EXAMINATION OF DIFFERENT GREEN PORTS INITIATIVES AND POSSIBLE APPLICATION TO EGYPTIAN PORTS

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ABSTRACT: The concept of Energy Efficiency is currently gaining strong momentum in the international community and specific applications are quite valid in the maritime Industry. The objective of limiting the energy footprint and controlling the global problem of Global warming and the emission of greenhouse gases cannot be over stressed. In response to the growing international problem many measures have been developed and implemented on the maritime level as well as the shore level. Many ports worldwide have adopted measures to maintain an energy efficient level of operation as well as motivating ship-owners to do the same by offering incentives. This paper will examine the currently adopted measures by many ports worldwide with the objective of applying the same measures in Egyptian ports. This paper will also show as a conclusion that many measures are very simple enough to apply and will have a strong impact on the overall image and traffic of Egyptian ports as well as having a positive impact on the energy efficiency of ship's visiting Egyptian ports, thus contributing to the overall global efforts in reduction of greenhouse gases..

Keywords: Energy Efficiency, Green ports, GHG Reduction.

1. INTRODUCTION

Pollutions emerge as a serious concern as soon as large populations and their activities and environments are directly affected. The visibility of the pollution itself or of its effects triggers action because the pollution cannot be ignored anymore. The massive extraction and combustion of fossil fuels, along with the release of chemical substances, affect the air quality. The cities were first affected by air pollution. The vicinity of industries and urban areas amplified the issue of air quality.

On a larger scale, from the 19th to the mid-20th century, London suffered from the smog caused by the combustion of large quantities of coal and other fossil fuels, impairing the air quality of the entire city. This smog became an issue to solve when, in December 1952, the premature death of 4000 was directly linked to this air pollution (Levingston, 2002)[1].

Despite such visible drawbacks, industrialism and trade became norms for economic growth. Because wealth and related power extracted from industrialism and trade mastery cannot be ignored, strong political supports induce worldwide spread of theses doctrines. In addition, favorable geopolitical triggers appeared with the decline of European and soviet empires and the global promotion of open market economy. In such contexts, industrialization and exchange exploded and new industrialized countries emerged.

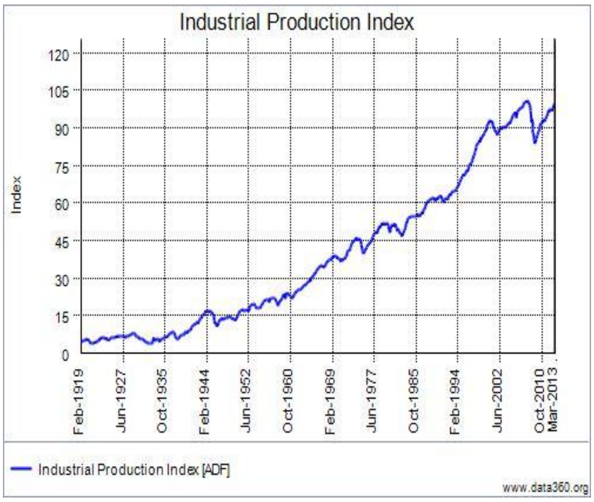

Figure 1: World Industrial production Index 1919-2013 (Data360, 2013)[2]

Fortunately, the undeniable impacts of air pollutants triggers regulatory processes aiming to mitigate the issue while concurrently raising awareness among the public as well as enhancing research on pollution – e.g. Chinese Ministry of Environmental Protection carefully monitors air emissions in large cities and develops regulations to mitigate the issue. So, through its deadly aftermath, the air contamination acquired social visibility and political recognizance.

The amounts of pollutant emitted in the air are becoming so large that their consequences cannot be ignored, both at local and global levels. The invisible air pollution obtains a social visibility and publicity through its unfortunate effects locally and through its impacts on the global climate system. Economic models and population growth modify faster than ever the air quality.

