, use of ammonium nitrate |
| *Brick kilns | Improving efficiency and introducing emission standards |

| | |
|---|---|
| *International shipping | Low sulfur fuels and control of particulate matter emissions |
| *Solvent use and refineries | Low solvent paints (both industrial and DIY applications), leak detection, incineration and recovery |
| **Measures contributing to development priority goals with benefits for air quality** | |
| Clean cooking | Clean fuels in cities (electricity, natural gas, liquefied petroleum gas [LPG]), LPG and advanced biomass cook stoves in rural areas; substitution of coal by briquettes |
| Renewables for power generation | Incentive instruments to foster extended use of wind, solar and hydro power for electricity generation and phase-out of least efficient plants |
| Energy efficiency standards - households | Incentive instruments for household appliances, buildings, lighting, heating and cooling; roof-top solar |
| *Energy efficiency standards - industry | Ambitious energy efficiency standards for industry |
| Electric cars | Promotion of electric cars |
| Improved public transport | Improved accessibility through public transport |
| Solid waste management | Centralized waste collection with source separation and treatment, incl. gas utilization |
| **Rice paddies | Intermittent aeration of continuously flooded rice fields |
| Wastewater treatment | Well managed two-stage treatment with biogas recovery |
| *Coal mining | Pre-mining recovery of coal mine gas |
| *Oil and gas production | Recovery of associated petroleum gas, stop routine flaring, leakage control |
| *HFC refrigerant replacement | Full compliance with the Kigali Amendment |

Source: UNEP, 2018

Measures with asterisk (*) are more applicable as national government interventions while measures with two asterisks (**) more appropriate to more rural settings.

Another resource is the Annex to Training Modules on Guidance Framework for Better Air Quality in Asian Cities: Guidance Area 6 – Clean Air Action Plans (Clean Air Asia and UNEP, 2019a) which contains detailed information on control measures for each sector (transportation, industries, small and medium enterprises, and households) and examples of their implementation in Asia.

The process of identifying and prioritizing control measures needs to be validated and legitimized by stakeholders in the city. During this step, it is important to make sure that decisions are not just consulted with the Multi-Stakeholder Working Group but all stakeholders who are affected by air pollution impacts and/or by the implementation of control measures. This is needed to solicit cooperation and ensure buy-in prior to implementation. With this in mind, the results of stakeholder mapping in **Step 1: Identify and understand stakeholders** prove to be important. The earlier Case

Study on Stakeholder engagement in Iloilo City, Philippines' CAAP development shows how stakeholder consultations were organized in identifying control measures for the city.

Aside from identifying and prioritizing control measures, this step also involves:

- Develop an implementation or workplan which considers stakeholder roles, timeline, resources needed
- Plan for financing or funding of control measures
- Conduct stakeholder consultations, solicit support and ensure buy-in prior to implementation

To prepare for implementation of the priority control measures, it is important for stakeholders to agree on the detailed steps for carrying out the measure, timeline, lead agencies and others. Developing an implementation plan or work plan is a good way to do this. An example of a high-level work plan from the Can Tho City CAAP (developed under the IBAQ Programme) shows the measures for Mobile Sources Can Tho will take, rationale, the agency responsible, time period and estimated cost for implementation.

CASE STUDY: Work plan for Mobile Sources control measures in Can Tho City's CAAP

| **Why** | **Measures and Actions** | Projects | **Legal Responsibility** | **Time Period of Implementation** | **Costs in million (in VND)** |
|---|---|---|---|---|---|
| **Addressing Mobile Sources** | | | | | |
| **$NO_X$, VOC, CO, $SO_2$ and $PM_{10}$** | 1. Control and Reduce On-Road Vehicle Emissions: Strengthen Enforcement of In-Use Automobile Inspections and Increase Scope to Cover Motorcycles | | | Year 2-5 | 4,140 |
| | 1.1 Set up a "Vehicle Inspection Task-Force" (VITF) consisting of representatives from VR, Can Tho, VEA, and Traffic Police. | Automobile vehicle inspection under Vehicle Inspection Task-Force | Can Tho DOT | Year 2-4 | 240 |
| | 1.2 Elaborate and agree on "Terms of Reference" (ToR) for the VITF. | | | | |
| | 1.3 Inspect/check emission from motorcycles | | | Year 5 | 3,900 per 5 years |

