

# CONFERENCE REPORT



**Particulate Matter (PM) and Black Carbon Emissions  
Inventory  
Tema Port  
PROJECT TASK FORCE INCEPTION WORKSHOP**

**Date: WEDNESDAY 31 AUGUST 2016**

**Venue: ROYAL NICK INTERNATIONAL HOTEL, TEMA. GHANA**

## **ABBREVIATIONS**

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ALCO	Abidjan Lagos Corridor Organization
BC	Black Carbon
CCAC	Climate and Clean Air Coalition
EPA	Environmental Protection Agency
GHS	Ghana Health Service
GPHA	Ghana Ports and Harbors Authority
OGV	Ocean Going Vessel
PM	Particulate Matter
SDGs	Sustainable Development Goals
UNEP	United Nations Environmental Program
VALCO	Volta Aluminum Company

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## **1.0 Background**

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Research posits that emissions of greenhouse gases contribute significantly to climate change. Ports are a significant source of global air pollution around coastal areas, exposing people to serious health and environmental impacts. Emissions from operations at ports are mostly from diesel/carbon-based fuel powered engines especially in ocean going vessels (OGV), trucks, locomotives.

Also, the use of diesel engines in ports produces emissions of significant amounts of particulate matter (PM), considerably contributing to regional air pollution. Black carbon (BC), a short-lived climate pollutant, is the second most important human emission after carbon dioxide in terms of its climate forcing.

These emissions have been known to have an important impact on human health and wellbeing; In an effort to understand the nature of the activities of these pollutants in the Tema port area, UNEP signed an agreement with ALCO in 2016, to conduct a project/study named Climate and Clean Air Coalition (CCAC) to Reduce Short-lived Climate Pollutants at TEMA Port.

## **1.1 Workshop Objectives**

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The workshop was organized as an inception meeting with ALCO, port authorities, the working group and the consultant with the view to set up of a working group of expert and stakeholders to oversee the development of a Draft Action Plan to reduce PM/BC emissions from Port of Tema

## **1.2 Participation**

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In all there were 22 participants. These were drawn from a cross section of institutions including ALCO, VALCO, EPA, The Ghana Health Service and Sunon Asogli Power Plant. A full list of attendees can be found in the appendix of this document.

### **1.3 Structure**

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The conference involved the giving of presentations from various invited experts to provide a multi angle background for the work to be undertaken.

Subsequently two groups were formed from which focus group discussions are to take place eventually.

## **2.0 Addresses and Presentations**

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### **2.1 Welcome Address**

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The ALCO Environmental Specialist began proceedings by welcoming the gathering to the occasion. He then thanked the funders of the project he further expressed his gratitude too to all stakeholders present and encouraged them to continue the good work and collaboration being put into this project in order to make it a success. He finally wished the gathering a good conference.

After the ALCO Environmental Specialist, the executive director of the EPA who was also present gave a brief statement. He acknowledged the presence of distinguished colleagues present and also of ALCO, thanking them for taking an interest in the project and making resources available for the project. He reminded the gathering of the importance of air quality, remarking that air cannot be filtered before use, underlying its importance and this the importance of the project. he further commented on the enormous air pollution sources in the port environment and acknowledged their adverse short-term health effects and long term climate change effects. In light of this he stressed the importance of the project, further aligning it to the achievement of the country's recently signed on Sustainable Development Goals (SDGs). He further iterated that the EPA was important for the project and vice versa as it was part of the institutions original constitutional mandate and affirmed his organization's commitment to participating in the project.

## 2.2 Presentations

Presentations were given by various speakers which were aimed at contextualizing the issues surrounding the theme from different professional angles. The consultant also gave a presentation which was aimed at providing a context as to the methodology of the study to be conducted at the Tema Harbor.

PRESENTER	ORGANIZATION	TITLE
Jules Venance Kouassi	ALCO	PM/BC Baseline Emission Inventory Study at Tema Port in Ghana
Dr Edith Clarke	GHS	Health Impacts of Port Emissions
Lambert Faabeluon	EPA	Overview of Air Quality Monitoring & Guidelines: Policy & Legislation, Programs and Projects
Mr Philip Acquah	Project Consultant	Opportunities and Challenges of Port Emissions Reduction Actions - Discussion

Find attached in the appendices full presentations delivered at the conference.

## 2.3 Comments and Responses from Presentations

Comment/Suggestion	Response
<b>One participant enquired about the contribution of the emergency power barge to emissions</b>	The consultant mentioned that the study would take into cognizance the boundaries of the port and the companies that operate within that boundary.
<b>It was mentioned that it would be appropriate to do another analysis between November and February as the change in wind direction changes the scenario as compared to the rest of the year in terms especially of the emissions blowing from the rest of the Tema industrial area</b>	The consultant mentioned that the EPA would carry that out as part of a wider project and that the influence of such a study was important in the dynamics of the analysis
<b>On bus rapid transport system, it was requested that more light be thrown on the implementation timeline as it has a lot of emission reduction potential</b>	Mr Faabeluon commented that a suggestion was made that a proposal for shuttles be provided from the entrance to the inner part of the port was not

	<p>supported by CEOs of companies operating in the port; this may have to be revisited.</p> <p>He further commented that he was unfortunately not privy to information regarding the BRT project and that his responsibility lied with the monitoring of emissions along the west Africa corridor which was on-going</p>
<p>it was also suggested that the EPAs air quality monitoring be publicized to serve as an early warning system for people living in such areas and to give an alert as to which groups of people were polluting the environment</p>	-
<p>In terms of the issue of minimizing burning of waste there was currently a project which was currently being implemented with the objectives of reduction of unintentional costs and also to phase down the use of mercury containing devices</p>	-
<p>It was also enquired if there a way the services sector is polluting the environment</p>	<p>It was an area that had to be researched deeper but there was a possibility of particulate matter pollution from folded up industries, and even from carbon footprint of patrons of hotels, etc. further a project called green passport would do this more efficiently.</p>
<p>It was mentioned that as a means to reduce emissions from trucks and public transportation vehicles, rail system could be further developed to reduce the activity of trucks</p>	-
<p>It was also suggested that the health linkages from emissions in all sectors should be identified and linked</p>	<p>Ghana already has a health impact assessment baseline and as was mentioned by Dr Clarke this data should be incorporated into the design of the program right from inception</p>

