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

CITY SOLUTIONS TOOLKIT:

DEVELOPMENT OF SOURCE AND EMISSIONS DATABASE

BACKGROUND INFORMATION

An emissions inventory (EI) is a complete listing, by source, of the amounts of air pollutants actually or potentially discharged into the atmosphere within a given geographic scope over a definite period of time (Clean Air Asia, 2016). Developing an EI involves compiling databases of information through different data collections and calculations. This pool of information is significant in air quality management (AQM), particularly in planning and implementation of AQM programs and initiatives. The data and information from such databases can be used for modeling and assessment, and prioritization of emission reduction measures and policies.

The development of an extensive source and emissions database is a good start for AQM. However, surveys and data collections can be very tasking and expensive to do. Thus, compiling a well-designed database with a data collection strategy would optimize available resources. The goal is to create informative and well-represented data sets, which could be used for policy formulation across sectors.

The practice of database development for emissions and sources are not well documented in the region. The goal of this module is to itemize the process of creating source and emissions databases embedded within the EI development process. This aims to facilitate the streamlining of data collection processes at the city-level, to contribute to the development of more extensive inventory at a national or even regional level.

THE METHODOLOGY

An emission and source database is an organized collection of air emissions data, which indicates quantities of emissions, sources and categories, and location. It could also include well-documented calculations with assumptions and values used. It is often developed through extensive data gathering and collated using formal design and modeling techniques (See module on [Data availability assessment and collection methods]). The following are the recommended steps in developing an emissions and source database.

1. Planning process and establishment of a working group

The development of comprehensive database is an integral part of compiling an EI. It usually commences with the establishment of a working group, often headed by the city environment office. This is comprised of technical officers from local government offices, with representatives from the academe to provide guidance, and civil society groups to provide input. The working group shall lead the planning and oversee the process of EI development, including the database creation. This shall include considering the items specified below (US EPA, 2017):

1. Objectives and end-user requirements of the inventory,
2. Identification of the geographical inventory area,
3. Consideration of all important sources,
4. Compatibility of defined source categories with available source and emission information,
5. Detailed source categories to facilitate control strategy projections,
6. Selection of an inventory data handling system,
7. Definition of data reporting formats,
8. Selection and documentation of quality assurance procedures,
9. Staff and budget allocations,
10. Logistical needs for data collection,
11. Identification of existing emissions estimates,
12. Determination of the temporal basis of emissions,
13. Determination of best collection methods for data,
14. Selection of the inventory base year,
15. Compilation of the frequency of emissions,
16. Adjustment of seasonal variations of emissions, and
17. Decisions made on emissions projections and projection period.

The usual timeframe for conducting an EI is six months (minimum) to one year, depending on the level of detail required or the EI approach that is agreed upon (See module on Data availability assessment and collection methods). It must be ensured that resources are allocated for all activities related to data collection, analysis and even reporting of the data (See modules on Air quality data analysis and utilization for different objectives and Data visualization of emissions inventory results).

2. Development of a database

There are three main source categories of emissions, namely stationary, mobile and area sources. The team can go through each of the categories and perform the following general steps: (1) identification of sources of emissions, (2) collection of activity data and emission factors, and (3) quantification of emissions.

The following section elaborates the steps for database creation for each emission source categories (Clean Air Asia and UN Environment, 2019).

STATIONARY (OR POINT) SOURCE INVENTORIES

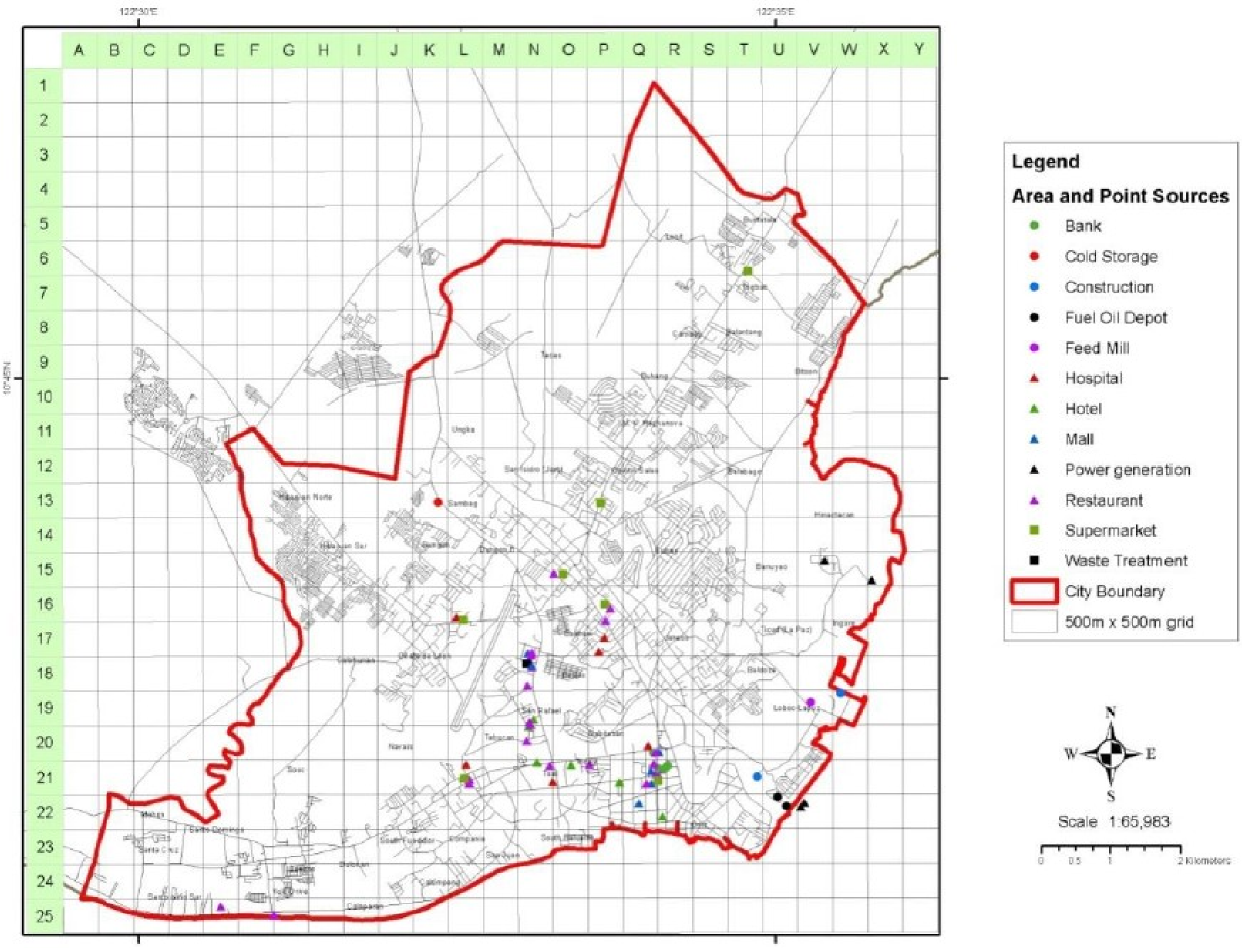
STEP 1: Identify source categories to determine emissions. This can be done through the following steps:

a. Examine if there are any past EI efforts in the area;
b. Look at permit files, source and compliance tests and review emission characterization documents;
c. Prepare a list of potential source categories based on the pollutants of interest;
    i. Eliminate any source categories not found in the study area, or which has no emission reduction methods available;
    ii. Separate point from area and line source categories;
d. Examine emission factors and estimation tools and decide on methodology;
    i. Prioritize sources by amount of emissions in each category;
    ii. Refine prioritization through expertise and experience while based on prior standards and researches;
e. Consider budget and time constraints to conduct the inventory; and
f. Document decisions to ensure transparency and consistency with future emissions inventories.

STEP 2: **Once the source categories have been determined, identify specific point sources within the study area.** Useful data sources for identifying potential/existing stationary sources include:

- Existing inventories;
- Inspection reports, self-monitoring reports, compliance reports, and permit files;
- Local information such as telephone directories or business license databases;
- Information from professional organizations such as trade associations, chamber of commerce and industry, and academic institutions (if applicable).

In identifying the point sources, it is important that aside from the name of the establishment/ facility /company, the classification of each is also done (e.g. food establishment/restaurant, manufacturing, power plant, etc.) for ease of data clustering in the analysis stage. For each point source identified, the coordinate location should be specified as well for ease of mapping. The image below is an example of point (and area) sources mapped in Iloilo City, Philippines, when an EI was developed for the city. Spatial mapping of the emissions sources can help in putting into perspective the geographical location and proximity of emission sources from each other.



The above figure is a sample point and area source map from an EI conducted in Iloilo City, Philippines. (ASEAN- GIZ, 2015)

STEP 3: **Create a list of potential sources, including name, location, size, and stationary source category.**

In the Iloilo study, one category of point sources is the power sector and was listed as follows:

Sources		Technology Type	Location
The power generation facilities in Iloilo City include a thermal diesel power plant and two power barges by the National Power Corporation (NPC)	Panay Power Corporation	Diesel thermal power plant	Brgy. Ignore, Lapuz, Lapaz, Iloilo City
	National Power Corporation Barge 101	Diesel thermal power plant	Brgy. Mansaya, Lapuz, Lapaz, Iloilo City
	National Power Corporation Barge 102	Diesel thermal power plant	Brgy. Mansaya, Lapuz, Lapaz, Iloilo City

Source: (ASEAN- GIZ, 2015)

STEP 4: **Collate facility activity data for use in the emissions calculations.** The following information sources and activities should be considered:

- Use of surveys, emissions declarations, and questionnaires;
- Direct plant inspection reports;
- Permit applications and files;
- Industrial directories;
- Commerce and labour statistics;
- National directories of manufacturers;
- Data compiled by private research and development companies;
- Trade and professional associations; and
- Similar facilities in other countries.

Step 5: Quantify emissions for point sources

It is possible to continuously monitor pollutant emissions of sources, but this requires extensive resources and labor to determine individual emission rates. Under these circumstances, it is common to model emissions by using general emission factors for point, area and line sources. Most emissions can be estimated using the simple relation (WHO, 1993; GAPF, 2012):

E = A • EF

Where:

E = emission rate [mass of pollutant/time unit];

A = activity rate [activity unit/time unit];
EF = emission factor [mass of pollutant/activity unit].

The emission factor (EF) is a representative value that attempts to relate the mass of a pollutant released to the atmosphere, with an activity associated with the release of that pollutant.

The mass of pollutant may be expressed in grams (g), kilograms (kg) or tons. Emission factors are based from literature through published experiments and compiled by regulatory agencies (See module on Compendium of emission factors).

