모의IMO총회
The Mock IMO Assembly

# Comprehensive IMO Initiative for Onshore Power Supply

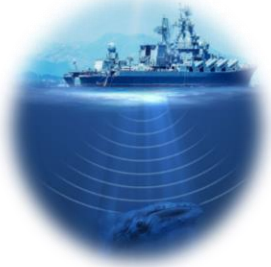
Team AMPERE

# CONTENTS

# Environmental Pollution by Ships

Nitrous Oxide


Carbon Dioxide



Noise Pollution

Sulfur Dioxide

Particulate Matter

Environ. Sci. Technol. 2007, 41, 8512–8518

**Mortality from Ship Emissions: A Global Assessment**

JAMES J. CORBETT,*,† JAMES J. WINEBRAKE,† ERIN H. GREEN,† PRASAD KASIBHATLA,‡ VERONIKA EYRING,§ AND AXEL LAUER§

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*Received July 09, 2007. Revised manuscript received September 28, 2007. Accepted October 04, 2007.*

Epidemiological studies consistently link ambient concentrations of particulate matter (PM) to negative health impacts, including asthma, heart attacks, hospital admissions, and premature mortality. We model ambient PM concentrations from oceangoing ships using two geospatial emissions inventories and two global aerosol models. We estimate global and regional mortalities by applying ambient PM increases due to ships to cardiopulmonary and lung cancer concentration-risk functions and population models. Our results indicate that shipping-related PM emissions are responsible for approximately 60,000 cardiopulmonary and lung cancer deaths annually, with most deaths occurring near coastlines in Europe, East Asia, and South Asia. Under current regulation and with the expected growth in shipping activity, we estimate that annual mortalities could increase by 40% by 2012.

**Introduction**

The marine transport sector contributes significantly to air pollution, particularly in coastal areas (*1*–*8*). Annually, ocean-going ships are estimated to emit 1.2–1.6 million metric tons (Tg) of particulate matter (PM) with aerodynamic diameters of 10 μm or less ($PM_{10}$), 4.7–6.5 Tg of sulfur oxides ($SO_x$ as S), and 5–6.9 Tg of nitrogen oxides ($NO_x$ as N) (*9*–*12*). Recent studies have estimated around 15% of global $NO_x$ and 5–8% of global $SO_x$ emissions are attributable to oceangoing ships (*10*, *11*). Given nearly 70% of ship emissions occur within 400 km of land (*2*, *11*, *12*), ships have the potential to contribute significant pollution in coastal communities—especially for $SO_x$. For instance, Capaldo et al. (*1*) estimate that ship emissions contribute between 5 and 20% of non-sea-salt sulfate concentrations and 5–30% of $SO_2$ concentrations in coastal regions.

Numerous studies in recent years have consistently linked air pollution to negative health effects for exposed populations (*13*, *14*). Ambient concentrations of PM have been associated with a wide range of health impacts including asthma, heart attacks, and hospital admissions. An important PM-related health effect is premature mortality; in particular, increases in concentrations of PM with aerodynamic diameters of 2.5 μm or less ($PM_{2.5}$) have been closely associated with increases in cardiopulmonary and lung cancer mortalities in exposed populations (*15*). Cohen et al. estimated approximately 0.8 million deaths per year worldwide from outdoor urban $PM_{2.5}$ air pollution, 1.2% of global premature mortalities each year (*16*).

Emissions from international ships are increasingly a focus for proposed regulation in local, national, and international arenas (*8*, *17*, *18*). Yet, in many ways regulatory deliberations have not been fully informed, as the extent of shipping emissions health impacts has been unknown. Previous assessments of regional shipping-related health impacts focused on European or Western United States regions, and ignore long-range and hemispheric pollutant transport (*8*, *19*). This undercounts international shipping impacts within local and regional jurisdictions, and does not properly inform international policy decision making.

**Assessing Mortality from Atmospheric Modeling of Ship Emissions**

Our approach is similar to that of other studies (*15*, *16*, *20*, *21*): (1) determine pollutant emissions from ships; (2) apply atmospheric transportation and chemistry models to estimate the increased concentrations due to ships; (3) estimate increased risk to exposed population due to these additional concentrations; and (4) calculate additional mortalities due to that increased risk.

We use two different geospatial ship data sets to help us construct geospatial emission inventories: the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) by Corbett et al. (*10*), and the Automated Mutual-assistance Vessel Rescue system (AMVER) by Eisdresen et al. (*12*). These two data sets combine detailed information about vessel characteristics with vessel traffic densities to determine emissions geospatially. However, each data set allocates ship-traffic intensities differently. For example, while all oceangoing commercial ship types are included in these data sets, ICOADS oversamples container ship traffic and refrigerated cargo ship (i.e., reefer) traffic, and AMVER oversamples bulk carrier and tanker traffic. Ship inventory differences affect regional atmospheric pollution concentrations, potentially influencing health effects estimates. Both inventories provide emissions data on a monthly time-resolution; for atmospheric modeling, we assume emissions occur uniformly throughout each month.

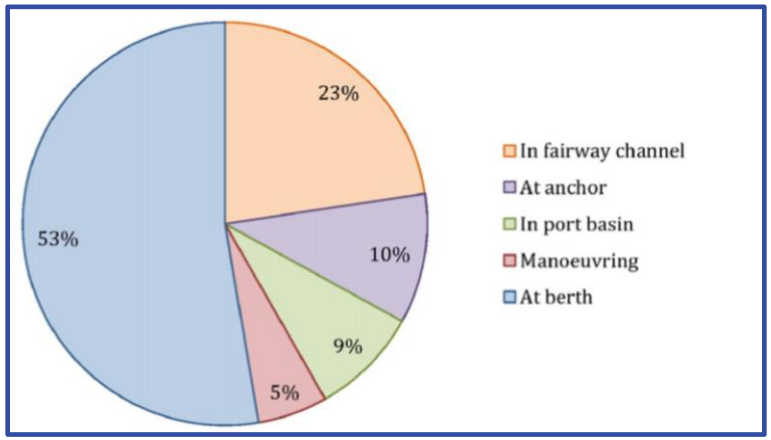
We generated three emissions inventory data sets for comparison. First, we used monthly resolved ICOADS 2002 emissions estimates of $NO_x$, $SO_x$, black carbon (BC), and particulate organic matter (POM) at a 0.1° × 0.1° global grid resolution (*Inventory A*). Second, we used AMVER 2001 emissions estimates of $NO_x$, $SO_x$, BC, and POM at a 1° × 1° global grid resolution from Eyring et al. (*Inventory B*) (*11*). Because of recent attention on the growth in commercial shipping activity, we also produced ICOADS-based ship inventories for 2012 (*Inventory C*) forecast using a uniform global average growth rate of 4.1% (*3*, *10*). Both inventories

Early mortality 60,000 deaths/year
→ $160 B Environmental Damage

*Source: Corbett et al., "Mortality from Ship Emissions", 2007*

# Emission at Ports

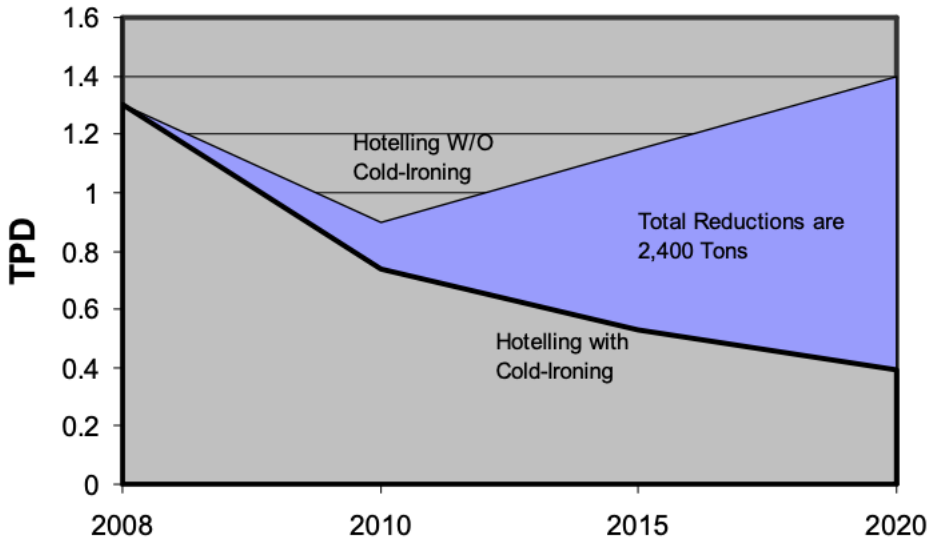
### Emissions of CO2 in five Different Operational Models from Ships to Ports




| Port Emissions | Emissions from Auxiliary Engines (ton) | | |
|---|---|---|---|
| | At Sea | Maneuvering | Hoteling |
| NOx | 50 | 160 | 721 |
| SO2 | 27 | 86 | 383 |
| CO2 | 2861 | 9156 | 41615 |
| VOC | 2 | 5 | 23.5 |
| PM | 2 | 5 | 23.5 |
| CO | 2 | 7 | 32 |

