A Framework for Transition to a Low Carbon Future in Sea Transport

Deputy Vice Chancellor Prof Derrick Armstrong

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

A joint collaboration between RMI Government and USP

MICRONESIAN CENTER FOR SUSTAINABLE TRANSPORT

A Catalyst for Change

Micronesian Center for Sustainable Transport

- RMI has requested USP establish a Centre of Excellence to support a whole of country strategy to tranistion to low carbon transport.
- Micronesian Presidents Summit July 2015 communiqué calls for action to transition Micronesia to low carbon transport, with sea transport as a starting point
- MPS 2018 saw this extended to include Tuvalu, Kiribati and Nauru and we also work closely with Solomon's, Fiji and Tonga to date.
- The MCST Framework has been endorsed by the Smaller Island States Leaders Forum in 2016 and the 2017 Regional Transport Ministers Forum in April 2017.

15th Micronesian Presidents' Summit

Majuro, Marshall Islands

July 14-15, 2015

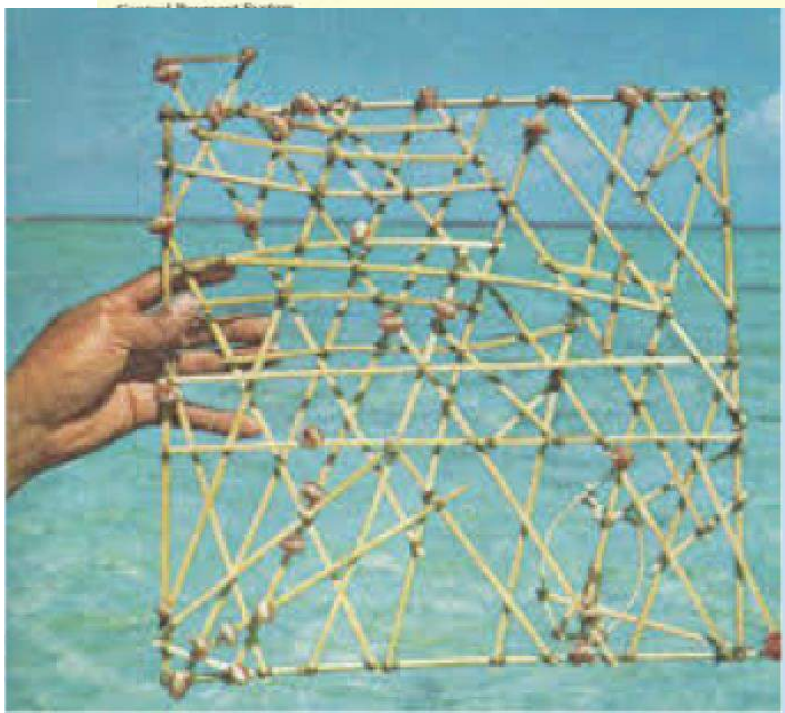
Boknake Hana

Statistical Commission to report on the actual data in order to shape the discussions and outcomes of the final targets, benchmarks and measurements to achieving SDGs.

Sustainable Sea Transportation

The Presidents endorsed setting national transport reduction targets, developing strategies to transition their countries to low carbon transport and establishing a Micronesian Sustainable Transport Center as priority actions to assist in reducing dependency on imported fuel and GHG emissions profiles.

The Presidents acknowledged the leadership of the RMI in setting a target to reduce transport emissions by 20% by 2020. The Presidents agreed to recommend to the Forum Leaders' meeting in Port Moresby in September that low carbon transport, particularly sea transport, be adopted as a regional priority, and that donors and bilateral partners be requested to support this priority with financial and technical resourcing.



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Marine Policy

journal homepage: www.elsevier.com/locate/marpol

A review of sustainable sea-transport for Oceania: Providing context for renewable energy shipping for the Pacific

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ABSTRACT

This paper summarises research and options for sustain
domestic shipping. This debate is situated initially with
shipping scenario, a region of minute economies connect
in the world. All current options are fossil fuel powered a
Many routes are marginal or unviable and a vicious cycle
Although a central and essential issue of many Pacific co
sea transport is currently invisible within the policy space
are possible and increasingly available. Recent researc
providing benefits across multiple wellbeings. The barr
poorly understood but are perceptual and institutional
critical experiments during the last oil crisis provide crit

frontiers in
MARINE SCIENCE

Policy and financing—why is sea transpor invisible in the search for a low carbon fut Island Countries?

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IRENA

RENEWABLE ENERGY OPTIONS FOR SHIPPING

TECHNOLOGY BRIEF

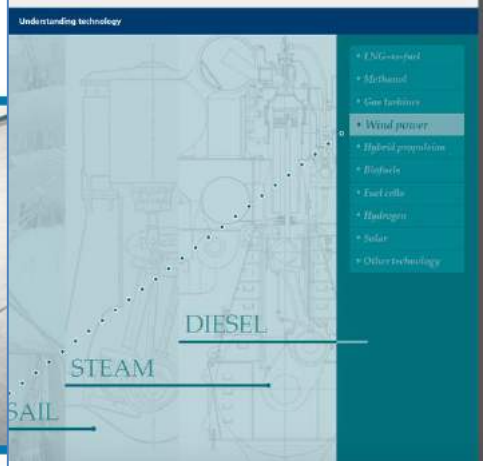
JANUARY 2015

Lloyd's Register Marine

Working together for a safer world

Wind-powered shipping

A review of the commercial, regulatory and technical factors affecting uptake of wind-assisted propulsion



A review of the NAEI shipping emissions methodology

Final report

Report for the Department for Business, Energy & Industrial Strategy
PO number 1109088

UMAS

LNG as a marine fuel in the EU

Market, bunkering infrastructure investments and risks in the context of GHG reductions

EDF ENVIRONMENTAL DEFENSE FUND
Finding the ways that work

COLUMBIA LAW SCHOOL
SABIN CENTER FOR CLIMATE CHANGE LAW

THE LEGAL BASES FOR IMO CLIMATE MEASURES

By Aoife O'Leary and Jennifer Brown

June 2018

UNCTAD

UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

REVIEW OF MARITIME TRANSPORT 2014

UNITED NATIONS

COLUMBIA LAW SCHOOL
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AUTHORITY OF PACIFIC ISLAND STATES TO REGULATE GREENHOUSE GASES FROM THE INTERNATIONAL SHIPPING SECTOR

BY MEREDITH WILENSKY
mwilensky@law.columbia.edu

FEBRUARY 3, 2014

Transitioning to Low Carbon Shipping Module – Sustainable Sea Transport Solutions for SIDS: Pacific Island Countries Case Studies

PRINT

This module has been prepared to provide background and lessons learnt from the reef of experience for decision and policy makers developing strategies for Small Island Developing States (SIDS), seeking to transition their sea transport to low carbon options. We have focused on the situation as it exists for Pacific Island Countries but the information in this module has direct relevance to all SIDS and many Less Developed Countries (LDCs).

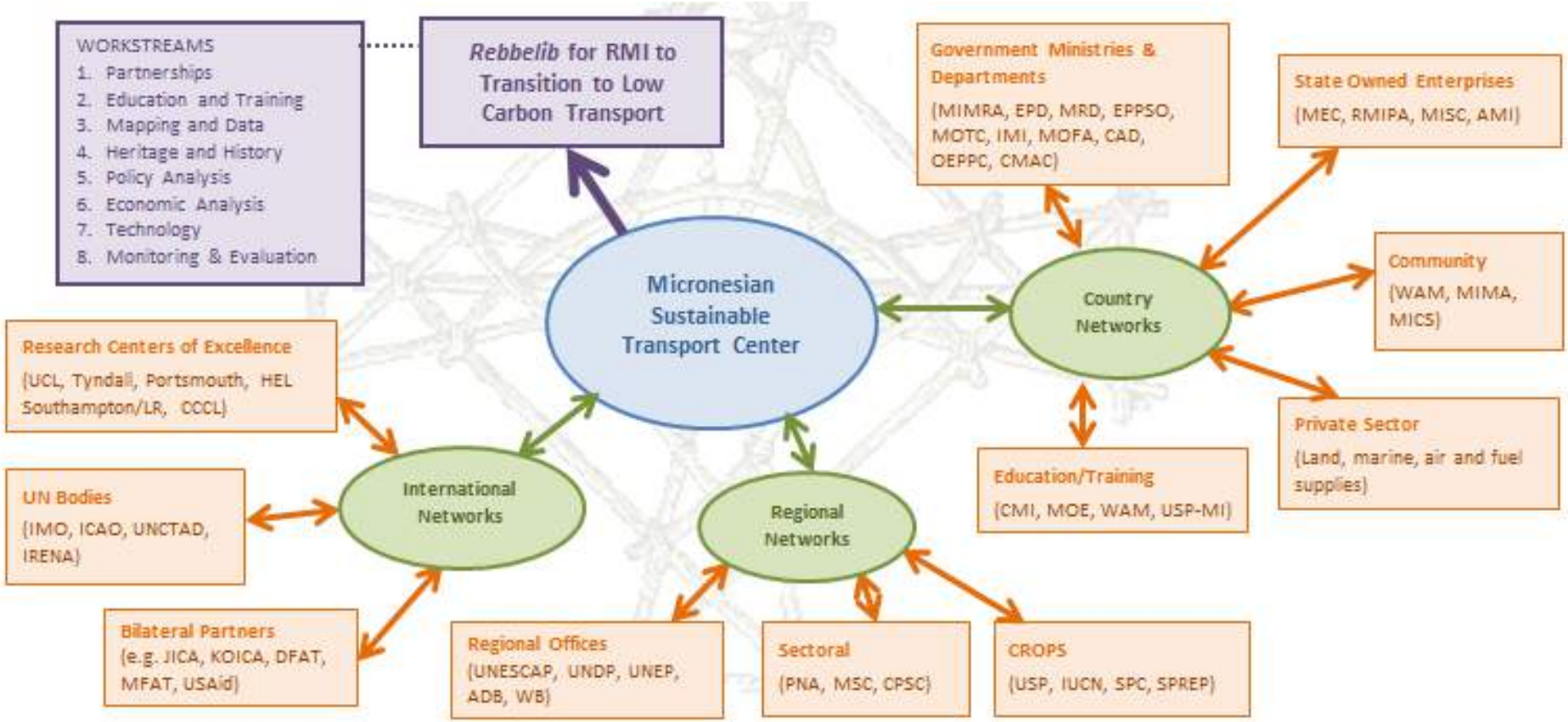
This module contains eight chapters, each covering a separate theme. There are additional resource materials including PowerPoint presentations for each section, fact sheets which summarize key information and provide case examples, a glossary and list of acronyms, a reference list and bibliography, and links to useful websites.

You can access all chapters including additional resource materials by clicking on the chapters below. Alternatively, you can download the full module and the full appendix further down.

RMI – 4 strand approach to low carbon shipping transition

- Shipping High Ambition Coalition (SHAC)
  - All Sectors must bear their 'fair share'
  - PSIDS unique issues must be accommodated and based on science
  - RMI is the 2nd largest registry in the world
  - At MECP72 RMI led a coalition of "High Ambition Countries" to set a target of AT LEAST 50% emissions reduction by 2050.
- Micronesia Center for Sustainable Transport
  - Whole of sector/whole of country low carbon transition
  - Catalyst for change, country driven
  - Endorsed by leaders of PAL, FSM, NAU, RMI, TUV, KIR, TOK, PIDF and USP Council
- Re-balance between transport/energy
  - Review NDCs to include transport and electricity emitting sectors
- Climate Financing for Pacific low carbon transition
  - RMI has a mandate from the Region's Transport Ministers to submit a regional $250m GCF application for low carbon shipping.

