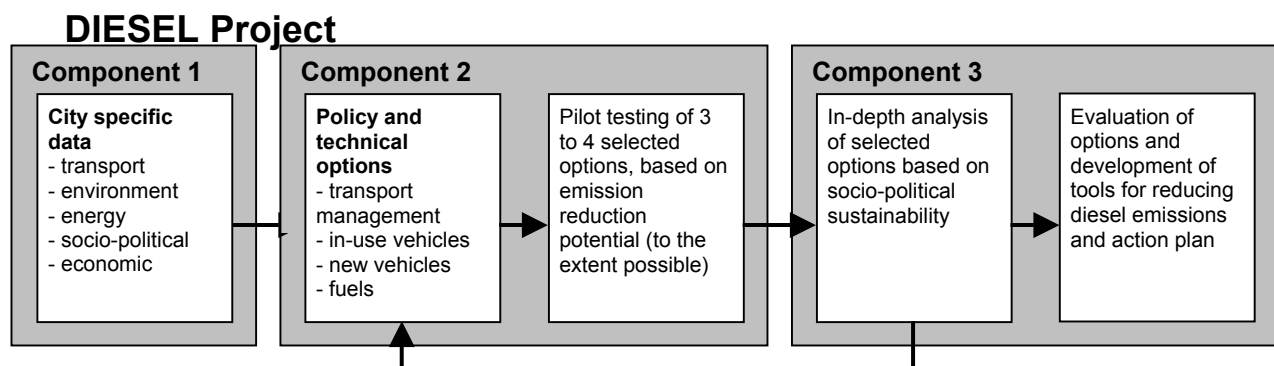




## TASK DESCRIPTION: DEVELOPING INTEGRATED EMISSION STRATEGIES FOR EXISTING LAND TRANSPORT (DIESEL)

The overall objective of this program is to develop a better understanding of the factors that influence vehicular emissions and to propose cost-effective control options in the context of the political economy of developing countries. The scope of work for this program includes development of city-specific databases relating to diesel emissions from in-use vehicles (component 1), analysis of policy and technical options to reduce diesel emissions (component 2), and stakeholder evaluation, development of action plans and dissemination of findings (component 3). A draft task description for this project in Bangkok is presented below for review and comment by the partners and collaborators of this project.



### COMPONENT 1: CURRENT SITUATION OF AIR QUALITY AND TRANSPORT IN BANGKOK

The first component of the program will focus on gathering existing information on air quality and mobile source emissions, and conducting some basic surveys on vehicle population characteristics and current transport policies in Bangkok. The following activities will be carried out: (1) collect data on ambient fine particulate matter (PM<sub>2.5</sub>); (2) collect existing information on PM emissions from diesel vehicles and survey vehicle drivers to collect information on vehicle population characteristics, (3) assess the current transport, environment and energy policy frameworks that affect diesel vehicle emissions in Bangkok. The 3 sub-components are somewhat independent and can be undertaken in parallel. They will be started as soon as possible.

#### SUB-COMPONENT 1.1 COLLECT AMBIENT FINE PARTICULATE MATTER (PM<sub>2.5</sub>) DATA

The objective of this component is to verify the level of ambient PM<sub>2.5</sub>. PM<sub>2.5</sub> rather than PM<sub>10</sub> is selected because PM<sub>10</sub> often contains a significant fraction of geological matter which is likely to have a much smaller health effect. In contrast, PM<sub>2.5</sub> is dominated by anthropogenic sources of particulate emissions or secondary particulate precursors. This will be accomplished by gathering and reviewing existing data and collecting additional data in partnership with local institutions and other programs.