*Source: https://safety4sea.com/cm-cold-ironing-the-role-of-ports-in-reducing-shipping-emissions/*

*Source: State of California ARB, "Diesel PM Exposure Assessment"*




Hoteling emissions contribute **34%** of total diesel Particulate Matter (PM)

Health risk to the residents in the surrounding communities

# What is OPS?

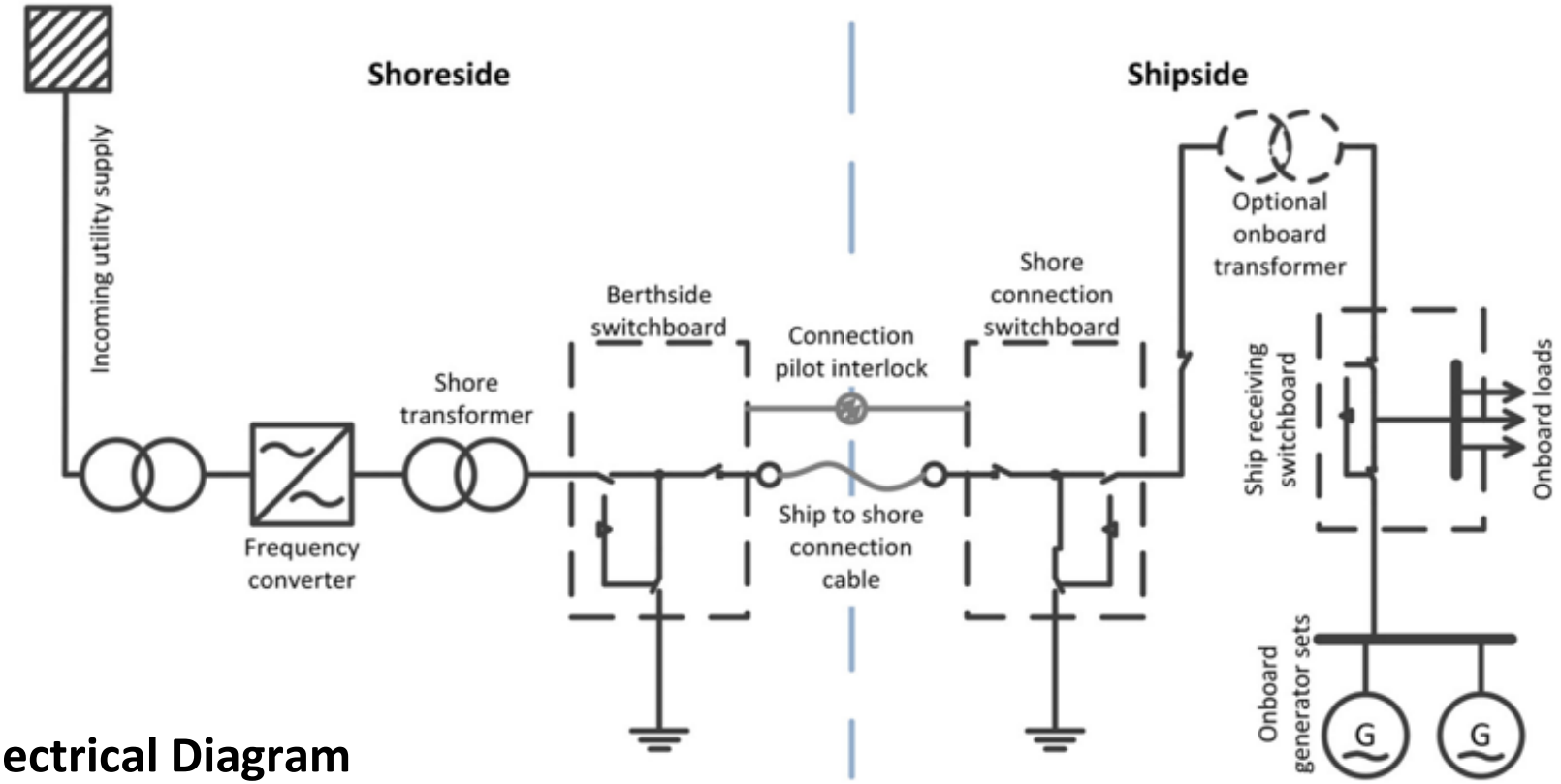

*Port of Los Angeles*

Auxiliary Diesel Engine

Shoreside Electricity

Lighting, air conditioning, etc. required during berth

# How does OPS work?




**Electrical Diagram**

*Source: National Technical University of Athens, 2014*

# Environmental Benefits of OPS (1)

| | Mean AE emissions (g/kWhe) | Power station emissions (g/kWhe) | Reduction (%) |
|---|---|---|---|
| $NO_x$ | 14.1 | 1.2 | 91.6 |
| CO | 0.9 | 0.2 | 75.6 |
| $SO_2$ | 2.2 | 1.2 | 45.8 |
| $CO_2$ | 718.6 | 542.6 | 24.5 |

*Source: William J. Hall, "Assessment of CO2 and priority pollutant reduction by installation of shoreside power", 2010*

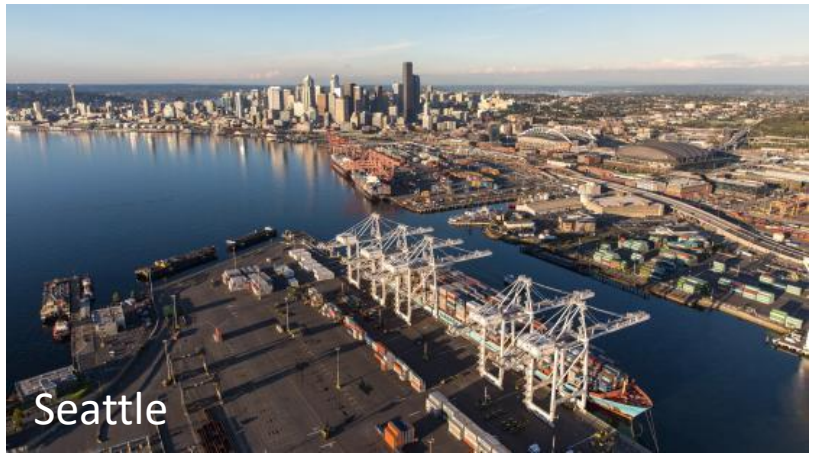
Improve **Air Quality** of the Port city
**Fuel-cost Savings** for on-board units
Reduction of **Vibrations** on board

105 x
Diesel oil consumption now 84 L/h

21 x
Hybrid fuel consumption after modernization 17 L/h

0 x
Fully electric after modernization 0 L/h

# Environmental Benefits of OPS (2)


| Name | Economic Costs | Environmental Benefits |
|---|---|---|
| California | $23.73 million in Proposition 1B funding from the State of California for shore power at 10 berths | **Reduced emissions by up to 75% since 2005** |
| Seattle | $1.49 million ARRA grant; $1.4 million EPA grant to install shore power infrastructure at the TOTE Terminal | **Annual CO2 emissions cut by up to 36%** |

*Source: US Environmental Protection Agency*

# Future of OPS: Electric and Autonomous Ships


Electric & Hybrid Ships

Average fuel cost reduction 56 %

Aligned with IMO's 2050 decarbonization targets


Autonomous Ships

Optimized operations using real-time data

Commercialization to begin in 2025

Necessity of an onshore power system

## MSC 101/24 (2019)

IMO INTERNATIONAL MARITIME ORGANIZATION **E**

MARITIME SAFETY COMMITTEE
101st session
Agenda item 24

MSC 101/24
12 July 2019
Original: ENGLISH

**REPORT OF THE MARITIME SAFETY COMMITTEE ON ITS 101ST SESSION**

**Table of contents**



I:\MSC\101\MSC 101-24.docx

EMPOWERING WOMEN IN THE MARITIME COMMUNITY

- Regulatory Scoping Exercise For The Use Of Maritime **Autonomous** Surface Ships (MASS)
- Goal-Based New Ship Construction Standards