Marshall Islands ***Rebbelib*** for Transition to Low Carbon Transport

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Transitioning to Low Carbon Sea Transport (TLCSeaT)

financed by German Government (BMU)

Majuro, August 20, 2018

A Transition towards Low Carbon Sea Transport

in The Republic of The Marshall Islands

Contents

I Overview on Objectives

- Reduction of RMI‘s GHG-Emissions from domestic sea transport

- Two phase approach:

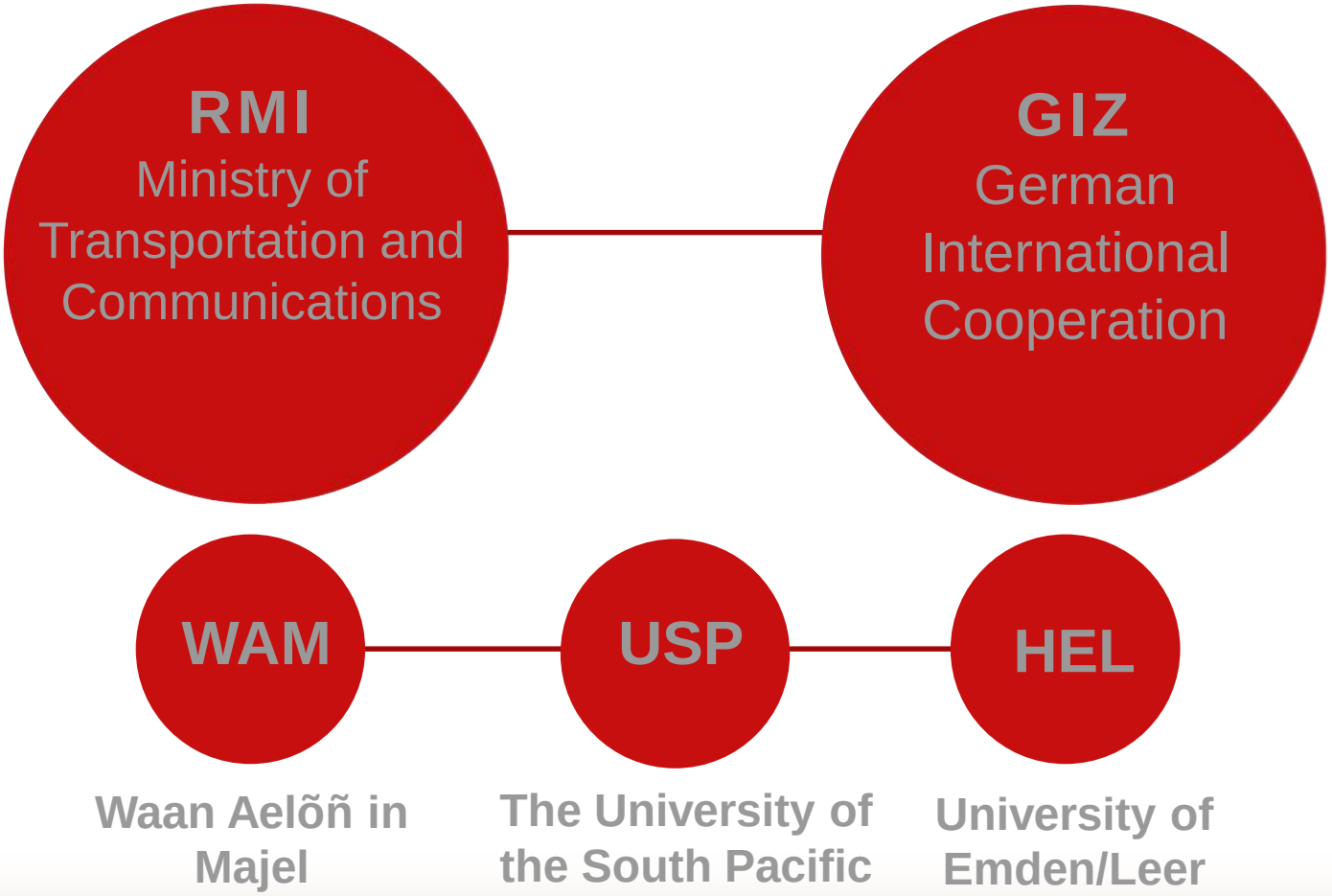
  1 Assessment of emissions, logistics and economics of domestic fleet operations

  2 Development of options for low-carbon-propulsion technologies

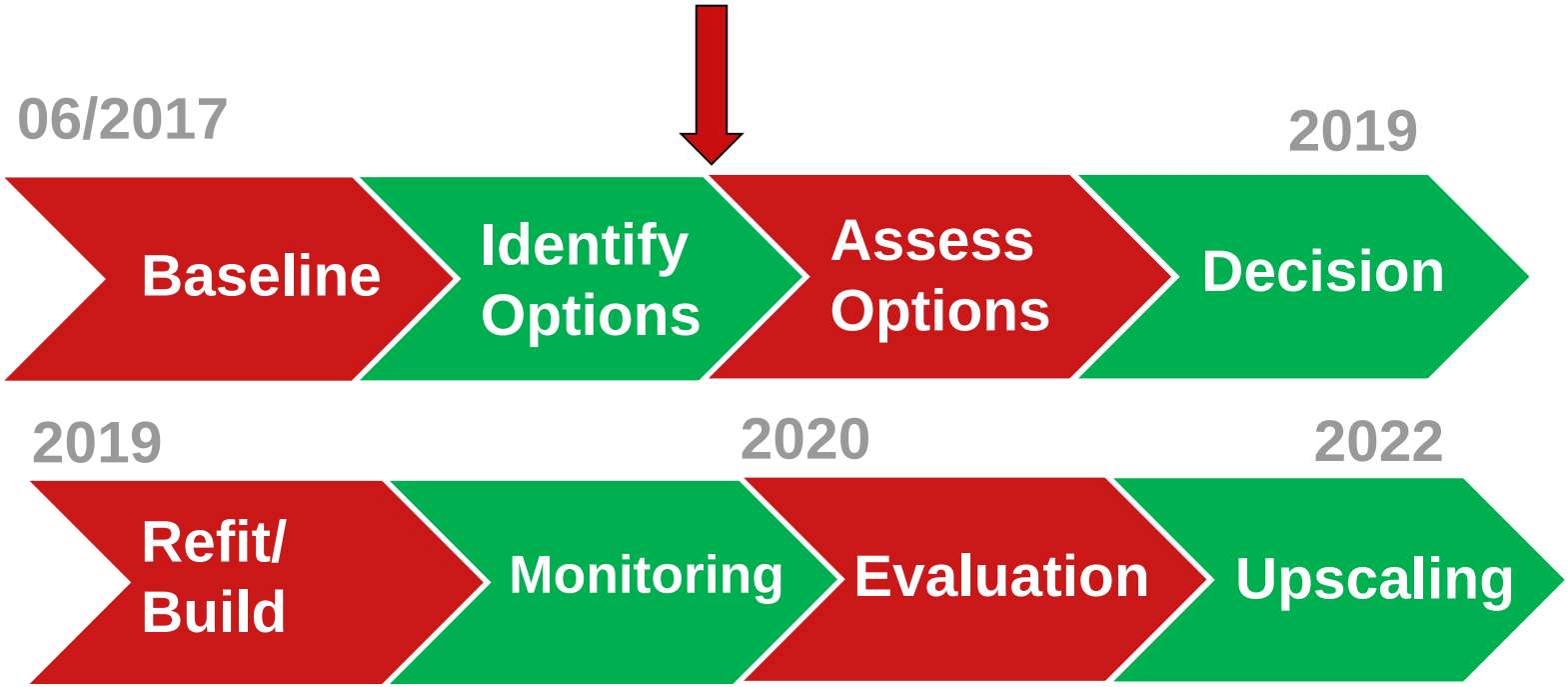
  for inter-atoll and inside-lagoon sea transport

- Policy Support to the RMI Government: strengthening, i.e. the High Ambition Coalition (HAC) for UNFCCC negotiations/IMO

II Implementing Partner Organisations



III Time Frame



IV Impact of TLCSeaT Project

Short/Medium Term Benefits

- Influence at international negotiations increased
- Raising of ambitions at IMO level in order to reduce emissions

Medium Term Benefits

- Lower costs in sea transport due to less fuel consumption
- Private sector operators: cost efficient sea transport
- Other States within the Pacific: fossil fuel reduction
- RMI mariners, students et al.: enhanced capacity

Long Term Benefits

- Contribution to achieve RMI‘s NDC targets
- Increased project impact due to upscaling process
- For RMI: improved connectivity between and within atolls

Why RMI?

- Front Runner (High Ambition Coalition) in the international Climate Debate
- Transport Sector is part of their NDC
- High Ambition in their NDC
- Highly dependent on Sea Transport
- Climate Vulnerable Country

Kommool Tata !

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MARITIME TECHNOLOGY COOPERATION CENTRE – PACIFIC (MTCC-PACIFIC)

CAPACITY BUILDING FOR CLIMATE MITIGATION IN THE MARITIME SHIPPING INDUSTRY

THE GLOBAL MTCC NETWORK (GMN) PROJECT

MTCC- Pacific Work and Progress in the Pacific region

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Pacific Community
Communauté du Pacifique

HOST INSTITUTIONS OF MTCC-PACIFIC

SPREP
Secretariat of the Pacific Regional Environment Programme

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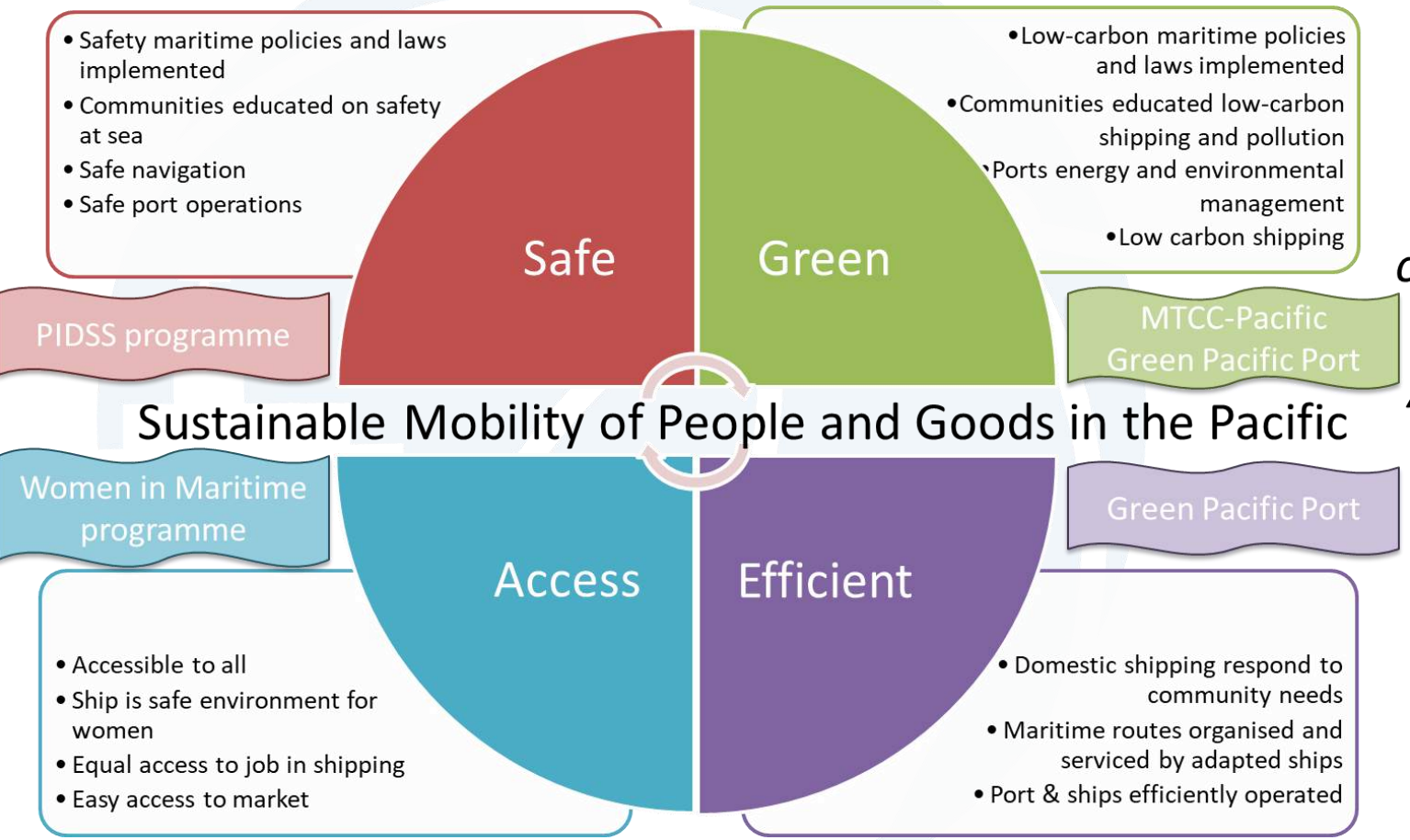
SPC approach to interisland shipping in the Pacific

- Issues affecting inter-island shipping in the Pacific:
  - Lack of safety management and safety awareness (ship operators and communities)
  - Inefficiency of domestic transportation systems in responding to communities needs
  - Lack of accessibility to shipping services by vulnerable groups
  - Lack of energy management (ship & shore)

- Need to rethink the approach to domestic shipping and commit as agreed in the December 2017 Regional Conference of MTCC-Pacific:
  - Infrastructure development and a combination of technical and operational measures, including options such as traditional navigation for inter-island mobility of people & goods
  - Need for collaboration, cooperation and partnerships from the international to regional, national and community levels

Sustainable Mobility of People and Goods in the Pacific



A Community-centred approach towards Safe, Accessible to All, Efficient and Green domestic shipping in the Pacific

Global Maritime Network

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University of Trinidad & Tobago

MTCC AFRICA
Maritime Technology Cooperation Centre

Jomo Kenyatta University of Agriculture & Technology, Kenya

MTCC ASIA
Maritime Technology Cooperation Centre

Shanghai Maritime university, China

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Pacific Community (SPC), Fiji

MTCC LATIN AMERICA
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Admin & Info.

