TERMS OF REFERENCE

Developing mobile source emissions inventory & emissions inventory integration

I. Background

As part of the "Sustainable Development Strategy (SDS): Egypt Vision 2030",[1]the country committed to halving its fine particulate matter (PM_{10}) air pollution by 2030. Significant improvements have been made towards that goal in recent years. In fact, Cairo's PM_{10} concentration fell by about 25 percent over the past decade. Despite these improvements, the city's pollution levels are still several times the WHO recommended concentrations and higher than national guidelines taking as these high levels are taking their toll on the health and quality of life of the population, in particular poor people. Subsequently, the Greater Cairo (GC) Cost of Environmental Degradation (COED) attributed to air pollution is by far the highest in the country, with a mean estimate equivalent to 1.35 percent of national GDP in 2017. Conversely, the GC COED attributed to waste (net of air pollution damages, via the burning of waste) is half the air pollution's COED and results in a mean estimate equivalent to 0.68 percent of national GDP in 2017 which includes the opportunity losses from composting, recycling, methane capture, etc. Moreover, recent studies on the COVID-19 show that there is an increased likelihood of contracting the disease with high levels of ambient pollutants.[2]

Climate change models project Egypt's mean annual temperature to increase between 2 ºC and 3 ºC by 2050 and an increase in the duration of long-lasting heatwaves. Hot sandstorms known as khamsin blow millions of tons of grit from the Sahara to the North African coast and increases in local temperatures of up to 20 ºC are projected to increase in frequency and intensity. By 2050 the intensity and seasonality of heavy rains, as well as the probability of droughts will increase. Long-lasting heatwaves likely will increase in duration of between 9 to 77 days by 2085. The GC area is vulnerable to all of these, as well as to river and urban flooding, water scarcity and wildfires. The impacts are severe, particularly for public health and agriculture. Climate change will put additional pressures on citizens' health, in the form of increases in the prevalence and severity of cardiopulmonary conditions through heat and sandstorms, potential increases in vector-borne diseases, through decreased nutrition and food security and reduced water quality. Further, it has been demonstrated that extreme heat events are linked to worsening air pollution.[3]

[1] http://www.cabinet.gov.eg/English/GovernmentStrategy/Pages/Egypt%E2%80%99sVision2030.aspx and https://www.greengrowthknowledge.org/sites/default/files/downloads/policy-database/Egypt%20Vision%202030%20%28English%29.pdf.

[2] Larsen, Bjorn. 2019. Egypt: Cost of Environmental Degradation: Air and Water Pollution. The World Bank. Washington, D.C.; and Back of the envelop calculations for cost of solid waste environmental degradation performed by the Team.

[3] Markandya and Chiabai, Valuing Climate Change Impacts on Human Health: Empirical Evidence from the Literature, Int. J. Environ. Res. Public Health, 6, 759–86, 2009.

In response to this situation, the Government of Egypt (GOI) is seeking to reduce air and climate emissions from critical sectors and increase resilience to air pollution in Greater Cairo. The project aims specifically to reduce emissions that contribute to air pollution concentrations, thus leading to air quality improvements, and to simultaneously mitigate climate change. Air pollutants include PM_{10} and $PM_{2.5}$, while climate pollutants include both longer lived greenhouse gases (GHGs) such as CO_2, as well as Short-lived Climate Pollutants (SLCPs) that include black carbon, methane and several short-lived HFCs.

Successful Air Quality Management (AQM) planning requires a detailed assessment of these emissions in ways that enable decision makers to (i) understand the many sectors that contribute to a city's air pollution problems, (ii) track the effectiveness of policies and strategies over time to establish an accountability framework for both climate mitigation and AQM planning and (iii) utilize these data to conduct periodic international reporting and to process emissions estimates for dispersion modeling, critical to AQ forecasting.

This solicitation seeks a consulting firm, referred to hereafter as "the consultant" to evaluate existing emission inventories for criteria air pollutants, greenhouse gases (GHGs) and short-lived climate pollutants (SLCPs), fill any gaps in these existing inventories (e.g. mobile sources) and integrate each of these (including a completed mobile source inventory) into a single unified database useful for policy tracking, international reporting, and dispersion modeling/forecasting to address air pollution and climate mitigation in GC and Egypt.

II. Objective of the Assignment

This procurement opportunity seeks to establish a contract between the GoE and a consulting firm to provide support to the Egyptian Environmental Affairs Agency (EEAA) and World Bank through the Greater Cairo Air Pollution and Climate Change Project (hereafter "The Project") to advance existing integrated climate and AQM planning (IC-AQMP) for the tri-city GC area as well as the country of Egypt as a whole, with a specific focus on reviewing existing emission inventory data products for GHGs, SLCPs and criteria air pollutants and synthesizing these with other information, including the development of a mobile source emission inventory resulting in an integrated database that can be utilized and continually updated.

Detailed Tasks:

The consultant is requested to conduct the following tasks:

1. **Review, refine, enhance and consolidate existing emission inventories:**
   The consultant will work with EEAA teams that are currently updating emission inventory databases for Egypt to obtain the best available data. EEAA has recently completed an inventory for point sources, area, biogenic and geogenic sources and has developed a "Roadmap" report for developing a mobile source inventory. The consultant will refine/ review and assess the existing system

   The consultant will need to work with EEAA to understand existing gaps and align the available information with best practices to develop a comprehensive inventory[4] for the

[4] For example, the mobile source inventory roadmap describes steps to be taken and data to be used, but has not yet used this information to develop the emissions estimates. Similarly, the biogenic and geogenic inventory that has

GCA and surrounding area[5]. The consultant will be asked to fill gaps, improve and enhance available data resulting in a single, internally consistent comprehensive inventory (i.e. covering point, area, biogenic, geogenic, and mobile, sources) that will be available for photochemical and dispersion modeling.