*Source: W. Litwin, "Experimental Research on the Energy Efficiency of a Parallel Hybrid Drive for an Inland Ship", MDPI, 2019.*

# Limitation (1): Price

**Cost of Transmission**

**$1 million – $3 million**

**Cost of Installation**

**$300,000 – $2 million**

**Capital Costs:**

Ship Retrofits and Shore-side Infrastructure

**Operating Costs:**

Energy, labor and routine maintenance

*Source: Ronald Ssali, Ship-port interface: analysis of the cost-effectiveness of cold ironing at Mombasa Port , World Maritime University, 2018.*

| | *Victoria Bridge* | *Hanjin Paris* | *Lihue* | *OOCL California* | *Chiquita Joy* | *Ecstasy* | *Chevron Washington* | *Groton* | *Alaskan Frontier* | *Ansac Harmony* | *Pyxis* | *Thorseggen* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total calls per year | 10 | 10 | 16 | 8 | 25 | 52 | 16 | 24 | 15 | 1 | 9 | 21 |
| Average Berth Time (hrs/call) | 44 | 63 | 50 | 121 | 68 | 12 | 32 | 56 | 33 | 60 | 17 | 48 |
| Average Power Demand at Berth (kW) | 600 | 4,800 | 1,700 | 5,200 | 3,500 | 7,000 | 2,300 | 300 | 3,780 | 600 | 1,510 | 600 |
| Total Annual Power Use (Million kW-hr) | 0.3 | 3.0 | 1.3 | 5.0 | 5.8 | 3.8 | 1.1 | 0.4 | 1.8 | 0.0 | 0.2 | 0.6 |
| Cost Effectiveness ($1,000/ton) | $87 | $15 | $37 | $11 | $11 | $9 | $44 | $42 | $15 | $426 | $38 | $90 |
| Ranking | 10 | 5 | 6 | 3 | 2 | 1 | 9 | 8 | 4 | 12 | 7 | 11 |
| Cost-Effective (Yes/No) | No | Yes | No | Yes | Yes | Yes | No | No | Yes | No | No | No |

*Source: Environ "Cold Ironing Cost Effectiveness"*

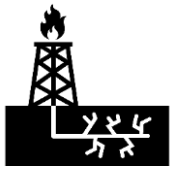
# Limitation (2): Sources of Energy

Energy Mix

Estimated GHG Emissions by OPS

| Port | Country | Coal | Fuel and LNG | Nuclear | RES (including Hydro) | Others (including waste, imports) | EFgrid[1] $CO_2$ (g/kWh) | EFgrid[1] $SO_2$ (g/kWh) | EFgrid[1] $NO_x$ (g/kWh) | EFgrid[1] PM2.5 (g/kWh) |
|---|---|---|---|---|---|---|---|---|---|---|
| Los Angeles | USA (California) | 0.4 | 61.1 | 8.6 | 23.4 | 6.5 | 251.1 | 0.045 | 0.091 | 0.002 |
| Virginia | USA (Virginia) | 26.9 | 29.1 | 39 | 5 | 0 | 397.7 | 0.408 | 0.318 | 0.003 |
| Juneau | USA (Alaska) | 31.7 | 32.5 | 27.6 | 8.1 | 0.1 | 478 | 0.726 | 0.318 | NA |
| Seattle | USA (Washington) | 5.8 | 9.8 | 8.2 | 76.1 | 0.1 | 101.7 | 0.045 | 0.045 | NA |
| Felixstowe | UK | 4.3 | 40.1 | 15.3 | 10 | 0.9 | 388.8 | 0.3 | 0.7 | 0.049 |
| Gothenburg | Sweden | 0.3 | 0.5 | 43 | 54.3 | 1.8 | 10.5 | 0.0069 | 0.03 | |
| Hamburg | Germany | 34.6 | 11.6 | 19.1 | 31.3 | 1.1 | 424.9 | 0.211 | 0.577 | 0.052 |

Coal



Fuel

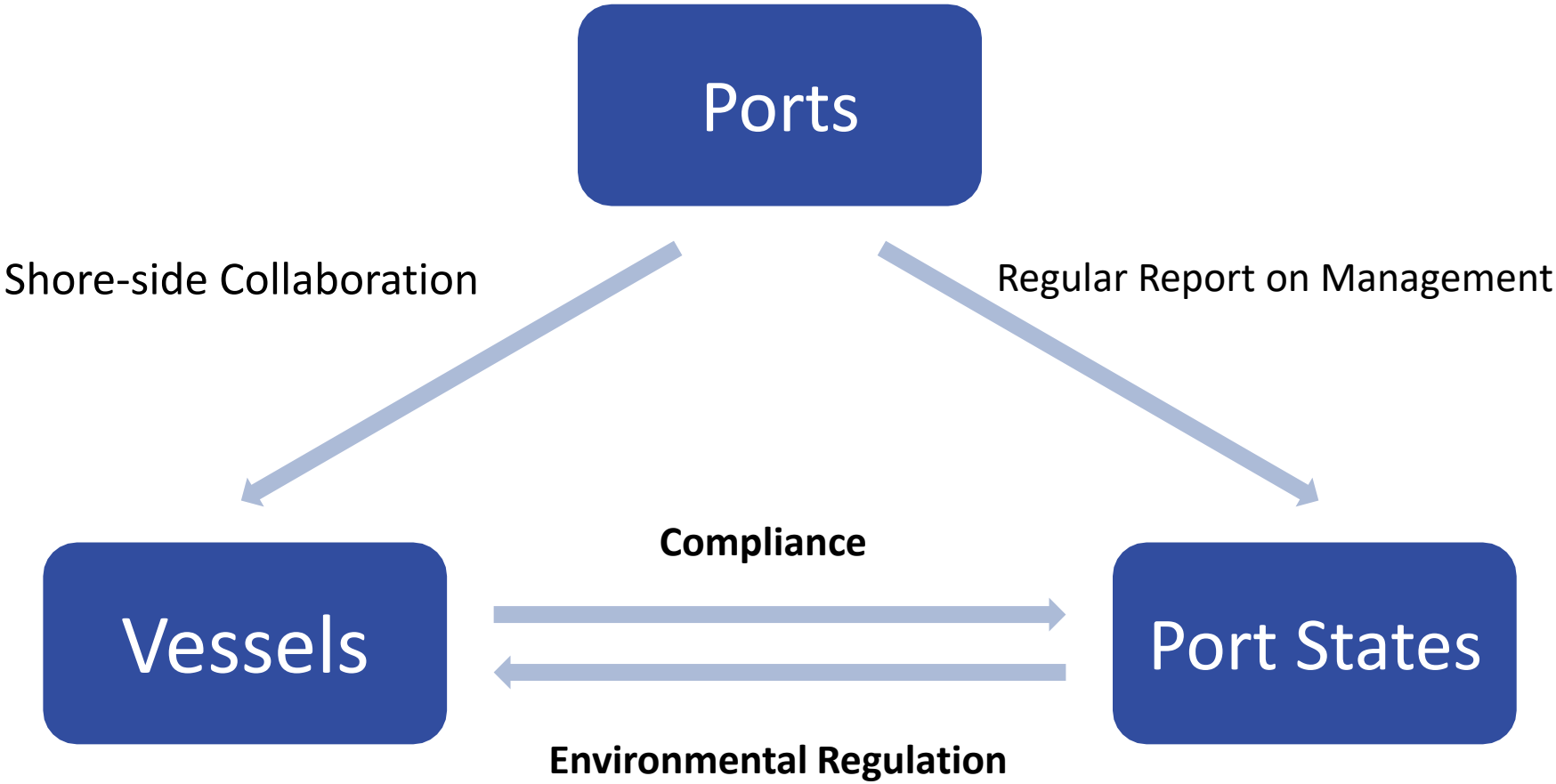
Without <u>sustainable</u> source of electricity generation, environmental benefits of OPS could be negligible.