<p><b>On the recommendation of carrying out health assessment, it was asked how this can be achieved based on the short lifespan of the project.</b></p>	<p>To this it was suggested that National service personnel to be admitted by industry could be used for the purpose of the study; baseline data could be taken from the period of their admission to after a three-month period</p> <p>Dr Clarke also added that her recommendation was more tuned towards the longer term project spanning 5 to 10 years</p> <p>The consultant also added that one of the recommendations that could come up after the study was a real-time monitoring of health impacts even after the project; thus would lead to more data for analysis</p>
<p><b>Moving forward there should be a link between academia such that pertinent research questions from industry would be relayed to academia for research; furthermore, proposals are being put forward for a research fund to be setup for such purposes.</b></p>	<p>Mr Poaman also added that the suggestion was a laudable one and should be advocated strongly and extended to other economic sectors such as agric, etc.</p>
<p><b>An enquiry was made as to how the objective of reducing travel distance of vessels to improve fuel efficiency was going to be achieved as numerous factors account for this, these include the type of vessel the type of cargo, cargo held by existing vessels in beddings etc.</b></p>	<p>In response the consultant answered that by logging in similar vessels at specified locations over say a year, it is possible to identify the traffic incoming of different types of cargo and assign specific beddings to each type of cargo. When this is done it is then possible to track the average distance travelled to the various beds and the difference speeds as well</p> <p>He added that the existing data is more production oriented than environmentally oriented and thus one of the objectives is therefore to disaggregate data so that the necessary info can be extrapolated from it</p>
<p><b>A participant enquired that as air pollution goes beyond just emissions from machines there were also others such as heavy metals from other activities etc,</b></p>	<p>The consultant mentioned that particulate matter pollution was also part of the scope of the project.</p>



therefore he enquired how the assessment of such emissions fit into the project

### 3.0 Project Outcome

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At the end of the project, participants had been able to:

- Gain insights as to the nature of operations of the port
- Understand Health Impact of port emissions
- Gain knowledge of EPA's existing and planned interventions and activities in managing emissions in the country
- Understand the approach to be used by the consultant and gain insight as to the required outcomes of the project
- Form 2 groups which will subsequently be engaged to assist in the development of a Draft Action Plan for the project

## APPENDICES

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### ATTENDANCE LIST




#	NAME	INSTITUTION	POSITION	CONTACT
1	Nana Okyir Baidoo	IGGS	Senior Consultant	<a href="mailto:Nanaob3gh@gmail.com">Nanaob3gh@gmail.com</a> /0208222050
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13	Lambert Fuabeluon	EPA	Director/SCP	<a href="mailto:lfuabeluon@gmail.com">lfuabeluon@gmail.com</a> /
14	Irene Opoku	AER/EPA	Acting Head	<a href="mailto:Irene.opoku@epa.gov.gh">Irene.opoku@epa.gov.gh</a>
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17	Kyekyeku Oppong Boadu	EPA	Ag. Director	
18	Kouami Julei V	ALCO	Environment Specialist	<a href="mailto:jvk@corridor-side.org">jvk@corridor-side.org</a>
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## Photo Gallery



## Presentations

Jules Venance KOUASSI, ALCO



**UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP)  
AND  
ABIDJAN LAGOS CORRIDOR ORGANIZATION (ALCO)**

**Accra Inception Meeting**  
August, 31, 2016  
ROYAL NICK INTERNATIONAL HOTEL, TEMA, GHANA


PM/BC Baseline Emission Inventory Study at Tema Port In  
Ghana

*Presented by Jules Venance KOUASSI Environment Specialist*

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### Plan

- Background
- Brief Presentation of ALCO
- UNEP Project
  - Projects Objectives
  - Expected Results
  - Activities
  - Stakeholders
  - Time frame and Budget
  - Next Steps
- Conclusion




### Background 1/2

- Research posits that emissions of greenhouse gases contribute significantly to climate change
- Ports are a significant source of global air pollution around coastal areas, exposing people to serious health and environmental impacts
- Emissions from operations at ports are mostly from diesel/carbon-based fuel powered engines especially in ocean going vessels (OGV), trucks, locomotives



### Background 2/2

- The use of diesel engines in ports produces emissions of significant amounts of particulate matter (PM), considerably contributing to regional air pollution. Black carbon (BC), a short-lived climate pollutant, is a solid carbonaceous particle
- Black Carbon (BC) emissions are the second most important human emission after carbon dioxide in terms of its climate forcing
- These emissions have an important impact on human health;
- In 2016, UNEP signed an agreement with ALCO to conduct a project/study named Climate and Clean Air Coalition (CCAC) to Reduce Short-lived Climate Pollutants at TEMA Port.



## Brief Presentation of ALCO 1/2

- ALCO is a sub regional organization put in place by 5 Heads of State of Côte d'Ivoire, Ghana, Togo, Benin and Nigeria since 2002
- ALCO is funded by Global Fund, World Bank, ECOWAS, WAHO, USAID, CDC, UNEP (now)
- ALCO interventions area : (1) Trade and transport facilitation and (2) Health activities (Ebola, HIV, STI targeting key populations etc.), Environment and climate change along Abidjan Lagos corridor



## Brief Presentation of ALCO 2/2



- 5 countries: **Côte d'Ivoire, Ghana, Togo, Bénin, Nigeria**
- 8 Border posts, 05 main ports, 05 main airports
- resident Population: 30 000 000
- People in transit : **47 000 000**
- the most important west africa corridor (representing approx 65% economic activities)

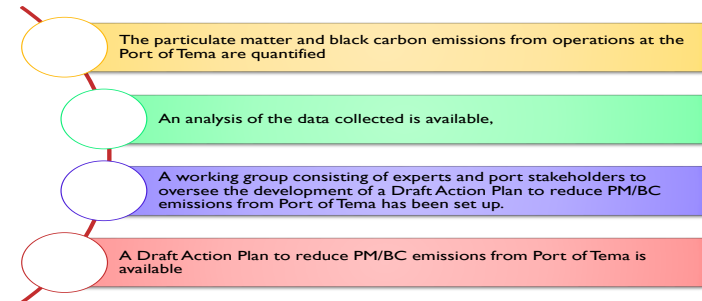


## UNEP Project: Project Objectives 1/6

- The key objective of this assignment is to build ongoing efforts to improve air quality and mitigate climate change by supporting the reduction of PM/BC emissions related to operations at the port and its immediate environs
- quantify the particulate matter and black carbon emissions from operations at the Port of Tema as a baseline for mitigation action planning
- support the setting up of a working group consisting of experts and port stakeholders to oversee the development of a Draft Action Plan to reduce PM/BC emissions from Port of Tema.



## Expected Results 2/6



### Activities 3/6

- Conduct at one of operation terminal of the port a baseline air emissions inventory (AEI) for the Port of Tema using the United States Environmental Protection Agency's (US EPA) methodology for inventorying port emissions i.e. *Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories (2009)*.
- Organize a two-days consultative multi-stakeholders workshop



### Stakeholders 4/6

- Relevant Government of Ghana policymakers (Transport Ministry, Environmental Ministry, etc.)
- Tema Metropolitan District
- Ghana Ports & Harbours Authority,
- port terminal
- Greater Accra Region
- operators,
- shipping companies (land and maritime),
- port associations and partnerships affiliated to the port
- regional multilateral organizations e.g. ECOWAS
- National team of CCAC
- port labor organizations,
- development partners,
- port law enforcement agencies,
- local academia,
- civil society groups,
- neighborhood associations,
- etc.



