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Consulting Engineers Serving the Marine Community

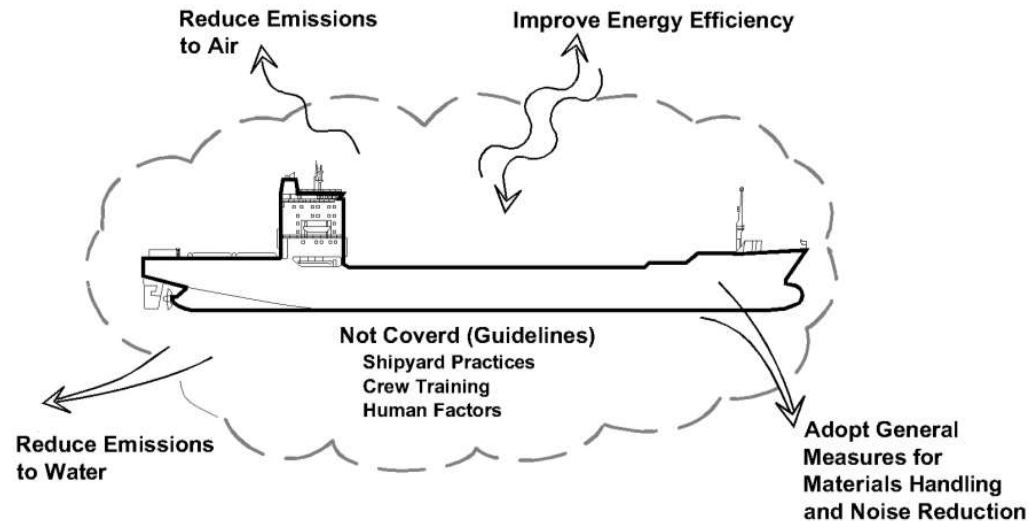
Marine Vessel Environmental Performance **MVEP: Assessment Methodology** **Ship Survey and Impact Calculations**

Presented by: Tim Leach, PE The Glostén Associates



Why, What, and Who is MVEP?

The Marine Vessel Environmental Performance Assessment (**MVEP**) is being developed to provide vessel designers, owners, operators, and other governing bodies with a standard methodology to **measure** and to **reduce** the environmental impact of their ships.



SNAME Technology and Research Bulletin

6-2 MVEP EE-1

PRESS RELEASE

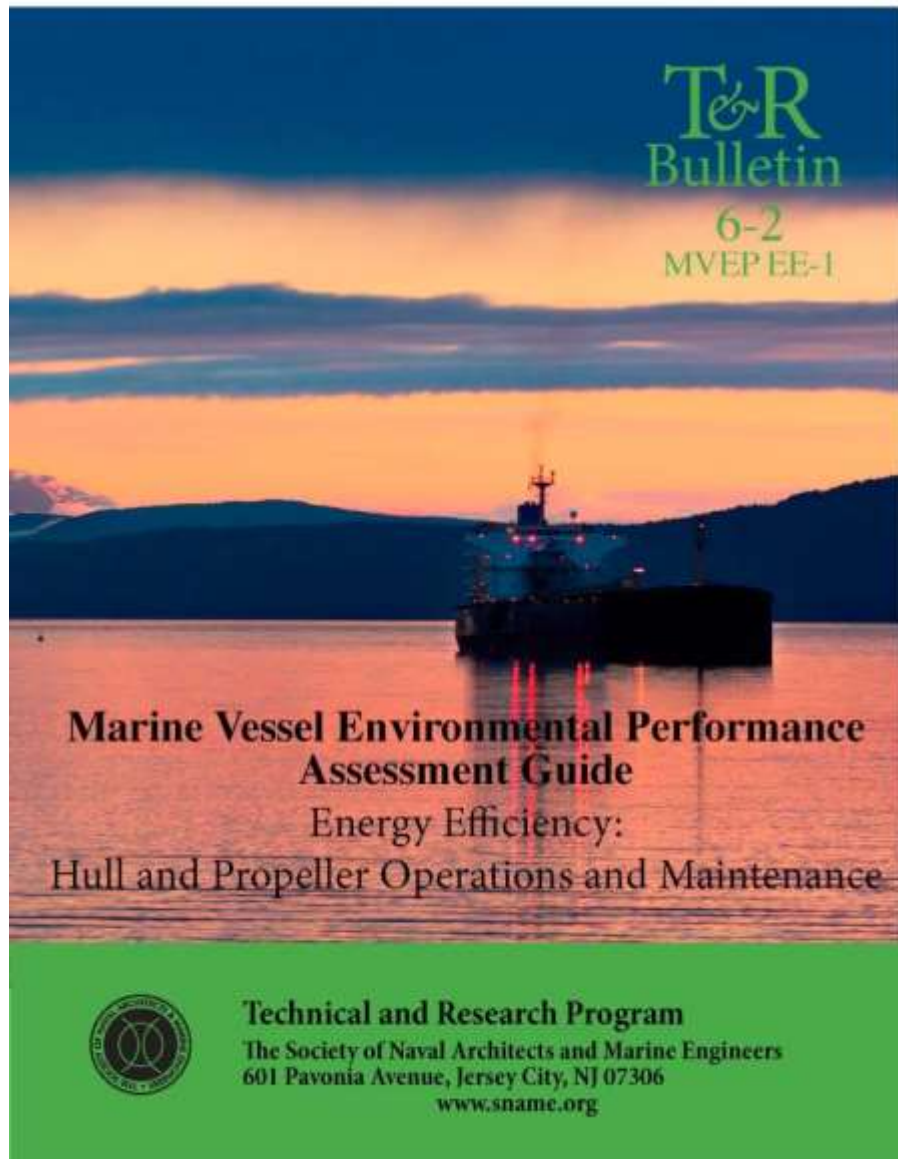


GUIDELINES FOR ENERGY EFFICIENCY: HULL AND PROPELLER OPERATIONS AND MAINTENANCE

THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS HAS PUBLISHED THE TECHNICAL REPORT Marine Vessel Environmental Performance (MVEP) Assessment Guide: Energy Efficiency: Hull and Propeller Operations and Maintenance. The bulletin was written by Daniel Kane, reviewed by SNAME Technical & Research Panel EC-10; Co-Chaired by Dr. Eleanor K.N. Kirtley, PE, Timothy S. Leach, PE, and Brian M. Ackerman, and approved by the Society's Environmental Engineering Committee Chaired by Bruce A. Russell. This Guide is the first in a series being developed to address vessel environmental performance.