| | | | | | |
|---|---|---|---|---|---|
| | 1.4 Mobilize the VITF to test motorcycle emissions | | | | |
| **All key pollutants** | 2. Improve Can Tho's Public Transportation | Competitive, safe, and affordable public transport system under the Re-organization of Traffic and Transport Task Force | Can Tho DOT | Year 2 | 600 |
| | 2.1 Public Transport Improvement Pilot Project | | | Year 2 | 600 |
| All key pollutants | 3. Increased Support for/Strengthening of Sustainable Urban Mobility | Foundation for Sustainable Mobility under Task Force on Reorganization of Transport and Traffic | Can Tho DOT, Ninh Kieu, Binh Thuy and Cai Rang districts PPC | Year 2-4 | 720 |
| | 3.1 Improvement of Pedestrian Facilities | | | Year 2 | 240 for study |
| | 3.2 Assessment, Design, and Implementation of a Pilot Project on Bike Sharing System | | | Year 2-4 | 480 for study (exclusive about 3,000 for bike investment) |

Source: Clean Air Asia, 2017

**Step 3.3: Formulate a monitoring and evaluation system**

A monitoring and evaluation (M&E) enables policy makers, stakeholders and the public to take stock of the progress towards the CAAP's vision as well as their city's AQM goals (GIZ and Clean Air Asia, 2015). M&E are distinct but interactive and mutually supporting processes. They provide a means for learning from the experience of implementing a plan or project (from planning, allocating resources, plan delivery) as well as demonstrating results as part of accountability to stakeholders.

Monitoring is the means by which management can track progress, identify problems and implement solutions. Work plans, implementation schedule or activity schedules, and project budget are useful tools in performing monitoring (Clean Air Asia and UNEP, 2019). This can be performed by the Secretariat of the city's CAAP process.

On the other hand, to establish an evaluation system is to prepare a systematic and objective means of assessing the CAAP's implementation. The evaluation will stem from the goals established in the CAAP's planning process – the city's vision for clean air, air quality goals, emission-reduction targets and other related parameters. Setting up the evaluation system means deciding how to translate these goals into quantifiable indicators (if not yet quantified), as well as how to measure and track them throughout and upon completion of the CAAP implementation.

A sound evaluation system will consider the following:

- How will we show that the CAAP has contributed to the city's overall vision and its vision for clean air?
- How will we track and demonstrate (at the end of CAAP period) that the city's air quality goals and emission reduction targets were met?
- Aside from air quality and emission-related parameters, what performance indicators are useful in showing the control measures are successful? It is recommended that SMART goals be assigned for each control measure. SMART stands for Specific-Measurable-Attainable-Realistic-Time Bound goals.
- Will available data allow the city to show improvements to public health resulting from the CAAP? Even if there are no direct correlations established between the measures and health incidences (e.g. decrease in morbidity or hospital admissions), it is worthwhile for health data trends to be noted in the evaluation system to reinforce that improving public health is one of the main drivers for AQM.

"A Clean Air Plan for Hong Kong, China", published in March 2013, was the first comprehensive policy document published by the Environment Bureau during the 2012-2017 term of government. The Environment Bureau collaborated with Transport and Housing Bureau, Food and Health Bureau, Development Bureau and various stakeholders to complete the plan. In June 2017, the Environment Bureau and the Environmental Protection Department of Hong Kong, China released a progress report which revealed discernible improvements in Hong Kong, China's air quality from 2013 to 2017 as a result of the CAAP. The case study provides a summary of the measure to phase out pre-Euro IV diesel commercial vehicles – from the rationalization until the evaluation of its effectiveness (HK, China Environment Bureau, 2013; HK, China Environment Bureau, 2017).