### Budget and Deliverables 5/6

The total Budget of this study is: **USD 29,500**  
**Key dates**

Delivrables	Dates
Preliminary baseline air emissions inventory (AEI) Report for the Port of Tema	• October, 15 <sup>th</sup> , 2016
Multi-stakeholders workshop report with draft PM/BC Action Plan for long term PM/BC emissions reductions at Port of Tema incorporating international best practices	• October, 31 <sup>st</sup> 2016



### Next Steps 1/6

- Organize the inception meeting with ALCO, port authorities, the working group and the consultant
- Set up of a working group of expert and stakeholders
- Data collection and analysis
- Validation workshop of the results and action plan



## Conclusion

- A successful implemented program to reduce PM/BC emissions at the Port of Tema will positively impact the environment, the people that work in the port as well as those that live in neighboring communities.
- A strong collaboration with stakeholders will help to reach the objectives of this project.
- ALCO as a regional organization has the capacity and the will to contribute to the achievement of this important project and extend it to other areas and countries




THANK YOU !!






**OVERVIEW OF AIR QUALITY MONITORING & GUIDELINES:  
POLICY & LEGISLATION, PROGRAMS AND PROJECTS**



**LAMBERT FAABELUON**  
DIRECTOR/ STANDARDS, COMPLIANCE & ENFORCEMENT DIVISION  
ENVIRONMENTAL PROTECTION AGENCY, GHANA


5 September 2016



**Presentation Outline**

- ❖ Accra-Capital & medium sized City of Ghana (area of area:2,592 km2 and is the fastest fastest growing urban area in Ghana and the 11<sup>th</sup> largest Metro in Africa
- ❖ Major sources of Air Pollution in Accra-Tema
- ❖ Legislation and Policies
- ❖ Milestone of Air Quality Monitoring and clean air initiative (AQM) in Ghana
- ❖ Work done on AQM in Accra
- ❖ Outcomes of AQM Implementations
- ❖ Challenges of AQM & Pollution reduction in Accra-Tema
- ❖ Way Forward & Conclusion

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air pollution  
problems in  
Ghana)

**LIGISLATION AND POLICIES**

- ❖ The EPA Act 1994, Act 490
- ❖ Urban Transport policy
- ❖ GRA Law (Act 634); Section XVII, chapter 87  
**SEE FOOT NOTE!!!!**
- ❖ petroleum and pricing deregulation policy (NPA) Act, 2005 (Act 691)

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### EPA Act 1994, Act 490

- ❖ The EPA Act 1994, Act 490 mandates the Agency to
  - co-manage, protect and enhance the country's environment;
  - seek national, international and multilateral collaboration in managing the country's environment
- Section 2 sets as amongst the key functions of the Agency as:
  - (i) to develop a comprehensive environmental quality database to guide policy formulation and implementation, and
  - (ii) to prescribe guidelines, standards and regulations relating to the pollution of air, water, land and any other forms of environmental pollution including the discharge of waste and the control of toxic substances;
  - Air quality guidelines developed in 2000

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### Urban Transport Policy

- ❖ The policy environment: Urban Transport policy (Utp) operation in relation to Ghana Shared Growth Development Agenda II (GSGDA II, 2015); section 2.6, pg. 25 Infrastructure and human settlements development (transport and logistics).
- ❖ main problems identified by urban transportation in Ghana;

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### Air Quality Monitoring Milestone/Interventions

- ❖ Air quality monitoring started in 1997 at Tarkwa, Accra, Tema, Kumasi, Takoradi.
- ❖ 14 AQM sites in Accra located in Residential, commercial, Industrial areas (see Map on slide 9)
- ❖ Development of Air Quality Guidelines, 2000
- ❖ Baseline Roadside Air Quality Survey as part of Leaded Gasoline Phase Out (2002)
- ❖ Phase-out leaded gasoline (petrol) in Dec 2003
- ❖ EPA/USEPA/UNEP Accra City Air Quality Capacity Building Project in 2005 (involvement of national stakeholder participation)
- ❖ National vehicular emissions inventory (2006)
- ❖ Urban Transport Project-AQM programme (2010)

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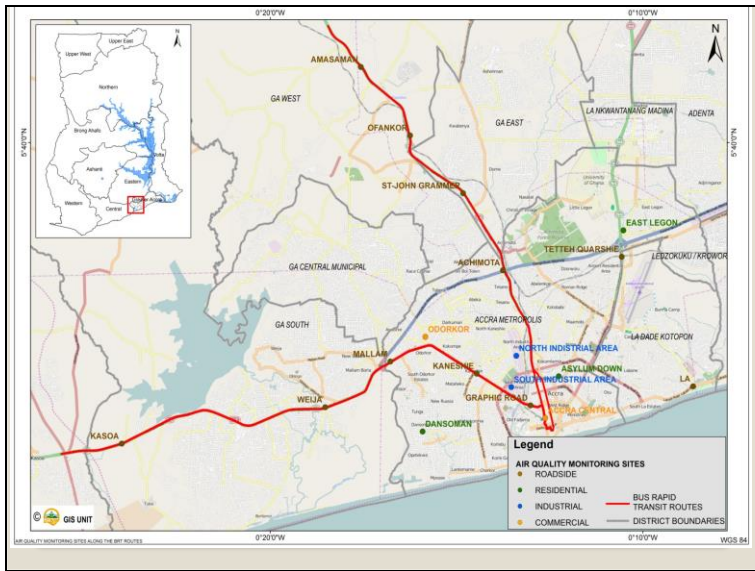


### Air Quality Monitoring Milestone/Interventions; Cont'n

- ❖ Air Pollution & Associated Health studies in Ghana (by GHS, 2010)
- ❖ Developed Roadmap for vehicular emissions and fuel Economy standards (2014)
- ❖ Developing Air quality and Vehicle emission and standards
- ❖ Introduction of age-based tax system for imported vehicles
- ❖ Introduction of petroleum and pricing deregulation policy