This guide discusses three main areas that relate to measuring and improving the energy efficiency of the hull and propeller in operations and maintenance. The first area describes the factors that cause an increase in hull resistance and the relative fuel consumption consequences of each. The next area reviews the current measurement and monitoring means of hull roughness. Lastly, prescriptive measures that minimize hull resistance and maximize propeller efficiency are provided. These measures include operational best practices before, during, and after drydocking, guidance on selecting a coating system, monitoring and measuring performance, and scheduling inspections and cleanings. A comparison of different hull coating systems is provided. Current regulations, initiatives, and future developments are presented. Integration of the proposed measures into an overall environmental strategy to reduce emissions is introduced.

The new publication is identified as Technical and Research Bulletin 6-2 MVEP EE-1. It is a 25-page report issued electronically. It may be ordered through the SNAME web site (<http://www.sname.org/SNAME/Go.aspx?c=ViewDocument&DocumentKey=ded3b7b0-d044-44c9-ac1f-45a1840f8b03>) or by contacting Tommie -Anne Faix (tfaix@sname.org) or 201-499-5068 for \$40 (\$20 for SNAME members).



SNAME Technology and Research Bulletin

6-2 MVEP AE-1

PRESS RELEASE

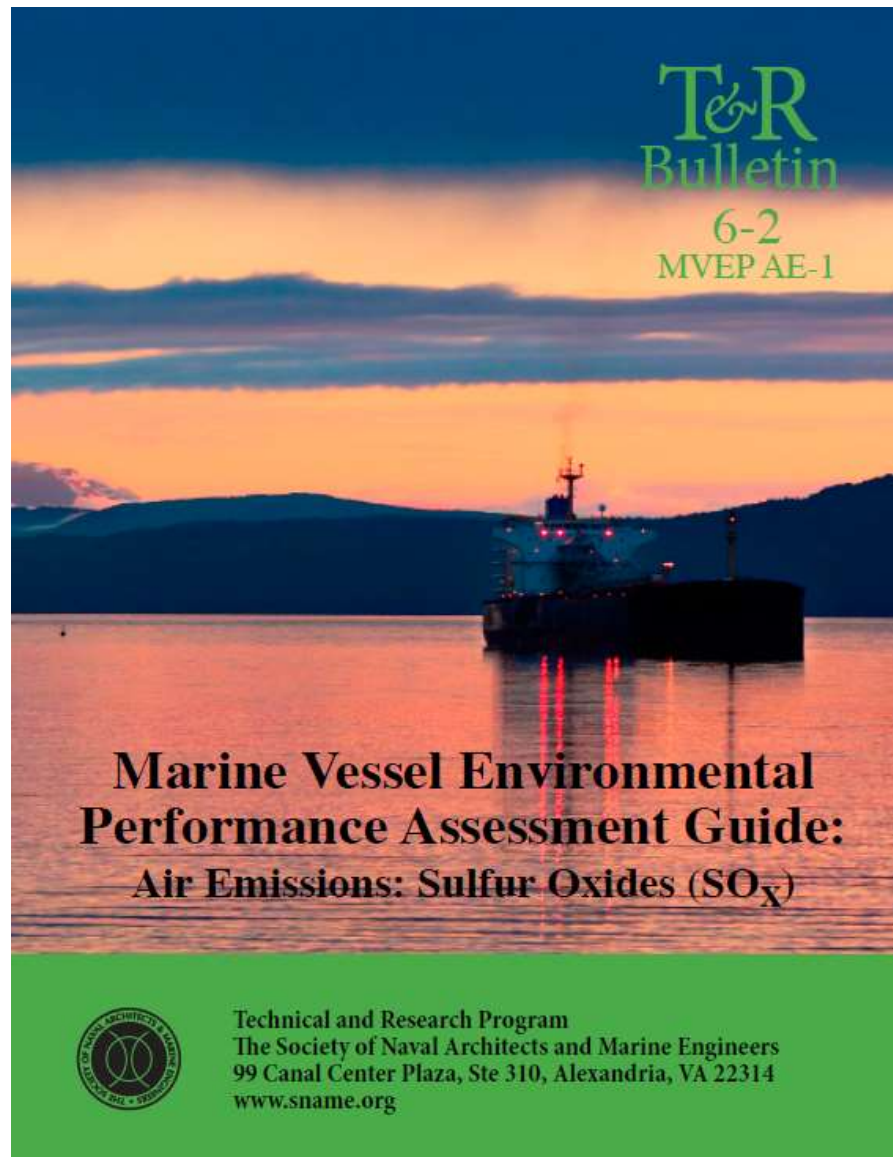


GUIDELINES FOR REDUCING AIR EMISSIONS: SULFUR OXIDES (SO_x)

THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS HAS PUBLISHED THE TECHNICAL REPORT Marine Vessel Environmental Performance (MVEP) Assessment Guide: Air Emissions: Sulfur Oxides (SO_x). The bulletin was written by Mark West and Brian Ackerman; reviewed by SNAME Technical & Research Panel EC-10 "Marine Vessel Environmental Performance" Co-Chaired by Dr. Eleanor K.N. Kirtley, PE, Timothy S. Leach, PE, and Brian M. Ackerman; and approved by the Society's Environmental Engineering Committee Chaired by Bruce A. Russell. This Guide is the second in a series being developed to address vessel environmental performance.