Direct emission measurement provides the most accurate emissions estimate but requires large resources. In case direct measurements cannot be done, appropriate emission factors are selected from existing compilations.

An alternative formulation of this equation is (US EPA, 2016a):

E = A • EFU • [1 – ER/100]

Where:

E = emission rate [mass of pollutant/time unit];

A = activity rate [activity unit/time unit];

EFU = emission factor of uncontrolled process [mass of pollutant/activity unit];

ER = overall emission reduction efficiency (per cent)

This is used if the database also consists of how much emissions were reduced because of management technology. The overall emission reduction efficiency (ER) refers to the level of pollutant capture that a particular control device produces.

The ER term in the above equation is a measure of the recovery in the process. Recovery depends on similar parameters to emissions such as the activity, type and age of technology. Defects in the operation of equipment designed to capture emissions through a control device can result in a substantial increase in emissions.

Air pollution inventories include data from large-scale facilities and industries called 'large point sources (LPS)' which produce significant emissions (e.g. power plants, refineries, chemical industries, etc.).

Data for LPS can be based on

1. Direct emission measurements,
2. Calculations from emission factors, and
3. Mass balance considerations.

Important notes:

- In combining data from LPS with data estimated from aggregated EFs and activity data (e.g. at the country level), it is important to check that emissions are not double counted and that the inventory is complete.
- In applying measurements to determine emissions, it is necessary to adhere to accepted standards.
- Emission factors need to be used with care, as adjustments in EFs may need to consider the differences in operating conditions, fuels and resource materials. Thus, EFs can also be area or country-specific even if these are referring to the same process (e.g. vehicle emissions in Europe for the same age of vehicle can be different from that of in an Asian city). Check literature of any specific EFs or calculations more appropriate for your city or country.
- Almost all of the information needed to perform an EI for stationary sources, especially the activity data, is recorded by the facility/company and are usually submitted to government offices (i.e. environment; trade and industry offices; energy department).

AREA SOURCE INVENTORIES

Area sources can be geographically dispersed and are often aggregated by source categories such as residential areas or household activities (e.g. open burning of wastes and other materials); small business activities (e.g. service stations, dry-cleaning facilities); agricultural burning; forest and bush fires; as well as other natural/biogenic sources (e.g. volcanic eruptions). A sample table of source category information is shown below. (These were the indicated area sources found in Iloilo City, Philippines (ASEAN- GIZ, 2015).

Categories	Facilities
Household cooking	Fuel use (charcoal, wood, LPG, kerosene)
Commercial cooking and baking	Bakeries, eatery/grilling
Other household sources	Animal manure, pesticides, garbage, mosquito coil, candles
Agricultural sources	Crop residue burning, fertilizer application, pesticides
Other commercial sources	
Evaporative emissions	Storage tank, refuelling, fuel depot, gas stations wastewater, slaughtering
Cremation	Funeral parlor
Landfill	Waste treatment facilities, controlled dumpsite/landfill
Solvents	
Welding	
Generator sets	Household, commercial facilities, banks, malls, etc.
Fuel Depot	

STEP1: **Map out the source categories mentioned above through previous methods of data collection the areas in the city/jurisdiction.**

STEP2: **Collect activity data**

While almost all information from stationary sources are recorded by the company/facility and submitted to the government, the gathering of activity data to calculate emissions from area sources is a bit more challenging. Through a top-down approach (See module on Data availability assessment and collection methods), general information can be obtained from national census/statistics offices which can provide data on population, number of households, fuel consumption, number of constructed structures, length of roads built, among others. Household area sources for instance, are usually underestimated since some census data is extrapolated, while unregulated activities such as waste burning does not have regular patterns. Although requires more time and resources, a bottom-up approach can provide more accurate activity data that can be used to calculate for area source emissions. The following tables are sample surveys from the Iloilo City Emissions Inventory report

(ASEAN- GIZ, 2015):

Source	Sample	Population
Cooking	7,350	222,526
Animal husbandry	1,890	53,696
Candle usage	1,744	49,225
Open burning	1,302	36,039
Mosquito coil usage	1,537	45,041
Pesticide surface application	1,846	53,566

Sample fuel use-related activity data under 'cooking':

Fuel Type	Fuel Usage per Fuel Type (kg)			Total Fuel Usage per Fuel Type (kg)
	Household	Grilling/Carinderia	Bakeries	
Charcoal (kg)	13,284,109	3,793,013	1,224	**17,078,364**
Kerosene (L)	25,707	690	144	**26,540**
LPG (kg)	1,583,801	86,450	60	**1,729,855**
Wood (kg)	1,758,142	35,726	25,536	**1.819,404**

Source: (ASEAN-GIZ,2015)

STEP3: Calculate emissions using the basic formula to estimate emissions of area sources:

Emissions from area sources can be calculated as the product of activity data and the EF, similar to the basic calculation of emissions from stationary sources.

E= A • EF

Where:

- **E** = emission rate [mass of pollutant/time unit];
- **A** = activity rate [activity unit/time unit]. For area sources, activity is accumulated over the area of interest, for example, fuel consumption or production process of a district.
- **EF** = customized/average emission factor over the area of interest [mass of pollutant/activity unit];

It is ideal to use local EFs if available, otherwise EFs that are based on national or census data can be used. Localized EFs are preferred when national-level emission factors do not account for local variation.

Important notes:

There are several specific EI details that should be considered when determining what information to gather from an area source:

- Geographical scope (i.e. city, district, province);
- Magnitude of pollutant levels (e.g. consider only area source emission above 5 tons per year of pollutant); and

- Source type (e.g. construction works with lower particle emission levels than wildfires).