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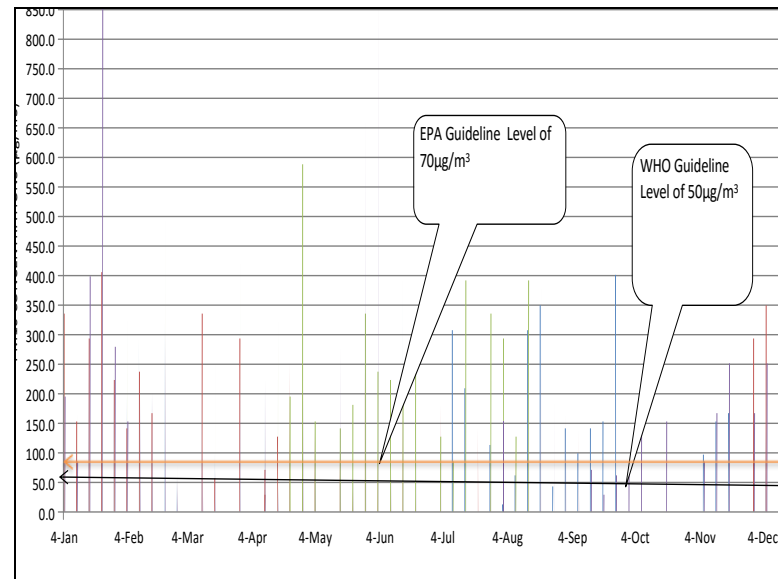
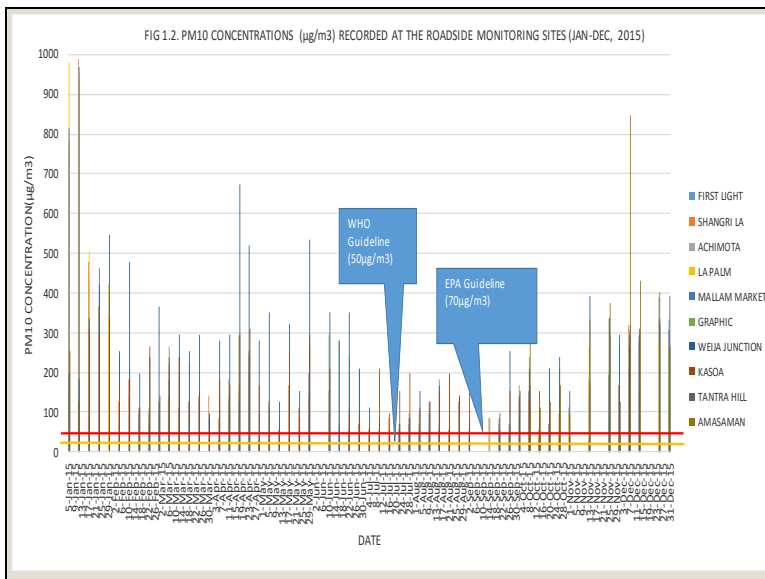


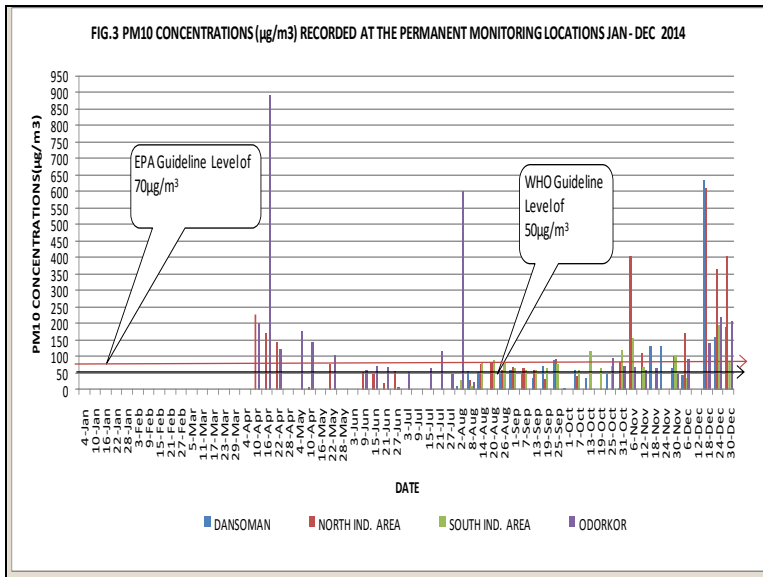


# OUTCOMES OF AQM IMPLEMENTATION



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### AIR QUALITY INDEX (AQI) SYSTEM-ADOPTED

- ❖ AQI is a measure of the quantity of harmful particles and chemicals in the air
- ❖ The AQI is an index for reporting daily air quality. It tells us how clean or polluted your air is, and what associated health effects might be a concern for us. The AQI focuses on health effects one may experience within a few hours or days after breathing polluted air.
- ❖ EPA calculates the AQI on PM, O<sub>3</sub>, CO, SO<sub>2</sub>, NO<sub>2</sub>.

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### How Does the AQI Work?

- ❖ It runs from 0 to 500 scale with the higher AQI value, indicating a greater level of air pollution and a greater health concern to the public.

### Understanding the AQI

- ❖ To make it easier to understand, the AQI is divided into six categories depicted by 6 colour coding system (Green, Yellow, Orange, Red, Purple and Maroon)
- ❖ Each category corresponds to a different level of health concern; as shown in next slide

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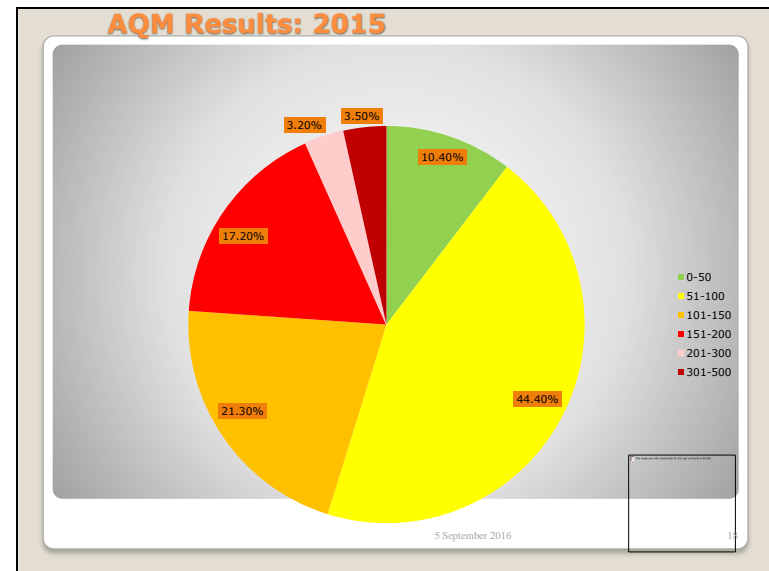
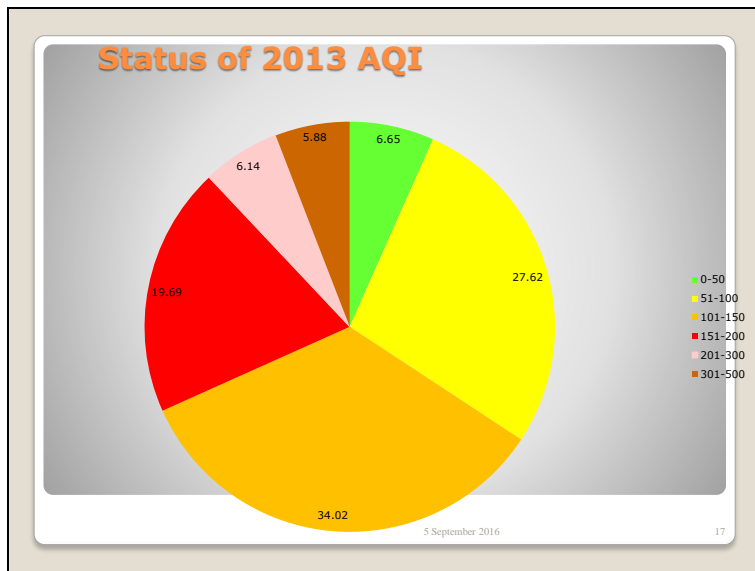
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### AQI GUIDE FOR PM10

