OVERVIEW OF AIR QUALITY IMPACT ASSESSMENT

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  - Air quality modelling
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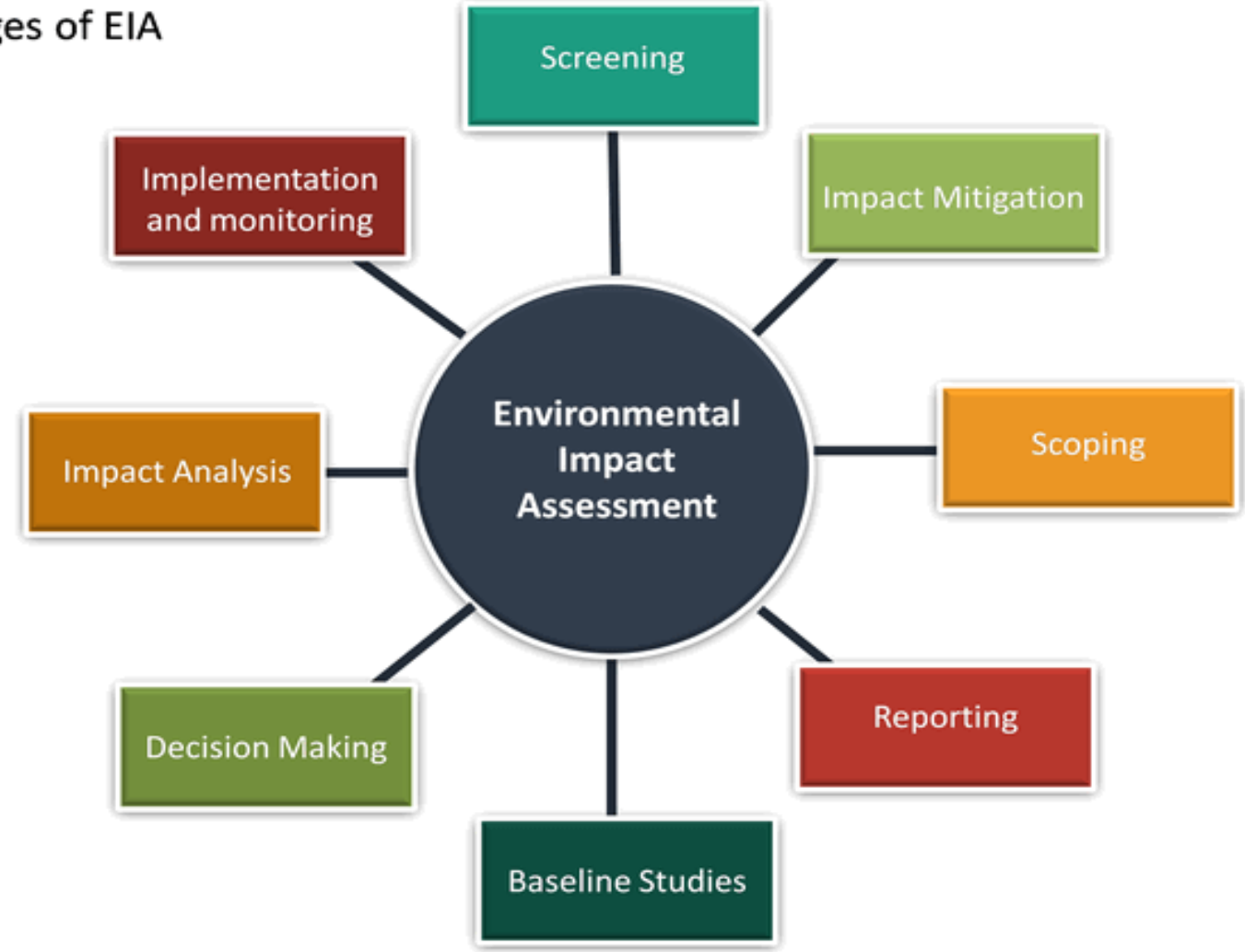
MEANING AND DEFINITION

- Environmental Impact Assessment (EIA) is the process of examining the anticipated direct and indirect environmental impacts of a proposed project or activity in order to determine appropriate mitigation measures and monitoring programs. It is generally used as a tool for environmental management.
- In general, Environmental Impact Assessment (EIA) system is for decision making to consider environmental, social and health impacts before project proceeding.
- Air pollution impact assessment or air quality impact assessment is an important part of EIA system. Air pollution impact assessment can be used for strategic environmental assessment and planning.
- Several essential steps of air quality impact assessment are source identification, prediction, and evaluation of critical variables and potential changes of air quality in the interested area, which are related to the projects or activities.