Area sources are numerous sources of air pollution emitting over a relatively small area or extended sources, which cannot be classified as a point source. Completing the area source inventory involves the following steps:

- Calculate emissions from the various area sources, using similar formulae as for point sources but with appropriately averaged EFs;
- Avoid duplication between area source and point source inventories. A key concern is the overlapping of area and point source categories. Take note that point sources usually have a localized outlet where pollutants are emitted (e.g. medium to large scale industries and facilities with stack emissions) while area sources are all emissions sources emitted over an area (not belonging to point and mobile sources). It is hence imperative to closely coordinate efforts in developing databases for the two inventories if there's no existing consolidated databases for all sources to avoid double counting.
- Make temporal and spatial adjustments, if necessary;
- Ensure quality assurance and quality control; and
- Prepare proper documentation.

MOBILE (ON-ROAD) INVENTORIES

Mobile sources of emissions are road-plying vehicles which transport passengers and goods. In this subsection, we discuss the basic formula for calculating emissions from on-road sources and the factors which influence the EI process.

Factors that influence mobile (on-road) inventories

The input parameters needed for a mobile (on-road) EI include the following (Clean Air Asia, 2016; US EPA, 2016b):

- Number and vehicle fleet composition (share of light duty vehicles, separated gasoline, CNG, liquefied petroleum gas (LPG) and diesel, trucks differentiated between medium and heavy duty, buses differentiated between urban buses and coaches, other heavy vehicles);
- Vehicle fleet information (i.e. age distribution, inspection and maintenance level, annual mileage);
- Number of vehicles meeting different emission standards;
- Road network information (i.e. road length, slope);
- Vehicle speed and acceleration information depending on the road category (i.e. urban, rural, highway);
- Meteorological conditions, day/night fluctuations, seasonal changes;
- Total fuel consumption and characterization (i.e. sulphur level, vapour pressure, aromatic and alcohol content).

For parameters such as average trip length, cylinder displacement, and the numbers of cold and hot starts, default values (statistical activity data) can be used. All of these are also part of the databases.

STEP1: **Count the number of vehicles covered.** For a given distance of road, count the number of vehicles that passes through, and classify per type (i.e. heavy-duty, light-duty, passenger car, bus, etc.). For experienced transport specialists, classification based on fuel used (i.e. gasoline or diesel) and engine (i.e. EURO classification) is also done. This can be done through manual street side counting or with the use of CCTV videos covering the span of the road of interest, which is more convenient. Representative vehicle counts should be done for weekdays (except Mondays and Fridays where heavier traffic flow is expected) and weekends and/or holidays.

If there are no available CCTV videos, national statistics data on the number of registered vehicles can be used to estimate the vehicle volume in specific roads, as well as to provide data on percent share of vehicle type, fuel use and engine type.

STEP2: Calculate emissions using the basic formula to estimate emissions of on-road mobile sources

Instead of the general 'activity data' that was accounted for in the stationary and area sources, the specific number of vehicles covered in the EI study must be known to be able to calculate for the emission rate. The total distance travelled by the vehicle must also be accounted for, as in the formula (EEA, 2016):

$$\mathbf{E = N \times VKT \times EF}$$

Where:

E = Emission rate [mass of pollutant/time unit];

N = Number of vehicle [veh.]

VKT= Mileage or distance travelled per vehicle [km/veh.]

EF = Emission factor [mass of pollutant/km];

The EFs to be used can be based from established references, but local EFs are always preferred.

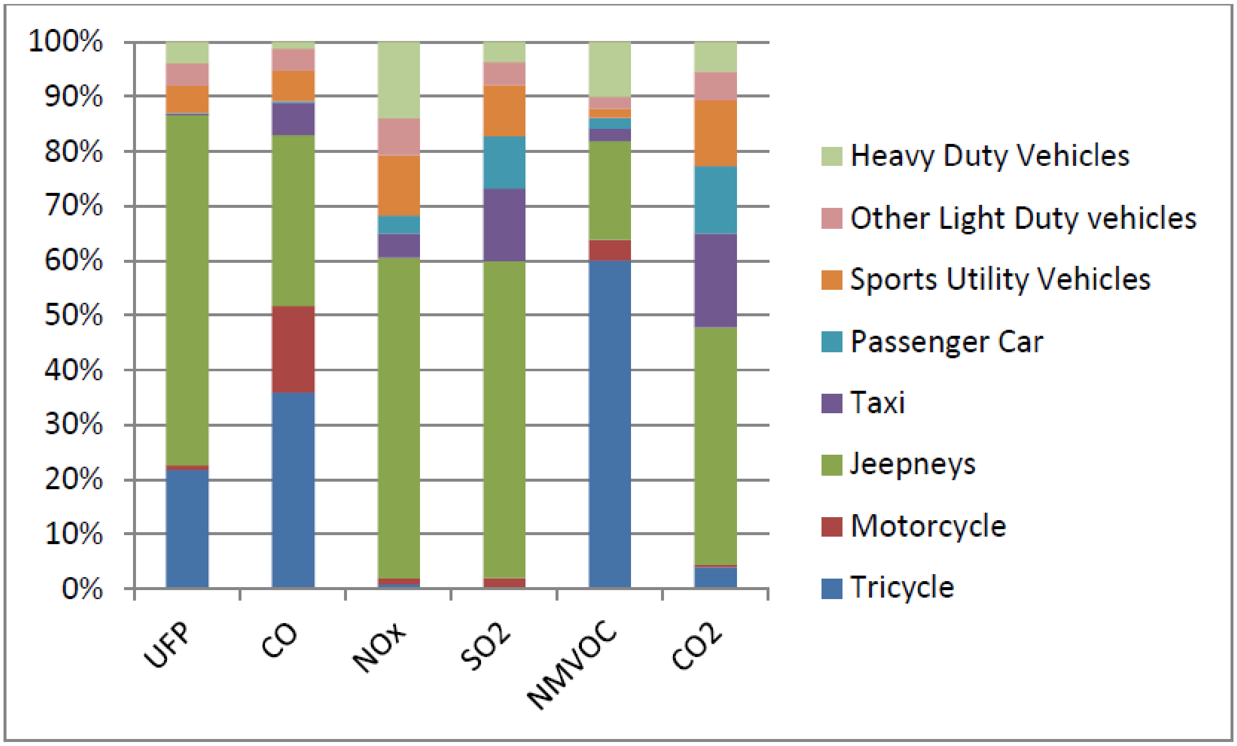
Important notes:

- A more accurate EI can be performed if data on per person length of the trip and driving behavior is also accounted for since more efficient driving lead to lower emissions (Clean Air Asia, 2016).
- Vehicle load must also be considered particularly for heavy duty trucks.
- Traffic congestion and road infrastructure also influence driving time and thus emissions by

vehicles.

- Implemented policies related to vehicle control and fuel standards also define the amount of pollutant emissions.

Sample mobile emissions data is shown in the figure below, from the mobile EI of Iloilo City. For almost all pollutants, the most significant emissions contribution is from jeepneys (local public vehicle), except for non-methane volatile organic compounds (VOCs) that are mainly contributed by tricycles.



Source: (ASEAN-GIZ, 2015)

MOBILE (OFF-ROAD) INVENTORIES

Off-road or 'non-road' EIs cover vehicles, engines, and equipment for various purposes (e.g. agriculture, construction, forestry, household and garden), and also include sport boats, passenger ships and other locomotives. The estimation of off-road machinery emissions is more complicated and inaccurate than for on-road vehicles. The problem is two-fold. Firstly, the EFs have higher uncertainty because this sector is diverse, each with unique conditions. Secondly, the activity data are less known than for on-road vehicles.

Determine availability of the following information (needed to establish an inventory for the off-road sector):

- number of engines,
- size,
- age distribution,
- fuel quality,

- duration of use, and
- average power used.

The method and calculation are similar with mobile on-road EIs. Consider the time that vehicles are running and provide a justifiable assumption to the behavior such as distance travelled, and power used.

EMISSIONS INVENTORY FOR NATURAL SOURCES

Natural (biogenic) sources include emissions of pollutants from volcanoes, deserts, seawater spread, accidental forest fires, lightning, forest/bush fires and biogenic emissions from swamps, forests, and other vegetation (US EPA, 2018a). This source category is difficult to control as processes based on natural phenomena and the source strengths occur unpredictably and therefore are not well-established. Natural sources are important sources of H_2S, CH_4, CO_2, VOCs and Radon (Rn) some of which are carcinogenic pollutants and precursors of regional O_3.

Non-anthropogenic biogenic CO_2 emissions are related to the natural carbon cycle. In contrast, anthropogenic biogenic CO_2 emissions are not considered as emissions from natural sources since they result from the combustion, harvest, digestion, fermentation, decomposition, or processing of biologically based materials (US EPA, 2018a). It can be complex, it is thus better to understand how to measure biogenic emissions and identify its sources.

Step 1: **Collect data** on the following:

- Locations of the natural sources
- Vegetation cover
- Land use
- Temperature
- Solar radiation

Step 2: Use modeling techniques

There is no accurate way to continuously monitor most of the natural sources, so modeling is utilized. The model inputs tend to be horizontally allocated (gridded) data, and the outputs are gridded biogenic emissions, which can then be utilized as input to photochemical grid models (US EPA, 2016a). See module on Air Quality Modeling Tools for Cities.

One of the easiest tools to use on database development and EI calculations is the Atmospheric Brown Clouds (ABC) Emission Inventory Manual, developed by the Asian Institute of Technology (AIT) through UN Environment. Building on other major EI manuals (i.e. EMEP/CORINAIR Guidebook, IPCC Guidelines, GAPF, EMEP/EEA revised guidelines), the ABC manual covers emissions of criteria and climate pollutants through compilations of existing EFs. An emissions calculation Excel file has been developed to complement the ABC EI Manual. For more information, please visit http://www.rrcap.ait.asia/Publications/ABC%20Emission%20Inventory%20Manual.pdf.

CASE STUDIES

There are two main approaches in conducting an EI. The top-down and bottom-up approach. Both approaches can be employed in order to balance availability of existing data and resources.
The case study below on residential coal consumption in People's Republic of China further describes the importance of combining both approaches to have a more reliable EI for air quality decision making. This presents an example of a source inventory:

Emissions Inventory of household coal consumption in People's Republic of China

The study aims to establish a high-resolution gridded EI in the Beijing-Tianjin-Hebei (BTH) region using the available EFs of air pollutants (SO_2, NH_3, NOx, CO, VOCs, BC, OC, $PM_{2.5}$ and PM_{10}) from household coal combustion.