The first strategy to reduce emissions without modifying socio-economics is to enhance energy efficiency. The concept of Energy Efficiency refers to the optimization of work by unit of energy consumed. In the shipping context, where most emissions are linked to engine consumption, fuel savings mathematically shrink air emissions.

Such a strategy possesses a clear validity in the context of energy scarcity and air emission concern. In addition, it avoids radical changes in emission control and therefore limits socio-economic disturbance.

International shipping is a major contributor to a group of pollutants together with greenhouse gas (GHG) emissions. Recently, its better energy efficiency and effective emission control has been a hot topic of discussion, in particular at the International Maritime Organization (IMO) from the viewpoint of both technical and operational measures. Among others, under the pressure of high oil prices, international shipping lines have focused on efficient ship operations that relate to energy efficiency issues in shipping, and particularly operational issues, to minimize fuel consumption and the resulting GHG emissions.

Port stay is an important component of international shipping and has a direct effect on ship operation and duration of ship’s stay which means a form of effect on the ships fuel consumption in port and GHG emissions. In light of the recent IMO regulations on the subject of energy efficiency, ports could play a very important role aimed at enhancing efficient vessel operations as well as an incentive role that motivates ship owners to operate their ships in an energy efficient manner. Offering incentives to ships also could accelerate the application of innovative technologies onboard ships in addition to adopting voluntary IMO measures by ship owners which could in turn facilitate the application of an overall energy efficient operation of maritime shipping.

2. GREEN PORT INITIATIVES

Various ports are promoting green initiatives that aim to reduce air emissions from ships. Green port initiatives are in place in particular in USA, Europe and to some extent Asia. In the majority of cases, air pollution is at the core of the green port initiatives. As a result of IMO regulations on reception facilities and port-level initiatives, the port services go much beyond the traditional ship cargo loading and discharging.

One of those initiatives is port related VOC management. Volatile Organic Compounds (VOCs) are the lighter parts of crude oil, or their products, that vaporize during the ship loading process in the loading tanks. This then normally vents to the atmosphere causing air pollution in port areas.

IMO MARPOL Annex VI regulations allow the Flag State to designate ports that intend to control and reduce VOC from tankers. This is embodied in Annex VI Regulation 15 on VOC. The regulation enables ports and terminals to implement VOC controls. For compliance purposes, these ports should have reception facility for such gases (e.g. the collection and safe disposal or use of gases). Tankers that visit such ports should also have a Vapor Emissions Control System (VECS) to be compliant with IMO MSC/Circ. 585 on Standards for VECS system (IMO 1992)[3]. Figure 2 shows a schematic of such a ship-board VECS.

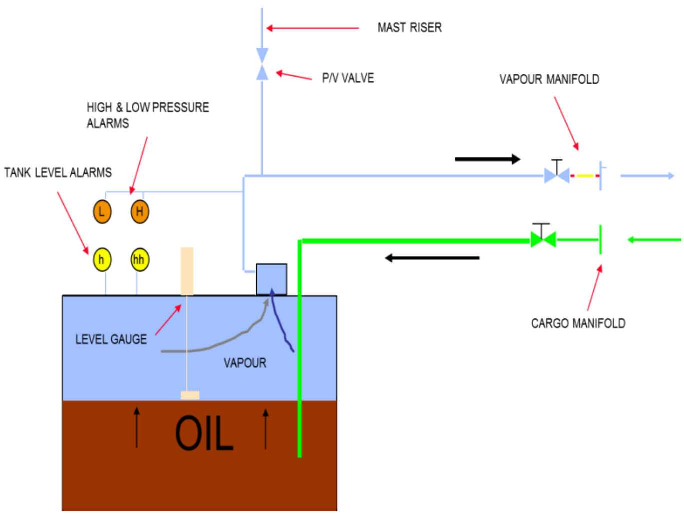

Figure 2 – Schematic of an oil tanker's VOC emissions control system

Additionally, crude oil tankers are required to have an approved VOC manual. This should contain procedures for minimizing VOC emissions during loading, sea passage and discharge and additional VOC during washing.