ENVIRONMENT IMPACT ASSESSMENT

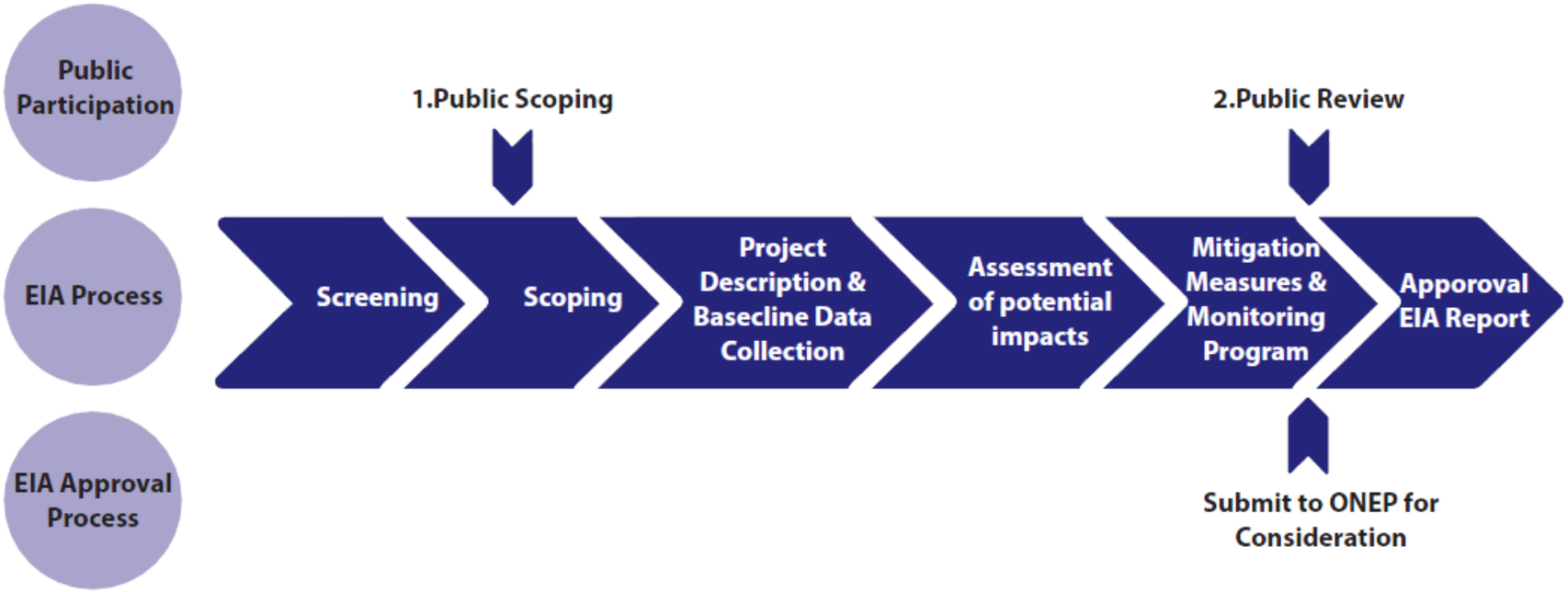
Key Stages of EIA



EIA System in ASEAN

Country	What are the tools of EIA?
Thailand	• Initial Environmental Examination (IEE) • Environmental Impact Assessment (EIA) • Environmental Health Impact Assessment (EHIA)
Brunei	Environmental Impact Analysis (EIA)
Cambodia	• Initial Environmental Impact Assessment (IEIA) • Full Environmental Impact Assessment (FEIA)
Indonesia	• Environmental Impact Analysis (AMDAL) • Environmental Management and Monitoring Efforts (UKL-UPL) • Statement of Management and Environmental Monitoring Ability (SPPL)
Lao PDR	• Initial Environmental Examination (IEE) • Environmental and Social Impact Assessment (ESIA)
Malaysia	• Preliminary Environmental Impact Assessment (PEIA) • Detailed Environmental Impact Assessment (DEIA)
Myanmar	• Initial Environmental Examination (IEE) • Environmental Impact Assessment (EIA)
The Philippines	• Initial Environmental Examination (IEE) • Environmental Impact Statement (EIS) • Environmental Performance Report and Management Plan (EPRMP)
Singapore	• Pollution Control Study (PCS) • Quantitative Risk Assessment (QRA)
Vietnam	• Environmental Impact Assessment (EIA) • Environmental Protection Plan (EPP)

Figure 1.1-1 Simplified Overview of Thailand's EIA Process



TYPES AND SIZES OF PROJECTS OR ACTIVITIES REQUIRING PREPARATION OF EIA REPORTS : EXAMPLE IN THAILAND (I)

Item	Type of projects or activities	Sizes	Principle, Method, Procedure
1.	**Mining defined by the Mineral Act:**		
	1.1 Mining projects as follow:		
	1.1.1 Coal Mining	All sizes	Submit during apply for mining concession
	1.1.2 Potash Mining	All sizes	Submit during apply for mining concession
	1.1.3 Rock Salt Mining	All sizes	Submit during apply for mining concession
	1.1.4 Limestone Mining for cement industry	All sizes	Submit during apply for mining concession
	1.1.5 All Metal Mining	All sizes	Submit during apply for mining concession
	1.2 Underground Mining Projects	All sizes	Submit during apply for mining concession
	1.3 All Mining Projects located in the following areas:		
	1.3.1 Class 1 Watershed area according to cabinet resolution	All sizes	Submit dunng apply for mining concession

TYPES AND SIZES OF PROJECTS OR ACTIVITIES REQUIRING PREPARATION OF EIA REPORTS : EXAMPLE IN THAILAND (II)

7.	Natural Gas Separation Industry or Natural Gas Reforming Industry	All sizes	Submit during apply for a permit of project construction or operation
8.	Chlor-alkaline Industry that required Sodium Chloride as raw material to produce Sodium Carbonate, Sodium Hydroxide, Hydrochloric Acid, Chlorine, Sodium Hypo-Chloride and Bleaching powder	Productivity each or total products are 100 tons/day or more	Submit during apply for a permit of project construction or operation
9.	Cement Industry	All sizes	Submit during apply for a permit of project construction or operation
10.	Pulp Industry	Productivity is 50 tons/ day or more	Submit during apply for a permit of project construction or operation
11.	Pesticide Industry or Industry producing active ingredient by	All sizes	Submit during apply for a permit of project construction or operation

AIR QUALITY IMPACT ASSESSMENT

- Air quality impact assessment (AQIA) is an important technique for determining the relative contribution to ground level pollutant concentrations of specific current or future source emissions at receptor sites. (Clark et. al,1984)
- The principal activities in AQIA are air quality modelling and monitoring techniques. The choice of techniques which are applicable to a particular situation is intimately related to the problem to be assessed.
- Objectives of AQIA are providing technical information for EIA report as well as air quality status of whatever concern.