Methodology:

- Bottom up method based on the activity data of residential coal consumption (performed especially because the actual data for household energy consumption is much higher than the statistical data)
- Top down approach using country-level data (historical coal consumption) which was obtained from 2010 census, and used to extrapolate all over the region
- Emission factors used were from previous local experimental studies
- Emission inventory results were compared with

Results:

- Results show that the actual average amount of residential coal consumption is over 0.7 t/yr per capita in 2013, which is higher than the census-reported value of 0.15 t/yr per capita.
- Due to different parameters used, the results of the study is two to six times lower than REAS (based on average surface temperature, full text at: https://doi.org/10.5194/acp-13-11019-2013) but higher than EDGAR (based on energy statistics data, full text at: https://doi.org/10.5194/acp-16-3825-2016) and MEIC (based on underestimated coal consumption, full text at: https://doi.org/10.5194/acp-17-1227-2017).

Conclusion:

The method of combining a top-down (statistical data) and bottom-up approach (survey information) yields the most reasonable emissions inventory for residential combustion sector.

The full study can be accessed through this link: https://doi.org/10.1016/j.scitotenv.2016.12.143

[Source: Miaomiao et al. (2016)]

Mobile Emissions Inventory in Beijing and Shanghai

A comparison study of vehicle activity and emission inventory between Beijing and Shanghai tackled systemic method of establishing emissions inventory for mobile sources for air quality study. The two cities were chosen because although they have similar vehicle fleet characteristics, different local policies on vehicles are being implemented. Aside from determining air pollutant emissions, city governments can benefit from knowing the implication of different policies on emissions generation.

Methodology:

- Vehicle distribution data was collected through video recordings on roadsides and actual surveys.
- Driving pattern data was obtained through computerized GPS technology that can measure vehicle location, speed, and altitude; volunteer drivers were also involved.
- Vehicle engine start patterns were collected using vehicle operating characteristics enunciators (VOCEs), which record vehicle system voltage per second. From this, information on the vehicle start time, operation period and idling time was obtained.
- The International Vehicle Emissions (IVE) model based on driving cycles and has basic emission factors for 1371 vehicle types, was used to calculate for the emissions

Results:

- The on-road vehicle emissions for Beijing are as follows: 3 tons (t) of PM, 199 t of NOx, 192 t of hydrocarbons (HC), and 2403 t of CO; while for Shanghai: 4 t of PM, 189 t of NOx, 113 t of HC, and 1009 t of CO.
- Although both cities have high daily travel of passenger cars and average fleet age is similar, they have different policies that resulted in different vehicle EFs, type distribution and diurnal travel. In Shanghai, getting a license for private passenger cars is more expensive. The fleet is therefore a mix of passenger cars, two-wheelers (motorcycles and mopeds) and taxis. Beijing on the other hand, is dominated by passenger vehicles but has less truck traffic which is restricted during daytime within the inner city. Beijing implements a stringent single vehicle emission standard that led to the low emission factor of single vehicles, while Shanghai successfully controlled the vehicle population, especially of private cars.

[Source: Liu et al. (2007)]

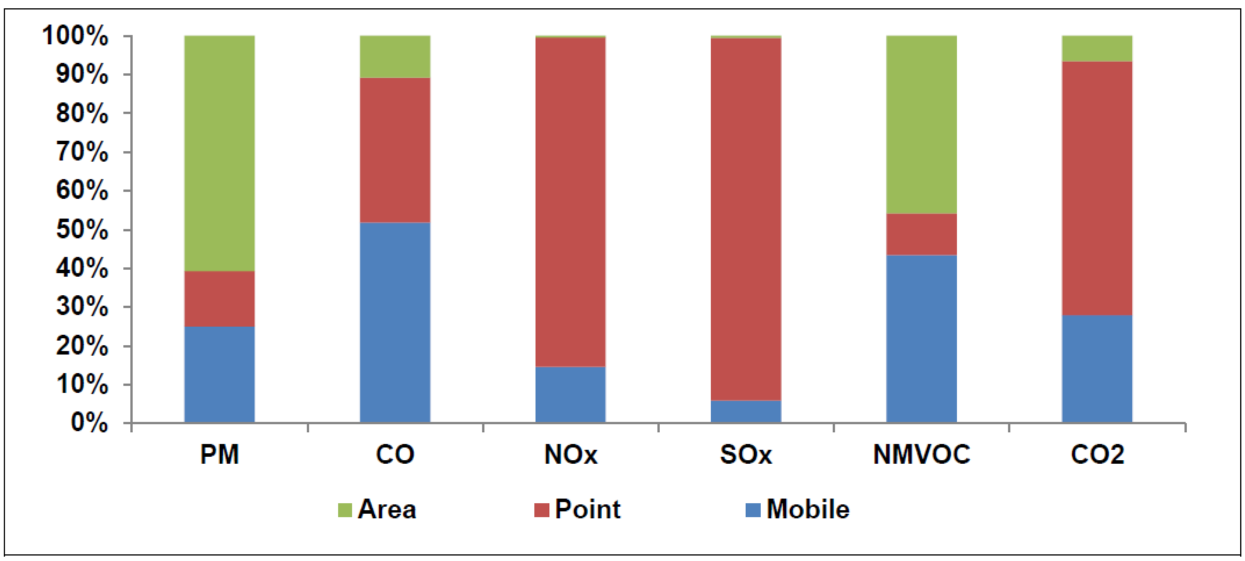
2015 Emissions Inventory Report, Iloilo City, Philippines

An emissions inventory is a requirement for any city in order to come up with an effective Air Quality Management program. An emissions inventory generated using top-down approach will not provide the spatial distribution of the air pollutant emissions in the city. The bottom-up approach allows the emissions to be mapped with a high degree of resolution. Shown below are results packaged as total emissions for the entire city of Iloilo.