Air Quality Data needs	Lead	Comments/Available Info
1. Available PM <sub>2.5</sub> data, preferably individual data points: <ol style="list-style-type: none"> <li>a. Ambient concentrations and average times (8-hours, 24-hours) at each location with dates</li> <li>b. Exposure data (personal monitors)</li> </ol>		
2. Corresponding meteorological data <ol style="list-style-type: none"> <li>a. Wind speed and direction, precipitation, stability</li> </ol>		
3. Description of monitoring methods and instruments: <ol style="list-style-type: none"> <li>a. Monitoring method (gravimetric, continuous)</li> <li>b. Location of stationary monitoring sites</li> <li>c. Instrument manufacturer, purchase year and maintenance records</li> <li>d. Flow control method, flow rates</li> <li>e. Filter manufacturer and conditioning procedure if gravimetric</li> <li>f. Calibration methods and frequency</li> <li>g. Sampling methods used (Reference Method)</li> <li>h. Sampling time and frequency</li> <li>i. Audit procedures and results</li> </ol>		
4. Data analysis and quality control <ol style="list-style-type: none"> <li>a. Data validation</li> <li>b. Statistical analysis</li> <li>c. Checks on data accuracy and precision</li> <li>d. Inter-laboratory comparison (in case of more than one laboratory), blind tests of reference samples</li> </ol>		
5. Recommendation for additional data needs, objectives and data collection strategy, and follow-up		

## SUB-COMPONENT 1.2 COLLECT EXISTING DIESEL VEHICLE EMISSION DATA

The objective of this sub-component is to collect available data on vehicle population characteristics and PM emissions data, and review the quality of data and test procedures used. Ideally the data should be categorized according to vehicle type, age, total mileage accumulated as well as annual distance traveled, and state of vehicle repair. A survey will be conducted for independent validation of the data on vehicle population characteristics, and to obtain additional information not available through vehicle registration. To this end, the following tasks will be performed.

### 1.2.A Basic Vehicle Information

Existing information on all vehicle types will be collected primarily through vehicle registration records.

Information on vehicle use	Lead	Comments/Available Info
1. Vehicle information (from vehicle registration or elsewhere) <ol style="list-style-type: none"> <li>a. Ownership (individual or commercial)</li> <li>b. Vehicle type</li> <li>c. Vehicle make</li> <li>d. Vehicle model year</li> <li>e. Gross vehicle weight (GVW)</li> </ol>		

Information on vehicle use	Lead	Comments/Available Info
<ul style="list-style-type: none"> <li>f. Odometer reading</li> <li>g. Transmission type (automatic or manual)</li> <li>h. Transmission configuration (#-speed)</li> <li>i. Engine type</li> <li>j. Engine displacement</li> <li>k. Number of cylinders</li> <li>l. Engine rated power (hp)</li> <li>m. Fuel type</li> <li>n. Control Technologies (naturally aspirated, turbo-charged, super-charged, type of injection, exhaust gas recirculation [EGR], type of catalyst)</li> <li>o. Vehicle emission deterioration factor (supplied by manufacturers)</li> </ul>		
2. Documentation on vehicle retirement		

### 1.2.B Vehicle Operation Validation Survey

A survey will be conducted to obtain independent information to validate the data gathered in 1.2.A. The magnitude and scope of the survey will depend on what data are already available. The information on vehicles not registered in the city, but that spend a fair amount of time in the city (such as delivery trucks), is unlikely to be available and will most probably require a survey.

Data need on vehicle operation	Lead	Comments/Available Info
1. Vehicle Operation Validation Survey		

### 1.2.C Data on Vehicle Emissions

Existing data on emissions from mobile sources will be gathered and analyzed.

Information requested from testing facilities:	Lead	Comments/Available Info
1. Mass emissions data (g/km or gm/kWh) <ul style="list-style-type: none"> <li>a. PM data on diesel vehicles, and all other mass emissions data</li> <li>b. PM data on non-diesel vehicles</li> <li>c. Description of test procedures including drive cycle, vehicle pre-conditioning, test matrix in each program, fuels used</li> </ul>		
2. Data from vehicle emissions inspection program to get historical trends and changes in fleet emission characteristics, as well as to understand the current system set-up and mode of operation. <ul style="list-style-type: none"> <li>a. Detailed description of the test procedures</li> <li>b. Detailed description of road-side tests procedures and sanctions</li> <li>c. Requirements for vehicle owners: test frequency and registration implications</li> <li>d. Historical data of test results (# of vehicles tested, test results by vehicle type/fuel/age/commercial or private operation, pass/fail percentages)</li> </ul>		

