Preparation and appraisal Part 1

- Day 1 Session 6
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Preparation & appraisal: Session 1

Using scenario analysis, this session aims to demonstrate how we can integrate air quality in the *Preparation* and *Appraisal* stages of the project lifecycle.

Scenario setting:

There is an island/archipelago country with problems on waste management system and electricity generation

1. How would you visualize this place? *What do you think are the experience/s of the residents?*

2. What do you think are the effects of the SWM and energy challenges of the site?
   In particular, what are the air quality implications of these challenges?

3. What solutions can be done?

Real-life scenario: Malé, Maldives

- Malé is the **8th most densely populated island** in the world, which poses significant problems for **waste management and electricity generation** due to lack of available space
- In 1991, the Maldives government reclaimed the nearby lagoon of **Thilafushi as a landfill site** (6km to the west of Malé)
- Maldives is dependent on **imported diesel (44%) for electricity generation**

➢ **Open dumping and burning of waste** without any pollution controls

➢ Persistent plumes of smoke visible from Malé and nearby resorts

➢ no existing national grid – **diesel for electricity generation** required for each of the islands

➢ high costs and climate change impacts

Real-life scenario: Malé, Maldives

1. What are the **key sources of air pollution in Greater Male** in the context of the issues provided?

2. **What are the key pollutants of concern**?

Scan the QR code to answer via menti

or Join at menti.com code 8225 9037

FIGURE 2: COMMON AIR POLLUTANTS AND EMISSIONS SOURCES

Particulate matter (PM)

Complex mixture of solid and liquid particles. Some emitted directly, some formed in the atmosphere as secondary PM. Grouped by particle size, the composition of PM tends to vary by source.

Sulfur dioxide (SO_2)

A gas produced due to the burning of sulfur containing fuels. Irritant effect on nose, throat and airways. Also contributes to the formation of secondary PM.

Non-methane volatile organic compounds (NMVOCs)

Consists of a large variety of compounds, from both natural and man-made sources such as industrial processes, domestic, and agriculture. React with NO_x in the atmosphere, in the presence of sunlight, to form topospheric O_3. Also, a key source of indoor air pollution.

Ammonia (NH_3)

A gas released from natural and man-made sources, such as fertilizer, manure and wastewater. Once in the atmosphere, contributes to habitat damage through acidification and eutrophication. Also contributes to the formation of secondary PM.

Nitrogen oxides (NO_x)

A group of highly reactive gases comprising nitrogen dioxide (NO_2) and nitric oxide (NO). Mainly formed by combustion processes and largely associated with transport and energy sector emissions. A respiratory irritant that causes inflammation of the airways and may cause reduced lung development. Contributes to the formation of ground-level ozone (O_3) in the presence of

Carbon monoxide (CO)

A gas produced through the incomplete burning of fuel e.g., from the domestic and transport sectors. The highest concentrations typically present in the air can be detrimental to health.

FIGURE 3: SHORT-LIVED CLIMATE POLLUTANTS, THEIR SOURCES AND LIFETIMES

Black Carbon (BC)

A climate forcer and air pollutant, is released during the burning of fossil fuels and crude fuels such as wood, charcoal, and kerosene.

Ground-level Ozone (O_3)

An air pollutant and greenhouse gas formed by the interaction of sunlight with methane, NMVOCs, and other emissions from vehicles and industry.

Methane (CH_4)

The second most abundant greenhouse gas after carbon dioxide, is emitted by human activities, such as fossil fuel production, waste, and agriculture, as well as by natural sources.

Hydrofluorocarbons (HFCs)

Human-made greenhouse gases used in air conditioning, refrigeration, solvents, fire extinguishing systems, and aerosols.

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Real-life scenario: Malé, Maldives

1. What are the **key sources of air pollution in Greater Male** in the context of the issues provided?

- **Open burning and dumping of waste** in the surrounding area due to inadequate waste transfer infrastructure (836 tons per day waste generation)
- **Mixed waste burned** without any pollution control
- **Disel generators** are one of primary sources of energy to the islands

2. **What are the key pollutants of concern**?

PM, BC, CH_4, NOx, VOCs, SO_2, and possibly some heavy metals (e.g., Lead)

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Group Discussion

Real-life scenario: Malé, Maldives
Understanding the air quality landscape

- Using your fact-finding skills, look through the reference folder and other online sources to answer the following with your group (25 min):

3. **What are existing national AQ related legislation, regulations and policy?**
4. **Transboundary air pollution issues and how the project may interact with these.**
5. **What kind of AQ information is already available in the Maldives?**