*Source: Zis, T. P., "Prospects of cold ironing as an emissions reduction option", p119, 2019.*

# CONTENTS

# Overall Dilemma

**Which Entity would Initiate Investment for OPS Implementation?**



# Problem 1: Safety and Standardization.

Ports with OPS

High Possibility for Accidents

YS Port, China

Accident in OPS Equipment

Why? **The absence of Universal Safety Guidelines**

IMO INTERNATIONAL MARITIME ORGANIZATION

E

MARITIME SAFETY COMMITTEE
98th session
Agenda item 20

MSC 98/20/7
7 March 2017
Original: ENGLISH

**WORK PROGRAMME**

**Proposal for a new output to develop safety standards for cold ironing of vessels and guidance on safe operation of On-shore Power Supply (OPS) service in port**

**Submitted by China**

**SUMMARY**

| | |
|---|---|
| *Executive summary:* | This document proposes a new output to develop safety standards for cold ironing of vessels and guidance on safe operation of On-shore Power Supply (OPS) service in port |
| *Strategic direction:* | 5.2 |
| *High-level action:* | 5.2.1 |
| *Output:* | No related provisions |
| *Action to be taken:* | Paragraph 24 |
| *Related documents:* | No related documents |

**Introduction**

1 This document is submitted in accordance with paragraph 4.6 of the *Organization and method of work of the Maritime Safety Committee and the Marine Environment Protection Committee and their subsidiary bodies* (MSC-MEPC.1/Circ.5) and proposes a new output to develop safety standards for cold ironing of vessels and guidance on safe operation of OPS service in port.

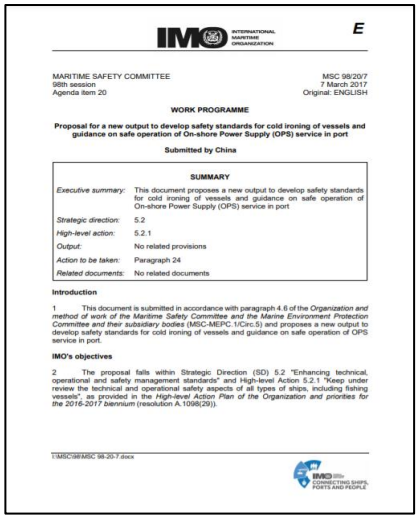
**IMO's objectives**

- Ineffective communication between vessels and the shore power supplier
- Insufficient maintenance of shore-side electricity frequency Converter
- Lack of personnel training

*MSC 98/20/7*

# Problem 1: Safety and Standardization

## MSC



IMO INTERNATIONAL MARITIME ORGANIZATION E

MARITIME SAFETY COMMITTEE
98th session
Agenda item 20

MSC 98/20/7
7 March 2017
Original: ENGLISH

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**IMO's objectives**

2 The proposal falls within Strategic Direction (SD) 5.2 "Enhancing technical, operational and safety management standards" and High-level Action 5.2.1 "Keep under review the technical and operational safety aspects of all types of ships, including fishing vessels", as provided in the *High-level Action Plan of the Organization and priorities for the 2016-2017 biennium* (resolution A.1098(29)).

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MSC 98/20/7 (2017)

**Proposal by China on safety guidelines (2017)**
Assigned SSE sub-committee to produce draft guidelines, currently pending approval of MSC.

**Limited to operational guidelines**

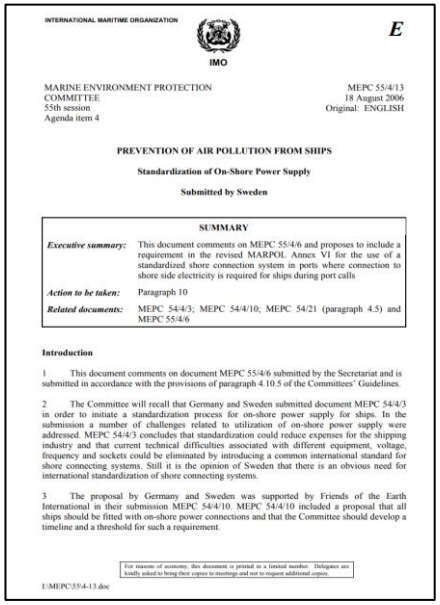
**Electrical Factors**

- <u>Compatibility of Voltage and Frequency</u>
- Shore Distribution System
- Shore-to-Ship Connection Equipment
- Transformers / Reactors
- Rotating Convertors
- Ship Distribution System

**Practical Elements**

- <u>Placement of the Plug Connection</u>
- Possibility of Power Loss due to Ununified System Design
- Cable and Cable Reels Design

# Problem 2: Absence of Mandatory Regulations (1)



INTERNATIONAL MARITIME ORGANIZATION

IMO

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MARINE ENVIRONMENT PROTECTION COMMITTEE
55th session
Agenda item 4

MEPC 55/4/13
18 August 2006
Original: ENGLISH

**PREVENTION OF AIR POLLUTION FROM SHIPS**

**Standardization of On-Shore Power Supply**

**Submitted by Sweden**

**SUMMARY**

| | |
|---|---|
| ***Executive summary:*** | This document comments on MEPC 55/4/6 and proposes to include a requirement in the revised MARPOL Annex VI for the use of a standardized shore connection system in ports where connection to shore side electricity is required for ships during port calls |
| ***Action to be taken:*** | Paragraph 10 |
| ***Related documents:*** | MEPC 54/4/3; MEPC 54/4/10; MEPC 54/21 (paragraph 4.5) and MEPC 55/4/6 |

**Introduction**

1 This document comments on document MEPC 55/4/6 submitted by the Secretariat and is submitted in accordance with the provisions of paragraph 4.10.5 of the Committees' Guidelines.

2 The Committee will recall that Germany and Sweden submitted document MEPC 54/4/3 in order to initiate a standardization process for on-shore power supply for ships. In the submission a number of challenges related to utilization of on-shore power supply were addressed. MEPC 54/4/3 concludes that standardization could reduce expenses for the shipping industry and that current technical difficulties associated with different equipment, voltage, frequency and sockets could be eliminated by introducing a common international standard for shore connecting systems. Still it is the opinion of Sweden that there is an obvious need for international standardization of shore connecting systems.

3 The proposal by Germany and Sweden was supported by Friends of the Earth International in their submission MEPC 54/4/10. MEPC 54/4/10 included a proposal that all ships should be fitted with on-shore power connections and that the Committee should develop a timeline and a threshold for such a requirement.

For reasons of economy, this document is printed in a limited number. Delegates are kindly asked to bring their copies to meetings and not to request additional copies.

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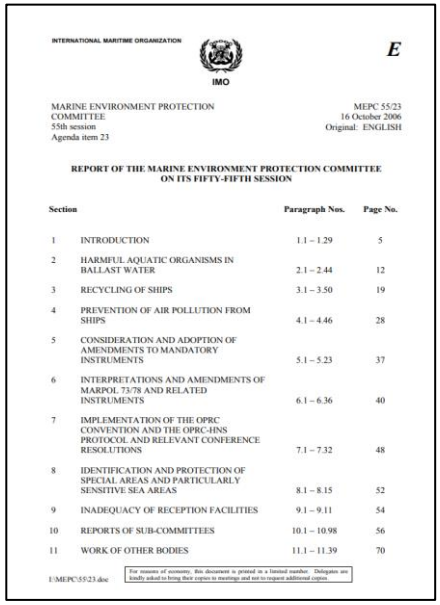
**MEPC 55/4/13 (Standardization of On-Shore Power Supply)**

"In order to make this benefit real, the requirement should be included in the revised MARPOL Annex VI as the appropriate instrument to regulate prevention of air pollution from international shipping. ."



INTERNATIONAL MARITIME ORGANIZATION

IMO

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MARINE ENVIRONMENT PROTECTION COMMITTEE
55th session
Agenda item 23

MEPC 55/23
16 October 2006
Original: ENGLISH

**REPORT OF THE MARINE ENVIRONMENT PROTECTION COMMITTEE ON ITS FIFTY-FIFTH SESSION**



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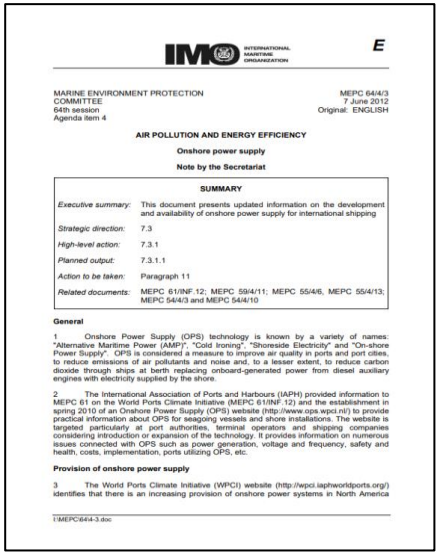
**MEPC 55/23 (Report of MEPC)**

"However, the Committee also agreed that there were still technical issues to be solved and that the **Committee should wait** until the standard was finalized before any decision for inclusion in the revised MARPOL Annex VI should be taken."