Our Services

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- Regional partnerships and collaboration is effective
- contribute to international networking
- Regional Action Plan and/or Strategy are adopted
- Resource mobilisation is conducted
- Internal systems and processes aligned with quality standards

Goal 1:

To be a Centre of Excellence supporting the region strategy for climate mitigation in the maritime industry

Goal 2:

To build the capacity in PICTs government and maritime industry for reducing GHG emissions

- National workshops/trainings are delivered for energy efficient operations of ships and ports and data collection and reporting
- Regional workshops/trainings are delivered for energy efficient operations of ships and ports and data collection and reporting

Goal 4:

To provide assistance to reduce GHG emissions from the maritime industry

- Pilot-projects are implemented to assist ships operators and ports to improve energy management on board domestic ships and in ports
- Laws and policies for the reduction of GHG emissions and energy management in the maritime industry are reviewed/drafted

Goal 3:

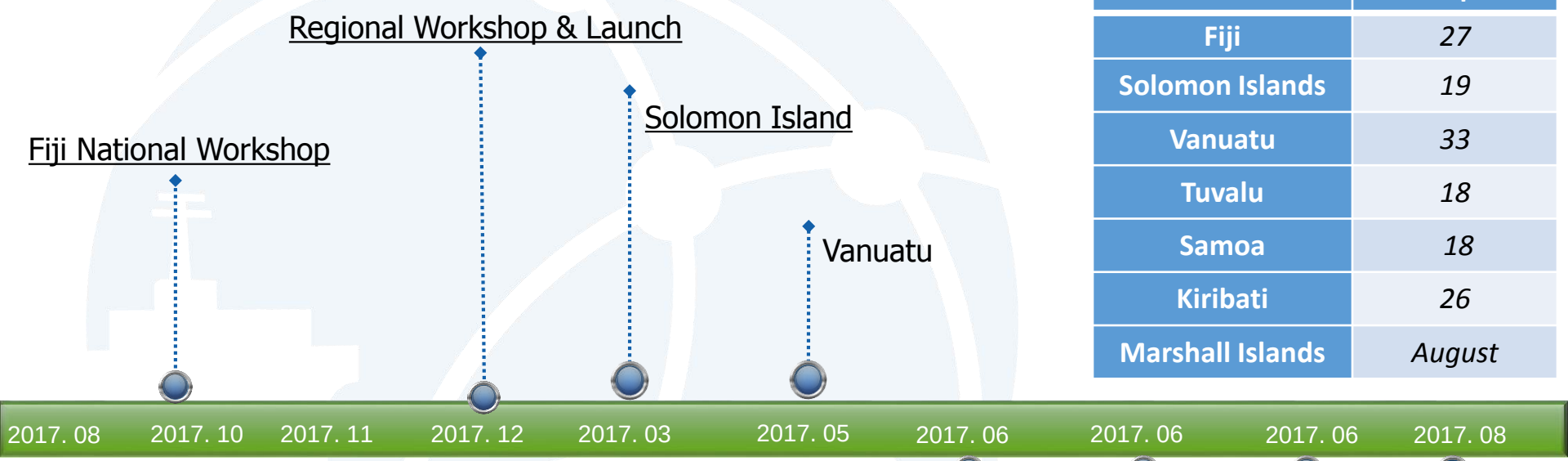
To transfer technology and knowledge for climate mitigation in the maritime industry

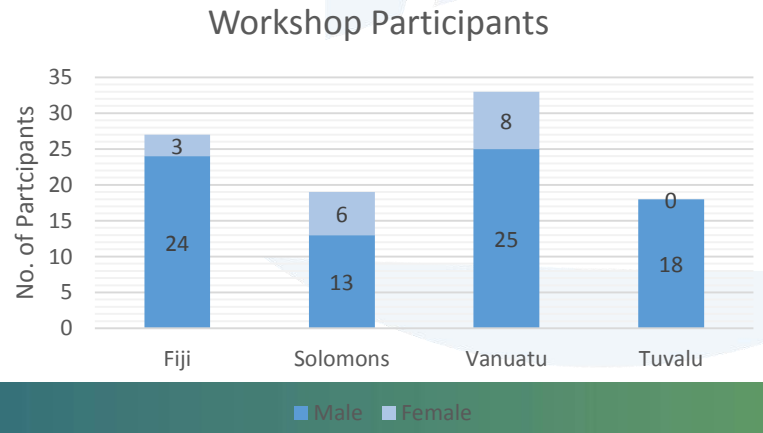
- ata related to GHG emissions in he maritime industry are collected and analysed
- A regional database is maintained and information made accessible
- Knowledge is disseminated through publications and information sharing

MTCC-Pacific Capacity Building Activities

- *MTCC-Pacific has completed 6 out 7 national workshops*

Target Countries	Number of Participants
Fiji	*27*
Solomon Islands	*19*
Vanuatu	*33*
Tuvalu	*18*
Samoa	*18*
Kiribati	*26*
Marshall Islands	*August*





MTCC-Pacific pilot-projects

Ship Energy Efficiency management Plan (SEEMP) implementation:

- The purpose of a SEEMP is to establish a mechanism for a company and/or a ship to improve the energy efficiency of a ship's operation and:
  - reduce fuel oil consumption & GHG emissions
  - Uptake new technologies and operations

Data collection & Energy Efficiency Operator Index (EEOI):

- Used to establish a consistent approach
- assist ship-owners/operator… in the evaluation of the performance of their fleet with regard to CO2 emissions
- In short, every operation aspect of ship has its own impact on EEOI and causes its variability

1. EEOI for a voyage; generally means the EEOI calculated for the period between a departure from a port to the departure from the next port.
2. Average Voyage EEOI; generally means the EEOI calculated for a number of voyages taken to return to the port of departure origin.

$$EEOI = \frac{\sum_j FC_j \times C_{Fj}}{mass_{cargo} \times D}$$

Where:

- *j is the fuel type (Diesel);*
- *i is the voyage number;*
- *FC_j j is the mass of consumed Diesel j at voyage i;*
- *C_{Fj} is the fuel mass to CO_2 mass conversion factor for Diesel j = 3.206;*
- *m_{cargo} is cargo carried in tonnes (t); and*
- *D is the distance in nautical miles (nm) corresponding to the cargo carried.*

*The calculated EEOI is expressed as **grams. CO_2 / (tonnes · nautical miles)** i.e. **g.CO_2 / t.nm***

3. For the purposes of calculating CO2 emissions, following formula was used:

$$Emission\ Factor\ (EF) = Fuel\ Consumped \times C_{Fj}$$

MTCC-Pacific pilot-projects

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Target Countries	Completed port Energy Audits
Fiji	25-29 September 2018 9-13 April 2018
Solomon Islands	21-25 August 2017
Samoa	21-25 August 2017
Tuvalu	28 May-1 June 2018
Marshall Islands	11-15 June 2018
Vanuatu	2-9 July 2018
Kiribati	19-25 July 2018

Figure 2 Delap Dock: Areas under th

Figure 1: Port of Apia audit boundary and objects.

MTCC-Pacific pilot-projects

Green Ports : SIPA – Port of Honiara

Comparing total energy use, (all fuels) for the period September 2016 to April 2017 vs September 2017 to April 2018:

- Overall energy use is down 8%, saving 15 tonnes of greenhouse gas a month on average.
- Electricity usage is down 21%, saving 13 tonnes of GHG a month on average.
- Diesel usage is down 7%, saving 4 tonnes of GHG a month on average.
- Monthly energy costs have dropped by 13% overall, saving on average SBD $72,000 a month, or around AUD $12,000 a month

Figure 1 Port of Honiara showing the audit boundary. Areas bordered in yellow and blue are excluded

If we **assume** all these savings are a result of **implementation** of measures recommended in the **energy audit**, over the 8 months to end of April 2018, **126 tonnes of GHG** will be saved, and **SBD $570,000** or around **$AUD 96,000** in **energy costs.**

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THANK YOU

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Pacific Islands Domestic Ship Safety (PIDSS) Programme

PIDSS Programme Outline

1. Why PIDSS in the region
2. PIDSS Programme
3. Theory of Change
4. Status
5. Issues & Lessons Learned
6. Establish Safety Culture

> *"A ship in harbor is safe, but that is not what ships are built for."*
> John A. Shedd, author and professor.

Why PIDSS introduced in the region?

mv Uean Te Raoi II – Kiribati/July 2009

mv Princess Ashyka – Tonga/August 2009

Why PIDSS introduced in the region?

An initiative endorsed by the 2009 Pacific Island Forum Leaders' meeting in Cairns Australia

PIDSS Programme – Safe Management System

- The PIDSS Safety Management System (SMS*) is designed to work with existing national domestic safety programs or to provide a complete safety package.
- While all activities are cleared through the Maritime Administration, PIDSS-SMS can be tailored to meet individual shipping company requirements.
- At all times the program strives to conduct its activities in conjunction with national surveyors/inspectors.
- Program design and training aligns with the principles outlined in the International Safety Management (ISM) Code, 2010 Edition.

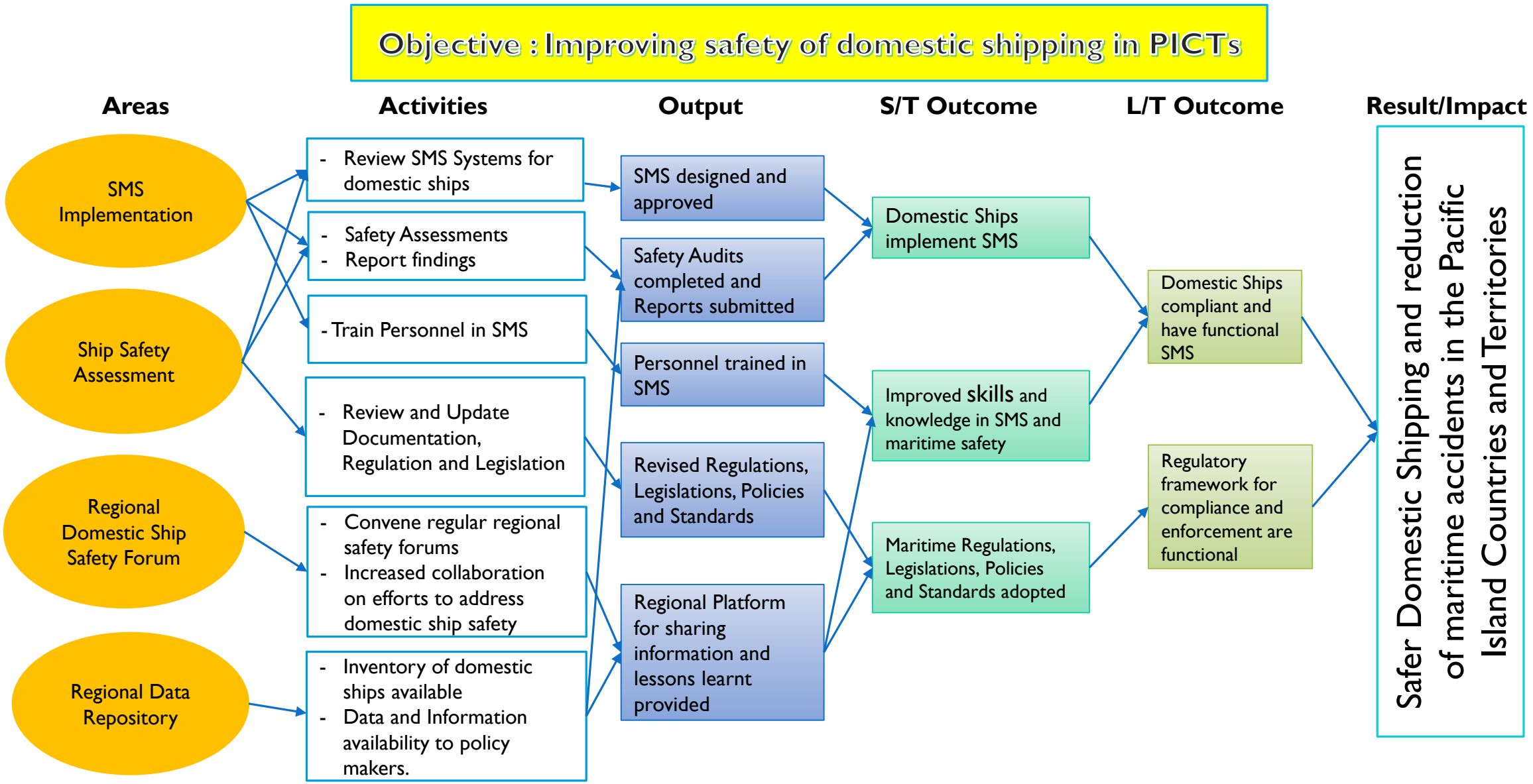
*SMS = ISM, SSM, SOP

PIDSS Programme – Components

- ✓ Conduct “baseline” safety surveys of domestic vessels.
- ✓ **Legislation**: assist with laws & regulations (PIMLaw models).
- ✓ **Training**: provided to Maritime Administration, industry & seafarers.
- ✓ **Implementation**: provide a Safe Management System and/or Plan tailored to shipping company/vessel.
- ✓ Support regional **domestic ferry safety forums**.

- ✓ **Checklists**: provide templates for non-convention vessels & small boats.
- ✓ **Monitoring**: conduct initial and follow-up external audits of approved SMS’s.
- ✓ **Reporting**: provide audit reports to assist with system improvement.
- ✓ **Mentoring**: work directly with national surveyors & designated persons.