Air Quality Index (AQI)	Levels of Health Concern/Protect Your Health
When the AQI is in this range:	...air quality conditions are:
<b>Good (0-50)</b>	No health impacts are expected when air quality is in this range
<b>Moderate (51-100)</b>	Unusually sensitive people should consider limiting prolonged outdoor exertion
<b>Unhealthy for Sensitive Groups (101-150)</b>	The following Groups should limit prolonged outdoor exertions: <ul style="list-style-type: none"> <li>▪ People with lung disease, such as asthma</li> <li>▪ Children and older adults</li> <li>▪ People are active outdoors</li> </ul>
<b>Unhealthy (151 to 200)</b>	The following groups should avoid prolonged outdoor exertions: <ul style="list-style-type: none"> <li>▪ People with lung disease, such as asthma</li> <li>▪ Children and older adults</li> <li>▪ People are active outdoors</li> <li>▪ Everyone else should limit prolonged outdoor exertion</li> </ul>
<b>Very Unhealthy (201 to 300)</b>	The following groups should avoid all outdoor exertions: <ul style="list-style-type: none"> <li>▪ People with lung disease, such as asthma</li> <li>▪ Children and older adults</li> <li>▪ People are active outdoors</li> </ul> Everyone else should limit prolonged outdoor exertion
<b>Hazardous (301 to 500)</b>	Everyone should avoid any outdoor exertion

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### Health Based effects of Air pollution (AQI): 2013-2014

❖ **Roadside locations:**

1. Green 31(9.17%)
2. Yellow : 116 (34.32%).
3. Orange (UFSG): 100 (29.59%)
4. Red (unhealthy): 55 (16.27%)
5. Purple (very Unhealthy): 23 (6.8%)
6. Maroon (Hazardous): 13 (3.85%)

❖ **Residential location:**

1. Green 10(47.62%)
2. Yellow : 7 (42.86%).
3. Orange (UFSG): 2 (9.52%)

**Commercial location:**

1. Green 5(18.52%)
2. Yellow : 15 (55.56%).
3. Orange (UFSG): 6 (22.22%)
4. Maroon: 1 (3.70%)

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### Health Based effects of Air pollution (AQI) Cont'n

❖ **Industrial Locations:**

1. Green 11(23.40%)
2. Yellow : 26 (55.32%).
3. Orange (UFSG): 6 (12.76%)
4. Red (unhealthy): 0 (0%)
5. Purple (very Unhealthy): 2 (4.36%)
6. Maroon (Hazardous): 2 (4.26%)

AQI formula:  $(\text{Pollutant conc}/\text{pollutant limit value}) \times 100$

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### Findings of Air Pollution & Health studies in Ghana

- ❖ Lower respiratory infection is second to malaria among top 10 causes of death in Ghana (GHS, 2010)
- ❖ Household air pollution (HAP) tops the Burden of diseases in Ghana. HAP causes 3,000 deaths of children under 5yrs.
- ❖ Association between incidence of ARIs and pollutants most marked for PM10 levels.
- ❖ Trends in incidence of ARIs follows PM10 level – Changes in ARI incidence occurring soon after changes in PM10s. Peaks: Jun-Jul; Nov – Jan
- ❖ Highest PM10 levels occur in roadside locations.
- ❖ Children aged 5yrs and below/asthmatics are most at risk of ARI

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### Challenges of AQM & Pollution Reduction in Accra

- ❖ Policy direction on continuous importation and use of overaged vehicles.
- ❖ Poor maintenance of vehicles.
- ❖ Clustering of commercial & residential facilities along major roads.
- ❖ Gaps in data gathering due to frequent shortage of consumables and lack of availability of monitoring vehicles/drivers. Limited Manpower
- ❖ Theft of air quality monitoring equipment in Tema and Accra
- ❖ Frequent vehicular knockdown of air quality monitoring posts.
- ❖ Funding & logistics challenges for AQM, public education and pollution related health studies.
- ❖ Inability to report AQM outcomes promptly to public

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### Programmes and Projects

#### ❖ Programmes:

- Inter-institutional collaboration on air quality issues: (eg. GHS, Global Alliance on Clean cook stoves, Stockholm Environment Institute, WHO, USEPA, AMA, World Bank, UNEP - Climate and Clean Air Coalition, Industrial Economics of USA, UN Habitat, ALCO etc.)

#### ❖ Project Areas & those under consideration:

- UTP
- Epidemiological studies by GHS
- World Bank/WHO PMEH
- UNEP: Sulphur reduction programme in ECOWAS
- UNEP and Switch Africa Green (SAG) Project - biogas promotion
- UNEP: Global Fuel Economy Initiative at national level

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### The Way Forward

- ❖ Establish Continuous air quality monitoring stations in Accra & relating monitoring results with respiratory ailments to aid in prompt reporting of air quality/health situations to public.
- ❖ Finalise the ongoing air quality/emission standards/Regulations.
- ❖ Reduction of Sulphur levels in fuel to 50ppm before 2020.
- ❖ Implement global fuel economy initiative at national level
- ❖ Promoting use of Non-burn techniques in management of health care, municipal solid waste and E-waste
- ❖ Sped up operation of Mass transport system (BRT) in Ghana
- ❖ Government taking a look again on the policy of importation of over-aged vehicles/scrap vehicle parts & engines.
- ❖ Energy & operational efficiencies in Steel & Cement plants
- ❖ Permanent AQM program for the Port of Tema/Tema Metropolis
- ❖ Further research: areas of AQM, exposure and epidemiology studies

## Conclusions

- ❖ Roadside and commercial sites mostly have high levels of particulate matter. This can be attributed to road dust, commercial activities, wind blown dust and vehicular exhaust emissions.
- ❖ Correlate the health impacts associated with outdoor and indoor air pollution as well as the vehicular emissions data in Accra on citizens especially the vulnerable group (children, women and the elderly).
- ❖ Create awareness on the health effects of air pollution.
- ❖ Research – For better understanding of magnitude of the problem of pollution related ill-health thru:
  - Exposure Assessments: for air pollutants
  - Epidemiological studies: Relating exposures to disease entities. - Respiratory, cardiovascular & other diseases attributable to different sources of air pollution

5 September 2016

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Let's clean the air !  
Let's repair the environment!  
Let's enjoy health & wealth!