# Problem 2: Absence of Mandatory Regulations (2)



IMO INTERNATIONAL MARITIME ORGANIZATION E

MARINE ENVIRONMENT PROTECTION COMMITTEE
64th session
Agenda item 4

MEPC 64/4/3
7 June 2012
Original: ENGLISH

**AIR POLLUTION AND ENERGY EFFICIENCY**

**Onshore power supply**

**Note by the Secretariat**

**SUMMARY**

| | |
|---|---|
| *Executive summary:* | This document presents updated information on the development and availability of onshore power supply for international shipping |
| *Strategic direction:* | 7.3 |
| *High-level action:* | 7.3.1 |
| *Planned output:* | 7.3.1.1 |
| *Action to be taken:* | Paragraph 11 |
| *Related documents:* | MEPC 61/INF.12; MEPC 59/4/11; MEPC 55/4/6, MEPC 55/4/13; MEPC 54/4/3 and MEPC 54/4/10 |

**General**

1 Onshore Power Supply (OPS) technology is known by a variety of names: "Alternative Maritime Power (AMP)", "Cold Ironing", "Shoreside Electricity" and "On-shore Power Supply". OPS is considered a measure to improve air quality in ports and port cities, to reduce emissions of air pollutants and noise and, to a lesser extent, to reduce carbon dioxide through ships at berth replacing onboard-generated power from diesel auxiliary engines with electricity supplied by the shore.

2 The International Association of Ports and Harbours (IAPH) provided information to MEPC 61 on the World Ports Climate Initiative (MEPC 61/INF.12) and the establishment in spring 2010 of an Onshore Power Supply (OPS) website (http://www.ops.wpci.nl/) to provide practical information about OPS for seagoing vessels and shore installations. The website is targeted particularly at port authorities, terminal operators and shipping companies considering introduction or expansion of the technology. It provides information on numerous issues connected with OPS such as power generation, voltage and frequency, safety and health, costs, implementation, ports utilizing OPS, etc.

**Provision of onshore power supply**

3 The World Ports Climate Initiative (WPCI) website (http://wpci.iaphworldports.org/) identifies that there is an increasing provision of onshore power systems in North America

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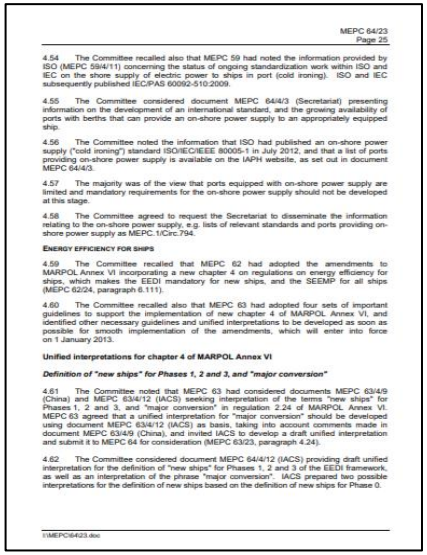

MEPC 64/23
Page 25

4.54 The Committee recalled also that MEPC 59 had noted the information provided by ISO (MEPC 59/4/11) concerning the status of ongoing standardization work within ISO and IEC on the shore supply of electric power to ships in port (cold ironing). ISO and IEC subsequently published IEC/PAS 60092-510:2009.

4.55 The Committee considered document MEPC 64/4/3 (Secretariat) presenting information on the development of an international standard, and the growing availability of ports with berths that can provide an on-shore power supply to an appropriately equipped ship.

4.56 The Committee noted the information that ISO had published an on-shore power supply ("cold ironing") standard ISO/IEC/IEEE 80005-1 in July 2012, and that a list of ports providing on-shore power supply is available on the IAPH website, as set out in document MEPC 64/4/3.

4.57 The majority was of the view that ports equipped with on-shore power supply are limited and mandatory requirements for the on-shore power supply should not be developed at this stage.

4.58 The Committee agreed to request the Secretariat to disseminate the information relating to the on-shore power supply, e.g. lists of relevant standards and ports providing on-shore power supply as MEPC.1/Circ.794.

**ENERGY EFFICIENCY FOR SHIPS**

4.59 The Committee recalled that MEPC 62 had adopted the amendments to MARPOL Annex VI incorporating a new chapter 4 on regulations on energy efficiency for ships, which makes the EEDI mandatory for new ships, and the SEEMP for all ships (MEPC 62/24, paragraph 6.111).

4.60 The Committee recalled also that MEPC 63 had adopted four sets of important guidelines to support the implementation of new chapter 4 of MARPOL Annex VI, and identified other necessary guidelines and unified interpretations to be developed as soon as possible for smooth implementation of the amendments, which will enter into force on 1 January 2013.

**Unified interpretations for chapter 4 of MARPOL Annex VI**

***Definition of "new ships" for Phases 1, 2 and 3, and "major conversion"***

4.61 The Committee noted that MEPC 63 had considered documents MEPC 63/4/9 (China) and MEPC 63/4/12 (IACS) seeking interpretation of the terms "new ships" for Phases 1, 2 and 3, and "major conversion" in regulation 2.24 of MARPOL Annex VI. MEPC 63 agreed that a unified interpretation for "major conversion" should be developed using document MEPC 63/4/12 (IACS) as basis, taking into account comments made in document MEPC 63/4/9 (China), and invited IACS to develop a draft unified interpretation and submit it to MEPC 64 for consideration (MEPC 63/23, paragraph 4.24).

4.62 The Committee considered document MEPC 64/4/12 (IACS) providing draft unified interpretation for the definition of "new ships" for Phases 1, 2 and 3 of the EEDI framework, as well as an interpretation of the phrase "major conversion". IACS prepared two possible interpretations for the definition of new ships based on the definition of new ships for Phase 0.

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**MEPC 64/4/3 (Update by Secretariat)**

"The Committee is **invited to consider** the information provided on the development and increasing availability of onshore power supply for international shipping and to take action as appropriate."

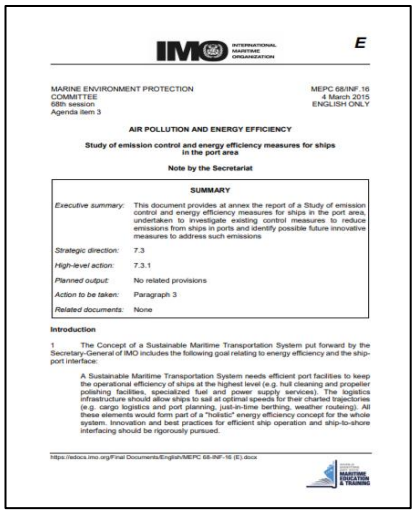
**MEPC 64/23 (Report of MEPC)**

"The majority was of the view that ports equipped with on-shore power supply are limited and mandatory requirements for the on-shore power supply **should not be developed** at this stage."

# Problem 2: Absence of Mandatory Regulations (3)

Lack of tangible outcomes even after MEPC 64

**2015, Secretariat**



IMO E

MARINE ENVIRONMENT PROTECTION COMMITTEE
68th session
Agenda item 3

MEPC 68/INF.16
4 March 2015
ENGLISH ONLY

AIR POLLUTION AND ENERGY EFFICIENCY

Study of emission control and energy efficiency measures for ships in the port area

Note by the Secretariat

SUMMARY

*Executive summary:* This document provides at annex the report of a Study of emission control and energy efficiency measures for ships in the port area, undertaken to investigate existing control measures to reduce emissions from ships in ports and identify possible future innovative measures to address such emissions

*Strategic direction:* 7.3

*High-level action:* 7.3.1

*Planned output:* No related provisions

*Action to be taken:* Paragraph 3

*Related documents:* None

Introduction

1 The Concept of a Sustainable Maritime Transportation System put forward by the Secretary-General of IMO includes the following goal relating to energy efficiency and the ship-port interface:

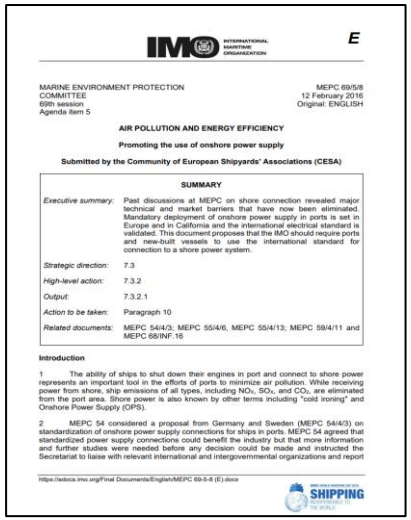
A Sustainable Maritime Transportation System needs efficient port facilities to keep the operational efficiency of ships at the highest level (e.g. hull cleaning and propeller polishing facilities, specialized fuel and power supply services). The logistics infrastructure should allow ships to sail at optimal speeds for their charted trajectories (e.g. cargo logistics and port planning, just-in-time berthing, weather routeing). All these elements would form part of a "holistic" energy efficiency concept for the whole system. Innovation and best practices for efficient ship operation and ship-to-shore interfacing should be rigorously pursued.

https://edocs.imo.org/Final Documents/English/MEPC 68-INF.16 (E).docx

**MEPC 68/INF.16**

(Study of emission control and energy efficiency, Secretariat)

**2016, CESA**



IMO E

MARINE ENVIRONMENT PROTECTION COMMITTEE
69th session
Agenda item 5

MEPC 69/5/8
12 February 2016
Original: ENGLISH

AIR POLLUTION AND ENERGY EFFICIENCY

Promoting the use of onshore power supply

Submitted by the Community of European Shipyards' Associations (CESA)

SUMMARY

*Executive summary:* Past discussions at MEPC on shore connection revealed major technical and market barriers that have now been eliminated. Mandatory deployment of onshore power supply in ports is set in Europe and in California and the international electrical standard is validated. This document proposes that the IMO should require ports and new-built vessels to use the international standard for connection to a shore power system.

*Strategic direction:* 7.3

*High-level action:* 7.3.2

*Output:* 7.3.2.1

*Action to be taken:* Paragraph 10

*Related documents:* MEPC 54/4/3; MEPC 55/4/6, MEPC 55/4/13; MEPC 59/4/11 and MEPC 68/INF.16

Introduction

1 The ability of ships to shut down their engines in port and connect to shore power represents an important tool in the efforts of ports to minimize air pollution. While receiving power from shore, ship emissions of all types, including $NO_x$, $SO_x$, and $CO_2$ are eliminated from the port area. Shore power is also known by other terms including "cold ironing" and Onshore Power Supply (OPS).

2 MEPC 54 considered a proposal from Germany and Sweden (MEPC 54/4/3) on standardization of onshore power supply connections for ships in ports. MEPC 54 agreed that standardized power supply connections could benefit the industry but that more information and further studies were needed before any decision could be made and instructed the Secretariat to liaise with relevant international and intergovernmental organizations and report

https://edocs.imo.org/Final Documents/English/MEPC 69-5-8 (E).docx

**MEPC 69/5/8**

(Promoting the use of onshore power supply)

# Problem 2: Absence of Mandatory Regulations (4)

However, there is a change of circumstances:

**Increase** in adoption of shore-side OPS

**Directive 2014/ 94/EU**

**12th & 13th Five Year Plans**

**California Air Resources Board**

**OPS at 13 ports and 243 berths by 2030**

The global OPS market is expected to grow at a **CAGR of 12.5%** during the forecast period (2019-2029)

*Source: ResearchAndMarket, "Alternate Marine Power - Global Market Outlook (2019-2027)"*

# Problem 3: Lack of Information (1)

## Fragmented and outdated information on OPS implementation

- IAPH's report from 2010 (MEPC 61/INF.12) is outdated and website (http://www.ops.wpci.nl/) is currently not functional.
- Subsequent academic research have only focused on *specific* ports; no comprehensive, global-scale survey to examine OPS implementation
- National action plans to implement OPS are not actively shared to the global community in an accessible manner

Negatively impacts decision-making for OPS implementation

# Problem 3: Lack of Information (2)

Research into OPS application

Global-scale Research

International Cooperation

**Need for a semi-permanent institution**

# Overview

***Problem in the Status Quo***

**IMO**

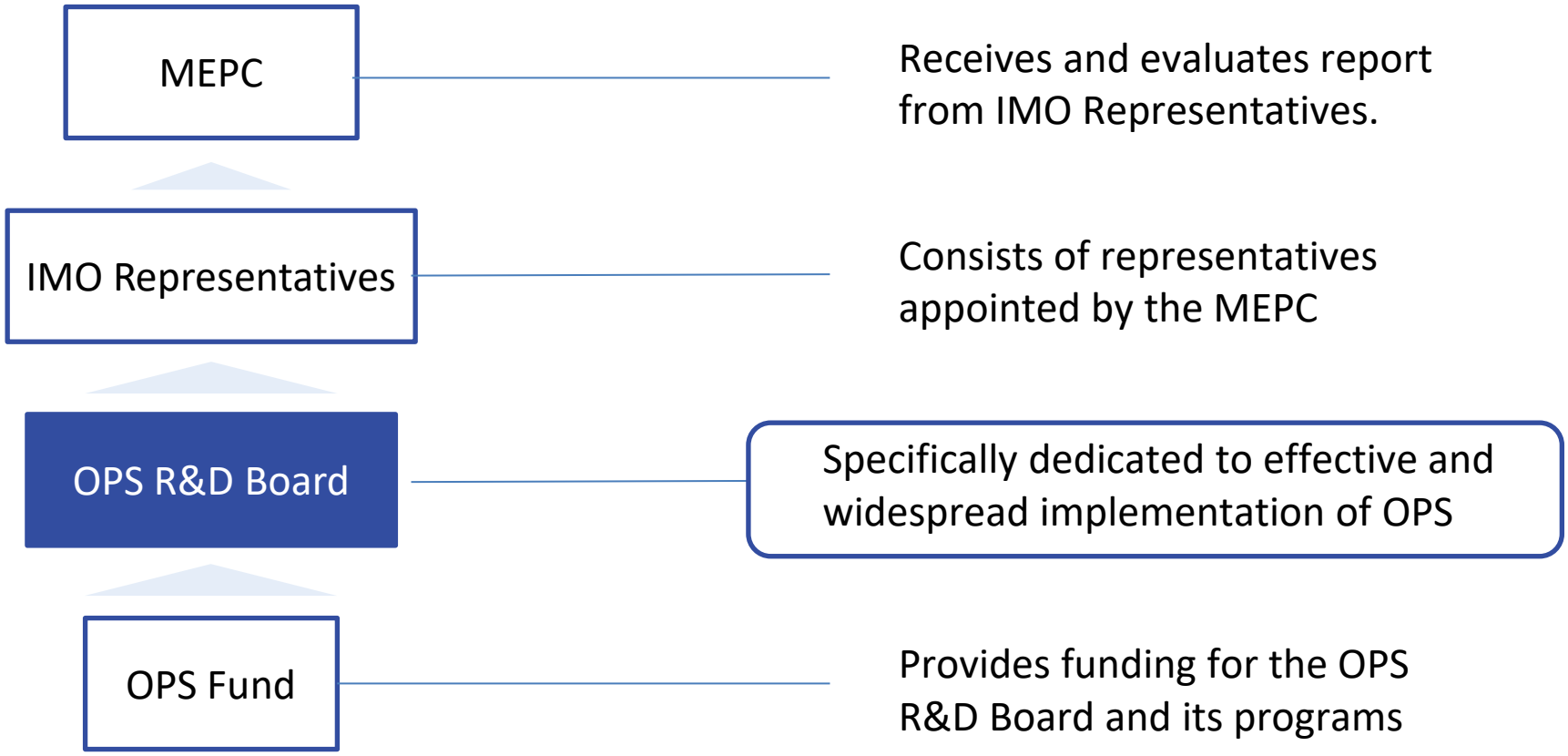
| | | |
|---|---|---|
| Lack Information | → | 1 Semi-permanent Institution |
| Lack of mandatory provisions by IMO | → | 2 OPS regulation for *ships* |
| Incomplete work on standardization and safety | → | 3 Standardization and Safety |

# SD 2: Integrate New Technologies into the Regulatory Framework


*Source: Park Han-seon (KMI), Implications of IMO Strategy Plan on shipping and shipbuilding industry*