Theory of Change

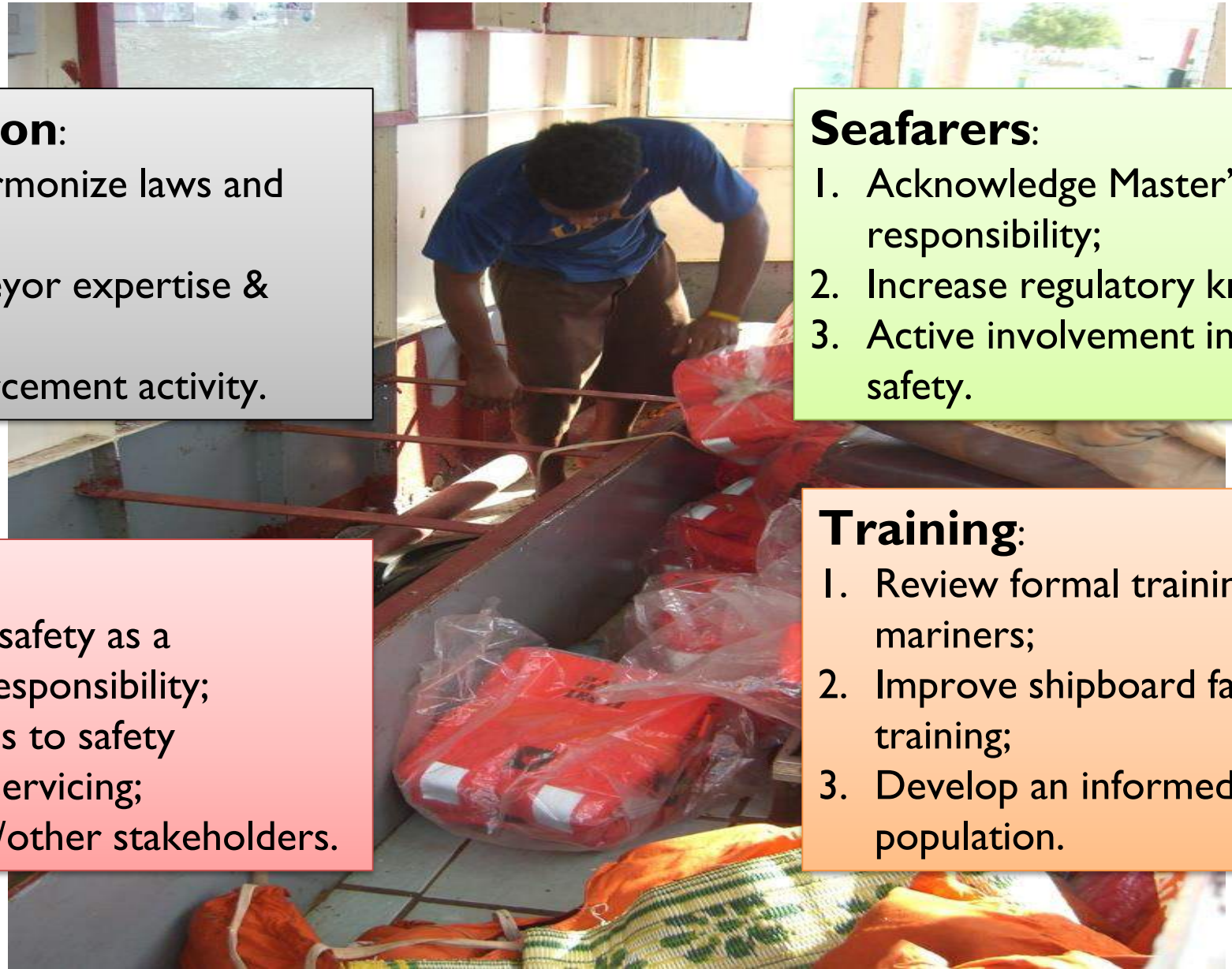


PIDSS Status as of 19 June 2018

Pacific Community
Communauté du Pacifique

Country	Year introduced	Total No. of Visits	Personnel trained	Registered Domestic vessels	Vsls cos'd /approved SOP	Initial Audits conducted	FU Audits conducted	Next Planned Visit
Tonga	2010	8	78	5	5/1	2010 = 3	2012 = 1	Nov 2018
Kiribati	2010	11	101	56	15/12	2010 = 1 2011 = 2 2012 = 1 2015 = 1 2016 = 4 2017 = 4 2018 = 2	2012 = 2 2016 = 1 2017 = 3 2018 = 1	June & Dec 2018
Marshall Is.	2013	7	63	29	17/1	None	None	Dec 2018
Vanuatu	2013(V)/2014(L)	6	42/29	56	39/0	None	None	Aug 2018
Solomon Is.	2014	5	30	253	25/4	2016 = 3 2017 = 1	None	July 2018
Tuvalu	2015	2	14	5	3/0	None	None	Dec 2018
FSM	2016	1	16	49	4/0	None	None	Oct 2018
Samoa	2016	1	18	5	5 (ISM)	None	None	Aug 2018

Issues and Lessons Learnt



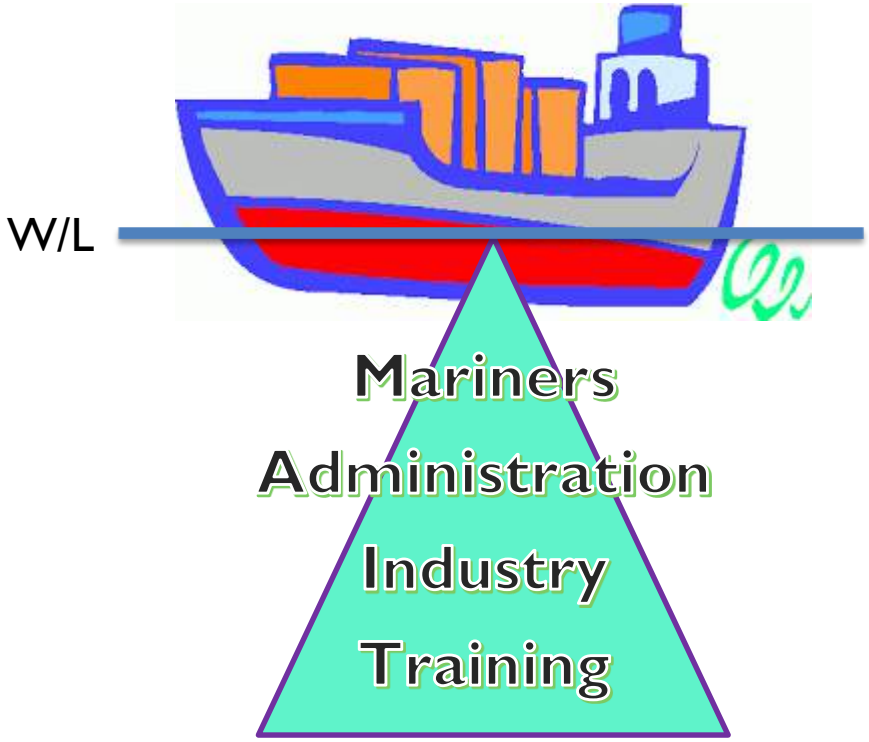
Administration:
1. Improve & harmonize laws and regulations;
2. Improve surveyor expertise & capability;
3. Increase enforcement activity.

Seafarers:
1. Acknowledge Master's responsibility;
2. Increase regulatory knowledge;
3. Active involvement in vessel's safety.

Industry:
1. Acknowledge safety as a "corporate" responsibility;
2. Improve access to safety equipment & servicing;
3. Coordinate w/other stakeholders.

Training:
1. Review formal training for domestic mariners;
2. Improve shipboard familiarization training;
3. Develop an informed traveling population.

Safety Culture vs Business-as-Usual model



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CAPACITY BUILDING FOR CLIMATE MITIGATION IN THE MARITIME SHIPPING INDUSTRY
THE GLOBAL MTCC NETWORK (GMN) PROJECT

Energy Management System & Plans

Presenter : MTCC-Pacific

National Workshop
Q3 2018

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Pacific Community
Communauté du Pacifique

HOST INSTITUTIONS OF MTCC-PACIFIC

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Secretariat of the Pacific Regional Environment Programme

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Content

- Overview of management systems
- ISO 50001 on Energy Management System (EnMS)
- Company Energy Management System (CEnMS)

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Overview of Management Systems

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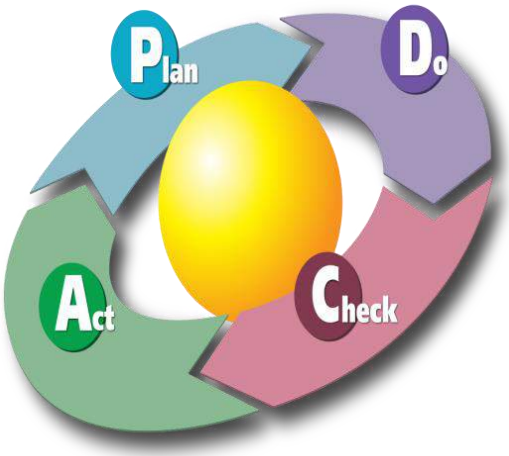
Role of top management

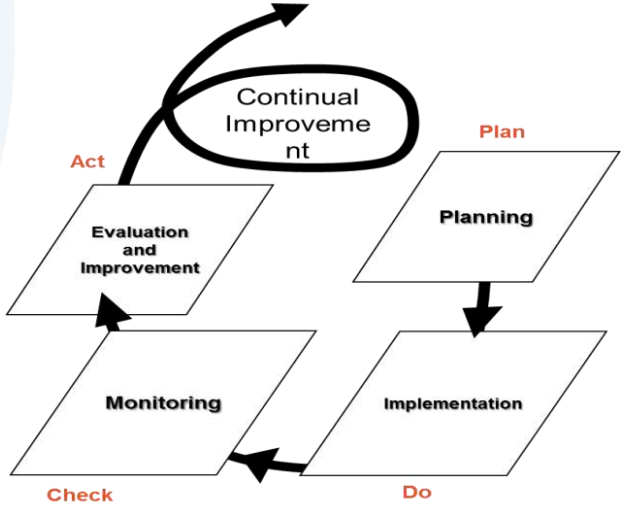
- The cornerstone of good management is:
  - Commitment from the top management; and
  - Dedication from the operating personnel.

- The ISM Code foundation is also based on this paradigm and requires:
  - Management commitment.
  - Staff/personnel empowerment.
  - Continuous improvement.

PDCA and continuous improvement

- PDCA is the most basic framework for any management system.
- **Plan:** An action plan of the activities that need to be done together with all relevant implementation details.
- **Do:** The implementation of the selected improvement measures.
- **Check:** Monitor the results of the implementation via effective data analysis and assessments.
- **Assess:** The effectiveness of the plan is reviewed and new targets are set for next PDCA cycle.



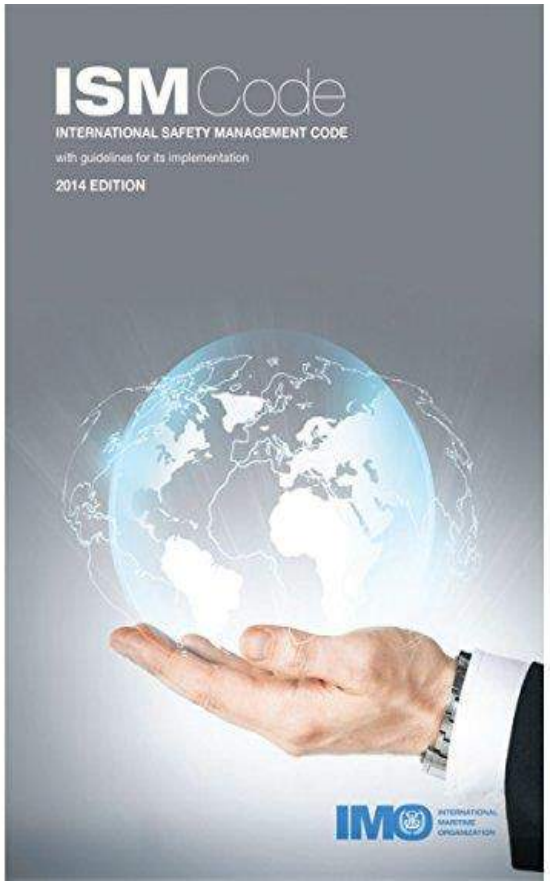


Management systems in shipping

- **ISM Code:** The most prominent management system that is already mandatory in shipping. Safety is at its core.
- **ISO 9001:** Quality Management System
- **ISO 14001:** Environmental Management System
- **OHSAS 18001:** Health and Safety Systems.
- **ISO 50001:** Energy Management System.

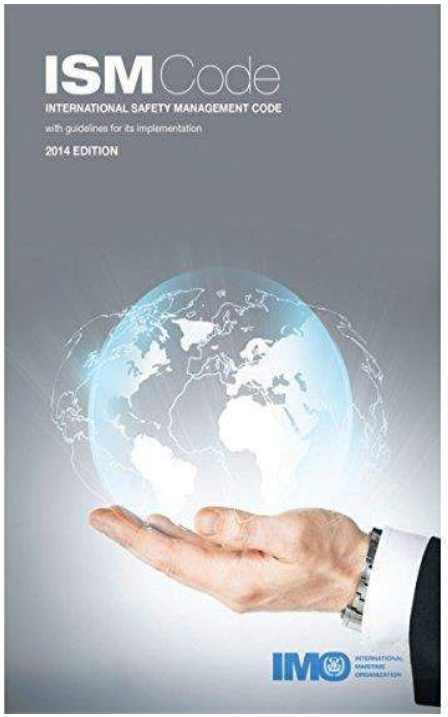
ISM Code

- A shipping-specific international regulations with the ultimate objectives:
  - To ensure safety at sea.
  - To prevent human injury or loss of life.
  - To avoid damage to the environment and the ship.



ISM Code

- In order to comply with the ISM code, each ship must have a working Safety Management System (SMS) to ensure:
  - Commitment from top management.
  - A “policy manual”.
  - A “procedures manual” that documents the ship-board activities.
  - Procedures for conducting both internal and external audits.
  - A designated person ashore to make sure the SMS implementation.
  - A system for checking actual practices versus planned.
  - Regular management reviews.