GENERAL CONCEPT OF AIR QUALITY IMPACT ASSESSMENT (1)

- Scoping of the project
  - Scoping is the stage of identification impacts needed to be assessed. Scoping will narrow down EIA study into the significant issues. Clear definitions and limits of the project or facility, and identification of air contaminants
  - Scoping is undertaken during the initial stage of the EIA process to set the boundary conditions for the scope of study and to identify interactions between project activities that may affect environment and receptors. This process may be generally called “Terms of Reference” (TOR) and typically performed by the Project Proponent together with the EIA developers or consultants.

GENERAL CONCEPT OF AIR QUALITY IMPACT ASSESSMENT (2)

- Characterizing and quantifying emissions in the interest areas
  - Identifying existing emission sources and contaminants released
  - Defining the contaminants of potential concern
  - Accounting for spatial and temporal variability
  - Quantifying emission rates
  - Temporal resolution of emission rates

GENERAL CONCEPT OF AIR QUALITY IMPACT ASSESSMENT (3)

- Estimated air quality concentration levels in the concern areas
- Spatial/temporal variations in air quality concentrations
  - Project-specific baseline air quality measurements.
  - Existing air quality (without project)
- Unavailable input data and conservative estimates
- Use of air quality assessment modeling results
- Worst-case air quality impacts

CHARACTERIZING AND QUANTIFYING EMISSION

- Identifying emission sources and contaminants released
- Defining the contaminants of potential concern
- Accounting for spatial and temporal variability
- Quantifying emission rates
- Temporal resolution of emission rates

MODELING AIR CONCENTRATIONS AND INCORPORATING APPROPRIATE METEOROLOGICAL DATA

- Modeling air concentrations
  - Simple box model
  - Dispersion model
  - Receptor model
- How the air situation change if the project will be in the area
  - Maximum concentration
  - Location of the maximum concentration
  - Variation with the wind speed/wind direction

ESTIMATED AIR QUALITY LEVELS IN THE SURROUNDING COMMUNITY

- Model prediction
  - Maximum concentration
  - Contour of the concentration
  - Location of the maximum concentration
  - Variation with mereological data

AIR QUALITY ASSESSMENT: AMBIENT AIR QUALITY MONITORING AND EMISSION MONITORING

- Ambient air quality monitoring
  - Existing air concentrations at area of concerns
  - Significant parameters
- Emission monitoring
  - Existing emission sources identification and control activities
  - Existing emission contribution
  - Emission rate

AMBIENT AIR QUALITY MONITORING (1)

- The general nature of any pollutant monitoring is to measure the time and spatial variability of its concentrations
- Such measurement are required to satisfy monitoring program goals or data uses such as determining population exposure and ascertaining compliance with air quality standards

AMBIENT AIR QUALITY MONITORING (2)

- Ambient air monitoring is the systematic, long-term assessment of pollutant levels by measuring the quantity and types of certain pollutants in the surrounding, outdoor air.
- Ambient air monitoring is an integral part of an effective air quality management system. Reasons to collect such data include to:
  - assess the extent of pollution;
  - provide air pollution data to the general public in a timely manner;
  - support implementation of air quality goals or standards;
  - evaluate the effectiveness of emissions control strategies;
  - Provide information on air quality trends;
  - provide data for the evaluation of air quality models; and
  - support research (e.g., long-term studies of the health effects of air pollution).

Reference: https://www.epa.gov/air-quality-management-process/ambient-air-monitoring

AMBIENT AIR QUALITY MONITORING (3)

- There are different methods to measure any given pollutant. A developer of a monitoring strategy should examine the options to determine which methods are most appropriate, taking into account the main uses of the data, initial investment costs for equipment, operating costs, reliability of systems, and ease of operation.
- The locations for monitoring stations depend on the purpose of the monitoring. Most air quality monitoring networks are designed to support human health objectives, and monitoring stations are established in population centers. They may be near busy roads, in city centers, or at locations of particular concern (e.g., a school, hospital, particular emissions sources). Monitoring stations also may be established to determine background pollution levels, away from urban areas and emissions sources.
- Systems are needed to ensure that data are of acceptable quality, to record and store the data, and to analyze the data and present results.