Thank you

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# Health Impacts of Port Emissions

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31/Aug/2016

## Outline

- Pollutant Contributing Sources
- Key Port Pollutant Emissions
- Health Impacts of Air pollutants
- Health Impacts of Pollutants in Port Emissions
- Recommendations

## Pollutant Contributing Sources

- Port operations / business processes:
- On-site transportation - Diesel trucks, trains, ships
  - Onsite energy plants
  - Industrial operations

## Port Emission Sources

- Fuel combustion in **engines** of:
  - Ocean going vessels (OGVs)
  - Harbour Craft ( e.g. tug boats )
  - Berthing/docking of Vessels
- Land-based port operations sources
  - Cargo Handling equipment eg forklifts, cranes etc.
  - Heavy Duty Diesel Vehicle (HDDV)
- Other land-based stationary sources in the Port catchment including"
  - Fuel Combustion industries ( power plants, and diesel generators) for lighting, & other office operations & industry
  - Industrial operations
    - Metal processing industries (aluminum smelting, scrap steel re-melting,
    - Mineral processing ( Cement conveying and bagging plants)





## Key Port Emissions - Types

- Criteria pollutants
  - Pollutants with ambient air quality Guidelines: based on short- and/or long-term human health effects associated with exposure to these pollutants.
    - Ground-level ozone (O<sub>3</sub>)
    - Carbon monoxide (CO)
    - Particulate matter less than 10 (PM<sub>10</sub>) and 2.5 microns (PM<sub>2.5</sub>)
    - Nitrogen dioxide (NO<sub>2</sub>)
    - Sulfur dioxide (SO<sub>2</sub>):
    - Lead (Pb).
  - Ammonia and other species also contribute to secondary PM formation

## Greenhouse gases (GHGs)

- GHGs associated with combustion of diesel (and other fossil fuels),
  - Carbon dioxide (CO<sub>2</sub>), not traditional air pollutant but due to it being a greenhouse gas, is important in Climate Change
  - Methane (CH<sub>4</sub>) and
  - nitrous oxide (NO<sub>2</sub>)
- Black carbon**
  - In addition to the GHGs, another pollutant of concern in climate change is elemental carbon (Black Carbon)
  - Of particular concern for ports is the fraction of the exhaust aerosol from **combustion of diesel** or other fossil fuels that is black or elemental carbon (soot/smoke particulates) – a component of Ultrafine particles (UFP) less than 0.1 μm diameter

## Contribution of shipping to Black Carbon

- 2000 : estimated as 7-9% (Bond et al, Eyring et al, 2010)
- 2010: estimated as 8-13%
- Projections for 2030: sector will increase or maintain share of diesel BC emissions : 5% - 35%
- Black Carbon has harmful health effects and is a so called short lived climate pollutant

## Particulate matter (PMs)

PM emissions : correlated with

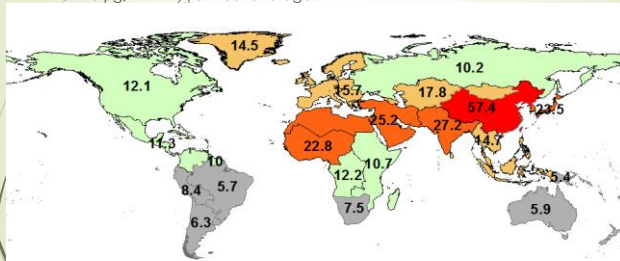
- more frequent asthma attacks,
- chronic bronchitis and
- lung cancer.
- worsening heart & lung diseases.
- **It is assumed that children get more infections of the middle ear with increased PM exposure.**
- In general, morbidity and mortality increase with increasing levels of PM.
  - the smaller the particles, the deeper they get into the lungs where they cause more serious consequences.
  - it is likely, that PM ends up in the blood stream, too.

## Hazardous air pollutants (HAPs), and toxic air contaminants (TACs)

- HAPs may have short-term and/or long-term exposure effects.
- ambient air contaminants that are known or suspected to cause :
  - cancer,
  - reproductive or birth defects,
  - adverse environmental effects, but
- Over 644 identified are components of diesel exhaust , including benzene, cadmium, formaldehyde, and 1,3-butadiene and PM.
- Do not have established ambient air quality standards.

## Results of the air pollution exposure assessment -2010

- The authors found that 89% of people live in areas that exceed the World Health Organization air quality guidelines of  $10 \mu\text{g}/\text{m}^3$   $\text{PM}_{2.5}$  annual average.



## WHO Air Quality Guidelines,

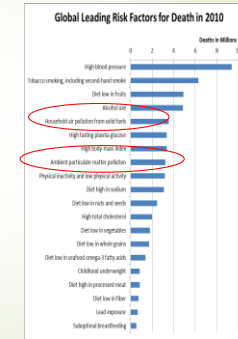
- PM<sub>2.5</sub>: 10  $\mu\text{g}/\text{m}^3$  annual mean 25  $\mu\text{g}/\text{m}^3$  24-hour mean
- PM<sub>10</sub>: 20  $\mu\text{g}/\text{m}^3$  annual mean 50  $\mu\text{g}/\text{m}^3$  24-hour mean
- SO<sub>2</sub> : 20  $\mu\text{g}/\text{m}^3$  24-hour mean 500  $\mu\text{g}/\text{m}^3$  10-minute mean
- NO<sub>2</sub> : 40  $\mu\text{g}/\text{m}^3$  annual mean 200  $\mu\text{g}/\text{m}^3$  1-hour mean
- O<sub>3</sub> : 100  $\mu\text{g}/\text{m}^3$  8-hour mean

## Attributable proportion of the Global burden of disease due to air pollution

- WHO global burden of disease (GBD) measures burden of disease using the disability-adjusted-life-year (DALY).
- DALY: A time-based measure that combines years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health.
- DALY metric was developed in the original GBD 1990 study to assess the burden of disease consistently across diseases, risk factors and regions.

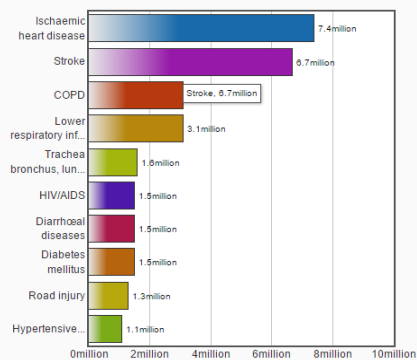
## The attributable proportion of the Global burden of disease due to air pollution: 2010

- The 2010 GBD places outdoor air pollution among the top 10 risks worldwide.
- Study shows that, annually, outdoor fine particle pollution contributes to over **3.2 million premature deaths** worldwide and over **74 million years of healthy life lost**.
- It also shows that household air pollution from the burning of solid fuels is responsible for a substantial burden of disease in low- and middle- income countries.