ISO 9001: Quality Management System (QMS)

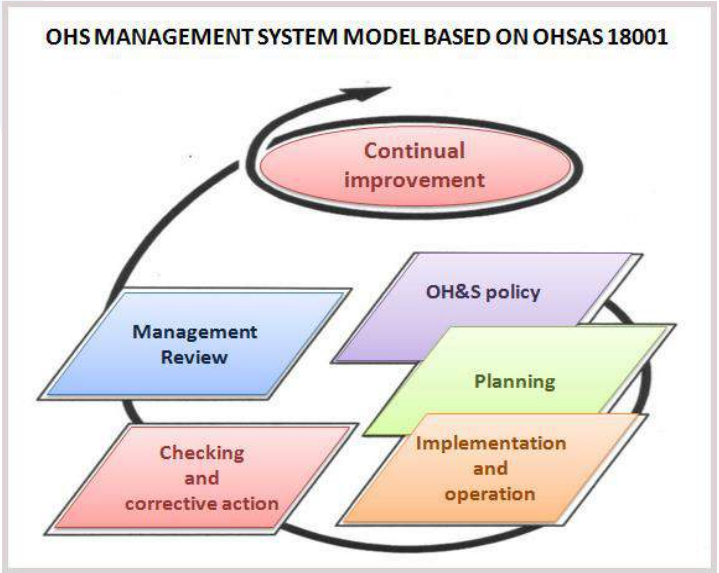
- The ISO 9000 series are related to quality management systems.
- Designed to help organizations ensure that:
  - They meet the needs of their clients/customers; and while
  - Meeting relevant statutory and regulatory requirements.
- The ISO 9001 is highly oriented towards “process improvements” .
- In shipping, many companies so far have adopted the ISO 9001.

ISO 14001 - Environmental Management System

- ISO 14000 series of standards relate to EMS (Environmental Management System).
- Designed to help organizations to minimize the negative impacts of their operations on the environment.
- ISO 14001 requires the organization to assess all of its “environmental aspects”.
- ISO 14001 main requirement is that the “significant environmental aspects” should be identified, documented and controlled/managed.
- The latest version is ISO 14001:2015 includes the concept of “continuous improvement” approach.

Occupational Health & Safety Assessment Specification

- OHSAS 18001 is a British Standard (BS) that is used globally.
- It deals with occupational health and safety risks and their control.
- OHSAS 18001 focuses on:
  - The need to identify all occupational health and safety hazards
  - Carry out their relevant risk assessment.
- The OHSAS 18001 has been harmonized with ISO 9001 and ISO 14001 to help organizations to integrate the quality, environmental and safety management systems.



http://www.imteqsolution.com/v3/ohsas.php

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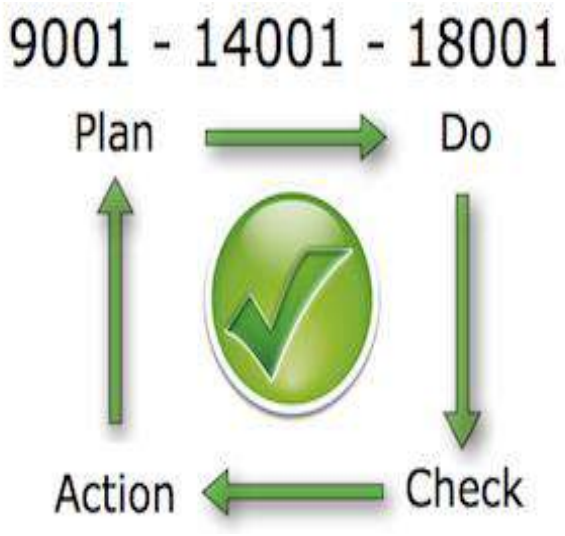
Commonalities

- It can be demonstrated that all the management standards have common features in areas of:
  - Need for defining objectives and policies
  - Need for top management engagement and commitment.
  - PDCA cycle approach for continuous improvement
  - Need for training of human resources
  - Need for monitoring and inspection
  - Etc.



- 50001

- Based on the above commonalities, certification bodies provide an integrated approach to their verification and certification.

ISO Standards and ISM Code

- ISM Code is mandatory.
- Anything included in a ship's SMS will be regarded as mandatory.
- ISO Standards (9001, 14001, etc.) are not mandatory.
- Care should be exercised not to cause complications with regard to ISM related Flag State and Port State Control inspections.
- Once an environmental / energy management procedure becomes part of the ship's SMS, it will become mandatory to follow the processes even if the requirements are not mandatory.

ISO 50001 on Energy Management System

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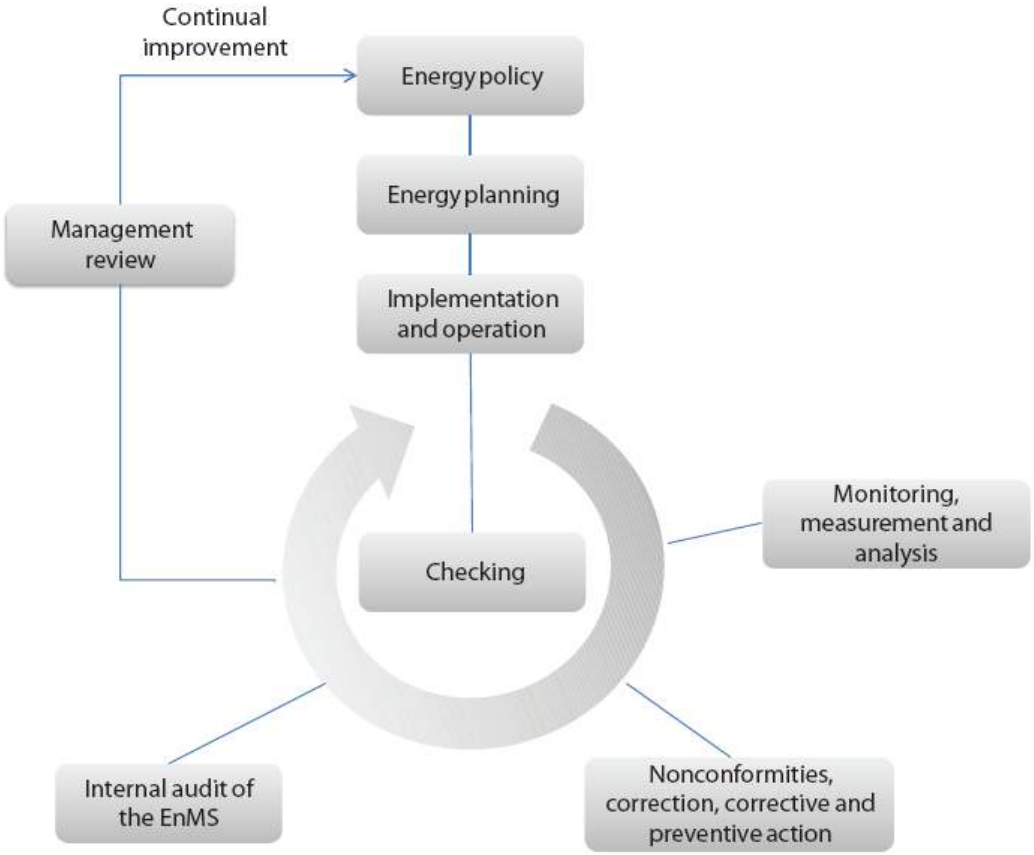
ISO 50001 Energy Management System process

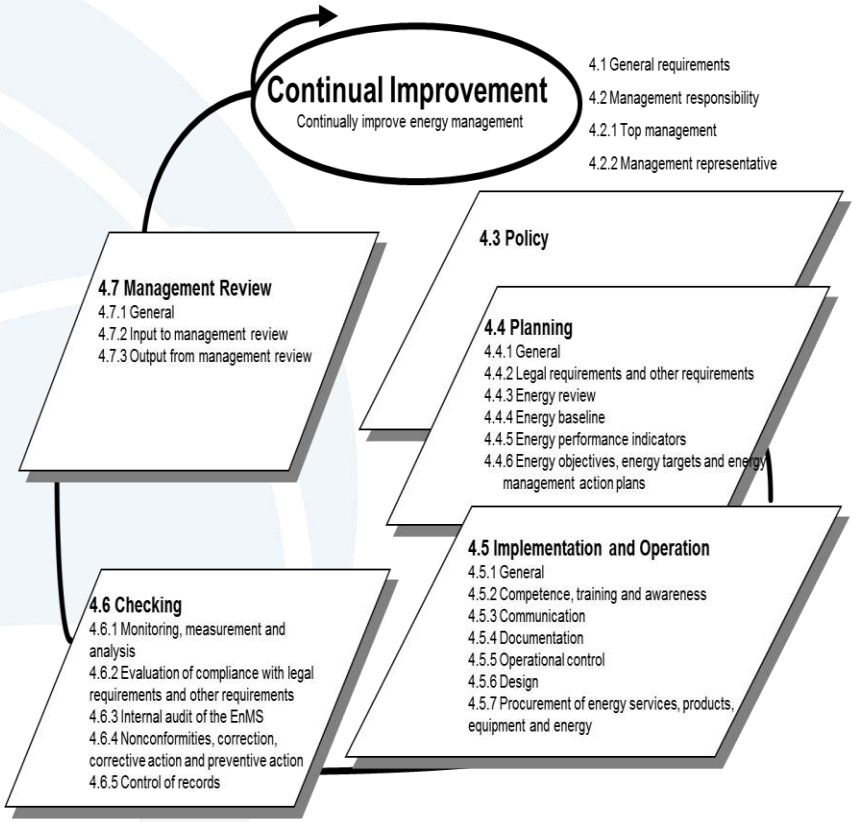
- Energy policy
- Energy planning
- Implementation
- Checking
- Management review



Source: ISO 50001:2011

Continuous cycle and content of ISO 50001

- This shows the overall content of the standard.
- ISO 50001 sections and clauses.
- Continuous improvement cycle.
- The starting point is the “energy policy”.



Company Energy Policy

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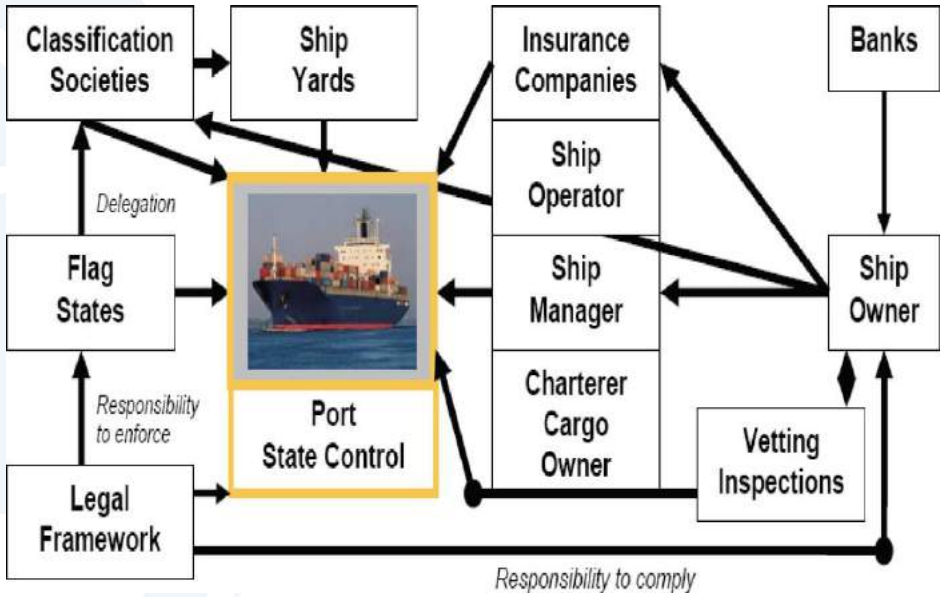
Energy efficiency policy and commitment

Company energy policy set the agenda for control of GHG emissions and fuel cost.

Main questions:

- What to be included?
- Whose responsibility?
- Objectives and targets?
- Stakeholders coordination?
- Employee training?
- Self evaluation and improvement?
- Investment aspects?



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Energy efficiency policy and commitment

Commitment from the top management:

- Commitment from the management at the highest level should be demonstrated via energy policy endorsement and communication.

Energy efficiency policy and targets

Setting targets and aims

- Commitment is best to be demonstrated by setting energy efficiency targets.
- Quantitative to extent possible.

Energy efficiency policy and communications

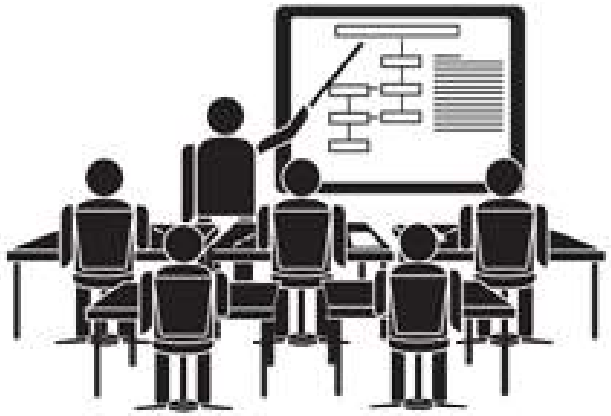
Communication of energy efficiency policy

- Energy policy should be used to communicate the company's top-level requirements to staff at all levels.

Energy efficiency policy and training

Awareness and training and the provision of guidance and advice to ship and shore staff:

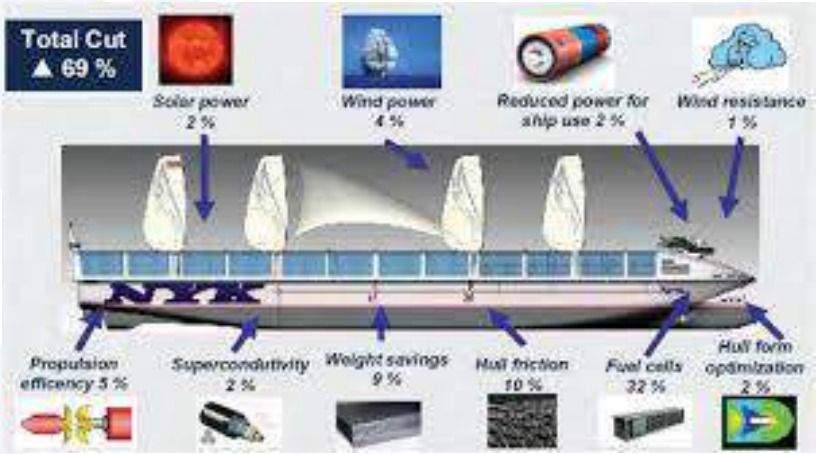
- Energy policy should show commitment to staff's training.