# CONTENTS

# 1.1. OPS Research and Development Board



# 1.2. Research and Development Functions

**Development**

**(1) Research into new technologies on OPS**

**(2) Financial support to research activities of developing countries and smaller companies**
(cf. OPS Fund)

**Research**

**(1) Implementation of data collection system on OPS** (cf. *SEEMP*)

*Shipside*: Ship → Flag State → Sec→ R&D Board

*Port-side*: State → Sec→ R&D Board

**(2) Advise most effective OPS implementation**
(based on sea routes, etc.)

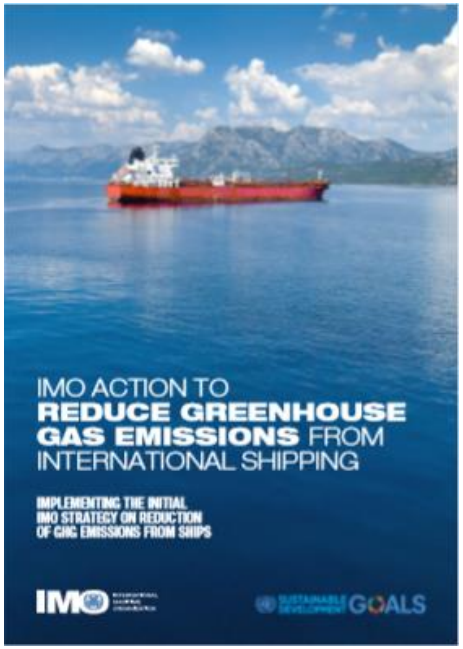
# 1.3. Authority for Establishment of Board

## Initial Strategy on the Reduction of GHG Emissions
*Resolution MEPC.304(72)*

**Candidate short-term measures**

4.7 […] All the following candidate measures represent possible short-term further action of the Organization on matters related to the reduction of GHG emissions from ships:

.9 **initiate research and development activities** addressing marine propulsion, alternative low-carbon and zero-carbon fuels, and **innovative technologies** to further enhance the energy efficiency of ships and establish an **International Maritime Research Board** to coordinate and oversee these R&D efforts;



# 1.4. Authority for OPS Fund

- R&D Board will be funded by a **Multi-Donor Trust Fund**, established pursuant to IMO Financial Regulation Clause 6.7.

REGULATION 6.7

(a) Trust, reserve and special funds may be established by the Secretary-General or the Assembly as may from time to time be required to deliver work in accordance with the Organization's Strategic Plan. The Secretary-General shall report to the Council on the establishment of any new funds.

(b) Unless otherwise provided, the purpose and limits of each trust, reserve and special fund shall be clearly defined by the appropriate authority and shall be administered in accordance with these Regulations.

Invite Member States to encourage and/or require contribution and participation from relevant stakeholders, such as energy suppliers, marine engine companies, specialized research and development institutions, foundations, etc.

# 1.5. Proposed Legal Mechanism: MARPOL

R&D Board may be established by creating a **new Chapter 5** outlining regulations for greenhouse gas reduction research and development under Annex VI of MARPOL, to include OPS.

Annex VI- Regulations for the Prevention of Air Pollution from Ships

Chapter 1 – General

Chapter 2 – Survey, certification and means of control

Chapter 3 – Requirements for control of emissions from ships

Chapter 4- Regulations on energy efficiency for ships

*Chapter 5- Greenhouse Gas Reduction Research and Development*

*- Regulation XX: OPS Development and Research Board*

Committee may also consider what mechanism is most appropriate.

# 2.1. Mandating OPS for ships

| Mandatory Facilities | Marine Ballast Water Management | Scrubber Systems |
|---|---|---|
| **Relevant Regulations** | IMO released 14 Guidance documents for Ballast Water management & Guidelines for Ballast Water Exchange (79 countries) | MARPOL Annex VI, regulation 14: The sulphur oxides regulation applies **to all ships**, whether they are on international voyages or between two or more countries. |

*Source: MEPC.151(55), MEPC.161(56), MEPC209(63)*

**Implication**

Possible to justify guidelines and regulations for *ship-side* OPS

# 2.2. Mandating OPS for new ships

Manufacturing cost for new ships significantly lower than modification cost for existing ships, so it is a priority to make sure **new ships** are fitted with OPS.

**Table 2.** Specifications of shore power

| Vessel type (length) | Average power demand (MW) | Peak power demand (MW) | Peak power demand for 95% of vessels (MW) |
|---|---|---|---|
| Container vessels (< 140 m) | 0.17 | 1 | 0.8 |
| Container vessels (> 140 m) | 1.2 | 8 | 5 |
| Container vessels (total) | 0.8 | 8 | 4 |
| RoRo and vehicle vessels | 1.5 | 2 | 1.8 |
| Oil and product tankers | 1.4 | 2.7 | 2.5 |
| Cruise ships (< 200 m) | 4.1 | 7.3 | 6.7 |
| Cruise ships (> 200 m) | 7.5 | 11 | 9.5 |
| Cruise ships (> 300 m) | 10 | 20 | 12.5 |

Need for different requirements based on vessel types

*Source: Wang et al., "Costs and Benefits of Shore Power at Port of Shenzhen", ICCT, 2015*

# 2.3. Mandating OPS for existing ships

**What**

Sequential requirement scheme for OPS for existing ships

**How**

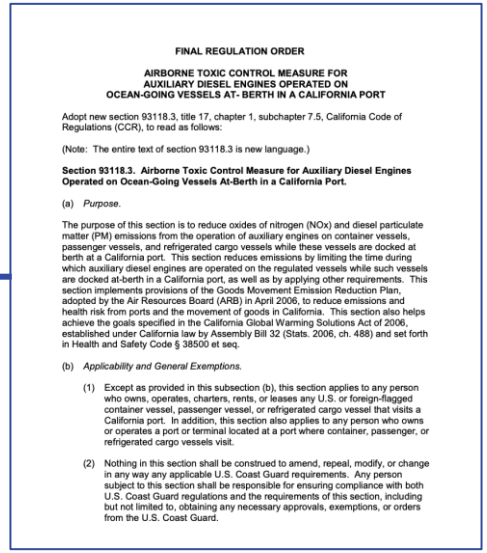
Regulatory measures will gradually apply to the existing fleet & R&D Board would provide relevant Information to Shipowners

**Why**

- A Need for Shipowners to Assess Information and to choose appropriate berths & shipping lanes
- Fleet-based regulation lessens the burden for shipping companies that operates multiple vessels as proven after the “At Birth Regulation” implemented by California (CCR).

**Impact**

Alleviating financial burden for shipping companies with fleets in operation



FINAL REGULATION ORDER

AIRBORNE TOXIC CONTROL MEASURE FOR AUXILIARY DIESEL ENGINES OPERATED ON OCEAN-GOING VESSELS AT- BERTH IN A CALIFORNIA PORT

Adopt new section 93118.3, title 17, chapter 1, subchapter 7.5, California Code of Regulations (CCR), to read as follows:

(Note: The entire text of section 93118.3 is new language.)

**Section 93118.3. Airborne Toxic Control Measure for Auxiliary Diesel Engines Operated on Ocean-Going Vessels At-Berth in a California Port.**

(a) *Purpose.*

The purpose of this section is to reduce oxides of nitrogen (NOx) and diesel particulate matter (PM) emissions from the operation of auxiliary engines on container vessels, passenger vessels, and refrigerated cargo vessels while these vessels are docked at berth at a California port. This section reduces emissions by limiting the time during which auxiliary diesel engines are operated on the regulated vessels while such vessels are docked at-berth in a California port, as well as by applying other requirements. This section implements provisions of the Goods Movement Emission Reduction Plan, adopted by the Air Resources Board (ARB) in April 2006, to reduce emissions and health risk from ports and the movement of goods in California. This section also helps achieve the goals specified in the California Global Warming Solutions Act of 2006, established under California law by Assembly Bill 32 (Stats. 2006, ch. 488) and set forth in Health and Safety Code § 38500 et seq.

(b) *Applicability and General Exemptions.*

(1) Except as provided in this subsection (b), this section applies to any person who owns, operates, charters, rents, or leases any U.S. or foreign-flagged container vessel, passenger vessel, or refrigerated cargo vessel that visits a California port. In addition, this section also applies to any person who owns or operates a port or terminal located at a port where container, passenger, or refrigerated cargo vessels visit.

(2) Nothing in this section shall be construed to amend, repeal, modify, or change in any way any applicable U.S. Coast Guard requirements. Any person subject to this section shall be responsible for ensuring compliance with both U.S. Coast Guard regulations and the requirements of this section, including but not limited to, obtaining any necessary approvals, exemptions, or orders from the U.S. Coast Guard.