This guide provides recommendations on technologies, practices, and fuels that control and reduce sulfur oxide (SO_x) emissions. Designed to assist with SO_x management and reduction on ocean-going vessels, both environmental and financial impacts of SO_x emissions are addressed. The guide discusses regulations and provides information to make informed decisions. Limitations on SO_x are currently in place with more stringent regulations coming in the near future. Options for assessing emissions performance are provided along with a standard methodology for determining SO_x output from a vessel. The various options for SO_x reduction are discussed to assist in the evaluation of each and consideration of the environmental and economic tradeoffs involved. The guide is an essential tool for understanding and integrating SO_x emission reduction approaches onboard.

The new publication is identified as Technical and Research Bulletin 6-2 MVEP AE-1. It is a 52-page report issued electronically. It may be ordered for \$40 (\$20 for SNAME members) through the SNAME web site (www.sname.org) or directly at <http://tinyurl.com/ms6pb4s> or by contacting Kristin Walker at kwalker@sname.org or 703-997- 6710



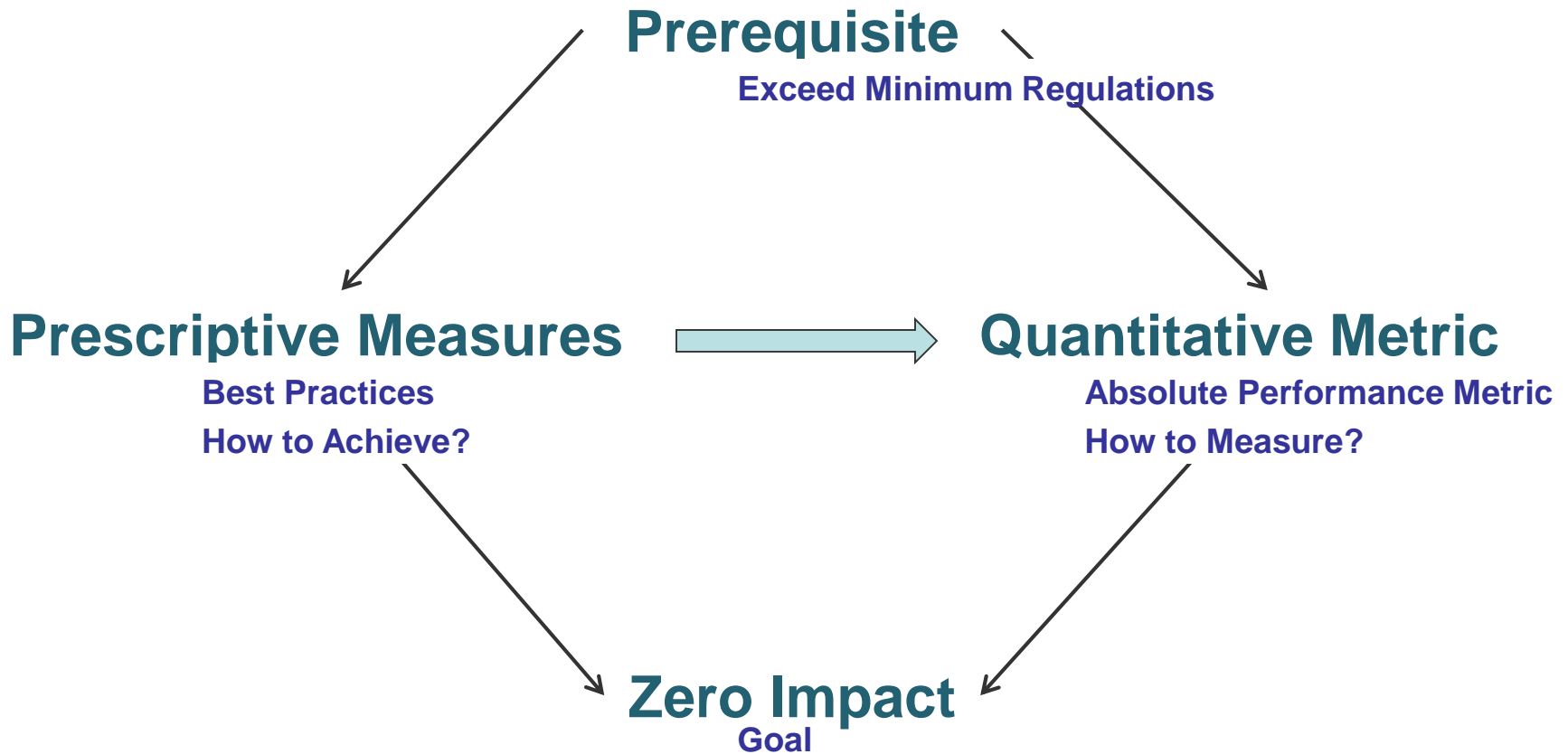
T&R
Bulletin
6-2
MVEP AE-1

**Marine Vessel Environmental
Performance Assessment Guide:
Air Emissions: Sulfur Oxides (SO_x)**

 Technical and Research Program
The Society of Naval Architects and Marine Engineers
99 Canal Center Plaza, Ste 310, Alexandria, VA 22314
www.sname.org



