# Module 6:

# Energy Management Plan and System

## IMO Train the Trainer Course


**Name of the Presenter**
**Affiliation of the presenter,**
**City, Country**


## Energy Efficient Ship Operation

**Venue, City, Country**
**Day xx to Day yy, Month, Year**

# Content

- Overview of management systems
- ISO 50001 on Energy Management System (EnMS)
- IMO SEEMP
- Company Energy Management System (CEnMS)
- Ship energy audit and review
- Ship performance monitoring
- IMO data collection and EU MRV

# Overview of Management Systems

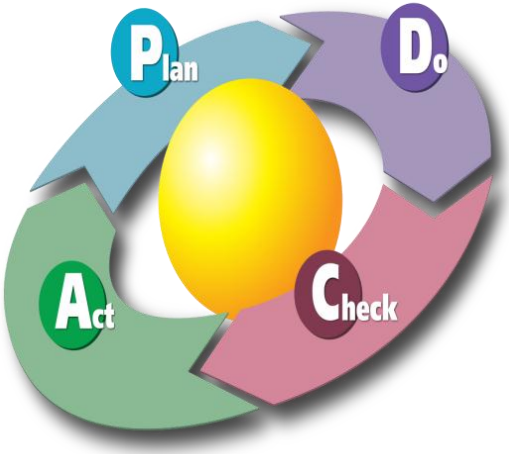
# Role of top management

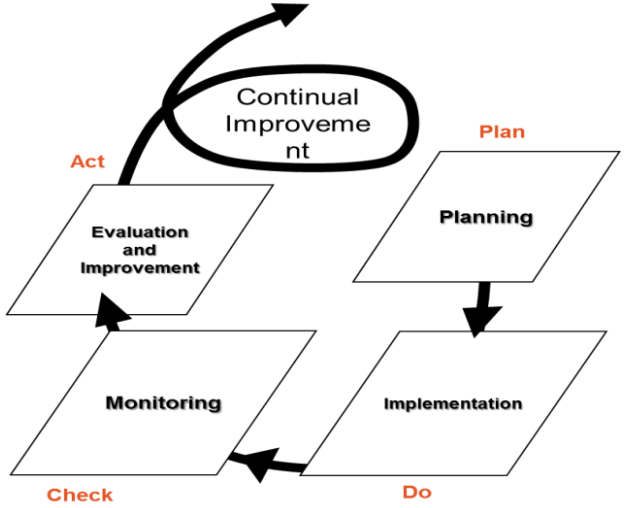
- The cornerstone of good management is:
  - Commitment from the top management; and
  - Dedication from the operating personnel.


- 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.
- **Act:** The effectiveness of the plan is reviewed and new targets are set for next PDCA cycle.