California, *“At Birth Regulation”*, mandating OPS Adoption for Ships

*Source: https://ww2.arb.ca.gov/resources/documents/berth-faqs*

# 2.4. Proposed Legal Mechanism: MARPOL

Requirements for OPS on ships can be added as a new Rule under Chapter 3 of MARPOL Annex VI, and precise requirements for ships can be outlined in a new 'Appendix XI.'

## Annex VI- Regulations for the Prevention of Air Pollution from Ships

Chapter 3 – Requirement for control of emissions from ships

| | |
|---|---|
| Regulation 12 | Ozone-depleting substances. |
| Regulation 13 | Nitrogen oxides (NOx) |
| Regulation 14 | Sulphur oxides (SOx) |
| […] | |
| *Regulation XX* | *Onshore Power Supply (OPS)* |

Committee may also consider what mechanism is most appropriate.

# 3.1. Standardization and Safety

**What**

Address areas left out by SSE 7

**How**

Propose comprehensive *protocols* on…
(1) minimum performance standards under various conditions
(2) universal plug connection
(3) compatibility assessment procedures

**Why**

Not restricted to discussing *operational safety* guidelines like current SSE Correspondence Group(s)

**Impact**

More comprehensive safety and standardization regulation

# 3.2. Proposed Legal Mechanism: SOLAS

MSC should discuss amendments to SOLAS to incorporate relevant safety and standardization protocols in Chapter II-1.

**Chapter II-1:** Construction - Structure, subdivision and stability, machinery and electrical installations

Part D: Electrical Installations

Regulation 40: General

Regulation 41: Main source of electrical power and lighting systems

[…]

***Regulation XX: Equipment for Onshore Power Supply (OPS)***

Remaining protocols should be incorporated into Guidelines issued by IMO.

# CONTENTS

# Summary

| *Problem in the Status Quo* | Need | Proposed Action |
|---|---|---|
| **Information** | 1 **Semi-permanent Institution** | Amendments to **MARPOL** to create an OPS Research and Development Board |
| **No mandatory provisions** | 2 **OPS regulation for *ships*** | Amendments to **MARPOL** to add mandatory OPS provision for ships |
| **Partial safety & standards** | 3 **Standardization and Safety** | Amendments to **SOLAS** and additional safety and standardization **Guidelines** |

# Further Actions: Port-side Collaboration (1)

**What**

Recommendations for port-side OPS

**How**

Recommendations will scale according to..

(1) Generation Mix (renewable energy usage)
(2) Trade volume measured in TEU & lay-time

**Why**

Inefficient to require OPS installation for ports without much usage.

→ EU Directive 2014/94 Article 4: "[…] unless there is no demand, and the costs are disproportionate to the benefits"

**Impact**

Optimum allocation of resources to ports that can maximize environmental benefits

# Further Actions: Port-side Collaboration (2)

## Drafting Guidelines

(6) The port or terminal **shall** provide sufficient electrical power to all normal operations during the port including calculated peak consumption.

→ The port or terminal **should** provide sufficient electrical power to all normal operations during the port including calculated peak consumption.

Why? To provide more flexible and informative guidelines to portside adoption of OPS

**ANNEX**

Draft Regulation [xx]

**ON-SHORE POWER SUPPLY FOR SHIPS IN PORT**

(1) If connection to on-shore electrical power supply for ships during port stays is required in ports or terminals under the jurisdiction of a Party to the Protocol of 1997, the requirement shall be regulated in accordance with the provisions of this regulation.

(2) A party to the Protocol considering introducing requirements for calling ships to connect to shore side electrical power supply should undertake an assessment of the environmental benefits and of the cost benefit of addressing emission from ships at berth compared to addressing land based sources. The assessment should take into account how the supplied electrical power is generated and if similar environmental benefits could be achieved by other more cost effective means.

(3) A port or terminal requiring ships to connect to on-shore power supply should at suitable intervals determine the emission of NOx, SOx, PM and $CO_2$ per generated kW/h for the supplied electrical power, using the same denomination as described in the corresponding regulation within this annex. This information should be made available for ships at request.

(4) 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 dictates otherwise, be exempted from the requirement to connect to shore side electrical power.

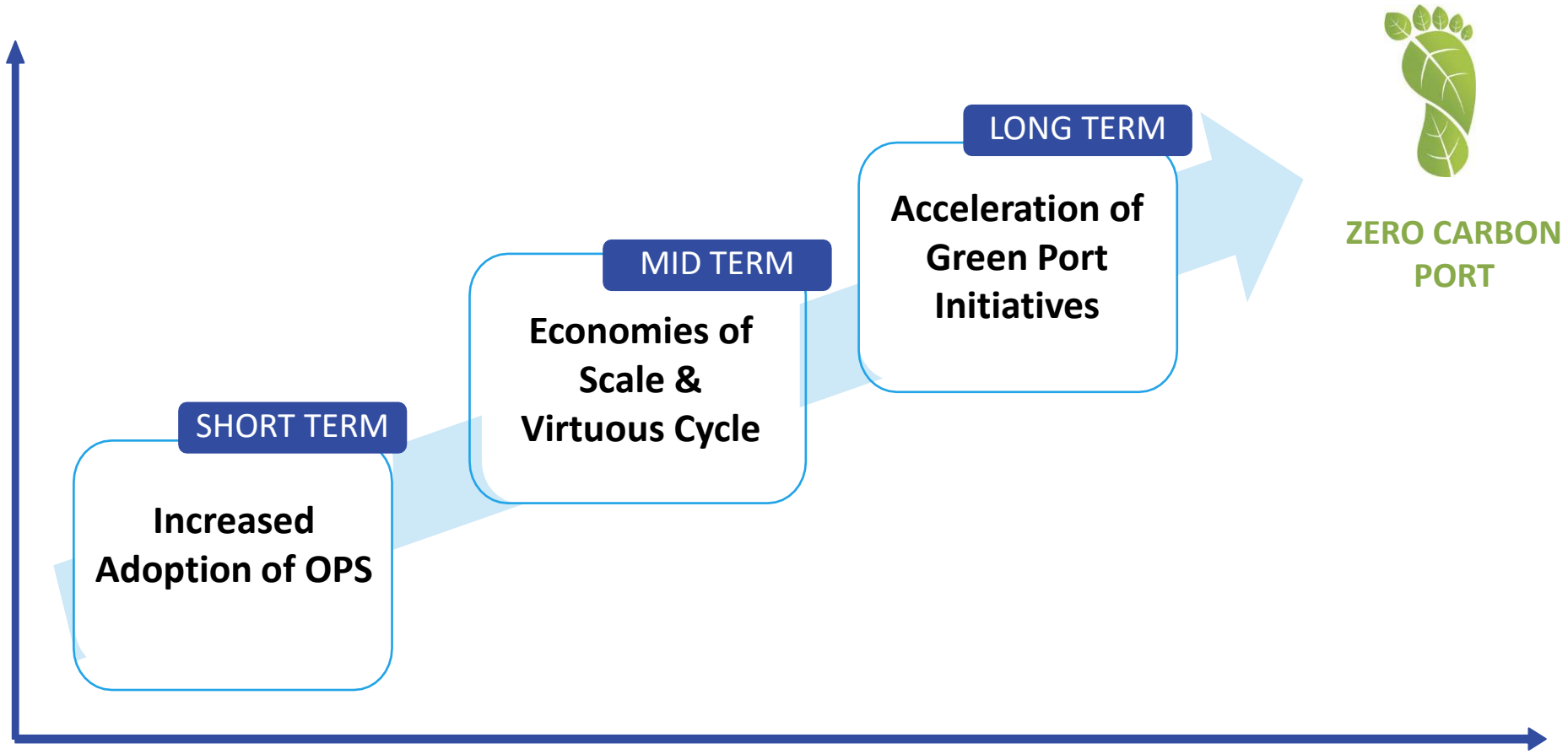
(5) No ship should be required to connect to on-shore power supply when the planned port stay at the actual berth is less than [2] hours.

(6) The port or terminal shall provide sufficient electrical power to sustain all normal operations during the port call including calculated peak consumption.

(7) Ports or terminals requiring ships to connect to shore side power supply should as soon as a ship has provided information that it intends to call their port or terminal inform about the regulations and require the ship to provide data on their calculated peak consumption and other relevant data such as location of connection point(s) on board.

(8) All possible steps should be taken by the port or terminal operators or by the appropriate authority to avoid power cuts. If ports or terminals experience periods with reduced or unstable power supply, ships should not be required to connect to shore side power during such periods and calling ships should be informed accordingly as early as practically possible.

# Final Remarks



# THANK YOU

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Team AMPERE