Currently, a number of ports have been assigned as VOC control ports; see the list below (Table 1).

Table 1 – Designated ports with VOC emissions control (IMO 2011)[4]

DESIGNATED PORTS AT WHICH VOC EMISSIONS ARE REGULATED

NAME OF PORTS, TERMINAL/FACILITY		SIZE OF TANKERS	CARGOES REQUIRING VAPOUR EMISSION CONTROL SYSTEMS	EFFECTIVE DATE
The Netherlands				
Amsterdam	All terminals	All sizes	Cargoes with VOC, with the exception of methane, with a vapour pressure of 1 kPa (10 mbar) or more at a temperature of 293.15 K (20°C) or such cargoes with an equal volatility of 10 mbar	9 November 2011
Rotterdam	Botlek Tank Terminal, Rubis, ETT, Argos	All sizes	Cargoes with VOC, with a vapour pressure of 1 kPa (10 mbar) or more at a temperature of 293.15 K (20°C). For Rubis only, substances under class LT2 are to be controlled	9 November 2011
Moerdijk	Afval Stoffen Terminal Moerdijk ATM, Shell Chemie Moerdijk, Den Hartoch Moerdijk bv	All sizes	Cargoes with VOC, smelling products and ADR Class 3 and 6	9 November 2011
Terneuzen	Dow Benelux BV Terneuzen, Oiltanking Terneuzen BV.	100,000 GT and less	Cargoes with VOC	9 November 2011
Groningen	VOPAK	All sizes	Cargoes with VOC, with the exception of methane, with a vapour pressure of 1 kPa (10 mbar) or more at a temperature of 293.15 K (20°C) or such cargoes with an equal volatility of 10 mbar	1 July 2012
Vlissingen	Zeeland refinery	9,000 GT and above	Cargoes with VOC	9 November 2011
The Republic of Korea				
Busan Incheon Pyeongtaek/Dangjin Ulsan Yeosu Kwangyang		400 GT and above	Crude oil Gasoline Naphtha	20 May 2009
Daesan		400 GT and above	Crude oil Gasoline Naphtha	20 May 2015

The Application of a differentiated port dues system is also another example. Some of the ports provide incentives for efficient and clean shipping via reduced port dues based on their regulated emissions levels. Examples are the Swedish ports that currently provide differentiated port dues based on environmental criteria. About 20-25 of the bigger ports in Sweden have differentiated the port dues on the basis of the sulphur content of the fuel used and the NOx emissions from the engines on-board. For example, in Gothenburg, Sweden the port dues are increased if the sulphur content of the fuel exceeds 0.2%. For ships with a NOx emission level lower than 12 g/kWh, a discount is applied that increases progressively

Fees manipulation based on energy efficient performance have other forms other than port dues. Stated could apply incentive measures on their own ships such as the differentiated ship registration fees based on EEDI. The EEDI (Energy Efficiency Design Index) is part of the new regulation under MARPOL Annex VI that aims to improve shipping CO2 emissions via enforcing future targets for ship designs that will provide major reductions to EEDI. Some administrations have taken, or are evaluating, to use this index for differentiated registration fee or tonnage taxation. An example of such an initiative is the one by Singapore MPA (Maritime Port Authority) in 2011 that was undertaken under the Singapore Green Ship Program (MPA 2014)[5].

The Green Ship Programme targets Singapore-flagged ships. The MPA will provide incentives to ship owners who adopt energy efficient ship designs that will reduce fuel consumption and carbon dioxide emissions. Accordingly, Singapore-flagged ships registered on or after 1 July 2011, which go beyond the requirements of the International Maritime Organization's

EEDI, will enjoy a 50% reduction on the Initial Registration Fees under both the normal registration and the Block Transfer Scheme during the registration of the ship. They will also enjoy a 20% rebate on Annual Tonnage Tax payable every year for a number of years based on a scheme that uses EEDI.