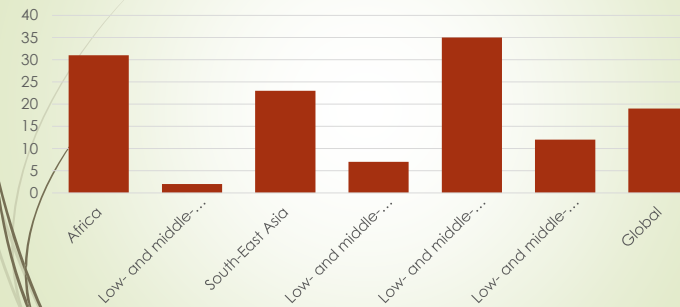


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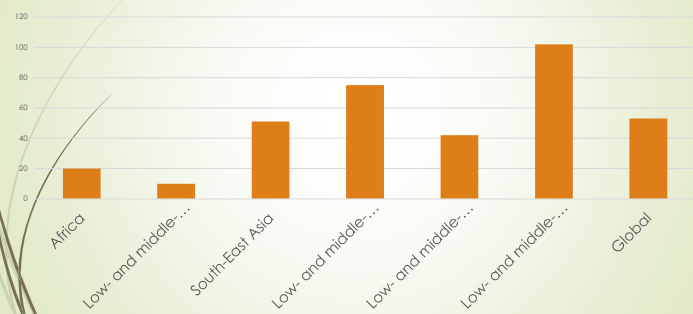
## The 10 leading causes of death in the world 2012



## 2012 Ambient air pollution attributable deaths per 100'000 children under 5 years

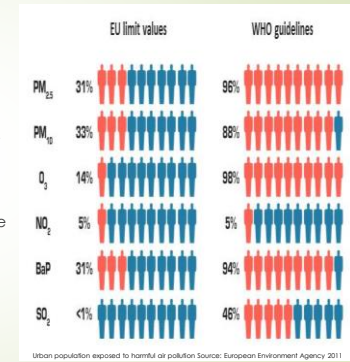


## 2012 Ambient air pollution attributable deaths per 100'000 capita



## Health impact of Air Pollutant in the EU

- Up to 98 % of Europe's urban population is exposed to dangerous air pollution levels exceeding the WHO's Air Quality Guidelines which are stricter compared to the EU regulations.
- the exposure to PM2.5 shortens life expectancy in the EU by more than eight months (European Environment Agency).
- 400,000 premature deaths in the EU linked to poor air quality, .



## Health Effects of emissions in ports

- June 2012: WHO confirmed diesel exhausts as carcinogenic
- SO<sub>2</sub> - can be transported very long distances by wind. Coastal and even hinterland regions may get polluted by emissions from shipping and port activities.
  - respiratory irritants and co-responsible for increased mortality rates, eg in the coastal areas of North America and Europe.
- NOx :emissions diminish lung function and increase risk of cardiovascular diseases.
- NOx also precursor of O<sub>3</sub> (ground level ozone) - very dangerous for human health - causes irritation, impairment and inflammation of the respiratory system, headaches, an impairment of physical ability and an increase in the frequency of asthma attacks.
- Significant contribution of emissions from diesel engines to ill-health or premature deaths due to air pollution:
- 15% (60,000 of 400,000 deaths) deaths in EU attributed to shipping

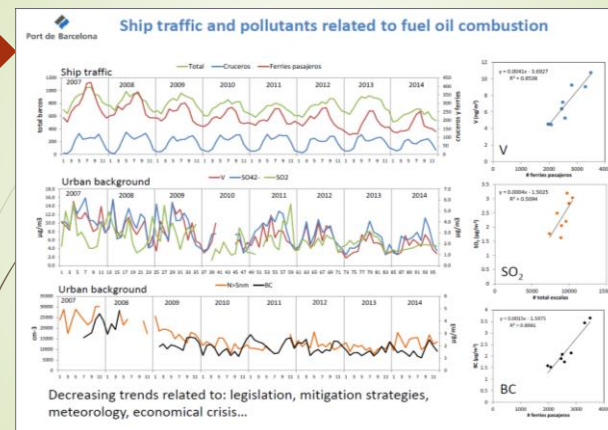
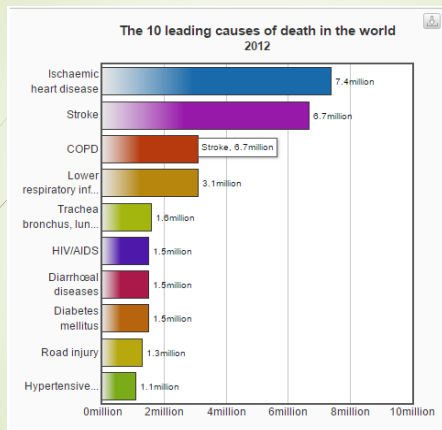
## Health Effects of emissions in ports

### Acute Effects:

- Acute rhinitis
- Acute bronchitis
- Asthmatic attacks
- Ear infections

### Chronic Effects:

- Chronic obstructive airway disease eg chronic bronchitis , tracheitis etc
- Chronic sinusitis
- Lung cancer.
- Worsening heart diseases with complications eg heart attacks, strokes etc
- Worsening lung diseases eg TB , HIV /TB co-morbidity



## Limitations of the data on health impacts of port emissions

- Paucity of data relating port emissions with health impacts
- Most of the data describing  $PM_{2.5}$  & associated disease burden currently is based on the 2010 GBD study & few other studies
- GBD does not provide data specific to health effects emissions from ports
- The air quality analysis for GBD relied upon estimates from satellite data, chemical transport models and ground-level measurements
- Evidence on adverse health effects of, and deaths from ambient air pollution were drawn from thousands of peer-reviewed studies.
- Most of the data are based on studies from the US and Europe.
- Makes many assumptions some of which may not hold in our local environment eg  $PM_{2.5}$  levels

## Recommendations

The emissions reduction action plan should include :

- health-related impact assessment program comprising of:
  - Baseline health impact assessment** (involving workers in various sectors of the port as well as visitors to the port) as part of the environment, health and safety (EHS) programs of Tema Port under the emissions reduction program.
  - Establishment /enhancement of a disease surveillance system that monitors disease prevalence alongside emissions levels as part of an EPA and Tema Port emissions and environmental quality monitoring programs
  - Assessment of health related benefits of an emissions reduction program

## Recommendations

- The Benefits:
- facilitate the quantification of the health impacts of air pollution
- provide a baseline against which future findings can be assessed
- facilitate the setting of realistic air quality standards for local ports
- Facilitate selection of control measures eg those leading to lowering of PM levels and subsequent reduction of adverse health impacts
- Quantifying health effects can provide further incentives for public expenditures and for policies to reduce energy consumption and emissions of greenhouse gases and air pollution.