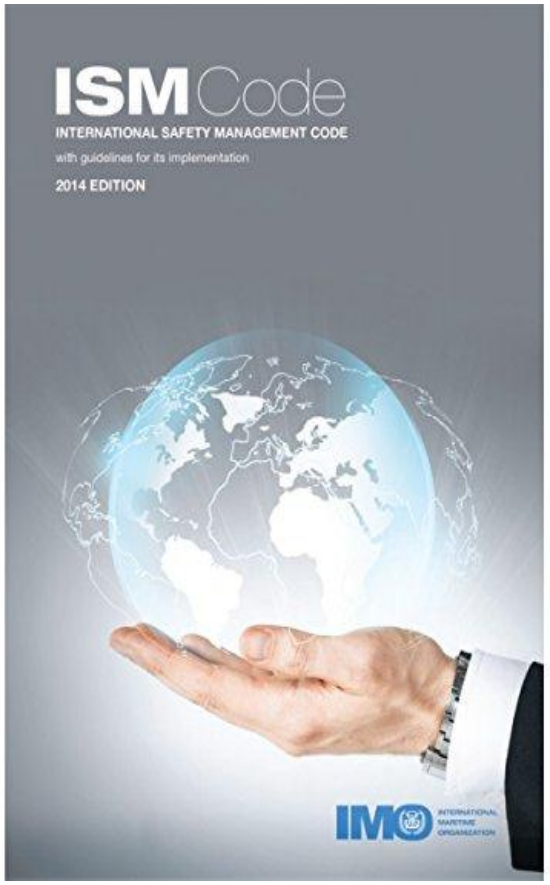



# Management systems in shipping

- **ISM Code:** The most prominent management system that is already mandatory in shipping. Safety is at its core.
- **ISO 9001:** Quality Management System
- **ISO 140001:** Environmental management system
- **OHSAS 18001:** Health and safety systems.
- **ISO 50001:** Energy management system.

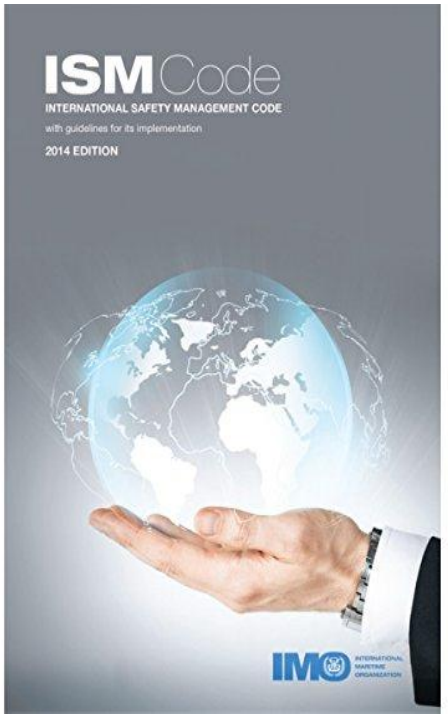
# ISM Code

- 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)

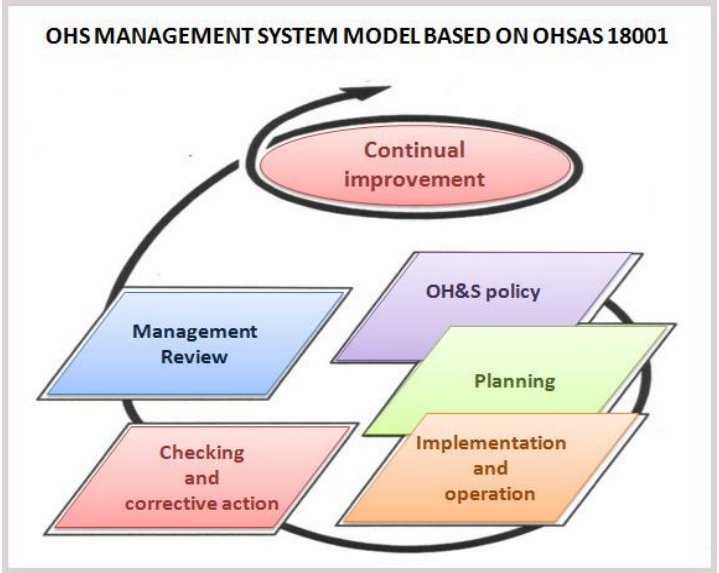
- The ISO 9000 series are related to quality management systems.
- Designed to help organizations ensure that:
  - They meet the needs of their clients/customers; and while
  - Meeting relevant statutory and regulatory requirements.
- The ISO 9001 is highly oriented towards “process improvements” .
-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

# ISO 14001 - Environmental Management System (EMS)

- 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 140001 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.