Existing ships which utilise energy efficient ship designs that meet the requirements for the Green Ship Programme can also take part in this programme, but will only enjoy the 20% rebate on Annual Tonnage Tax payable every year until the ship ceases to exceed the requirements of IMO EEDI reference lines.

2.1 Environmental Ship Index (ESI)

A large number of the world's key ports have committed themselves to reducing the port-related GHG. This commitment is called the World Port Climate Initiative (WPCI). One aspect of this initiative is giving incentives to ships that visit such ports as a way of reducing port-related emissions.

One of the projects within WPCI is the development of an Environmental Ship Index (ESI). The ESI identifies seagoing ships that perform better in reducing air emissions than the levels required by the IMO. The ESI evaluates the amount of nitrogen oxide (NOx), sulphur oxide (SOx) that is released by a ship and includes a reporting scheme on the greenhouse gas emission of the ship.

The ESI aims to identify cleaner ships in a general way. The index is intended to be used by ports to reward ships when they participate in the scheme for promoting clean shipping. Also, WPCI encourages the shippers and ship owners to use the index as their own promotional instrument.

ESI is a voluntary scheme designed to improve the environmental performance of sea going vessels. It can be applied to all types of seagoing ships. It is easy to calculate and simple in its approach.

ESI relies on various formulas for the calculation of various parts for NOx, SOx and CO2. It additionally awards a bonus for the presence of OPS. The ESI Score ranges from 0 for a ship that meets the IMO environmental regulations that is already in force and 100 for a ship that emits no SOx and no NOx and reports or monitors its energy efficiency. In other words, a ship with a score of 0 points is actually in full compliance with the applicable requirements and thus OK and the ship with 100 points has zero air emissions. In reality, the best performing ships currently score at around 40 points (WPCI 2014)[6].

2.2 Incentive schemes

Jan Fransen, Managing director of the green awards foundation quoted that "Incentive schemes, such as the green award, contribute to motivation and differentiation of quality of shipping. As it is, the commercial market seems to allow standard shipping, regardless of efforts done by regulatory institutions. Green Awards help create a market mechanism that is to result in preference for quality tonnage on the charter market and elimination of substandard tonnage".

The incentive for an operator to reduce fuel and thereby reduce GHG emissions is reduced costs. While there are many opportunities to optimise and improve operational efficiency it will require the participation of several parties it is essential that each of the parties has the incentives and flexibility to join the energy-saving effort. Ports, as demonstrated by programs such as the green awards program, can contribute effectively to offering incentive schemes that can motivate ship owners to apply green measures on their ships and additionally many other aspects could be covered as well such as safety aspects and even efficient ship operations.

The green awards incentives could best be described through the following tables which outlines different incentives offered to ships that hold the green awards certificates.

Table 2. Examples of incentives offered by different ports for Green awards ships (Green award 2014)[7]

Name	*Country*	*Benefits*
Port of Ghent	Belgium	Reductions on the ship's tonnage. The ship's tonnage (ST) is reduced however by: - 15% if it concerns sea-going vessels for which a valid bulk Green Award certificate can be submitted; - 20% if it concerns sea-going vessels not used for ro/ro operations or recorded in Lloyd's Register of Shipping as "pallets carrier" for which a valid short sea Green Award certificate can be submitted - 10% discount on the harbor dues to Green Award certified inland navigation vessels from 1-01-2013
Port Metro Vancouver	Canada	23.4% savings over the basic harbor dues rate for oil tankers and bulk carriers. Port Metro Vancouver recognizes Green Award certified vessels as eligible at the Bronze level under the EcoAction program.
Gibraltar Port Authority	Gibraltar	a 5% reduction in tonnage dues for all Green Award certified vessels entering BGTW (British Gibraltar Territorial Waters) and calling at the Gibraltar Port.
Centre Port Wellington	New Zealand	3% of the port's Marine Services Charge (MSC) for bulk carriers and oil tankers
Sohar Industrial Port Company	Sultanate of Oman	5% rebate on port dues for tankers
Port of Amsterdam	The Netherlands	6% premium on the port fees for Crude oil/Product Tankers and for Cargo Bulk Carriers
Port of Zevenellen	The Netherlands	- 10% discount on the port dues for inland barges
Zeeland Seaports Vlissingen, Terneuzen	The Netherlands	- 6% premium on the port fees for Crude oil/Product Tankers and bulk carriers - 10% discount on the harbor dues to Green Award certified inland barges from 1-01-2013