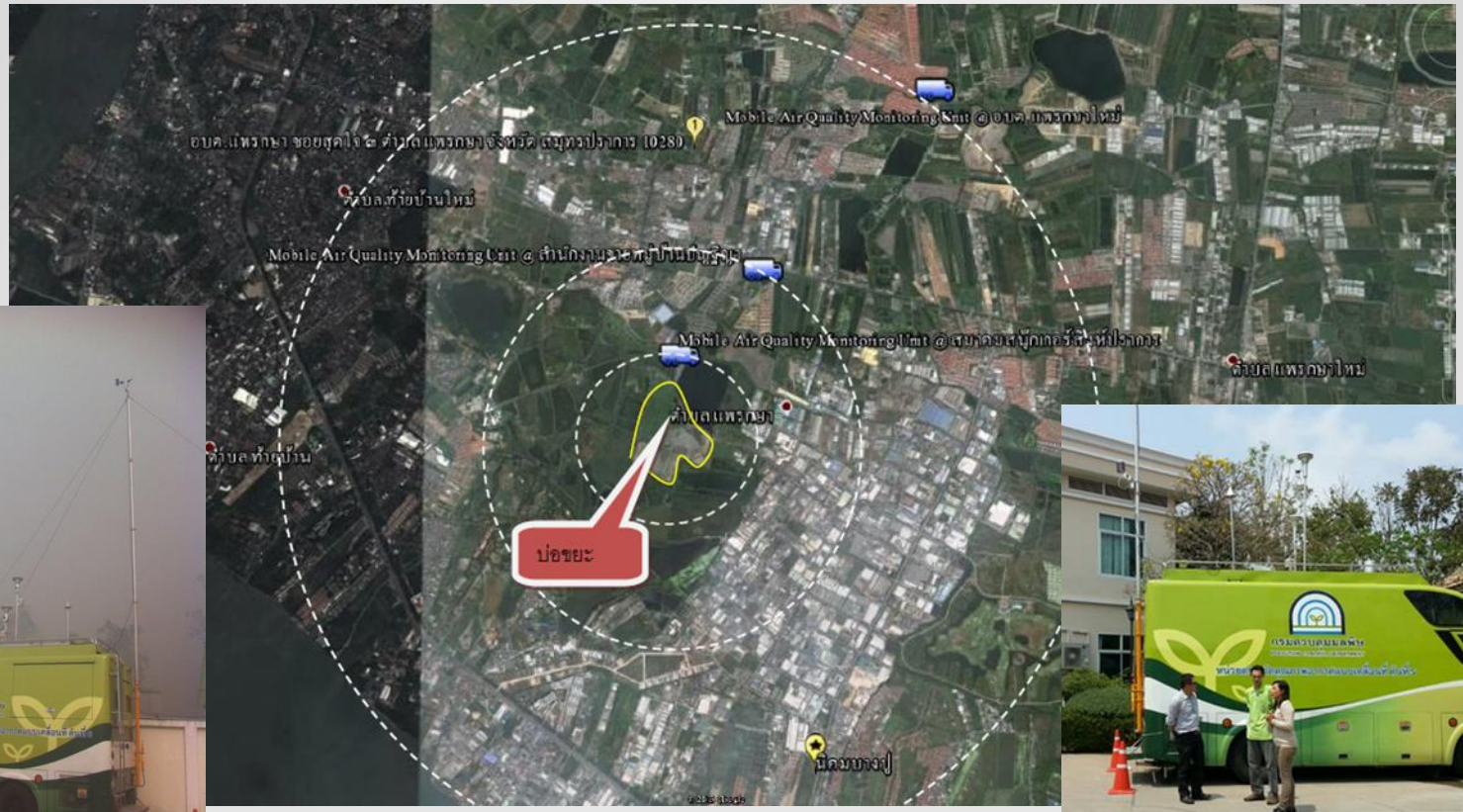
Reference: https://www.epa.gov/air-quality-management-process/ambient-air-monitoring

AMBIENT AIR QUALITY MONITORING TSP AND PM_{10} MONITORING

AMBIENT AIR QUALITY MONITORING: ROADSIDE STATIONS - TSP $PM_{2.5}/PM_{10}$

AMBIENT AIR QUALITY MONITORING PM_{10} AND $PM_{2.5}$ MONITORING

EXAMPLE OF AMBIENT AIR QUALITY MONITORING BY MOBILE UNITS DURING THE SOLID WASTE SITE BURNING EPISODE



AIR MODELING FOR AIR QUALITY ASSESSMENT (1)

- Simple Box model is the simple atmospheric dispersion model, which can be used to calculate ground-level concentrations of specific air pollutants of concern emitted from the project-activity. A box model is based on the assumption that pollutants emitted to the atmosphere are uniformly mixed in a volume, or “box” (Canter, 1985 in Mareddy, 2017).
- The box model can be used for single-point, multiple-point, area, or line, or “hybrid-type” sources of air pollution
- The box-model results can be interpreted on a pollutant-by-pollutant basis, in relation to existing ambient-air-quality and the relevant standard. It is important to compare the sum of the existing pollutant concentration and the concentration from the proposed project or activity, as calculated from the box model, to the value given in the applicable standard.