Energy efficiency policy and investment

Policy on alternative fuels and alternative technologies

- Any investment plan will be good to be clarified in the policy statement.



NYK Super Eco 2030 future technologies

Energy efficiency policy and link to other corporate activities

The company energy policy:

- Should show how energy policy links to other policies (e.g. environment)
- How relates to IMO regulations and ISO standards?

Energy efficiency policy and fleet management

Adjusting the company operations regarding fleet and its trades:

- Policy should refer to major operational management aspects that company will undertake to save energy.
- Fleet deployment.
- Slow steaming
- Just in time operation

http://www.bmtsmart.com/fleet-and-vessel-performance-monitoring/the-importance-of-fleet-vessel-performance-management/

Summary on energy efficiency policy content

Includes the following for energy performance:

- A commitment to continual improvement
- A commitment to ensure the availability of resources to achieve objectives and targets;
- A commitment to comply with applicable legal and other requirements;
- A framework for setting and reviewing energy objectives and targets;
- A commitment to training staff and engaging other stakeholders.
- Supports the purchase of energy-efficient products and services,
- Is documented and communicated at all levels within the organization;
- Is regularly reviewed, and updated as necessary.

Energy Planning, Implementation, Monitoring and Reviews

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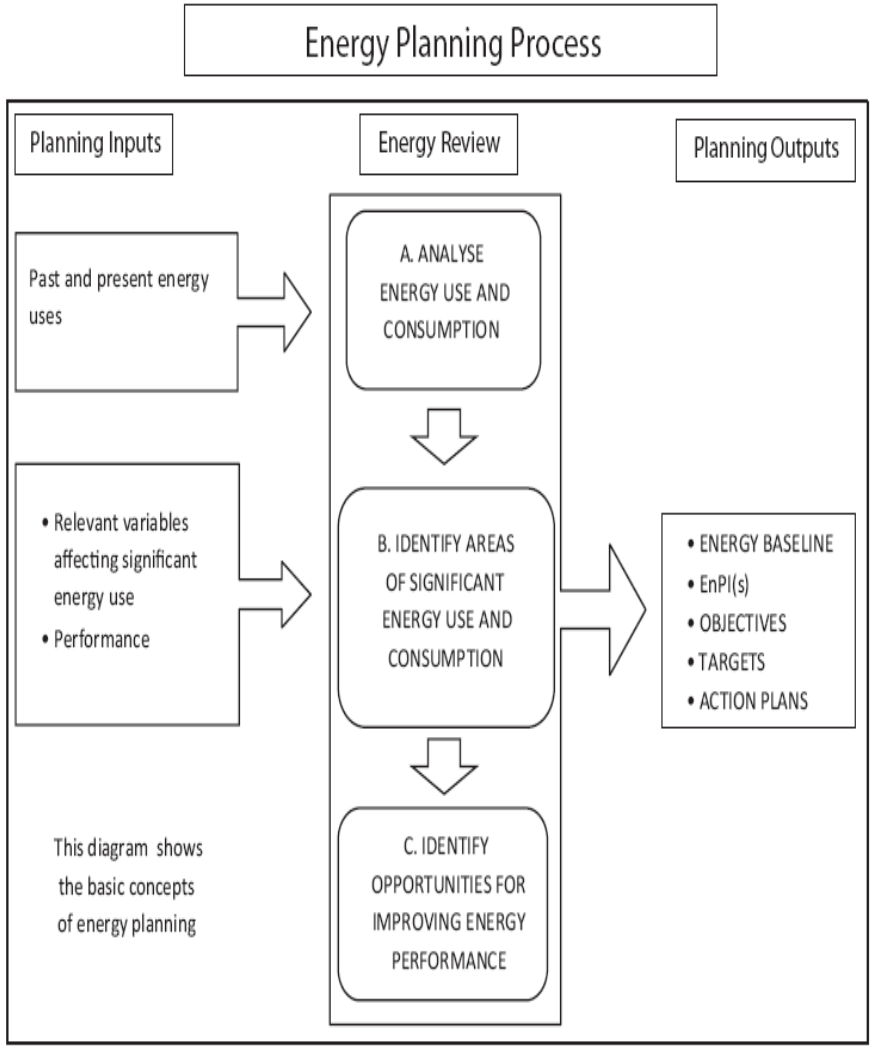
ISO 50001:
Energy planning process

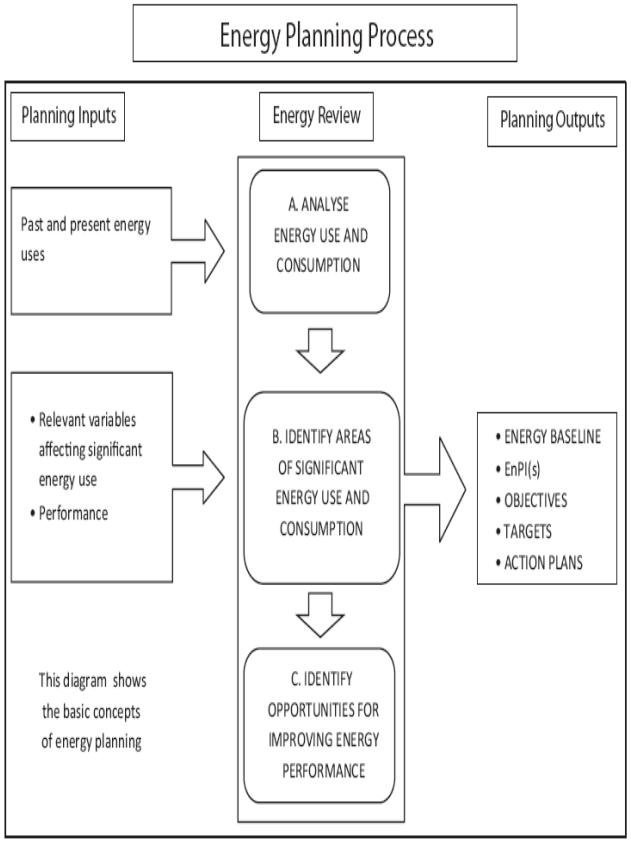
- Energy planning shall be consistent with the energy policy.
- Energy planning should lead to activities that continually improve energy performance.
- Energy planning shall involve a review of the organization's activities that can affect energy performance.
- Energy review forms the core of the planning activities.



Source: ISO 50001:2011

ISO 50001: Energy review

- ISO 50001 stipulates that a company shall develop, record and maintain an energy review.
- Inputs to energy review are the past performance and relevant information
- The outputs of energy review will include the following:
  - Energy baseline(s)
  - Energy performance indicators
  - Objectives,
  - Targets
  - Energy efficiency measures
- The above outputs will be directly used for the design and implementation of the EnMS.



Source: ISO 50001:2011

The "energy review" process is similar to an "energy audit" and will be discussed later

ISO 50001: Target setting

- ISO 50001 does not prescribe specific energy performance criteria or target levels.
- However, it requires the organization to continually improve its energy performan
- For a shipping company this practically implies that it should select some key performance indicators (KPI) in order to demonstrate improved energy performance.

ISO 50001:
Top management responsibility

- Defining, establishing, implementing and maintaining an energy policy;
- Appointing a management representative and the formation of an energy management team;
- Providing the resources for implementation purposes.
- Communicating the importance of energy management to those in the organization;
- Ensuring that energy objectives and targets are established;
- Ensuring that “energy performance indicators” are appropriate to the organization;
- Conducting management reviews.

ISO 50001: Management representative responsibilities

- Top management should also appoint a management representative(s).
- Responsibilities:
  - Ensure the EnMS is established, implemented, maintained, and continually improved;
  - Report to top management on implementation of the EnMS;
  - Ensure that the planning complies with energy policy;
  - Define and communicate roles and responsibilities
  - Determine criteria and methods needed to ensure that both the operation and control of the EnMS are effective;
  - Promote awareness of the energy policy and objectives.

ISO 50001: Monitoring

- ISO 50001 stipulates that the company shall ensure that the key characteristics of its operations that impact energy performance are monitored, measured and analysed at planned intervals.
- Some methods such as performance monitoring, etc. are advocated by the ISO 50001.
- ISO 50001 also advocates the effective use of internal audits as a monitoring method.
- Records of the audit results shall be maintained and reported to top management.

ISO 50001: Management reviews

- Within ISO 50001, the management review is a requirement.
- For the review purposes, some inputs and outputs are expected.
- Inputs to the management review include:
  - Follow-up actions from previous management reviews;
  - Review of the energy policy;
  - Review of energy performance and related indicators;
  - Evaluation of compliance with legal and other requirements;
  - The extent that energy objectives and targets have been met;
  - The EnMS audit results;
  - The status of corrective actions and preventive actions;
  - Projected energy performance for the following period;
  - Recommendations for improvement.

ISO 50001: Management reviews

- Outputs from the management review are expected to be items such as:
  - Changes in the energy performance of the organization;
  - Changes to the energy policy;
  - Changes to the energy performance indicators;
  - Changes to objectives, targets or other elements of the EnMS.
  - Changes to allocation of resources.
  - Based on the above outputs, a new cycle of continual improvement will begin.

Shipping Company Energy Management System (CEnMS)

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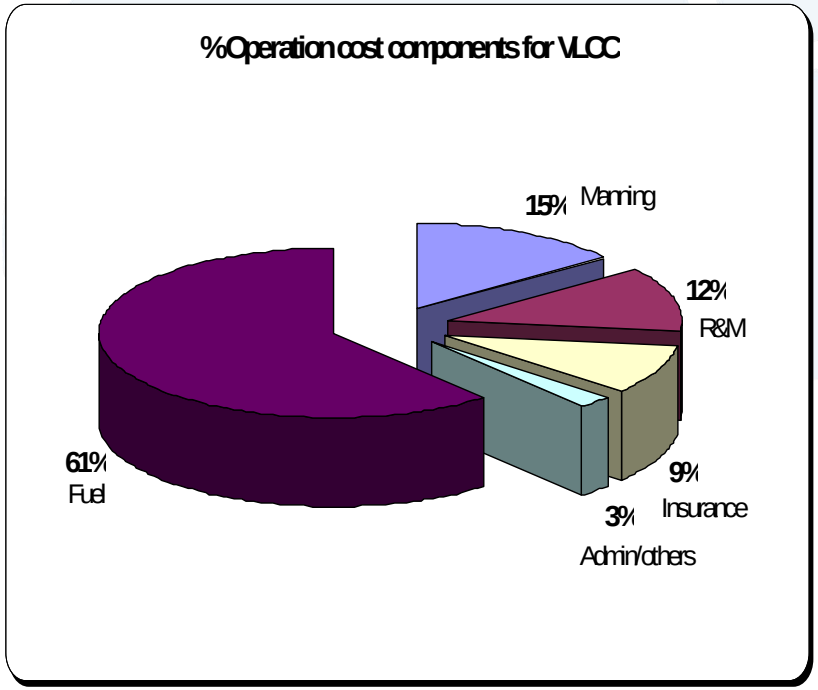
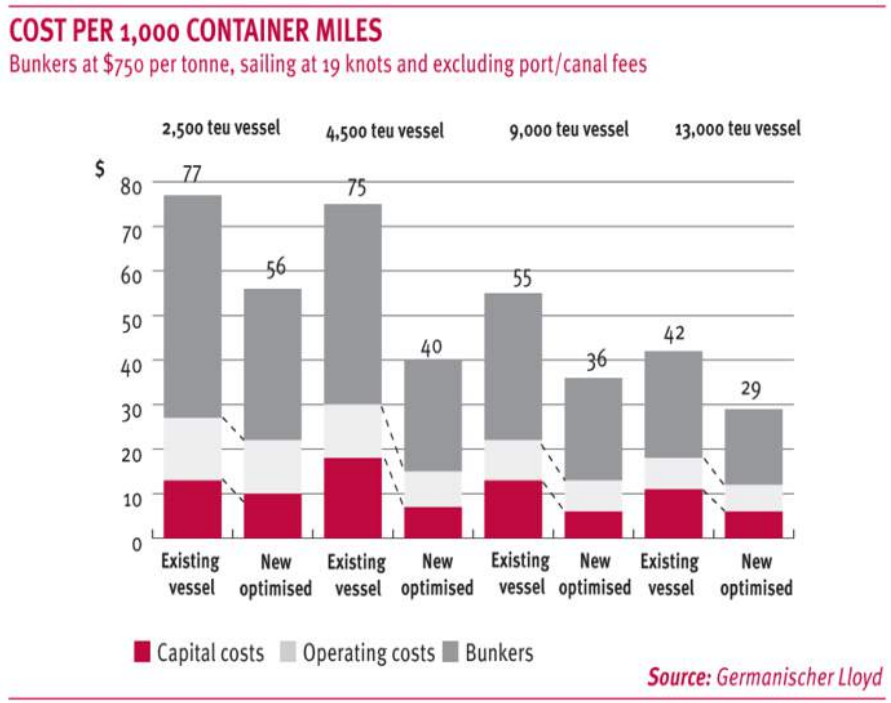
Why energy management?

- Ship fuel cost
- Climate change
- Existence of big potentials for saving, etc.

Question: How best a company can organise itself for energy management?