2.3 Onshore Power Supply (OPS)

During the ship's port operations and at berth, auxiliary engines are run in order to generate electricity for supply to ship-board systems as well as to the cargo loading or unloading machinery, where applicable. The amount of power generated and fuel consumed is dependent on type of ships and could be anything from a few hundred kW to several MW of electric power. The operation of auxiliary engines is a major source of SOx, NOx and particulate emissions at port. The amount of emissions is generally proportional to the amount of fuel used. The longer the ship stays at berth, the more the fuel consumption increases and thereby the more the exhaust pollutants emitted to the port.

Concern over air quality in ports has led to growing pressure on port operators to reduce exhaust emissions; in particular pollutants of SOx, NOx and Particulate Matter (PM). The supply of power from onshore (port) to ship is one system that has been advocated for this purpose. Use of this system allows ships to turn off their engines when in port and plug into a shore-side electricity supply. As a result, not only are the air emissions in port reduced but also this helps positively with other aspects of the ship and port operations It is claimed that these systems, in addition to the environmental and social benefits, could provide economical savings to all stakeholders.

The use of OPS may be regulated as a response to a specific, local problem (pollution) with a specific, local solution. For ports, the ability to supply power to ships at berth enables them to establish a more efficient overall electrical supply and also act as a utility. For the port area community, there is an additional benefit of reduced noise and vibration in harbor areas. For ship staff, when the system is fully operational, more time will be available to deal with maintenance and other aspects of port-related activities.

To use OPS, there will be a need for extra investment both at shore-side (port) and ship side. As the responsibility for supply of electricity to ship is with port, the capital investment of ports will be more significant. Additional investments stem from construction and installation at the quay and potential needs related to strengthening the port's electricity grid.

OPS solutions often comprise the entire chain from the incoming substation and include transformers and frequency converters to match the grid power voltage and frequency to the ship's connection between the onshore power supply grid and the ship's internal system.

Accordingly, the shore side system requires the following (M. Martelin et al, 2010)[8]:

1. Transformer for voltage reduction: The transformer steps down the power supply from a voltage level optimized for distribution (eg, 20 kV) to one of the two voltage levels standardized for shore-ship power connections for 11 or 6.6 kV as required by the ship.
2. Switchgear for electrical safety: Each shore-based power connection point requires some sort of medium-voltage switchgear with an automated earthing switch. In essence, the switchgear interrupts the power supply and ensures that there is absolutely no power in the cables between the ship and shore while they are being handled and connected.
3. Frequency converter: The majority of ships operate with a 60 Hz supply, whereas local power grids in many parts of the world use 50 Hz. As a result, most shore-based power connections will require a frequency conversion. Static frequency converters provide an economical solution to connect any ship to any grid independent of the required frequency.

4. Automation system: The shore side infrastructure for a shore-to-ship power connection must include an automation and communications system that allows personnel to coordinate the connection of cables and synchronize the ship's electrical load to the shore side supply.

There are proposals to add some new regulations to MARPOL Annex VI on introducing requirements for the future wider use of OPS (Lloyd's Register, 2012)[9]. Accordingly, ships should undertake an assessment of the environmental benefits and of the cost benefit of addressing emissions from ships at berth. As part of this, it should be taken into account how the supplied electrical power is generated, and if similar environmental benefits could be achieved by other more cost-effective means.