- Place your answers in the meta cards and the flipcharts for your group

Real-life scenario: Malé, Maldives

Understanding the air quality landscape

National AQ related legislation, regulations and policy	*Transboundary air pollution issues*	*Available AQ information*
National Action Plan on Air Pollutants (2019-2030) Maldives' Third Nationally Determined Contribution	'air quality in Male' is influenced by both domestic and long range transboundary sources, especially from incomplete combustion in shipping, transport and open burning of waste' In the dry season, 90% of $PM_{2.5}$ is from transboundary sources, in remote location such as Hanimaadhoo (Budhavant et al, 2015)	'limited studies done on urban air quality with an absence of long-term monitoring' (NAP) (Noora et al. 2025): - Higher levels of $PM_{2.5}$ were measured in the dry season and the 24-h WHO-recommended level was surpassed in 67% of the days in the dry season (transboundary) -$PM_{2.5}$ concentrations in at least 93% of the days in the wet season (Apr–Oct) remained within the daily limit. - Besides vehicular emission, electricity generation, biomass burning, sea transport and construction activities are the likely local sources of $PM_{2.5}$

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Air quality landscape

- The **Maldives Ministry of Tourism and Environment** is responsible for environmental pollution monitoring
  - ➢ National Action Plan on Air Pollutants (2019-2030)
    - Increase renewable energy and more energy efficient measures
      - Supported by the Scaling-up Renewable Energy (SREP) Investment Plan
    - Stop opening burning in Thilafushi and waste-to-energy projects
  - ➢ Maldives' Third Nationally Determined Contribution
    - Develop and operationalise three regional waste management systems in the Maldives.
    - Expand composting programmes across the Maldives to promote waste-to-resource recovery.
    - Remediation of the two largest dumpsites and establish island waste and resource management centres throughout the country.
    - Meet 33% of electricity needs from renewable energy sources.

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Project Design Checklist

- The toolkit provides a checklist (p.48) that helps in understanding the project site
  - Determine the **existing national air quality related legislation, regulations and policies**, including whether there is a Clean Air Action Plan, or similar, in place and assess the implications for project design.
  - Be aware of **transboundary pollution issues** and how your project may interact with these.
- Assess what **existing data** are available to inform project planning (*see the toolbox in Section 3.2.4 for supporting information, guidance, and tools related to this*).

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At the project design stage, it's useful to undertake the following:

Project Design Checklist

Determine the existing national air quality related legislation, regulations and policies, including whether there is a Clean Air Action Plan, or similar, in place and assess the implications for project design. Relevant documentation could include:

- ☐ Regulations and policies relating to specific sectors, for example industrial or vehicle emission limits.
- ☐ National emission ceiling limits/regulations.
- ☐ Planned or in-progress sectoral actions to reduce emissions of air pollutants.
- ☐ National and/or regional agreements on air quality, including if there is an airsheds approach to air quality management.
- ☐ Clean Air Action Plans with background information on air quality, including air quality monitoring data, identification of key emission sources and a list of current and planned actions to improve air quality.
- ☐ Climate Action Plans, which often include emissions inventories and projections of greenhouse gas emissions, priority climate action plans and other information that may be relevant to air quality initiatives.
- ☐ Understand how the project may be able to support/contribute to national goals and objectives around air quality.

Be aware of transboundary pollution issues and how your project may interact with these. This may include the following considerations:

- ☐ Ensuring the project aligns with international treaties such as the UN Convention on Long-Range Transboundary Air Pollution (CLRTAP).
- ☐ Compliance with environmental regulations in both the project's location, and potentially other affected countries.
- ☐ Consider the transboundary influence of the project from an air quality perspective.
- ☐ Consider how the project might contribute to existing activities to address transboundary pollution issues.

Assess what existing data are available (see the toolbox in Section 3.2.4 for supporting information, guidance, and tools related to this). This will help to understand which pollutants may already be an issue, as well as what data may be available for setting a baseline and measuring project impacts. Data may include:

- ☐ Existing air pollution measurement infrastructure, and associated monitoring data.
- ☐ Emissions inventories and/or source apportionment studies.
- ☐ Air pollutant dispersion modelling studies.

Case Study: The ADB Greater Malé Environmental Improvement and Waste Management Project

- The project will establish a sustainable regional solid waste treatment system in the Greater Malé capital region by
  - developing treatment (proven waste-to-energy [WTE] technology), recycling and disposal infrastructure;
  - strengthening institutional capacities for sustainable solid waste services delivery and environmental monitoring; and
  - improving public awareness on WTE and reduce-reuse-recycle (3Rs).