# OPPORTUNITIES AND CHALLENGES OF PORT EMISSIONS REDUCTION ACTIONS-Discussion

Philip Acquah  
Lead Consultant

## Outcome

- implemented environmentally sound and sustainable port emissions reduction strategy and action plan
- Continuous improvement plans of inventory quality (TCCCA) implemented

## Impact

- more sustainable ports system built
- healthy air quality in port environment and communities
- reduced climate risk and carbon foot print while supporting economy growth and jobs.
- Baseline Port Health Impact assessment undertaken
- Follow-up real time air quality monitoring and health impact assessment with ort Health
- 
- 

## Outputs of

- Present and future boundary of analysis defined
- Present and future expansion and emissions implications outlined.
- Baseline business emissions processes, categories and emissions types documented
- Collected Data disaggregated as far as existing data formats permit
- Emissions methodologies developed and documented for institutional memory and sustained air emission inventory (AEI) by Tema Port

## Outputs of

- Baseline emissions inventory by gases and by business processes/categories estimated
- Business-as-usual/ Without measures (WoM) scenario developed over 2017-2030
- Identified Emissions reduction opportunities and With Measures (WM) scenario developed
- mitigation challenges identified for continues improvement With Additional Measure (WAM)
- Developed Continuous improvement plans for inventory data quality (TCCCA principle)

## Emission Inventory for the Business Process Components

- collect and analyze data for the Port business processes
- Collect data for in-port emission sources and emission sources outside the port within a defined air shed boundary of the port.
- Collect data for emission sources outside the port within a defined air shed boundary of the port.
- Identify data needs/gaps to accurately quantify port emissions in future.
- calculate historic and baseline emissions inventory by processes for 2013-2015 ( 2015 as the base year)

## Identification of Business Process Component Producing Pollution

- Main harbour business processes
- ( OGVs,
- Harbour Craft,
- CHE,
- HDDVs,
- Ship Year
- Fishing Harbour Operations

## Emission Inventory for the Business Process Components

- Estimate emissions contributions by business processes
- Estimate emissions at the Tema Port using existing methodologies.
- Develop and document methodologies as tools & institutional memory for sustained air emission inventory (AEI)
- Undertake emission inventory on oxides of nitrogen (NOX), carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), and particulate matter less than 10 microns (PM<sub>10</sub>) and 2.5 microns (PM<sub>2.5</sub>) in diameter, Black Carbon (BC) and sulfur dioxide (SO<sub>2</sub>)



## Analyze Pollution Source Component Impacts

- Outline the challenges facing the port from pollution, congestion, logistics etc.;
- catalogue on going initiatives to address these issues;
- identify anchors and/or linkages to existing initiatives for PM/BC/GHG emissions reduction strategies;

## Formulation of Action to Reduce Emission

- Develop actions plans and strategies to reduce emissions at the port,
- Identify strategies for long term PM/BC emissions reductions incorporating international best practices
- Develop inventory quality improvement plan based on the IPCC quality principle (TCCCA)-transparency-comparability-consistency overtime-accuracy)

## Opportunities

- **Framework to implement strategies involving**
  - encouraging environmental progress at ports;
  - reduce climate risk;
  - support operational and technological improvements to increase energy and operational efficiency;
  - improve community health and air quality; and
  - to encourage sustainable economic development that supports the economy and jobs (USEPA, 2009).

## Data & Tools

- **To develop** credible environmental data and tools to assess criteria pollutants and climate emissions,
- To Assess population exposure PMs and BC with updates on future progress
- To Assess environmental impact of port growth with implementation of expansion project
- To Provide Available methodologies for Tema port and stakeholders to conduct respective emission assessments, and

## Data & Tools

- Drive good local decision-making; and inform national policy-formulation
- Establish a baseline of emissions for the Tema Port and the vulnerable Tema community to track progress over time as new technology and efficiency improvements are implemented; and
- Help the Port, its customers and other transportation companies target future emissions reduction efforts and benefits

## Key Actions

Component	Framework of Emission
<b>Cargo Handling Equipment</b>	<p>A: Improvement on the container movement system                      Improvement on the data system of stacking and circulation of container                      Improvement of operation pattern on the marshal yard</p> <p>S: Adjustment of CHE capacity to the handled demand</p> <p>I: Promote the use of fuel-efficient CHE equipments</p> <p>F: The use of clean fuel</p>

## Key Actions (ASIF)

Component	Framework of Emission
<b>Vessels</b>	A: Reduce the travel distance of the vessel Improvement on circulation in the harbor pond
	S: The use of large size ship
	I: The use of efficient-fuel ship engine technology
	F: The use off shore power, CNG, Biodiesel, environmentally-friendly-fuel

## Key Actions

Component	Framework of Emission
<b>Harbor Craft</b>	A: Improvement of ship movement pattern Improvement of harbor craft load pattern suitable with the sea flow
	I: The use of fuel-efficient ship engine technology
	F: The use of environmentally-friendly fuel

## Key Actions

Component	Framework of Emission
<b>Heavy Duty Diesel Vehicles</b>	A: Improvement on the truck movement pattern in the port Management of queue and congestion
	S: The use of efficient heavy duty truck
	I: The use of more efficient truck engine technology
	F: The use of environmentally-friendly fuel

## USA Policies and measures (PaMs)

- Demonstrating the applicability and benefits of new retrofit technologies for vehicle fuel efficiency improvement
- Fuel switching to alternatively-fueled vehicles to LNG as Ghana develops infrastructure for LNG
- Introduce national Environmental Management System for Port Operations and On-road
- 

## USA Policies and measures (PaMs)

<b>Vessels and Harbour Craft</b>	vessel speed reduction in RSZ,
	shore power and cleaner fuels for OGVs,,
	replacing harbor craft engines with Tier 2 and 3 engines
	meeting Tier 4 standards with cargo handling equipment ultimately
	Using low-sulfur distillate fuels at berth.

## USA Policies and measures (PaMs)

<b>Heavy Duty Diesel Vehicles</b>	Ports restricts the operation of trucks that do not meet the clean standards established in the Plan.
	Ports impose a system of fees and transportation charges on shippers to raise the necessary funds to pay for the cleaner trucks
	such supporting engine retrofit and engine tuning to demonstrate the benefits of cleaner trucks

## USA Policies and measures (PaMs)

<b>Cargo Handling Equipment</b>	Using ultra-low sulfur diesel, biodiesel, and other cleaner-burning fuels in cargo-handling equipment.
	Replacing diesel-fueled cranes and equipment with electric cranes and cleaner fuels.
	Reducing truck idling, decreasing truck trips on local roads and lessening construction impacts
	Low moisture content fuels.

## Way Forward

- Discuss the Emissions reduction action plan development
- Discuss the key actions and typical US policies and measures