Assessment Methodology



MVEP Assessment Methodology

Ship Survey and Impact Calculations

Metrics formulated for 10
air and effluent emissions

Calculation **tool**

Two day **survey** onboard
the *TS Golden Bear*



Metric Development

Constraints

Inputs can be gathered from readily available data sources

< Two-day survey

Objectives

Applicability

Accuracy






Air emissions: CO₂, NO_x, SO₂, PM, VOC Inputs

Pull down menus



yes													Is fuel consumption estimate data available for each device? (yes/no)												
Vessel Engine & Boiler Data																									
Engine/Boiler		Engine/Bumer Hours			Consumption by device (LT)			Device	Device	Emission	Rated Power /		Units	Cylinder											
Name	Start	End	Annual	ULSD			Use	Type	Standard	Therm. Output			Disp. (l)												
PME	42247	42725	478	137			Prop	M/HSD	Base	12500	HP		78												
SME	41722	42479	757	218			Prop	M/HSD	Base	12500	HP		78												
SSDG_1	46588	47353	765	85			Aux	M/HSD	Base	900	kW		15												
SSDG_2	49052	50089	1037	115			Aux	M/HSD	Base	900	kW		15												
SSDG_3	47682	48877	1195	132			Aux	M/HSD	Base	900	kW		15												
Boiler_1*	0		0	56			Aux	B	Base	400	HP														
Boiler_2*	0		0	131			Aux	B	Base	200	HP														
	0		0																						
	0		0																						

BSFC, EF_{NO_x} , EF_{PM} , EF_{HC} lookup from Device Use, Type, Displacement, Emission Standard



Air emissions: CO₂, NO_x, SO₂, PM, VOC Metrics (tonnes / yr)

Emission (tonnes/yr) = Fuel Consumed x Emission Content

$$\text{CO}_2 = \text{FC (tonnes)} \times C_f \text{ (tonnes-CO}_2\text{/tonnes-fuel)}$$

$$\text{SO}_2 = 2.0 \times \text{FC (tonnes)} \times S_{\%} \text{ (\%)}$$

$$\text{NO}_x = \text{FC} / \text{BSFC (g-fuel / kW-hr)} \times \text{EF}_{\text{NO}_x} \text{ (g-NO}_x\text{ / kW-hr)}$$

$$\text{PM} = \text{FC} / \text{BSFC} \times \text{EF}_{\text{PM}} - 7.0 \times \text{FSC} (S_{\% \text{EPA Base}} - S_{\%})$$

$$\text{VOC} = 1.053 \times \text{FC} / \text{BSFC} \times \text{EF}_{\text{HC}}$$



Effluents / Discharges: Oily water

WD1: Oily Water			Instructions
OWS Performance			
Treatment Level	15 ppm, 107(49)		
Discharge Date	Volume (m3)	Type	<ol style="list-style-type: none"> 1. Enter Period Start Date. 2. Select OWS Treatment Level: 15 ppm, 60(33) 15 ppm, 107(49) 10 ppm, 107(49) 5 ppm, 107(49) 3. Use Oil Record Book to enter first oily water discharge date, volume (in cubic meters), and type: To Shore To Sea To Other Tanks 4. Enter subsequent oily water discharges below first line. 5. To add additional entry lines, insert new row at row labeled "INSERT THIS ROW".
19-Sep-11	5.1	To Shore	
20-Sep-11	7.1	To Shore	
22-Sep-11	2.3	To Shore	
26-Sep-11	8.5	To Shore	
27-Sep-11	6.7	To Shore	
29-Sep-11	8.2	To Shore	
30-Sep-11	5.5	To Shore	
3-Oct-11	2.5	To Shore	
4-Oct-11	4.9	To Shore	
6-Oct-11	5.4	To Shore	



Effluents / Discharges: Ballast water

WD1: Oily Water			Instructions
OWS Performance			
Treatment Level	15 ppm, 107(49)		
Discharge Date	Volume (m3)	Type	
19-Sep-11	5.1	To Shore	

1. Enter Period Start Date.
2. Select OWS Treatment Level:
15 ppm, 60(33)

WD2.1: Ballast Water and Sediment				Instructions
Discharge Date	Treatment, ID	Volume, IA (m3)		
20-S				<ol style="list-style-type: none"> 1. Enter Period Start Date. 2. Use Ballast Water Record Book to determine first discharge in past year. 3. Enter date, treatment type, and volume in first line. Treatment types are: No Management Exchange IMO D2/USCG Phase 1 USCG Alternate 3 USCG Alternate 4 Discharge to shore 4. Enter subsequent discharges below first line. 5. To add additional entry lines, insert new row at row labeled 'INSERT THIS ROW'.
22-S				
26-S	17-Jan-12	No Management	220.0	
27-S	17-Jan-12	No Management	185.0	
29-S	20-Mar-12	No Management	248.0	
30-S	20-Mar-12	No Management	248.0	
3-Oct	3-Apr-12	No Management	91.0	
4-Oct	3-Apr-12	No Management	153.0	
6-Oct	9-Apr-12	No Management	96.0	
	9-Apr-12	No Management	96.0	
	9-Apr-12	No Management	102.0	
	9-Apr-12	No Management	126.0	
	16-Apr-12	No Management	115.0	

Effluents / Discharges: Wastewater

WD1: Oily Water			Instructions	
<u>OWS Performance</u>				
Treatment Level	15 ppm, 107(49)			
Discharge Date	Volume (m3)	Type	1. Enter Period Start Date. 2. Select OWS Treatment Level: 15 ppm, 60(33)	
19-Sep-11	5.1	To Shore		
20-S	WD2.1: Ballast Water and Sediment			Instructions
22-S	Discharge Date	Treatment, ID	Volume, IA (m3)	1. Enter Period Start Date.
26-S	17-Jan-12	No Management	220.0	2. Use Ballast Water Record Book to determine first discharge in past year.
27-S	17-Jan-12			
29-S	20-Mar-12			
30-S	20-Mar-12			
3-Oct	3-Apr-12	Level 2 BOD ₅	Level 2 Not Used	Instructions 1. Enter Period Start Date. 2. If Level 2 treatment (AWT) is used on a wastewater stream, select equipment rated performance for Level 2 BOD ₅ : 0 mg/L 5 mg/L 10 mg/L 15 mg/L 20 mg/L 25 mg/L 30 mg/L If not, select "Level 2 not used". 3. Select treatment type for Black Water waste streams, Grey Water waste streams, and Ground Food waste streams: Level 1 Level 1D Level 2 None No Discharge 4. Use vessel sign-in log to enter total annual Person-Days.
4-Oct	3-Apr-12	Black Water	Level 1	
6-Oct	9-Apr-12	Gray Water	None	
	9-Apr-12	Ground Food	None	
	9-Apr-12			
	9-Apr-12			
	9-Apr-12			
	16-Apr-12			
		People on Voyage	346	
		Days on Voyage	63	
<u>Vessel Loading</u>			Annual Sanitary Waste Impact	Result
Annual Person-Days			21798	Kilograms BOD ₅
				1333