CASE STUDY: Demonstrating roadside air quality improvement in Hong Kong, China's CAAP Progress Report for 2013-2017

Hong Kong, China's CAAP was comprised of six components: (a) Improving air quality and its management system; (b) Reducing roadside pollution; (c) Reducing marine emissions; (d) Emission control of power plants; (e) Emission control of non-road mobile machinery; and (f) Mainland and regional collaboration. Each of these six components had its own M&E system.

To reduce roadside pollution, one of the government's end-of-pipe solutions involved targeting three types of high polluting vehicles. These were (a) pre-Euro IV diesel commercial vehicles (DCV),

(b) inadequately maintained liquefied petroleum gas (LPG) and petrol vehicles, and (c) Euro II and Euro III franchised buses. The vehicle types were selected based on the comprehensive baseline assessment showing these to be the dominant sources of $PM_{10}$ and $NO_X$ despite comprising a small percentage of Hong Kong, China's vehicle fleet:

FIGURE 9 Types and numbers of registered vehicles in Hong Kong (as at December 2012)

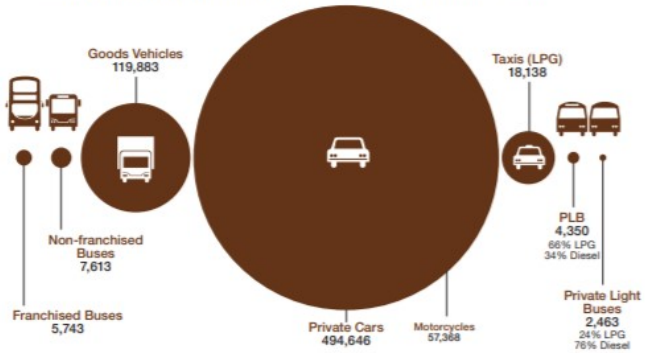
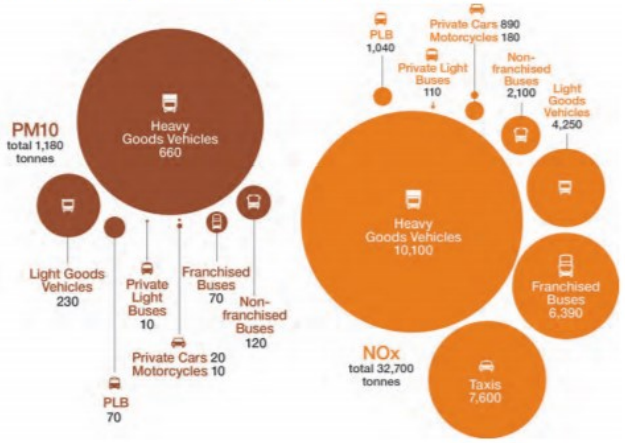
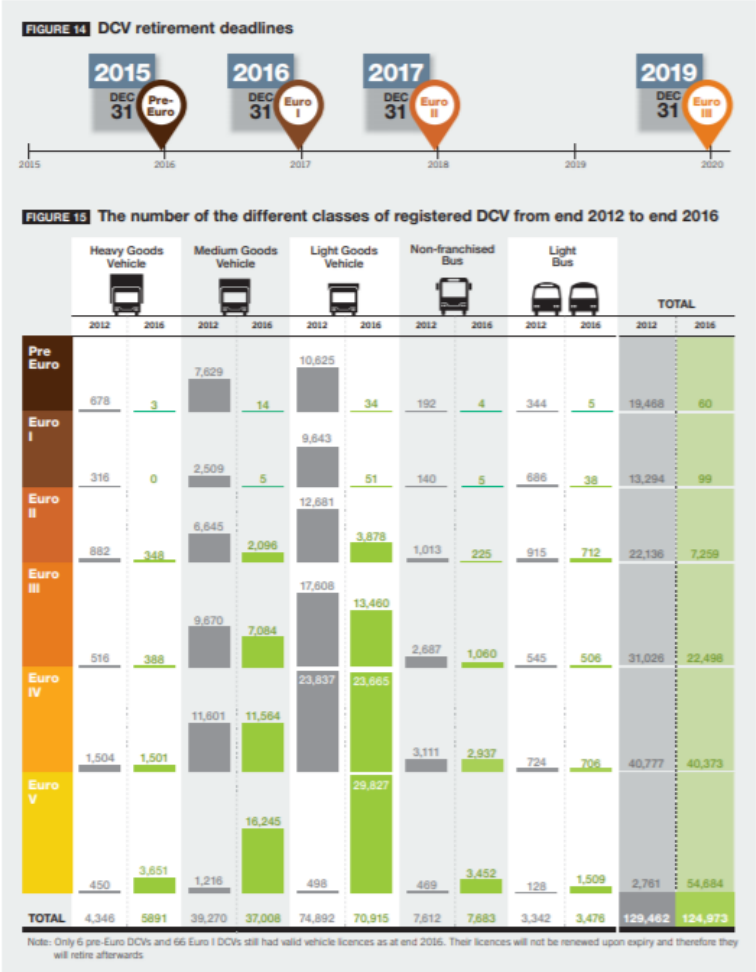