<p><b>3. Existing data from most recent tests on heavy-duty diesel vehicles and light-duty diesel vehicles from partners</b></p> <ul style="list-style-type: none"> <li>a. Detailed description of the test procedures and test matrix</li> <li>b. Vehicle description (make, year, engine size) and fuel description</li> <li>c. Description of data analysis and quality control</li> </ul>		
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### Sub-component 1.3. Current Policy Framework that Affects Diesel Vehicle Emissions

The objective of this sub-component is to understand the policy backdrop for the three sectors (transport, environment, and energy) that affect current diesel vehicle emissions and help analyze, and ultimately recommend, cost-effective and viable options for the future.

**Transport policy:** Collect information on the state of the public transport sector, traffic management, demand management, regulation of transport operations, urban planning, and mass transit policies as they relate to diesel vehicle emissions, and possible reduction options.

Data request on traffic management	Lead	Comments/Available Info
<p>1. Current operation of public bus transport in Bangkok</p> <ul style="list-style-type: none"> <li>e. Licensing arrangements for BMTA</li> <li>f. Bus fare subsidies</li> <li>g. Bus priority schemes</li> </ul>		
<p>2. Status of BMA and other major truck fleets</p> <ul style="list-style-type: none"> <li>a. Operation</li> <li>b. Financial status</li> <li>c. Government support, including fiscal</li> <li>d. Policy or market distortions</li> </ul>		
<p>3. Traffic management measures being proposed or implemented</p> <ul style="list-style-type: none"> <li>a. Status of area traffic control</li> <li>b. Traffic segregation (priority bus lanes, dedicated bus lanes, restrictions on certain vehicle types)</li> <li>c. Incident detection and intelligent transport systems (ITS)</li> <li>d. Parking policy including pricing</li> <li>e. Direct pricing policy (excluding fuel taxation): road user charges, toll roads, congestion charging</li> <li>f. Status of, and future plans for, ring roads, radial roads, fly-overs</li> <li>g. Enforcement arrangements</li> </ul>		
<p>4. Demand management measures being proposed or implemented</p> <ul style="list-style-type: none"> <li>a. Physical restraints</li> <li>b. Extent to which non-motorized transport is promoted</li> </ul>		
<p>5. Status of mass transit and any integrated transport plan for its development and inter-linkages with bus policy</p>		
<p>6. Any information on urban planning (trend towards or away from densification, parking provision), and coordination with traffic management</p>		

- **Taxation:** Collect information on the current vehicle taxation policy that may be encouraging diesel vehicle use.

Data request on vehicle tax structure	Lead	Comments/Available Info
1. Tax structure by vehicle age, fuel type and engine size or vehicle weight <ol style="list-style-type: none"> <li>Import duties</li> <li>Vehicle registration tax</li> <li>Annual license fee and structure (function of market value, age, engine size?)</li> <li>Any other taxes, rebates or tax exemptions</li> <li>Whether or not there are axle weight specific charges for heavy-duty vehicles</li> </ol>		

- **Fuel:** Collect information on the pricing structure of gasoline, diesel, kerosene and natural gas, and the current policy stance on alternative fuels.

Data request on fuel	Lead	Comments/Available Info
2. Retail prices and taxation of different fuels: gasoline (by octane number), diesel (including diesel containing synthetic diesel from Fischer-Tropsch sold by Shell), kerosene, LPG and CNG. Is diesel adulteration a problem?		
3. Rebates given to non-private users of diesel (goods transport, agriculture, industry)		
4. Tax structure and collection systems from refinery to consumer for fuels and lubricants		
5. What alternative fuels are being considered as diesel substitutes (CNG, bio-diesel, synthetic diesel, DME)? Need for fiscal incentives and other policy issues?		