Effluents / Discharges: Solid waste

WD1: Oily Water			Instructions					
OWS Performance								
Treatment Level	15 ppm, 107(49)							
Discharge Date	Volume (m3)	Type	1. Enter Period Start Date. 2. Select OWS Treatment Level: 15 ppm, 60(33)					
19-Sep-11	5.1	To Shore						
20-S	WD2.1: Ballast Water and Sediment			Instructions				
22-S	Discharge Date	Treatment, ID	Volume, IA (m3)	1. Enter Period Start Date.				
26-S	17-Jan-12	No Management	220.0	2. Use Ballast Water Record Book to determine first discharge in past year.				
27-S	17-Jan-12							
29-S	20-Mar-12	WD3: Sanitary Systems		Instructions				
30-S	20-Mar-12							
3-Oct	3-Apr-12	WD4: Solid Waste						
4-Oct	3-Apr-12	Instructions						
6-Oct	9-Apr-12	1. Enter Period Start Date.						
	9-Apr-12	2. Use Garbage Record Book and/or vessel garbage receipts to enter first solid waste reception facility discharge date, quantity (Mass or Volume), if recycled (Yes or No), if compacted (Yes or No), and select waste type:						
	9-Apr-12	Wood/dunnage						
	9-Apr-12	Plastics						
	9-Apr-12	Food Waste						
	9-Apr-12	Cooking Oil						
	16-Apr-12	Incinerator Ash						
		Mixed Waste/Other						
		3. Enter mass when possible. Otherwise, enter approximate volume.						
		4. Enter subsequent discharges below first line.						
		5. To add additional entry lines, insert new row at row labeled 'INSERT THIS ROW'.						
			Quantity		Recycled	Compacted		
	Discharge Date	Type	Mass (MT)	Vol (m3)	(Yes/No)	(Yes/No)		
	Vessel Loading	2-May-12	Food Wastes	0	4	No	No	Sea
	Annual Person-Day	2-May-12	Mixed Waste/Other		1	No	No	Sea
		30-Apr-12	Mixed Waste/Other		18	No	Yes	Port
		3-May-12	Mixed Waste/Other		12	No	Yes	Port
		5-May-12	Food Waste		5	No	No	Sea



Metrics: Oily water, ballast water, wastewater, and solid waste

Impact = Quality x Quantity

$$\text{Oil (mL)} = T \text{ (ppm)} \times (V_1 + V_2 + V_3) \text{ (m}^3\text{)}$$

$$\text{BW (Inoculum Impact)} = ID \text{ (density)} \times IA \text{ (abundance, m}^3\text{)}$$

$$\text{Wastewater (g-BOD5)} = (C_B T_B + C_G T_G + C_F T_F) \times PD$$

$$= C T_{B=\text{Black}, G=\text{Grey}, F=\text{Food}} \text{ (g-BOD5 / PD)} \times PD \text{ (person-days)}$$

$$\text{Solids (tonnes)} = M_{\text{uncyclable}} + \rho V_{\text{uncompacted}} + 5\rho V_{\text{compacted}}$$

Performance Summary

MVEP Vessel Performance Summary				
Vessel	CMA TS Golden Bear		Survey #	1
Survey Lead	B. Davidson		Survey Date(s)	1-Sep-12
Annual Impact Results				
Metric	Date	Surveyor	Units	Result
Carbon Dioxide (CO2)	1-Sep-12	BD	Tonnes CO2	3005
AE1 Nitrogen Oxides (NOx)			Tonnes NOx	45.2
AE2 Sulfur Dioxide (SO2)			Tonnes SO2	1.2
AE3 Particulate Matter (PM10)			Tonnes PM10	0.8
AE4 Volatile Organic Compounds			Tonnes VOC	1.2
WD1 Oily Water			mL Oil	3994
WD2.1 Ballast Water			Inoculum Impact	757735
WD2.2 Biofouling, Hull			Rank, 0-5	0.0
Biofouling, Niche Areas			Rank, 0-5	0.0
WD3 Sanitary Systems			Kilograms BOD5	1333
WD4 Solid Waste			Tonnes Solid Waste	48.0



Search for A Green Stamp

RCRV Design Team is working to reduce environmental impact of the vessel

AGOR 23 Midlife is including emissions reduction as part of selection criteria for repowering

How can this effort be quantified and recognized?





Search for A Green Stamp

Evaluated five of developed award /recognition programs

1. USGBC – LEED
2. RightShip and Carbon War Room EVDI
3. Green Marine
4. International Association of Ports and Harbors' (IAPH)
Environmental Ship Index (ESI)
5. Green Award



Search for A Green Stamp

Evaluated five of developed award /recognition programs

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Environmental Ship Index (ESI)
5. Green Award

ESI focuses on

SO_x, NO_x, CO₂, and OPS



How is MVEP used?