Reference: https://www.epa.gov

BOX MODEL: EXAMPLE

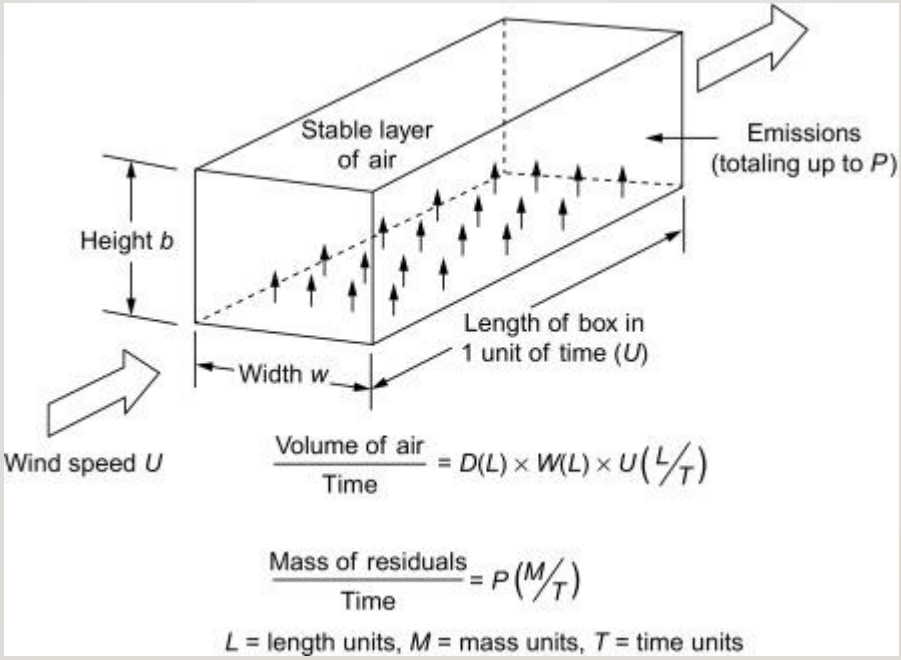


Fig. 5.4. Air available for dilution in a simple box model (Ortolano, 1985).

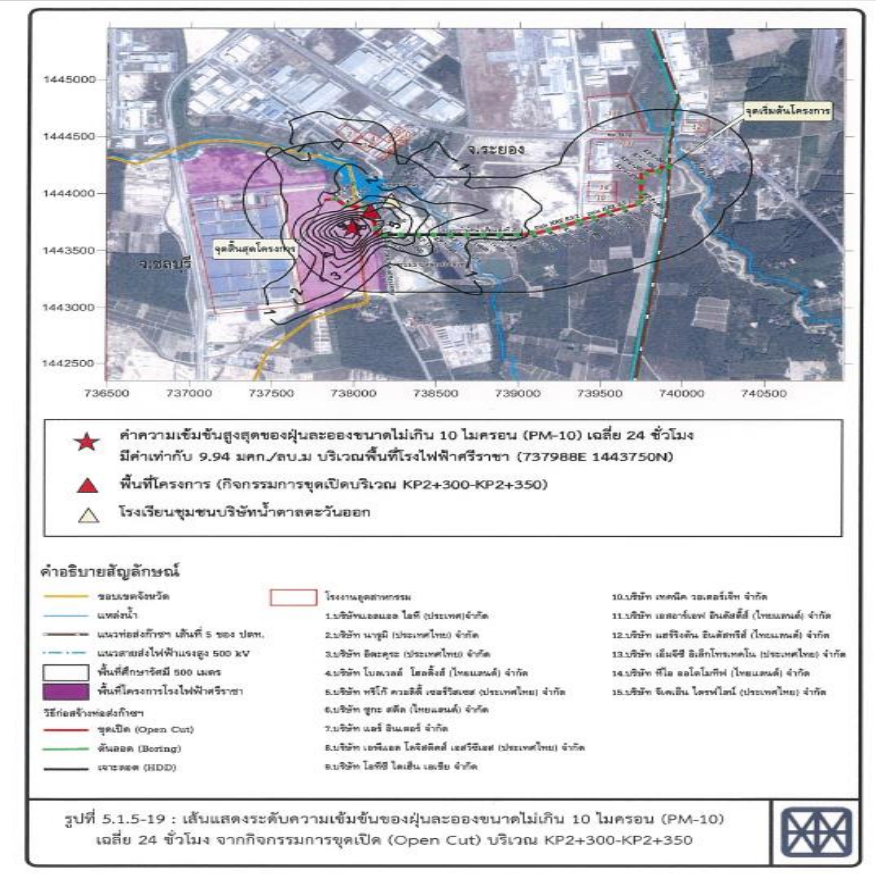
AIR MODELING FOR AIR QUALITY ASSESSMENT (2)

- Dispersion models uses mathematical formulations to characterize the atmospheric processes that disperse a pollutant emitted by a source. Based on emissions and meteorological inputs, a dispersion model can be used to predict concentrations at selected downwind receptor locations. Example: AERMOD, CALpuff
- Receptor models are mathematical or statistical procedures for identifying and quantifying the sources of air pollutants at a receptor location. The EPA has developed the Chemical Mass Balance (CMB) and Unmix models as well as the Positive Matrix Factorization (PMF) method for use in air quality management.