(PM10+UFP)		CO	NO_X	SO_X	NMVOC	CO2
Mobile	200	2,753	1,285	225	774	169,839
Point	115	1,980	7,459	3,604	192	397,653
Area	485	571	33	17	815	39,559
Total	**800**	**5,304**	**8,777**	**3,846**	**1,781**	**607,051**

Source: (ASEAN-GIZ, 2015)

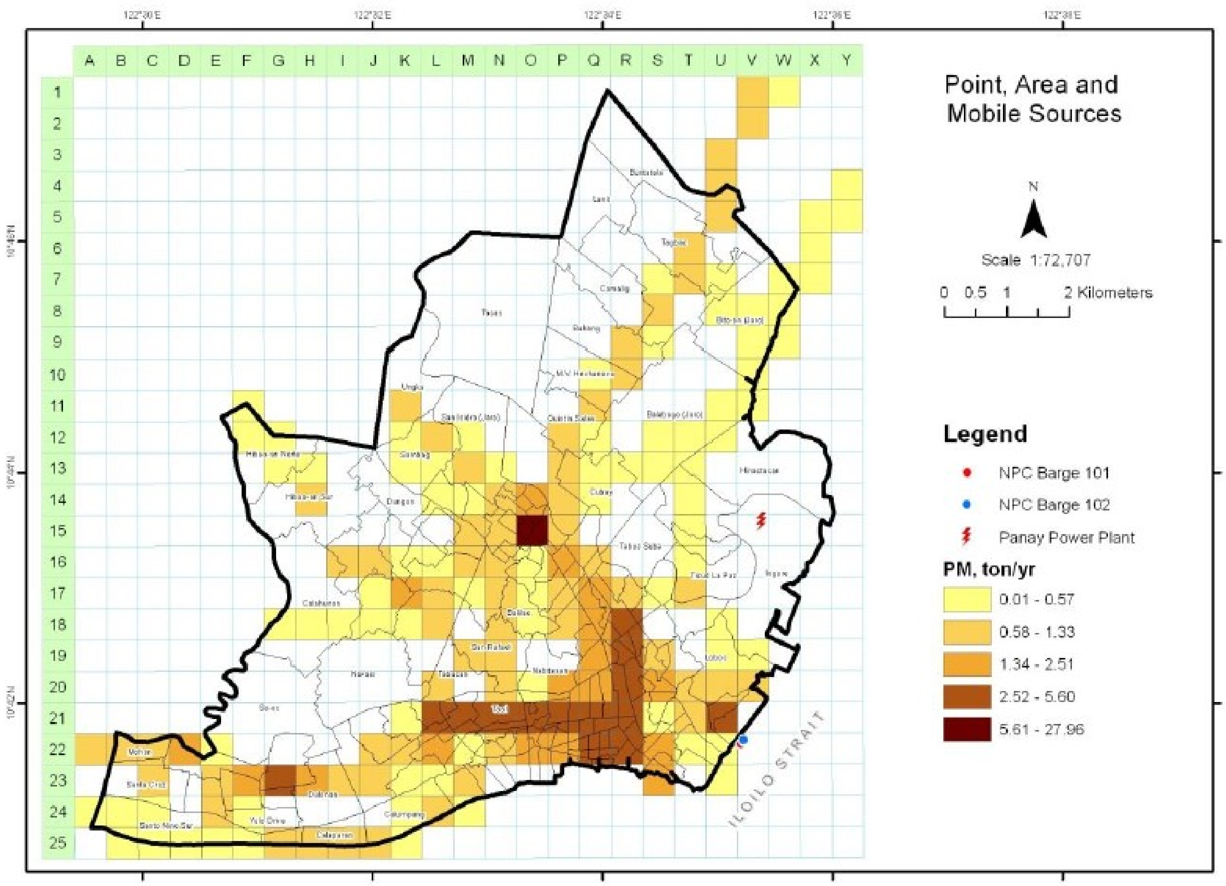
Visually, one can show the emissions through a bar graph: Labelled as 'percent share emission breakdown by major source'

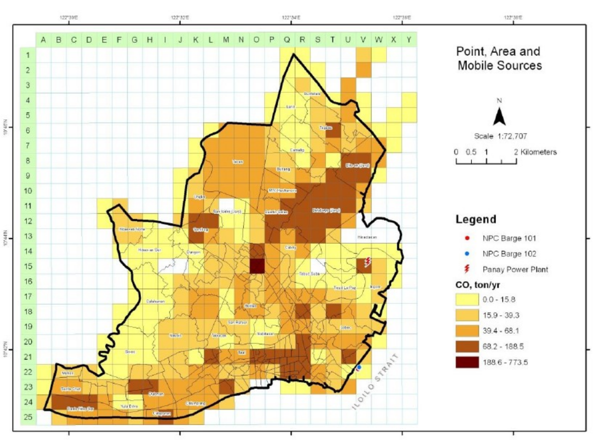


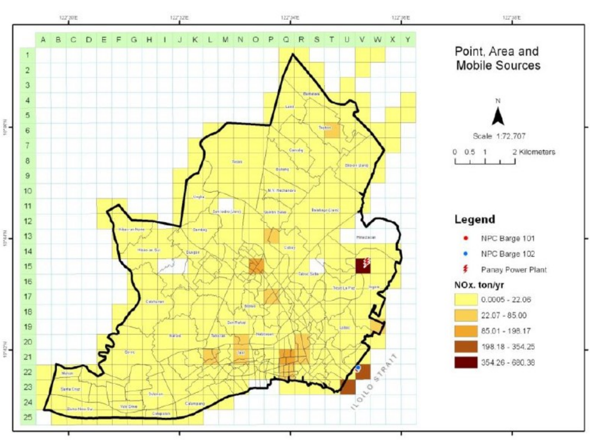
Source: (ASEAN-GIZ, 2015)