## **COMPONENT 2. ANALYSIS OF POLICY AND TECHNICAL OPTIONS TO REDUCE DIESEL EMISSIONS**

The second component of the program will study the emission reduction potential of a number of policy and technical options. It is divided into the following sub-components: (1) developing selected vehicle emission factors as a function of operating and vehicle parameters, (2) selecting and analyzing a number of options that could achieve certain emission reductions, and (3) pilot testing a few options to quantify the costs and scope for emission reduction, and assess the operational challenges under real-world conditions.

### **SUB-COMPONENT 2.1. DEVELOPING EMISSION FACTORS FOR DIESEL VEHICLES AND SELECTED ALTERNATIVES**

#### **2.1.A. Test Procedure Development**

The parameters that can potentially be examined in developing emission factors include vehicle category (light-duty, medium-duty, heavy-duty trucks, heavy-duty buses), vehicle size, vehicle technology (including retrofitting with specific technologies), vehicle age, total distance traveled, state of vehicle repair (tested as-received and after servicing, or poorly maintained versus well maintained), drive cycle, fuel quality (for example, conventional diesel and one reformulated diesel), and fuel type. To limit the number of test runs, factorial design will be used to develop the test matrix. There will be a trade-off between the number of vehicles and parameters examined on one hand and the number of tests conducted on the other. The final test matrix will be developed after several iterations. In addition, mass emissions will be compared with measurements taken in emissions inspection programs with a view to developing a test protocol for identifying gross polluters that is more accurate, reproducible, and difficult to defeat. See Annex B for more details about problems with the currently used procedure. For this last task, as much information as possible will be incorporated from work undertaken by other researchers around the world.

<b>Procedures to be agreed on</b>	<b>Lead</b>	<b>Comments/Available Info</b>
1. New emission data to be obtained for this project <ul style="list-style-type: none"> <li>a. Test methodology and important factors</li> <li>b. Test matrix using factorial design</li> <li>c. Data analysis and quality control</li> </ul> 2. Methodology for checking correlation between mass emissions and measurements obtained in inspection programs		

#### **2.1.B. Data Collection for Emission Factors**

<b>Information to be developed and gathered</b>	<b>Lead</b>	<b>Comments/Available Info</b>
1. Emission factors of different vehicles <ul style="list-style-type: none"> <li>a. Well vs. poorly maintained in-use diesel vehicles</li> <li>b. Engine size, vehicle type, age, mileage</li> <li>c. Diesel vehicles with different control technologies</li> <li>d. Retrofitting in-use diesel vehicles (for example</li> </ul>		

replacement with a more modern engine, or retrofitting an oxidation catalyst) e. Different fuel options		
2. Emission factors under different operational conditions a. Load b. Drive cycle: Possible options include simulating congested urban traffic, type-approval drive cycle, simulating stop-and-start bus operation, and steady-state for emissions inspection.		
3. Possible development of a test protocol to be used in a targeted emissions inspection program for identifying gross polluters more accurately.		

## SUB-COMPONENT 2.2. ANALYSIS OF SELECTED OPTIONS

### 2.2.A. In-Use Vehicle Options

Options to be analyzed	Lead	Comments/Available Info
1. Establishing emission standards that can realistically be achieved by the majority (~80%) of all diesel vehicles with reasonable efforts, and the likely scenario for further tightening. This would require (1) identifying reasonably reproducible procedures for measuring emissions; (2) carrying out a fleet-wide study to estimate current emission levels and to establish initial cut-points, (3) examining how much it would cost to repair gross-polluters to meet the cut-points to estimate the time table for tightening standards, and (4) revising the cut-points if sufficient progress is made during the pilot to improve the overall vehicle fleet emission characteristics.		
2. Studying the feasibility and cost-effectiveness of establishing a targeted system of emissions inspection for diesels: criteria for selectivity, requirements for administrative control, likely test costs, total number of test lanes required, frequency of testing, management of test centers		
3. Vehicle upgrade and scrappage requirement policies (age or emissions based)		
4. Identifying implementable corrective measures for operational misuse (e.g. over fuelling, over loading, wrong lubricants, aggressive driving), including estimates of costs and benefits, and a market-based approach to promoting		