(a) VLCC operational cost breakdown



(b) Containerships total cost breakdown

Shipping company approach to energy management

- Two tier approach:
  - SEEMP for ship-level energy management (IMO Guidelines)
  - CEnMS (Company Energy Management System) for fleet-level energy management. (ISO 50001).
- A CEnMS needs to deal with both shore-based and ship-based energy efficiency aspects.
- As such, SEEMP will be a sub-set of the EnMS.
- Thus, application of CEnMS in a shipping company should be fully in harmony with ship-board SEEMP and vice a versa.

Scope of a shipping CEnMS

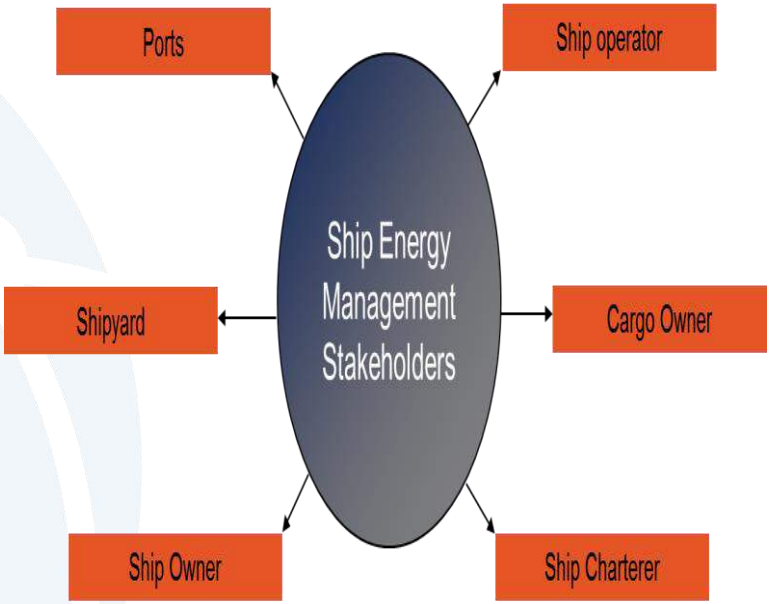
- The ship-related CEnMS scope includes:
  - Defining the ship's energy efficiency measures (EEMs).
  - Documenting EEMs in the form of SEEMP for ship-board implementation.
  - Conducting monitoring and management review; as applied to individual SEEMP.
- The shore-based CEnMS scope of activities include:
  - Policy development
  - Planning for ships and overall fleet.
  - Gathering fleet data, monitoring and benchmarking.
  - Managing the investment on energy efficiency.
  - Training
  - Coordination with all stakeholders, Etc.

Scope of SEEMP and CEnMS

- Application domain:
  - SEEMP is “ship specific “.
  - CEnMS is “company specific” and includes the fleet.
- Main scope of activities:
  - SEEMP content is primarily implementation oriented.
  - The CEnMS on the other hand is more oriented to planning, monitoring coordination, training and evaluation of the fleet and company.
  - High level activities relating to energy such as bunkering, provision of third party services to ships and so on will be in the scope of CEnMS.
- Based on the above, the scope of the CEnMS and ship-level SEEMPs will be different and they will be more complementary rather than overlapping.

CEnMS: Stakeholders management

- Stakeholder for energy management is shown in the diagram
- Management of the company relation with the stakeholders is an important element of the CEnMS



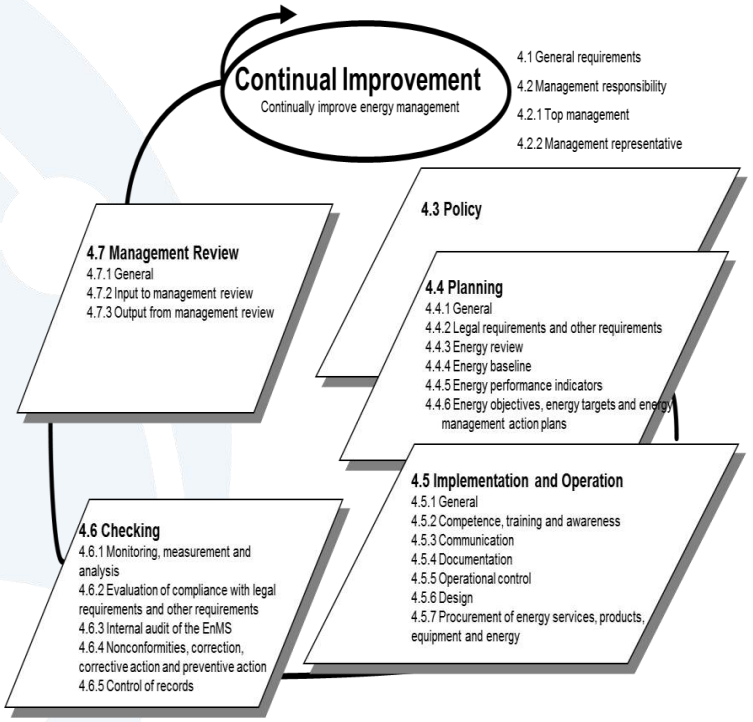
All the above stakeholders have impact on a ship's fuel consumption and its environmental footprint

CEnMS:
Company energy policy content

- Commitment at the highest level
- Company targets
- Communication to staff
- Monitoring methods
- Reporting and communication to external stakeholders
- Importance of ship specific SEEMPs
- Other specific aspects: The policy is best to contain the strategic aspects for:
  - Improving the utilization of its fleet's capacity
  - The need for planning, targets,
  - Replacement of older tonnage with more efficient ships
  - Technology upgrade aspects and financial commitment.

How to develop CEnMS

- CEnMS development and implementation is best to follow the ISO 50001 processes.
  - Energy policy
  - Energy review
  - Performance indicators
  - Monitoring
  - Etc.



ISO 50001 structure and content

Thank you for your attention

ANY QUESTIONS?

For more information please see:
www.imo.org

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A global network for energy-efficient shipping

MTCC PACIFIC
Maritime Technology Cooperation Centre

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MTCC PACIFIC
Maritime Technology Cooperation Centre

MARITIME TECHNOLOGY COOPERATION CENTRE – PACIFIC (MTCC-PACIFIC)

CAPACITY BUILDING FOR CLIMATE MITIGATION IN THE MARITIME SHIPPING INDUSTRY
THE GLOBAL MTCC NETWORK (GMN) PROJECT

Ship Board Energy Management

Presenter : MTCC-Pacific

National Workshop
Q3 2018

EUROPEAN UNION

IMO INTERNATIONAL MARITIME ORGANIZATION

Pacific Community
Communauté du Pacifique

HOST INSTITUTIONS OF MTCC-PACIFIC

SPREP
Secretariat of the Pacific Regional Environment Programme

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Content

- Ship-board organisation, roles and responsibilities.
- Overview of main ship-board EEMs.
- Trim optimisation, its impact and best practice.
- Ballast water management.
- Hull and propeller roughness and fouling.
- Engines and machinery utilization management.
- Fuel management: storage, treatment and purification.
- Technology upgrade.
- Steam system and boilers.

Ship-board Roles and Responsibilities

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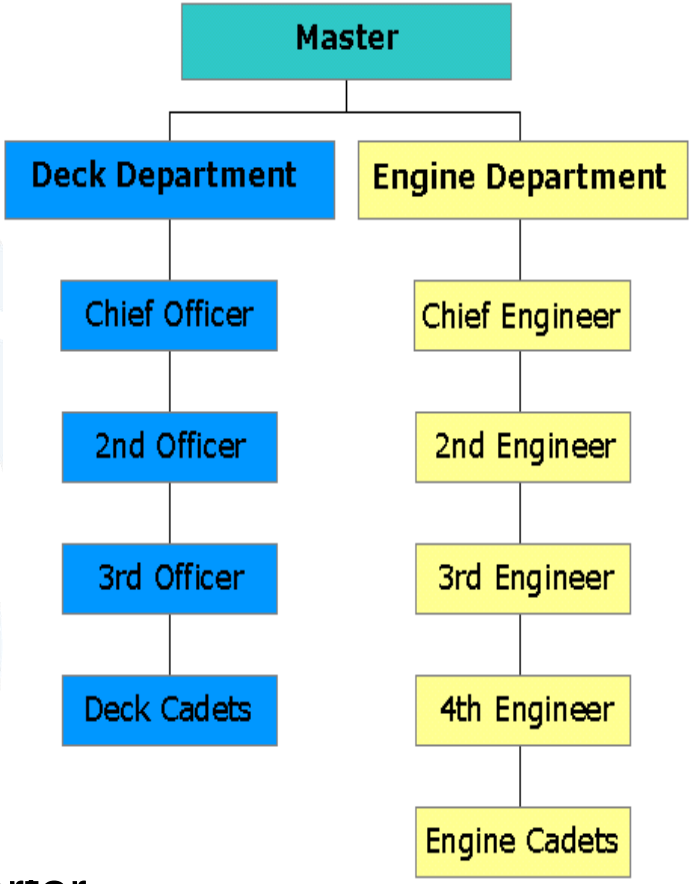
Ship-board organisation and responsibilities

- The Master is in full control and has ultimate responsibility.

Departments-

- Deck (Operation and Cargo)
  - Chief Officer
  - Second Officer, etc.
- Engine (Technical)
  - Chief engineer
  - Second engineer, etc.
- Catering (steward's)
  - Chief Steward and his/her staff
  - Food and all aspects of provisions.
  - Cleaning and maintaining officers' quarter
  - Managing the stores, etc.



[Maritime Profession Promotion Foundation]

Main ship-board staff impact on energy saving

- **The Master:** their commitment to SEE is vital; otherwise it will not succeed.
- **The Chief Officer** (2nd in command): Plays significant roles on the cargo and loading/unloading operations, ballast management operations, trim optimisation, etc.
- **The Chief Engineer:** Plays a major role on technical issues including the maintenance, condition and performance of engines and various machinery and the way they are utilised.
- **The Second Engineer:** By virtue of being the most engaged person in the engine department on day to day operation and maintenance of various systems, has the second most important role in engine department.

Importance of communications between departments

- **Main issue:** Lack of optimal communications between departments leads to waste of energy.
- For example, communication between deck and engine departments is essential for machinery use optimisation.
- To increase communications and collective planning, some policies may be put in place:
  - Set up daily meetings.
  - Plan ship-board work activities for reduction of electricity, compressed air, fresh water, etc. use together.
  - Plan cargo operations for saving energy.

Ship-board energy efficiency measures

- Optimized ship handling
  - Optimized trim
  - Optimized ballast
  - Optimum use of rudder and autopilot
- Optimized propulsion condition
  - Optimized hull
  - Clean propellers
  - Optimized main engines
- Optimized auxiliary machinery
- Fuel management
- Boilers and steam system
- Maintenance and energy efficiency
- Technical upgrades and retrofits

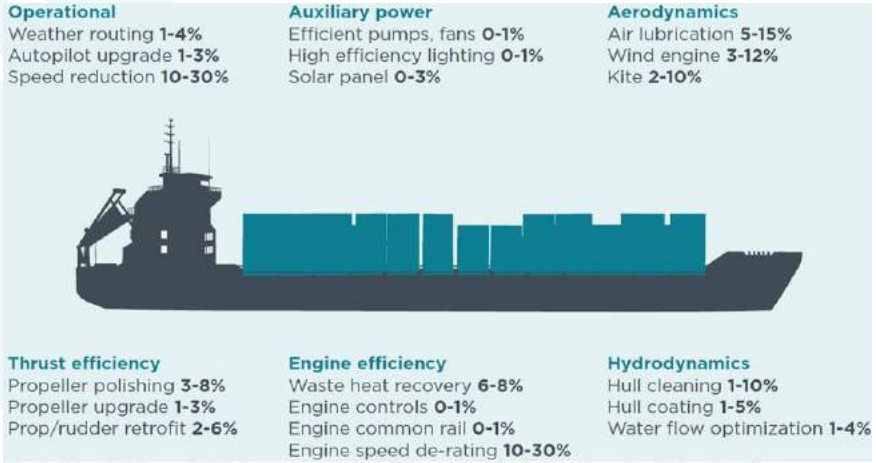


Figure 1: *Potential fuel use and CO_2 reductions from various efficiency approaches for ships (International Council on Clean Transportation (ICCT, July 2013). Long-term potential for increased shipping efficiency through the adoption of industry-leading practices.*

Trim Optimization

Trim Optimisation - Summary

- Trim influences FOC significantly, with evidence showing up to 4% savings.
- Trim impact is via changes to ship hydrodynamics and resistance.
- For every ship, there is a range of optimal trim;
- The optimum trim is a function of ship speed and draft.
- For certain ship types in particular those with higher speeds, slimmer body, pronounced bulbous bow and flat stern, trim will have more impact.
- Optimal trim are established either through extensive model testing or computational fluid dynamics (CFD) analytical methods.
- To achieve optimal trim, due consideration should be given to ship loading and its load planning.
- Ballast water (BW) and to some extent bunker fuel may be used to trim the vessel.

Ballast Water (BW) Optimization

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BW Optimisation – Energy efficiency methods

- **Carrying less BW:**
  - To save fuel, it is generally desirable to carry less weight.
  - Less ballast should not contravene any of the regulations and compromise the ship safety.
  - Also, this should not cause non-optimal trim.
- **Efficient ballast management operations:** This means performing the operation in a way that is more energy efficient. For example:
  - **Gravity assisted** ballast exchange is preferred to simple pumping in/out processes.
  - **Sequential** ballast exchange is more energy efficient than the flow-through method as less water needs to be displaced.
- **Trim optimisation:** Ballast should be used for trim optimisation.
- **Sediment removal:** Sediment removal leads to more cargo capacity and energy efficiency.