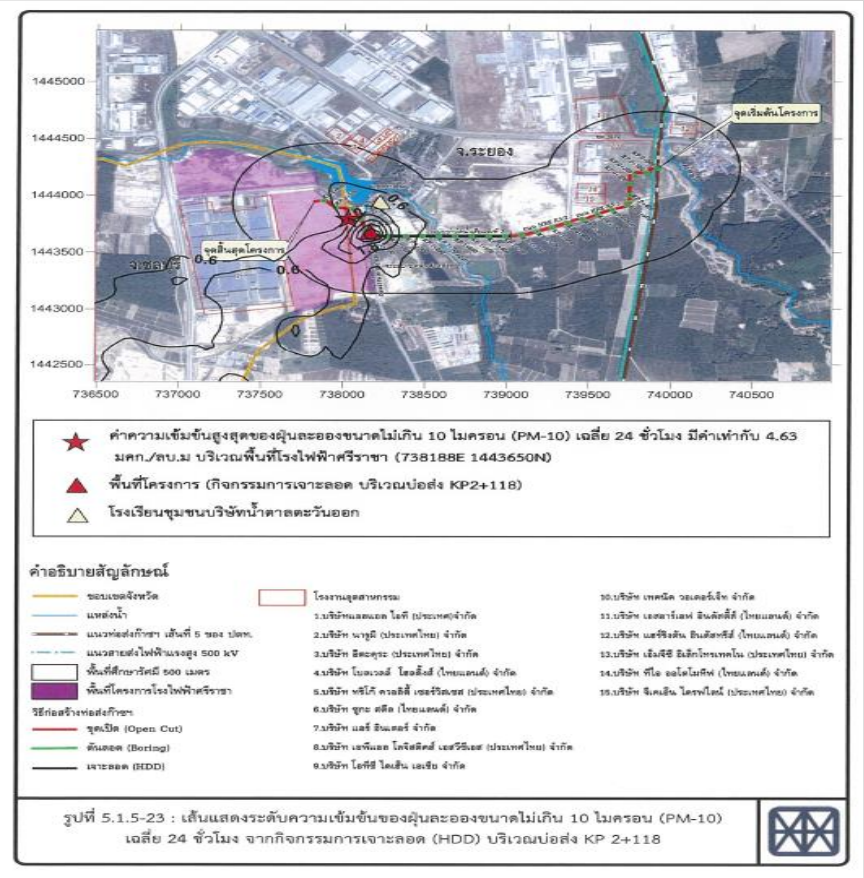
Reference: https://www.epa.gov

AIR QUALITY STATUS ESTIMATED BY BOX MODEL (EXAMPLE CASE IN THAILAND)

EXAMPLE OF DISPERSION MODEL IN EIA STUDY



รูปที่ 5.1.5-19 : เส้นแสดงระดับความเข้มข้นของฝุ่นละอองขนาดไม่เกิน 10 ไมครอน (PM-10) เฉลี่ย 24 ชั่วโมง จากกิจกรรมการขุดเปิด (Open Cut) บริเวณ KP2+300-KP2+350



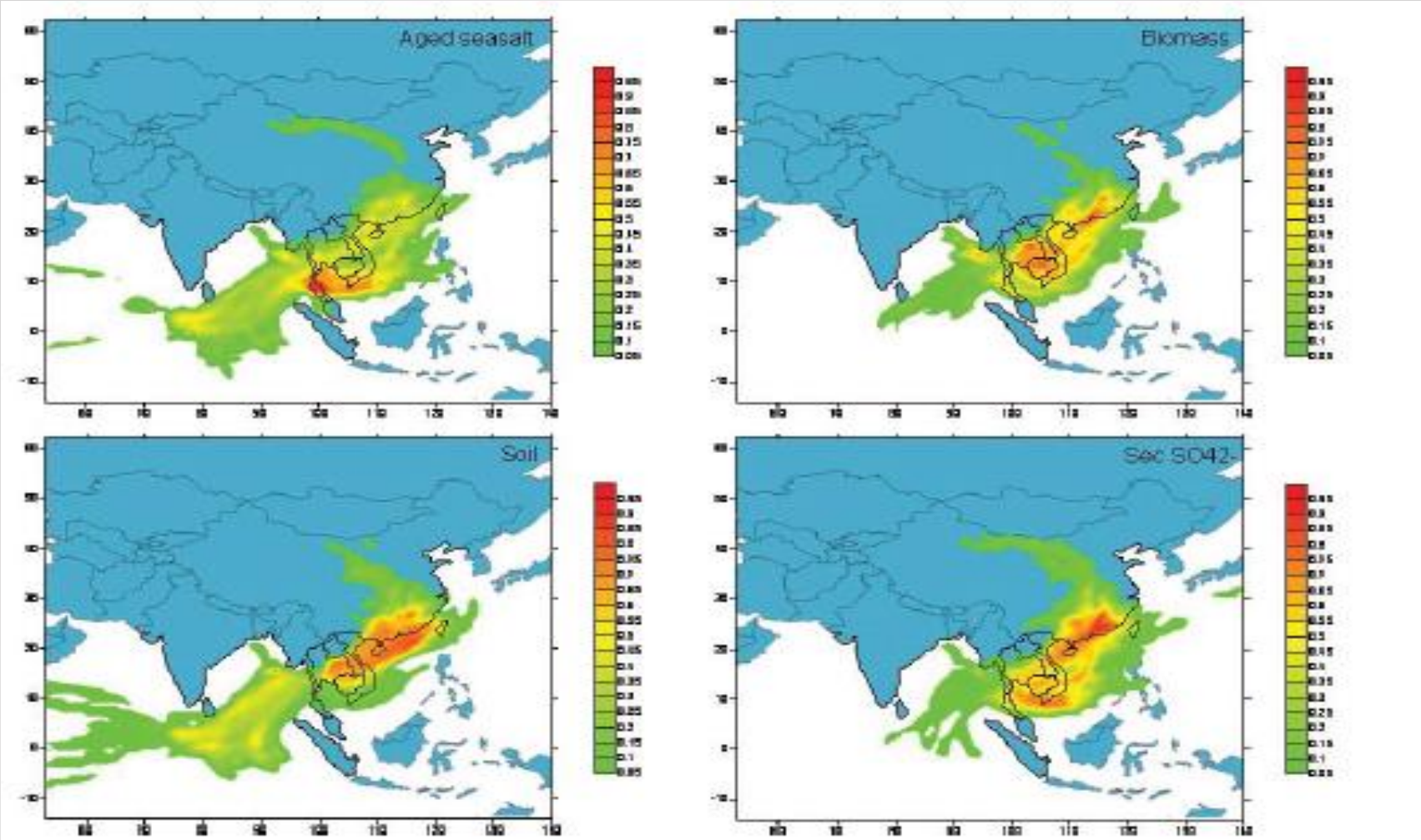
รูปที่ 5.1.5-23 : เส้นแสดงระดับความเข้มข้นของฝุ่นละอองขนาดไม่เกิน 10 ไมครอน (PM-10) เฉลี่ย 24 ชั่วโมง จากกิจกรรมการเจาะลอด (HDD) บริเวณบ่อส่ง KP 2+118