Options to be analyzed	Lead	Comments/Available Info
correct operation and maintenance of vehicles		
5. Pilot testing the corrective measures in one or two commercial fleets to identify benefits and implementation problems		
6. Retrofit programs to meet tighter emission standards (such as addition of oxidation catalysts, and engine upgrade/replacement)		

### 2.2.B Transport, New Vehicles and Fuel Policy Options

An integrated approach to tackling mobile sources of air pollution requires closely coupling technical measures with administrative and economic policy instruments. This sub-component considers different options for fuels, new vehicles, and transport policy.

Options to be analyzed	Lead	Comments/Available Info
1. Public transport sector reforms (e.g. alternatives for licensing public transport fleets, policies on bus fares, government policy toward mass transit, separation of regulating function from operations)		
2. Improving traffic flow improvements (low-cost options only)		
3. Options for more rigorous enforcement		
4. Phasing in tighter emission standards for new and in-use vehicles. This will include cost estimates of different vehicle emission and fuel quality standards.		
5. Policy support to promote the use of clean vehicle and fuel technology		
6. Drivers training on optimal operation (such as driving behavior, fuel injection settings, and loading) of vehicle and maintenance		

### SUPPLEMENTING OTHER ON-GOING STUDIES

In addition, this program will take the results of on-going studies in related fields, and do a limited amount of desk studies in these additional areas.



Tasks to be performed	Lead	Comments/Available Info
1. Identify ongoing studies and plan to incorporate results to avoid duplication		
2. Review remote sensing for smoke.		

### Component 3: Stakeholder Evaluation, Development of Action Plans and Dissemination

It will be helpful to have a simple analytical tool that can be used to evaluate different options. While such a tool is necessarily restricted to examining a limited range of options, mostly technical, it is nevertheless useful to have a city-specific decision support system that can help evaluate and compare the cost-effectiveness of different options. The information and data collected in this program will be used to develop such an analytical tool which will be used to enable evaluation of scenarios and help develop action plans.

The selected options will be analyzed and discussed from economic, environmental, technical, stakeholder, social, and sustainability perspectives. Only those options that are broadly accepted have a real chance to succeed and an action plan around those options will be designed. To accomplish this, the following tasks will be undertaken:

Tasks to be performed	Lead	Comments/Available Info
3. Develop analytical and information tools		
4. Engage in policy dialogues among stakeholders to discuss promising options for selection, using the analytical and information tools wherever applicable		
5. Discuss social, economic, and political difficulties vs. environmental benefits of different options and decide on options to be considered for action plans		
6. Develop action plans		

### Dissemination

The outcomes of the study (and outputs including the knowledge base and analytical tools) will be discussed in expert panels and disseminated through the Clean Air Initiative Network to a number of partner cities in developing countries. Throughout the project, city-specific workshops and thematic discussion groups and relevant stakeholders will be organized to raise awareness and to discuss different policy and technical options, and the social, political, and institutional requirements for the successful implementation of the measures proposed. At the end of the project, a major event will be organized to bring together leading experts, key companies, and decision makers to discuss the outcomes of this

project. Furthermore, a section of the Clean Air Initiative's website will be dedicated to the program, and the Clean Air Initiative's distance learning courses will be used to disseminate the information worldwide.

Tasks to be performed	Lead	Comments/Available Info
Dissemination of reports and organization of meetings <ul style="list-style-type: none"> <li>▪ Inception report, six-monthly progress reports</li> <li>▪ Action plans and assessment of potential for follow-up or scale-up with indicative funding requirements</li> <li>▪ Draft final and final report</li> <li>▪ Thematic and city-specific workshops</li> </ul>		
Website development and updates		
Distance Learning Course to disseminate lessons learned		