Tool for monitoring and demonstrating progress

Pathway to compliance and recognition

Cooperative Guidelines with your input, shared challenges, shared tools at low cost, with no commitment to a program

MEPC 63/23
Annex 9, page 1

ANNEX 9

RESOLUTION MEPC.213(63)

Adopted on 2 March 2012

2012 GUIDELINES FOR THE DEVELOPMENT OF A
SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP)

THE MARIN

RECALLING
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TIME

Vessel General Permit (VGP)

Version 2/5/2009

United States Environmental Protection Agency (EPA)
National Pollutant Discharge Elimination System (NPDES)

VESSEL GENERAL PERMIT FOR DISCHARGES INCIDENTAL TO THE NORMAL
OPERATION OF VESSELS (VGP)

AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Clean Water Act (CWA), as amended (33
U.S.C. 1251 et seq.), any owner or operator of a vessel operating in capacity as a means
of transportation who:

Is eligible for permit coverage under Part 1.2;

If required by Part 1.5.1, submits a completed accurate Notice of Intent (NOI)



References:

- [http://www.imo.org/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Technical%20and%20Operational%20Measures/MEPC.213\(63\).pdf](http://www.imo.org/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Technical%20and%20Operational%20Measures/MEPC.213(63).pdf)
- http://www.epa.gov/npdes/pubs/vessel_vgp_permit.pdf
- <http://shippingefficiency.org/userfiles/files/Data-Methodology.pdf>



Next steps, Lessons Learned

Thank you, Questions?

Implement Cal Maritime
feedback and Re-survey

Expand assessment

Metrics, Vessel types,
Automation

Rating System

Normalize, weight, & sum
Relate environment and
health impacts to fiscal
cost, \$

Contact:

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The Glosten Associates

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Extra Slides



Phase 2 Performance Assessment Guide Development Impact Checklist

Energy Efficiency

EE1 Energy Optimization Measures

- EE1.1 Lighting
- EE1.2 HVAC
- EE1.3 Pump and Piping Systems
- EE1.4 Mechanical Equipment Operations & Maintenance
- EE1.5 Hull & Propeller Operations & Maintenance
- EE1.6 Voyage Planning
- EE1.8 Waste Heat and Energy Recovery
- EE1.9 Hull Optimization
- EE1.10 Electrical Power Generation & Distribution

EE2 Innovations

- EE2.1 LNG
- EE2.2 Biofuels
- EE2.3 Renewable Energies

EE3 Green House Gas (CO₂)

Air Emissions

- AE1 Nitrogen Oxides (NO_x)
- AE2 Sulfur Oxides (SO_x)
- AE3 Particulate Matter (PM)
- AE4 Volatile Organic Compounds (VOCs)
- AE7 Port Air Emissions

Discharges to Water

WE1 Oily Water

WE2 Non-Indigenous Species Control

- WE2.1 Ballast Water and Sediment
- WE2.2 Hull Fouling

WE3 Sanitary Systems

WE4 Solid Waste

WE5 Incidental Discharges

WE6 Structural Protection of Oil

WE7 Water Interface Seals

General Measures

GM1 Materials: Reduction/Reuse/Recycle/Construction

GM2 Hotel Water Use: Reduction/Reuse/Recycle

GM3 Ocean Health and Aquatic Life

GM3.1 Underwater Noise

GM3.2 Wake Wash and Shore Protection

GM4 Hazardous Materials Control - Inventory Program

GM5 Ship Recycling



Existing Initiatives

Private & Public

BSR Clean Cargo Working Group

CWR ShippingEfficiency.org

Clean Shipping Index (Sweden)

Green Award (Netherlands)

Green Marine (US & Canada)

Green Ship of the Future (Denmark)