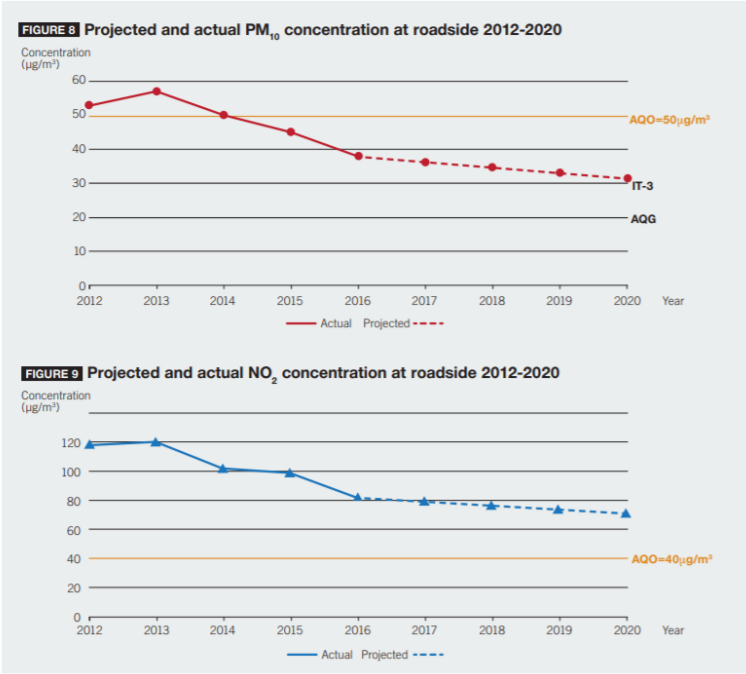

FIGURE 10 Emissions profiles of Hong Kong's vehicular fleet (as in 2011)




To address the first type of vehicles – pre-Euro IV diesel commercial vehicles (DCV) which include goods vehicles, light buses and non-franchised buses – the government came up with phased scheme for retiring Pre-Euro until Euro III vehicles. The evaluation for this measure, of course, included tracking the number of vehicles registered under the different classes of DCV from Pre-Euro to Euro V. The data that between 2012 to 2016, nearly all Pre-Euro and Euro I DCV have been phased out. The remaining DCV are expected to be phased out upon expiry of the vehicle licenses. Moreover, significant progress was shown in phasing out Euro II and III DCV.