Figure 1: Project Implementation Area

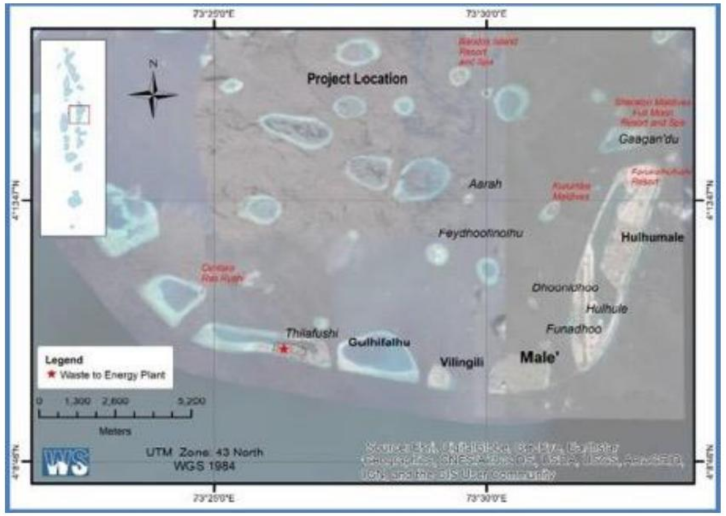
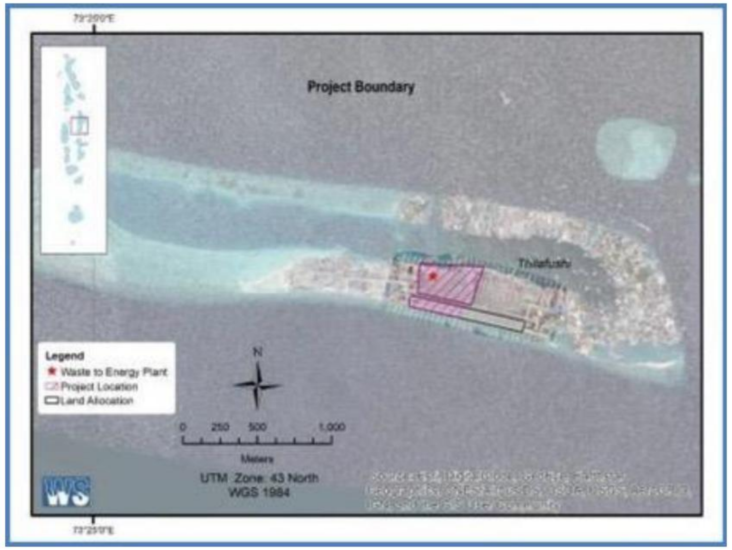


Figure 2: Proposed WTE Site in Thilafushi



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Available air quality information

Project baseline survey

- Short-term surveys carried near the existing site in 2018 and 2019 showed that **concentrations of pollutants exceeded WHO guidelines** downwind of the site during open burning
- Maximum 24-hour mean **$PM_{2.5}$ concentrations were over 15 times higher** than the WHO guidelines (350 µg/m3).
- Peak measured particulate matter concentrations exceeded 2000 µg/m^3.

Figure 15: Air quality monitoring at location AQ1 on 19rd March 2019

As per ToR additional survey for the parameter CH_4, VOC, CO_2, CO, H_2S has been undertaken at selected locations (see Methodology).

Figure 16: Air quality monitoring at location AQ3 on 20th August 2019

Images from https://www.adb.org/sites/default/files/project-documents/51077/51077-003-eia-en_2.pdf

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Case Study: Greater Malé Environmental Improvement and Waste Management Project

Phase 1:

Establishing **modern waste collection, transfer and disposal systems**, supported by building institutional capacity for sustainable services delivery and raising public awareness in reduce, reuse, recycle behaviours

Phase 2:

Construction of a **Waste-to-Energy plant** on Thilafushi and recycling and disposal infrastructure, combined with additional capacity building and public awareness campaigns.

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Group Discussion

Case study: Malé, Maldives
Identifying priority air quality options

- Based on what you know of the site, discuss with your group how you can improve the WtE project by identifying air quality measures or components that can complement or be added to the project (25 min):

Ideas on project components or measures	How it will address air pollution	Phase (1, 2, both, or additional)

- With guidance from the toolkit's **Feasibility Checklist** (p.50), what would be the top feasibility considerations from your proposed project ideas?
- Place your answers in the meta cards and the flipcharts for your group. Three (3) groups would be selected to share their work

Initial Feasibility Assessment Checklist

- Once a 'long list' of potential options has been drawn up, an initial feasibility assessment should take place
- This refine the list before more in-depth assessments of the impacts of the options takes place.
- This rapid assessment aims to produce a 'short list' of solutions for further exploration and discussion.
- A good sense check as to which solutions can be immediately ruled out, and which are likely to be most appropriate for the project's needs as a whole

(Check p.50 of the toolkit)

Initial Feasibility Assessment Checklist

- ☐ Is the cost of the proposed solution feasible? For example, is the cost to implement the solution a reasonable proportion of the total budget for the project, or would it incur an excessive cost that would jeopardize the viability of the project?
- ☐ Does the timeline to implement the proposed solution align with the timeline for implementation of the project as a whole? If the proposed solution would delay the project significantly, another option may be more appropriate.
- ☐ Are there any regulatory constraints that may prevent the proposed solution from being implemented? For example, national legislation is often required to enable Low Emission Zones to be enacted in cities.
- ☐ Is there sufficient technical capacity to implement the proposed solution? This could be within the local team on the group, within the funding agency, or via academia, consultants, or other technical experts that could be brought on to the project.
- ☐ Is the proposed solution likely to lead to increases GHG emissions? If a significant trade-off between air quality and GHGs is expected, then other solutions may be more appropriate.
- ☐ What is the potential of the solution for financial and economic returns? For example, any solution that charges penalties for non-compliance can generate revenue, and most solutions would be expected to generate an economic benefit via realization of improvements to human health.