AERMOD Model : PM10 at 24 hr. Average , max. concentration 9.94 microgram/m3

Ref. Sriracha Power Plant by TEAM Consultant, Thailand

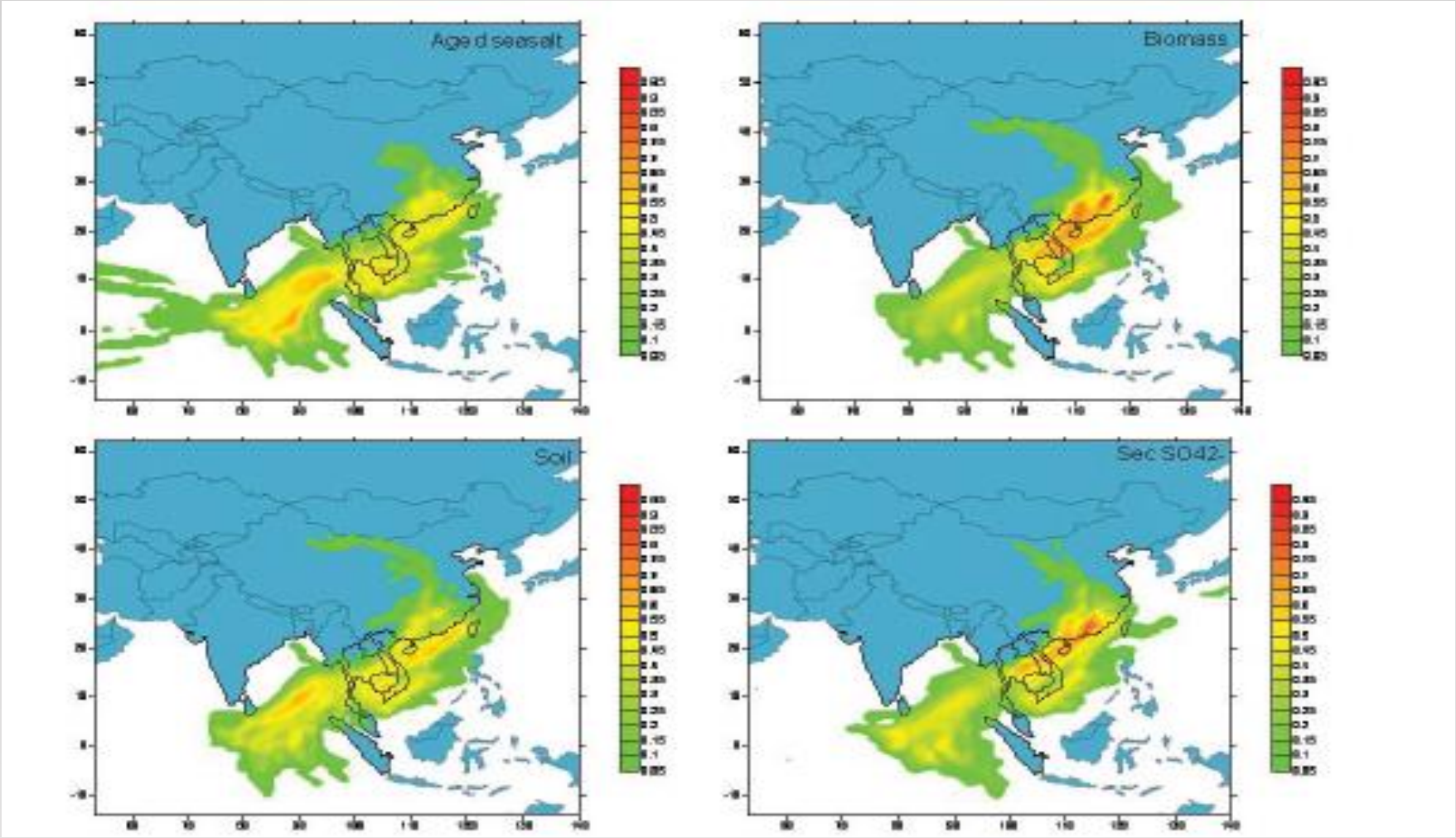
AERMOD Model : PM10 at 24 hr. Average , max. concentration 4.63 microgram/m3