To show the collective impact of all the roadside pollution control measures, the government shared actual roadside $PM_{10}/NO_X$ air quality monitoring data from 2012 to 2016 and projected concentrations from 2016 until 2020. The data exhibited a decreasing trend starting in 2013 (start of CAAP implementation). $PM_{10}$ concentrations showed compliance with Hong Kong, China's air quality guidelines since 2014. On the other hand, the government acknowledged that compliance with the national guidelines for $NO_X$ may be more challenging and will require more aggressive strategies.




(HK, China Environment Bureau, 2013; HK, China Environment Bureau, 2017)

**Step 3.4: Develop a communication plan**

Air quality communication aims to raise awareness, change attitudes and foster behavior change in support of the city's AQM efforts. A CAAP will only be considered to have served its purpose if the pollution control measures in the plan are adopted by policymakers and stakeholders. Communication promotes cooperation and collaboration by conveying the relevance and benefits of the measures to stakeholders. An effective air quality communication strategy considers the intended outcomes of the communication activities, target audience, key messages and communication channels to be utilized (Clean Air Asia, 2016 as cited in Clean Air Asia and UNEP 2019).

The steps on developing a communication plan within the context of a CAAP is available in the module on Communications planning for cities.

**STEP 4: Work towards mainstreaming AQM and the CAAP into the city's urban development**

To ensure that the CAAP is fully implemented is aligned with the city's overall development goals and plans, AQM and the CAAP must be mainstreamed into the city's urban development. This can be facilitated through: (1) integrating air quality management into governance, institutional arrangements and processes and (2) including air quality goals and considerations in the city's overall development goals, performance indicators and plans. Guidance for doing so can be found in the module on Guide to mainstreaming air quality and climate measures in urban development.

## CAAP OUTLINE: MARIKINA CITY, PHILIPPINES EXAMPLE

The outline of Marikina City's CAAP, completed in 2019, is shown in the box below.

**Clean Air Action Plan Outline: Marikina City, Philippines**

1. Preface

2. Executive Summary

3. Introduction
 a) Geography and topography
 b) Demography
 c) Development and priority thrusts of the city
 d) Drivers of air pollution and greenhouse gas emissions (Population growth, Urbanization, Economic activities, Transportation, Energy consumption)

4. Status of air quality
 a) Air quality monitoring data
 b) Pollution sources (Point, Area and Mobile Sources)
 c) Air pollution-related diseases (Mortality and Morbidity rates)
 d) Institutional framework within the city for AQM
 e) Existing air quality programs at the city-level
 d) Key AQM issues

5. Improving the city's air quality
 a. Baselining of the city's AQM capacity
 b. Summary of stakeholder engagement activities and inputs obtained

6. Towards a healthy and livable city
 a. Short-term pollution reduction measures
 b. Medium-term pollution reduction measures
 c. Long-term pollution reduction measures
 d. Measures to improve the city's AQM capacity

Source: Clean Air Asia, 2019

## TIMEFRAME

The approach for developing a CAAP will determine the timeline for its completion. For example, if existing air quality monitoring or emissions inventory data from local universities will be used, less time will be needed than if the city needs to install new monitors or collect additional data. Likewise, the frequency of stakeholder meetings and the level of participation that will be asked from them

throughout the entire process will impact the overall timeline. The objectives of developing the CAAP itself and the available resources will also determine the timeframe for CAAP development. The general formulation of a CAAP will take around 10 to 12 months with an implementation period of 3 to 5 years.

## BEYOND CAAP DEVELOPMENT AND IMPLEMENTATION

Aside from implementing the CAAP, performing M&E, and continuing the iterative CAAP cycle, it is suggested that the lessons learned from CAAP development and implementation be shared with other cities or countries. This creates opportunities for knowledge sharing and collaboration towards continued improvement of air quality and AQM capacity.

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