As part of the regulation, it is suggested:

1. Ships that can document that their on-board power production has lower total emissions than the supplied shore side electricity should, if no other local circumstances dictate otherwise, be exempted from the requirement to connect to shore side electrical power.
2. No ship should be required to connect to OPS when the planned port stay at the actual berth is less than a couple of hours (e.g. 2 hours).
3. The port or terminal shall provide sufficient electrical power to sustain all normal operations during the port call, including calculated peak consumption.
4. The costs for the ship to connect to shore power at berth should not exceed the average comparable costs of port services in general and the cost of supplied electricity to shore-based consumers within the vicinity of the port or terminal.

3. RESULTS AND DISCUSSION

Ports play an important role in shipping and have a great potential on impacting shipping energy efficiency. Egypt has an extensive ports system with considerable annual traffic. The total number of Egyptian ports is 15 ports with a total handling capacity of 133.75 million tons of cargo, 6.5 million TEU, and 2.6 million passenger annually (Egyptian Maritime Transport Sector, 2010)[10]. This is quite considerable port traffic when compared to other countries in the region.

In addition, the port of Alexandria for example is one of the top 10 ports by number of calls in the Mediterranean as shown in table 3.

Table 3. Top 10 Ports by Number of Calls (REMPEC, 2006)[11]

Port	No. Unique Vessels	No. Calls	Total DWT
Barcelona	1,775	9,112	132,272,844
Leghorn	1,278	6,953	79,246,383
Genoa	1,331	6,924	111,939,020
Gibraltar*	3,812	6,822	312,509,938
Valencia	1,066	5,776	109,524,853
Algeciras	1,740	4,844	160,730,519
Alexandria(EGY)	1,880	4,801	58,506,026
Piraeus	1,488	4,712	79,055,659
Algiers	871	4,615	39,810,728
Venice	1,300	4,480	57,910,567

**Mainly Bunkering Calls*

Given the pre-discussed large traffic on Egyptian ports, applying green initiatives will have a considerable impact on the emission of GHG in the Mediterranean and Red Sea regions. There are many measures that could be taken by ports to reduce the emissions of greenhouse gases both from the port area itself and the ships that visit those ports. If we examine some of those measures we will find them very simple and require actually no infrastructure of any kind of investment. Some of these measures are incentive schemes which need nothing from the port's side except applying to join the prospective scheme and obtaining approval from the respective ministry, which in the case of Egypt will be the ministry of transport, to get special reduction in certain fees.

The fact that all those measures are voluntary for ships, no obligation will be imposed on the state to develop legal measures for application that should have statutory backing especially with respect to violations and sanctions or regarding any kind of compliance monitoring and enforcement aspects which is customary for application of other international conventions.

On the other hand some measures such as installing an Onshore Power Supply system will require a considerable capital investment. As a feasibility study on the installation of such a system in the port of Vancouver in Canada shows, the investment will range from 1 million to 14 million US dollars, depending on the existing infrastructure.

In Egypt the cost is currently difficult to calculate and requires further research into the subject however, it will still remain a major capital investment. In addition the issue of profitability for the Egyptian ports still need to be investigated and researched in the future due to the different sources of power supply over the country which varies from wind energy in some areas in the red sea, to hydro energy from the Aswan dam to Fuel power plants. The location of each port will determine the cost of energy consumption by that port as well as the infrastructure requirements to install an Onshore Power Supply system.

4. CONCLUSION

Many incentive schemes exist today and joining those schemes improves the green image of the member ports. It is recommended that different Egyptian port authorities consider contacting schemes such as the green awards certification scheme and the World Ports Climate Initiative and obtain memberships and start offering incentives to ships. It is also recommended that Egyptian flagged ships should be given registration fees reduction based on their energy efficiency levels as per IMO requirements.

Such measures will not only improve the green image of Egyptian ports, but could also offer a reduction in ports costs to ship operators that could improve the competitive levels of Egyptian ports in the Mediterranean region.

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