BW Optimisation – Voyage management aspects

- The voyage should be planned taking into account when BW exchange can be carried out.
- Also, trim optimisation and adjustments while in passage should be pre-planned relative to the port normally even-keel operation.
- Sediment uptake and removal should be controlled as part of voyage planning to ensure minimal level of sediments.

Hull and Propeller Condition and Cleaning

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Hull Coating

- For lower speed ships skin friction resistance dominates;
- For a VLCC at full load condition 90% of resistance is from hull friction;
- Strategy: Reducing hull friction resistance.
- There are advanced hull coating that may be used for this purpose.
- Application of advanced coatings will be more expensive but return on investment could be short.

Main factors that influence hull fouling rates:

- Initial roughness of the hull
- Quality of hull coating
- Robustness of the coating with respect to mechanical damage
- The areas of the hull where there is sunlight
- Sea water temperature
- The salinity of the water (performance of coating will be a function of salinity of water)
- Amount of algae in the water
- Ship speed and its operation profile
- Hull maintenance

Hull cleaning

- Regular in-service cleaning is beneficial if damage to coating is avoided.
- For partial cleaning, the priorities:
  - Forward third of hull.
  - Remainder of hull working from forward to aft with emphasis on areas which have more exposure to light.
- Regular cleaning of macro-fouling is highly recommended.
- For best results, the scheduling of cleaning should be based either on performance monitoring or on regular under-water inspections.
- Regular inspection, photographs and roughness measurements would be a prudent way to monitor the impact of cleaning and the condition of the coating.

Propeller aspects

- Similar to the hull surface, propellers suffer degradation in performance due to surface roughness.
- Polishing will mainly reduce the frictional losses of the propeller but will in many cases also reduce the rotational losses.
- Corrosion and cavitation erosion and impingement attack can cause roughness.
- Improper maintenance can also increase roughness.
- It has been estimated that polishing a roughened propeller surface may result in a decrease in fuel consumption of up to 3%.
- Divers can clean a 5 bladed and 10 m diameter propeller in about 3-4 hours for a cost of about US $3,000 in the Far East (Europe is more expensive).

Condition based hull and propeller cleaning

- Major questions:
  - What are the optimal timings for hull and propeller cleaning?
  - What is the best routine for cleaning whilst safeguarding the existing paint system.
  - What is the time and cost to apply a new coating and which one?
- Condition-based hull and propeller maintenance tries to give an answer for bullet 1. This can be done in two ways:
  - Measure/observe actual hull and propeller roughness/fouling and compare with baseline values that indicate when cleaning should be done. Use of divers.
  - Use performance analysis packages that track changes in fuel consumption, shaft power and main engine power to identify degrading surface conditions.

Engines and Machinery Load and Utilisation Management

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Machinery load and operation profile

- The concept of “machinery load” optimisation and “parallel operation” reductions can be used for energy saving purposes.
- On-board ships, there are numerous instances that two machinery may be used in parallel; both at low loads.
- The load profile for a multi-machinery setup could provide valuable information on method of load sharing strategy and management between machinery.
- In such cases, there are always scope for reduction of machinery usage via reducing their parallel operations.

System Planning for Energy Use Reduction

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System planning – Areas to cover

- Ship operation involves a variety of activities and tasks including:
  - Loading / Unloading
  - Ballasting / de-ballasting
  - Inner gas generation and top ups (oil/product tankers)
  - Bunkering
  - Manoeuvring
  - Stand-by
  - Normal passage operation
  - Waiting and anchorage, Etc.

- How many machinery do we need for each of the above modes?

- System planning helps use of less machinery for doing the same job.

Fuel Management

Summary of fuel management energy efficiency measures

- Economical amount of bunker fuel is carried.
- Ensure tank fittings (manhole covers, vent pipes, etc.) do not allow water, cargo or other material to get into the fuel.
- Ensure that tank wall condition is in good order
- Fuel measurement and metering is the first step for subsequent performance analysis of various engines and boilers.

Ship Maintenance and Energy Efficiency

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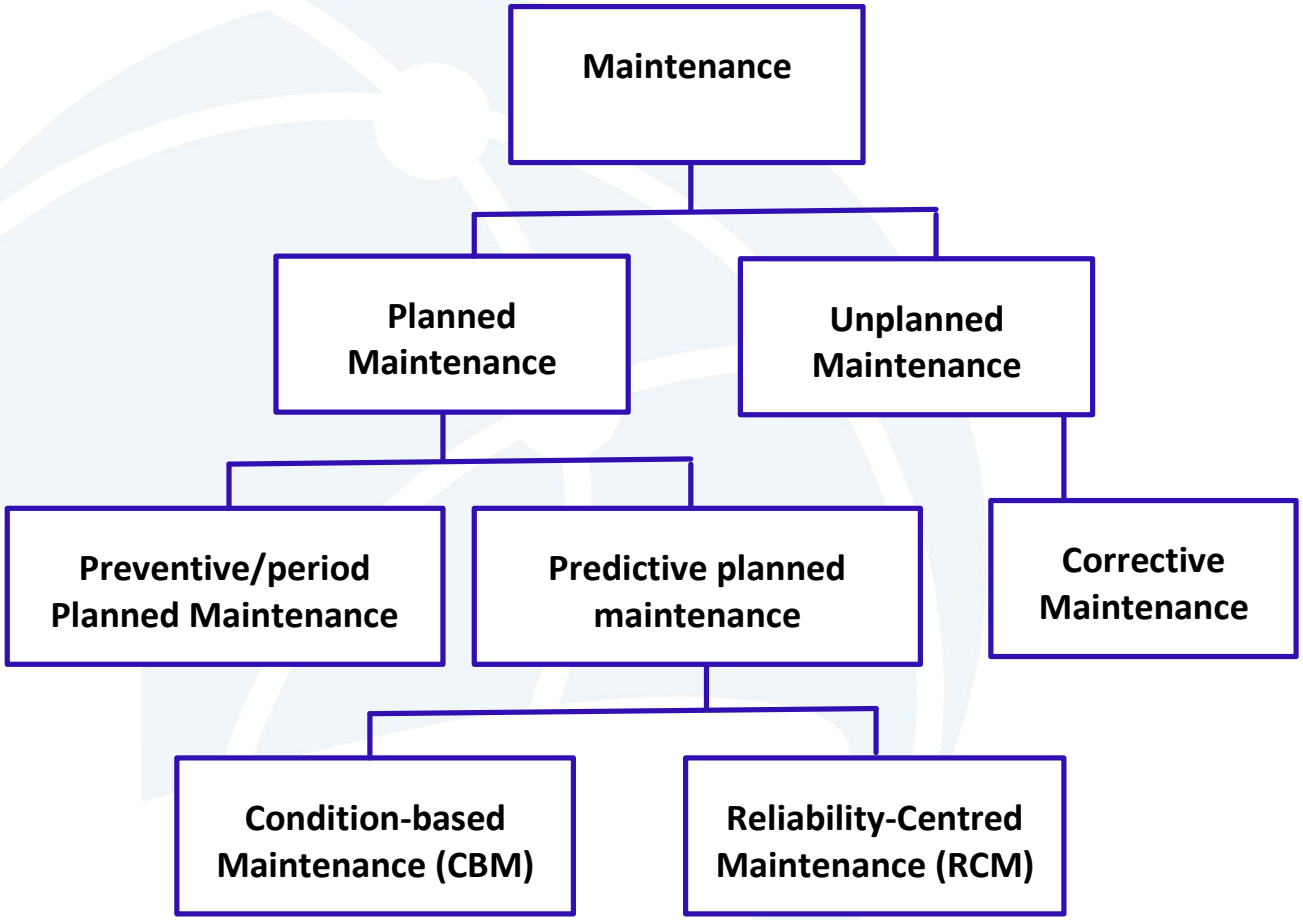
Requirements for maintenance management

- International Safety Management (ISM) Code specifies the regulations for ship maintenance for safety
- The ISM Code stipulates that each ship operator is responsible for the safe and pollution free operation of the ship.
- The part of the ISM Code on "maintenance of the ship and its equipment" describes in general how ships should be maintained, inspected, non-conformities be reported and corrective actions are taken.
- From ISM Code perspective, efforts should be directed at safety and environmental protection.
- Fortunately, SEE is compatible with good maintenance and improves accordingly.

Types of maintenance



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Types of maintenance

- **Unplanned Maintenance: (**breakdown maintenance).
- **Corrective maintenance:** The corrective maintenance may be defined as maintenance which is carried out after failure detection.
- **Planned Maintenance:** Maintenance according to a defined schedule
- **Preventive Maintenance:** (a subset of planned maintenance). Preventive maintenance usually depends on the manufacturer‘s recommendations and past experience for scheduling repair or replacement time.
- **Predictive Maintenance:** This is a subset of planned maintenance**.** This is generally based on what is referred to as:
  - **Condition-based maintenance** (CBM); or
  - **Reliability-based maintenance** (RCM).

Maintenance and SEE

- Good maintenance is fundamental for energy efficient operation of machines and systems.
- Maintenance of the hull, propeller and main engine are very effective for energy efficiency as discussed before.
  - These items will not be discussed further.

Boilers and Steam System

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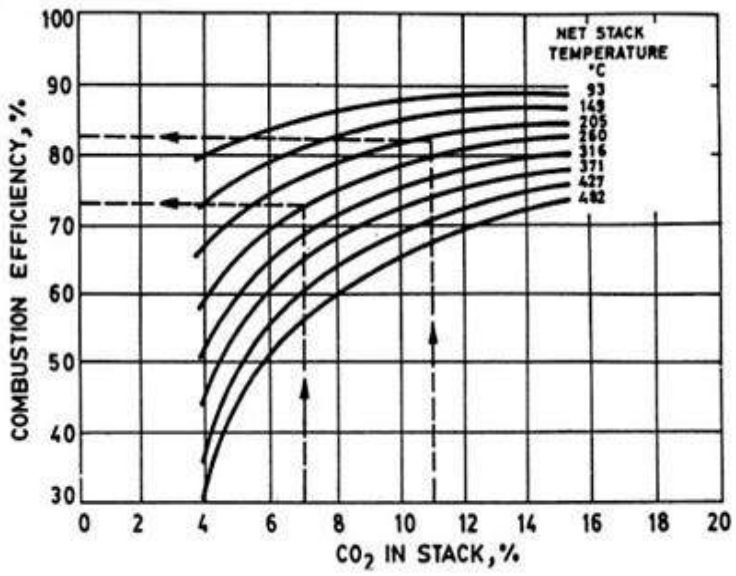
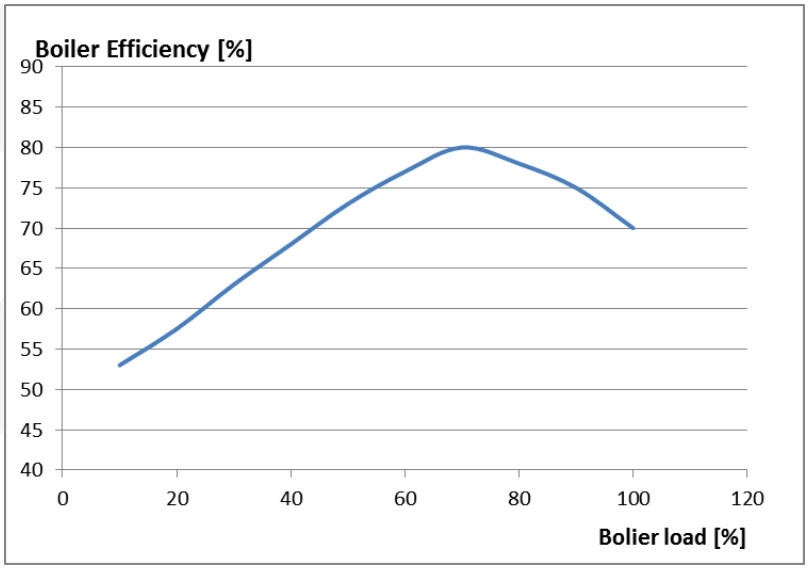
Boiler energy efficiency measures

For good operation and maintenance, avoid:

- Fouling of all heat transfer surfaces
- Fouling of boiler tubes and heat transfer surfaces on the gas side
- Fouling or scaling of boiler tubes on the water side.
- Low hot well temperature
- High blow-down levels
- Excess air in the boiler
- Low load factor operation



BOILER COMBUSTION EFFICIENCY INCREASE



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Steam system energy efficiency measures

- **Steam distribution system energy efficiency measures**
  - Reduce steam leakage
  - Reduce heat loss due to inadequate insulation
  - Reduce steam trap losses
- **Steam end-use energy efficiency measures**
  - Steam end-use could vary according to ship types. The main users of steam include:
    - Steam-driven cargo pumps in tankers.
    - Steam driven ballast pumps
    - Cargo heating
    - Fuel storage, treatment and condition system
    - Fresh water generation especially in cruise ships
    - HVAC system in particular in cruise ships

Steam system: Ship-board best practice

- Steam pipes insulation should be kept in good condition.
- Boiler insulation should be kept in good condition.
- Steam leaks are to be identified and stopped.
- Boiler pressure setting for burner start/stop is as wide as practicable.
- Cargo tank heating according to the specification of cargo.
- Steam trap maintenance should be carried out regularly.
- Starting of auxiliary boilers too far in advance of intended use is to be avoided.
- Steam dumping when possible is to be avoided.
- Pipe/ valve lagging/insulation is to be maintained

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THANK YOU

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