IMO EEDI, EEOI, SEEMP

InterManager Shipping KPI StandardProtection

ISO 14000, 14001

Rightship Environmental Rating, EVDI

SNAME Marine Vessel

Environmental Performance

FFTF Sustainable Shipping Index

WPCI Environmental Ship Index

Class Society Notations

ABS Green Passport, ENVIRO, O&EP

BV Green Rating Composite Index

NK Environmental Awareness

DNV Clean, Clean Design, Triple-E

GL CO2 Index Cert, Green Passport

LR Green Passport, Environmental

Comprehensive

Guidance

Technical, Objective ★

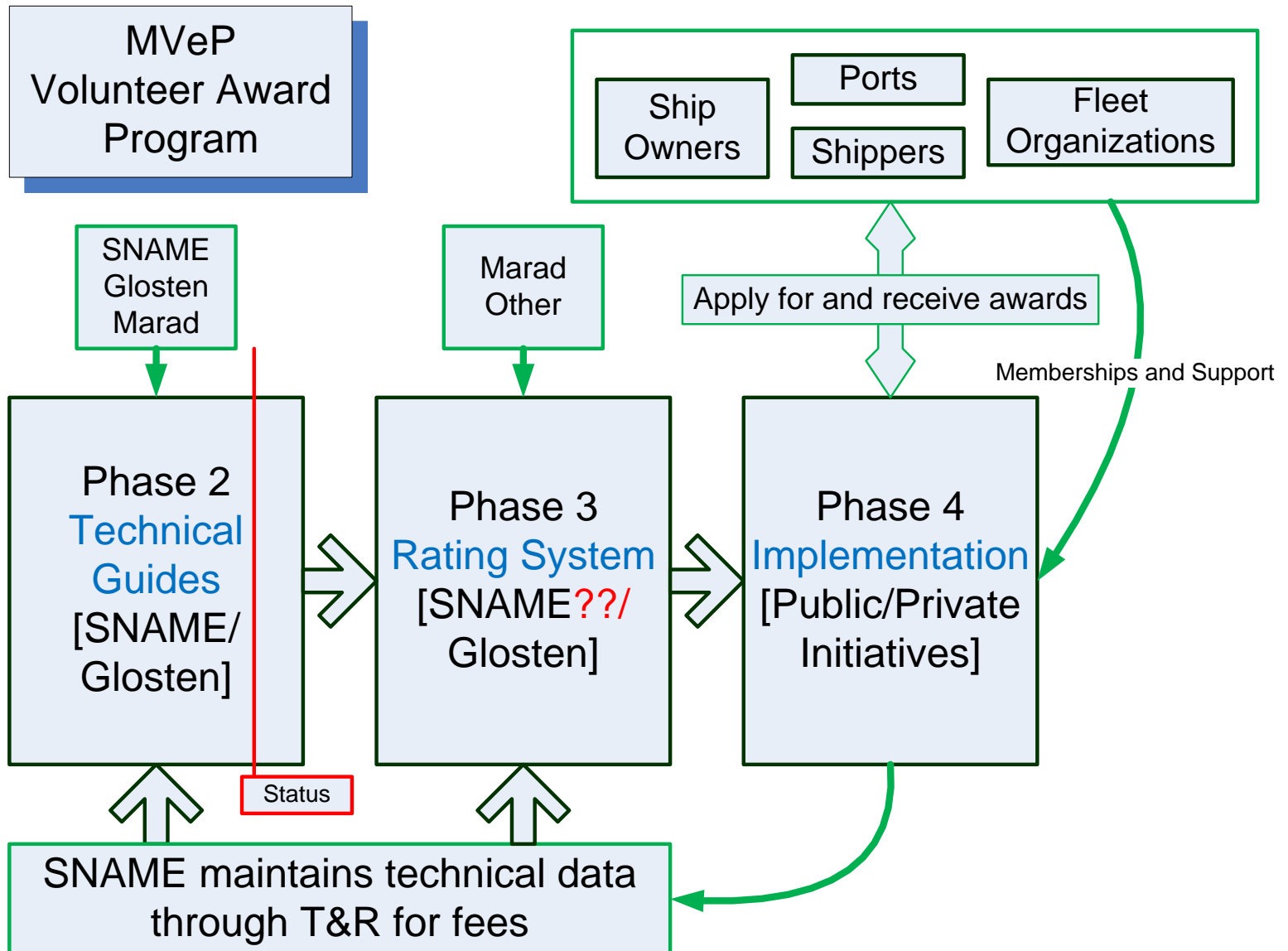
Transparent

Quantitative



MVeP Development Flow Chart

Volunteer Award Program Model

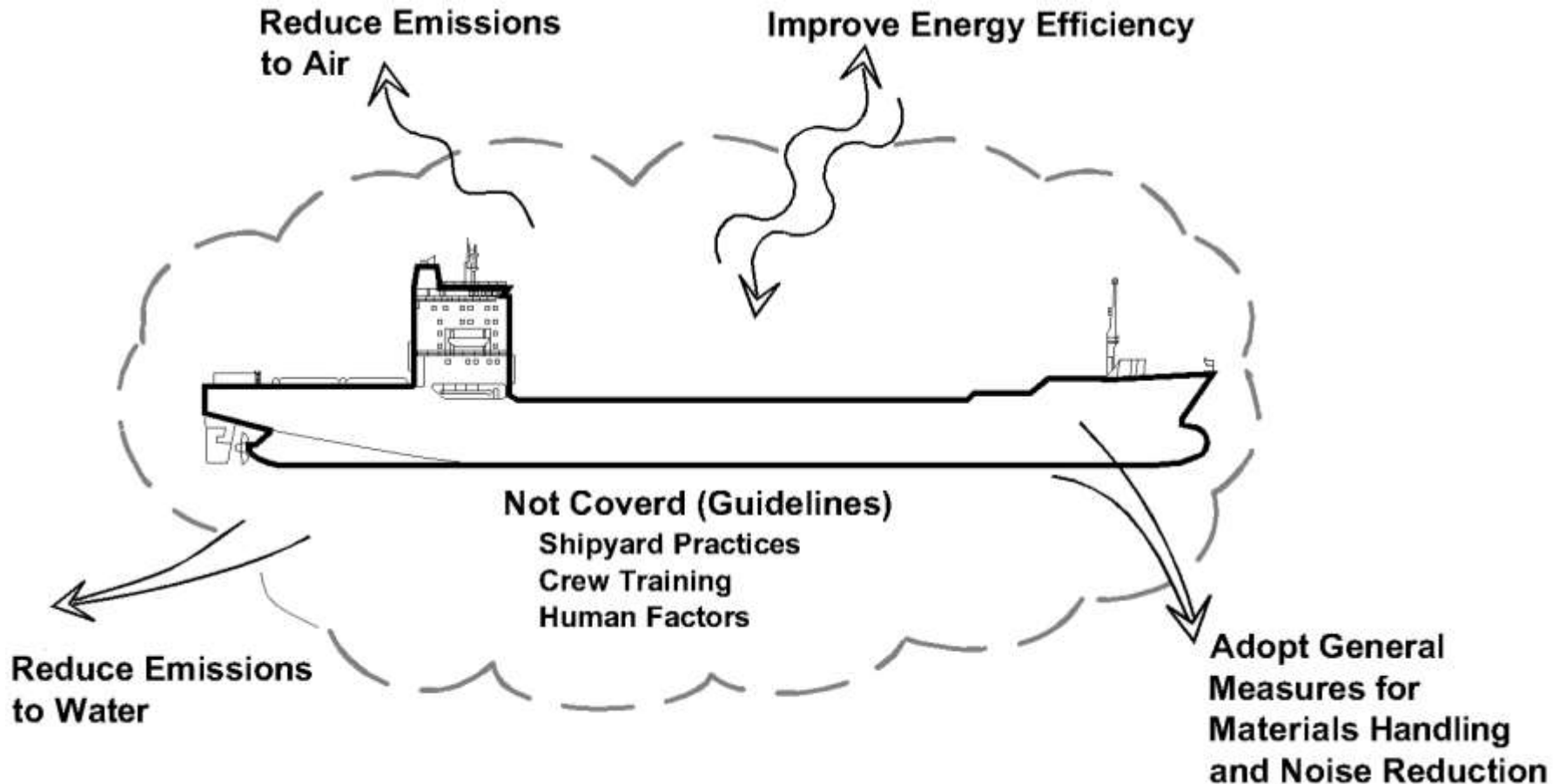




“How Green is Green?” - MVeP

Holistic Approach to Marine Vessels

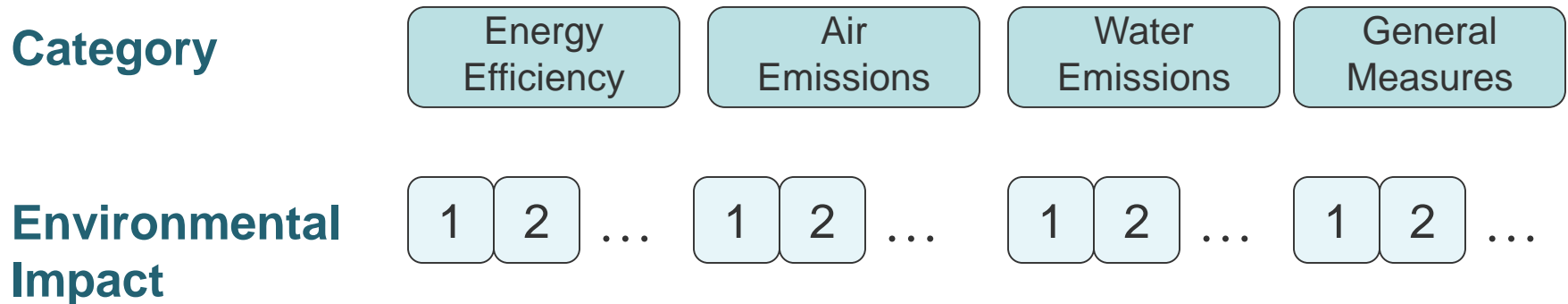
Mission Statement: “Provide a common technical basis for assessing environmental performance, so that marine vessel designers, builders, and operators can understand relative environmental impacts of design decisions and operational practices.”



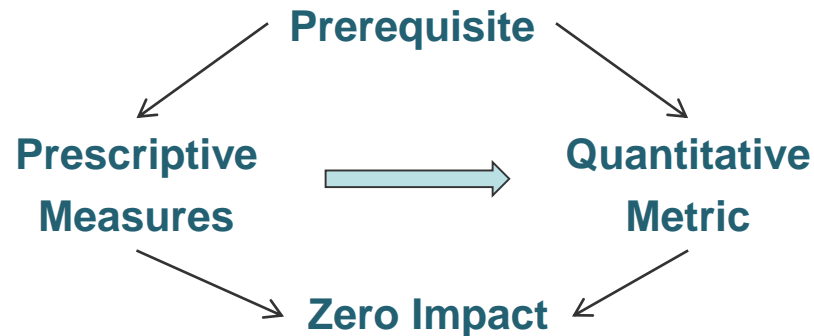


MVeP Phase 1 Pilot Project

- Identify Need – **Holistic** Assessment, Standard Performance Criteria
- **Checklist** of 34 environmental impacts
- Organized impacts and developed **Assessment Methodology** to be filled in
- 3 example **Performance Assessment Guides & Template**



Assessment Methodology



www.sname.org/mvep



Phase 2 Performance Assessment Guides

Performance Assessment Guide

1. Scope and Applicability
2. Statement of the Problem
- 3. *Assessment Methodology***
 - 1. Prerequisite**
 - 2. Prescriptive Measures**