In the report, it is best to show complete information so the raw data in tables should still be placed. Bar graphs help in the visualization but again the main value of this topic is to be able to contribute to the database of EIs where actual numbers are paramount. After which the appropriate communication of the data through maps should be done to make the information accessible to stakeholder. The following section show samples of these. More detailed guidance is provided by the module on [Data visualization of emissions inventory results](#).

After the full EI is done, the pollutant concentrations contributed by all emissions sources can be presented in a map just like what was done in Iloilo City. In the map below, it can be seen that the study area has been divided into grids, and a color gradient represents the level of particulate matter (PM) in tons/year, with the legend showing that the darker the color, the higher the emissions. The same was done for other pollutants CO, NOx, SOx, NMVOC and CO2 (ASEAN-GIZ, 2015).







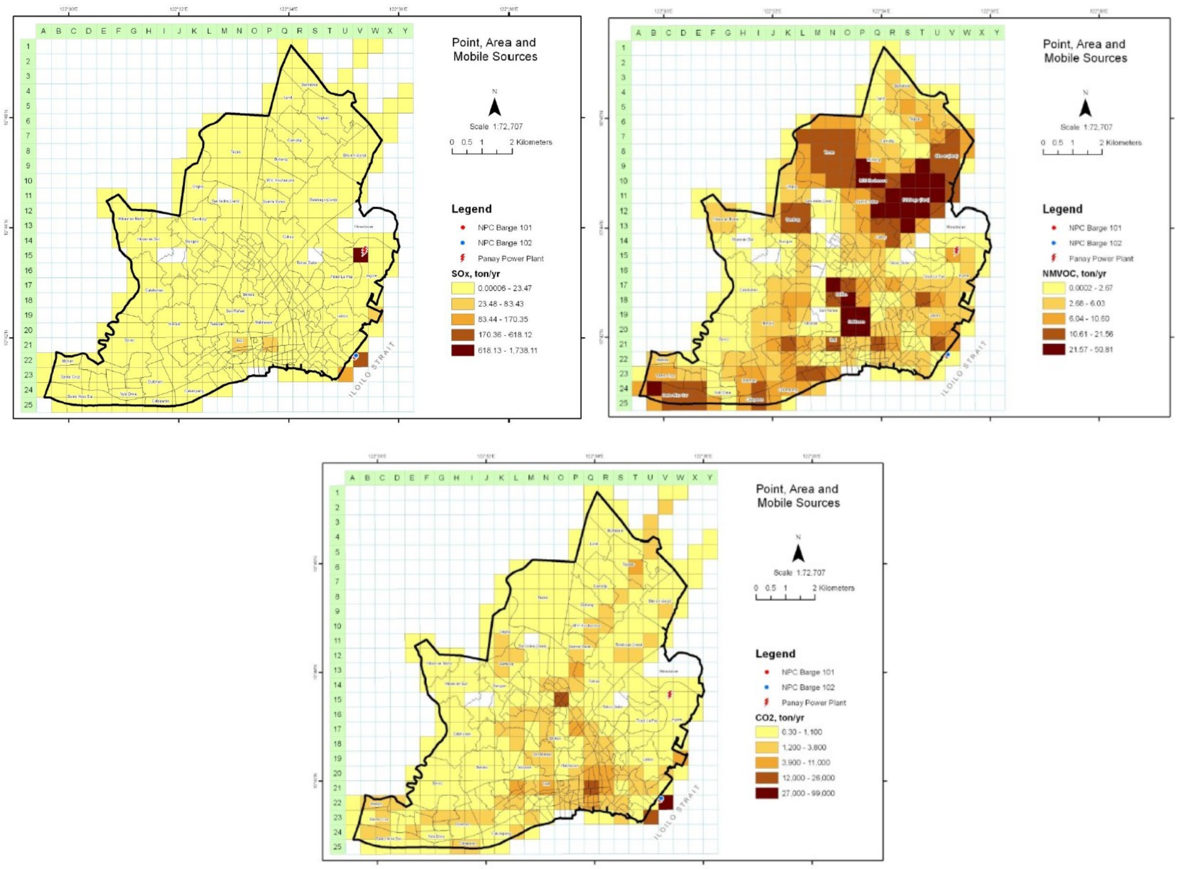


Image source: (ASEAN-GIZ, 2015)

Spatial maps of emissions identify which part of the city has the highest pollutants and must thus be prioritized for action by air quality managers, policymakers, and stakeholders. The data can be assessed together with air quality monitoring data, meteorological data, and geospatial location of emission sources. Having easy to understand maps also has more appeal to policymakers since it tells the story without having to present so much numbers. Kindly refer to the module on Data visualization of emissions inventory results for other methods on how to present data from EI databases.

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