2. **Develop mobile sources Inventory:**
   The consultant will refine/ review and assess the existing system and develop the mobile source emission inventory (MEI), that includes local emission factors for mobile sources to be developed (Diesel, Gasoline and NG) via a new emission testing program.

3. **Developing new comprehensive integrated modeling for the emission inventory from all sources of air pollution and climate change**
   The consultant will work with EEAA to develop and incorporate available emission inventory data, including the review, updating and utilization of new data provided by relevant ministries (e.g. see the roadmap report, but this will include vehicle registration data from Ministry of Interior, industrial activity data from Ministry of Industry, etc.) and integrate these data with the existing inventories. The creation of gridded emission files may include defining the airshed that affects air quality in GCA, applying land-use regression techniques to define sharp spatial gradients (e.g., via satellite-based methods) or identifying socio-economic indicators or technology distributions that that can be used to improve spatial surrogates for emissions distributions, and potentially break out inventory data by socio-economic status.

   The consultant may also propose the development of locally appropriate source characterizations/emission profiles for specific source categories known to affect GCA air quality or to identify and address weaknesses in the national GHG inventory. In this task, the consultant will develop an interface for data extraction and reporting.

4. **Synthesize and integrate data in a single unified emission inventory for Egypt:**
   The resulting inventory will be presented in (a) a spreadsheet or database format as well as (b) gridded emission files (NetCDF format) appropriate for chemical transport modeling and finally (c) as a IPCC-compliant national GHG emission inventory useful for submission under the UNFCCC. The final products should include all pollutants as relevant (e.g., IPCC-compliant inventory should include the six Kyoto gases, black carbon, methane, short-lived HFCs and N_2O; the gridded emission files should include Pb, CO, primary $PM_{2.5}$, primary PM_{10}, NOx, SO_2, VOC, ammonia and hazardous air pollutants; the database should include all of the above).

been developed by another vendor does not include the relatively small contribution to NOx from lightning or GHG emissions due to vegetation and land-use changes but may need to be completed (guidance has already been developed for both of these tasks) and integrated into this emissions framework.

[5] The entire country of Egypt will have to be covered to some degree both to satisfy the need to provide international reporting of GHGs at the national level under IPCC methodologies, and to include air pollution emissions from areas surrounding the tri-city area in so far as emissions from surrounding regions need to be included within larger nested modeling domains for GC AQ forecasting.

5. **Training EEAA and their partners in the use, updating and processing of the emissions data for future policy tracking, air dispersion modeling and international reporting:**
   The consultant will work with EEAA and the relevant partners to ensure that the final products are useful for Ministry staff, their vendors and their partners to achieve air quality and climate mitigation goals with the emissions database. This means identifying and training on aspects of inventory collection and refinement that may have come out during the course of the refinement process undertaken, ensuring that chemical transport modelers are able to process gridded emissions files in the future based on updated or refined inputs, and ensuring that members of the Egypt Climate Change Committee are able to generate new IPCC-compliant reports of GHG and/or SLCP emissions.

Administrative and Reporting Arrangement

The consultant will work collaboratively in partnership with EEAA staff and with other development partners that are also supporting EEAA staff with AQM planning (including the World Bank). For example, the EEAA maintains a partnership with the Cairo University and has a contract with another consulting firm to perform meteorological modeling. The consultant will also need to liaise with other ministries that may be providing data inputs to the emissions estimation process, but this is to be coordinated through EEAA.

III. Duration of the Assignment

The consultant will work to complete deliverables between **August 1, 2023 and July 31, 2025** (within 24 months of the start of contract). This work will require reporting to the EEAA as outlined above.

IV. Deliverables

Serial No.	Deliverable	Time from Contract Signature
1	Inception Report laying out the work program.	1 month
2	Roadmap report for comprehensive inventory development and processing, and expected form of deliverables.	3 months
3	Training plan.	3months
4	Egyptian inventory for criteria air pollutants from mobile sources, including the real measurement and the developed local emission factors for (Diesel, Gasoline and NG) vehicles.	15 months
5	Egyptian inventory for criteria air pollutants (including point, area, biogenic, geogenic, and mobile sources), SLCPs and GHGs in database format (i.e. Comprehensive Emission Database).	20 months

6	Final emissions inventory in three formats.	24 months

V. The Consultant Qualifications and Experience

- Experience in air quality management planning.
- Experience in emissions inventory development, inventory verification system, and establishing ongoing reporting mechanisms.
- Experience in dispersion modeling.
- Experience in international GHG reporting.
- Experience in developing vehicle emissions factors (gasoline, diesel & NG), and establishing ongoing reporting mechanisms.
- Broad access to both academic and private sector expertise that can contribute knowledge to Egyptian agencies, institutions and personnel.
- Experience in capacity building in the use, updating and processing of the emissions data for future policy tracking, air dispersion modeling and international reporting, and in undertaking complex data analysis and environmental assessments in low- and middle-income countries.

The consultant will also work closely with other members of the Project team including TBD. The consultant staff will be available for meetings and appointments per the schedule of EEAA and the World Bank teams. The consultant will be expected to present results to multi-stakeholders in GCA every 6 months (3 times) during the contract period.