 - 3. Quantitative Metric**
 - 4. Zero Impact**
4. Level Justifications
5. Regulatory Environment
6. Directions for Future R&D
7. Design Integration
8. Supporting Documents

MARINE VESSEL ENVIRONMENTAL PERFORMANCE ASSESSMENT GUIDE

EE1.2 Energy Optimization Measures: HVAC

Prepared for
SNAME Technical & Research Steering Committee

Presented by:
The Glostien Associates, Inc.
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29 January 2010
Rev. A



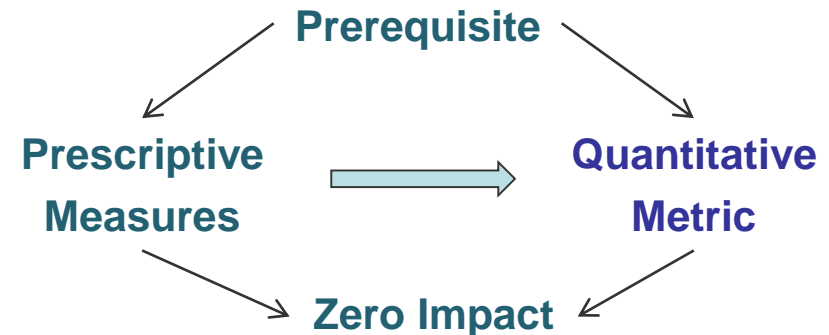
MVeP Phase 3 Implementation

Who Uses?

- Ship **Designers** and **Owners** looking for guidance on developing new vessels
- **Operators** looking for guidance on improving current performance

Who Might Implement?

- **Port** wanting to give incentives to a green vessel
- **Regulatory body** with capacity to audit, verify, and certify
- **Private environmental initiatives** expanding their scope



How Might They Implement?

- **Normalize** absolute measurement by service provided
- **Weight** and **Sum** impacts
- **Peer Group**
- **Baseline** and **Performance Threshold**



Phase III Score sheet

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Category Name	Impact #	Sub Impact #	Impact Name	Quantitative Metric Score	Quantitative Metric Units	Ship Type Normalizing Factor Value	Ship Type Normalizing Factor Type	Impact Weighting Factor	Allowable Impact Weighting Factor Range	Normalized Metric Score		
2	Energy Efficiency	1		Energy Optimazation Measures							0		
3			1	Lighting							0		
4			2	HVAC	100 kWhr	100	passeng	??	0,1	1			
5			3	Pump and Piping	100 kWhr	1E4	teu-nm	??	0,1	1			
			4	Mech. Equip. Operations and						0			