Ref. Sriracha Power Plant by TEAM Consultant, Thailand



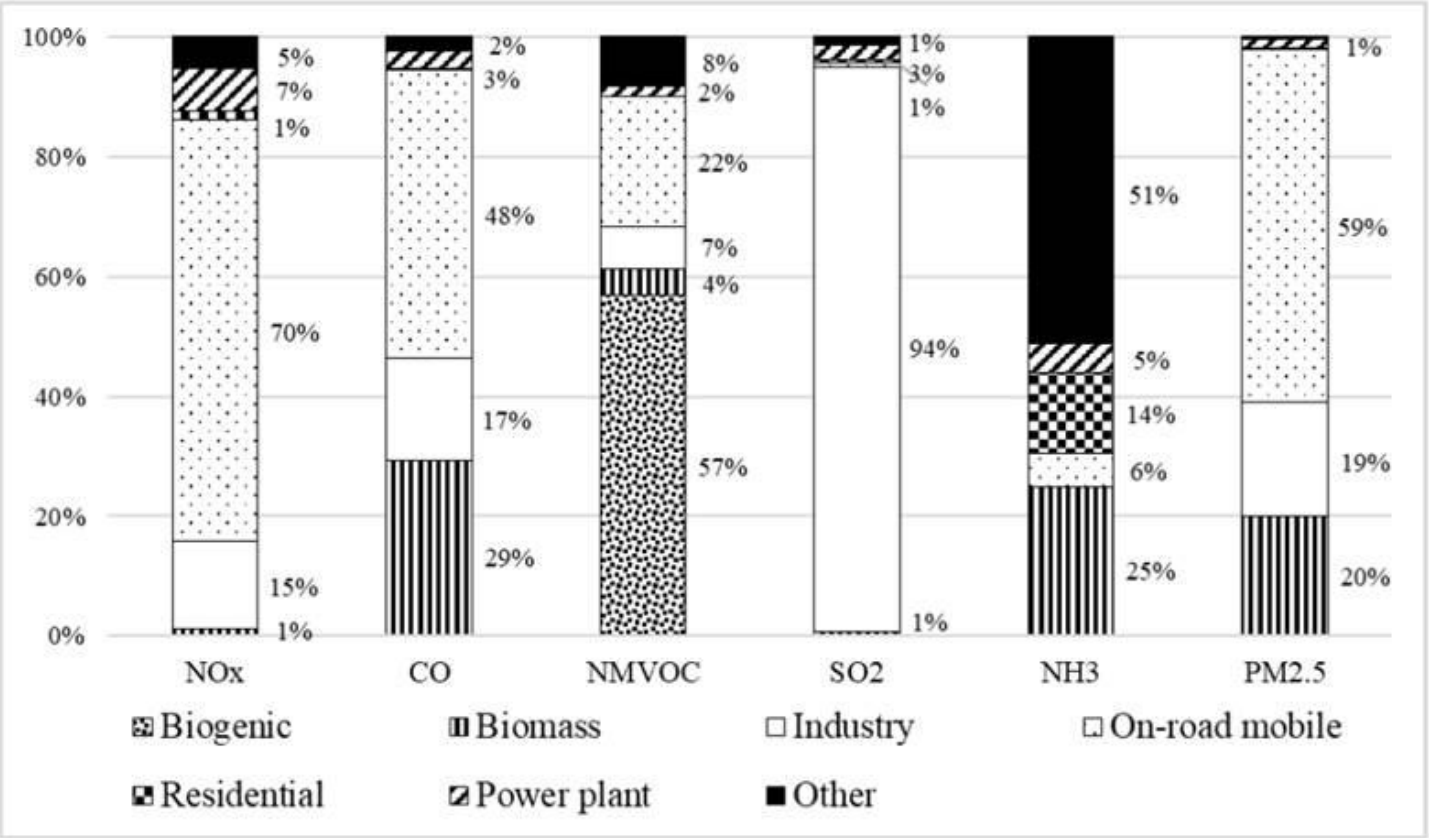
PMF Model analysis to identify potential sources of PM2.5 in Bangkok

Ref. Wimolwattanapun et al.-Atmospheric Pollution Research 2 (2011) 172-181



PMF Model analysis to identify potential sources of PM2.5 in Pathumthani

Ref. Wimolwattanapun et al.-Atmospheric Pollution Research 2 (2011) 172-181



PMF Model : Source identification of PM2.5 in Bangkok

Reference : Daiju Narita et al. ; Pollution Characteristics and Policy Actions on Fine Particulate Matter in a Growing Asian Economy: The Case of Bangkok Metropolitan Region, Atmosphere,2019

AIR QUALITY IMPACT ASSESSMENT

- No significant change
  - Continuous monitoring to examine the air quality situation and trends
- Significant change
  - Prevention and mitigation measures
  - Monitoring program : Continuous monitoring measures – Ambient air and source monitoring
- Precaution
  - Air quality impact assessment is generally not include emergency emission (unpredictable, but can be prepared necessary measures for emergency release)

SUMMARY

- The Terms of Reference of the Assessment Study should be sufficiently clear and encompassing to incorporate all sources of air emissions to be included in the AQIA.
- Worst-case air quality impacts are assessed by considering a combination of maximal emissions combined with worst-case (poor dispersion) meteorology.
- All potential sources of air emissions must be identified in order to fully identify all contaminants potentially emitted (Contaminants of Potential Concern).
- Project emissions can vary in time and space .
- Spatial and temporal variations in baseline air quality levels must be recognized and accounted for.
- Assessment input data may be estimated as long as it is estimated in a fully conservative manner or on a (more refined) probabilistic basis.
- Prevention and mitigation measures as well as continuous monitoring program are necessary. These measures should set up based on information of such specific activities and period of concern activities.

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- Clark A.1., McIntyre,, A.E. Lester, J.N.and Perry, R. Air quality impact assessment. Environ Monitoring Assessment. 1984, 4 (3):205-32. .