# OHSAS 18001: Occupational Health and Safety Assessment Specification

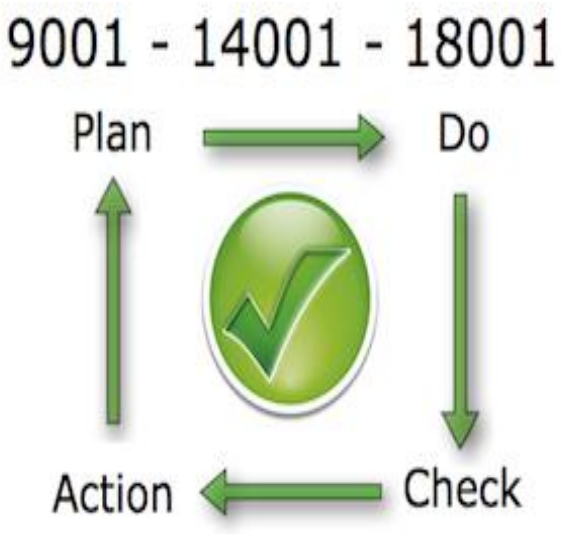

- OHSAS 18001 is a British Standard (BS) that is used globally.
- It deals with occupational health and safety risks and their control.
- OHSAS 18001 focuses on:
  - The need to identify all occupational health and safety hazards
  - Carry out their relevant risk assessment.
- The OHSAS 18001 has been 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

# 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.

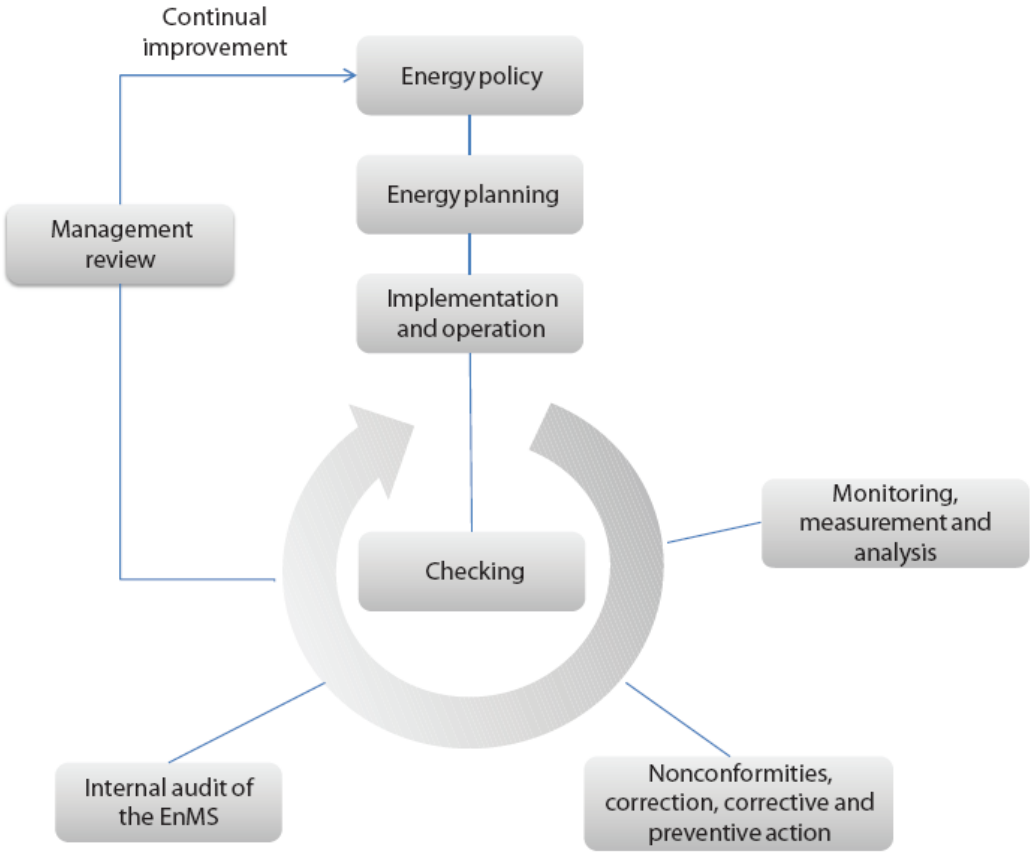
# ISO standards and ISM Code

- 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

# ISO 50001 energy management processes

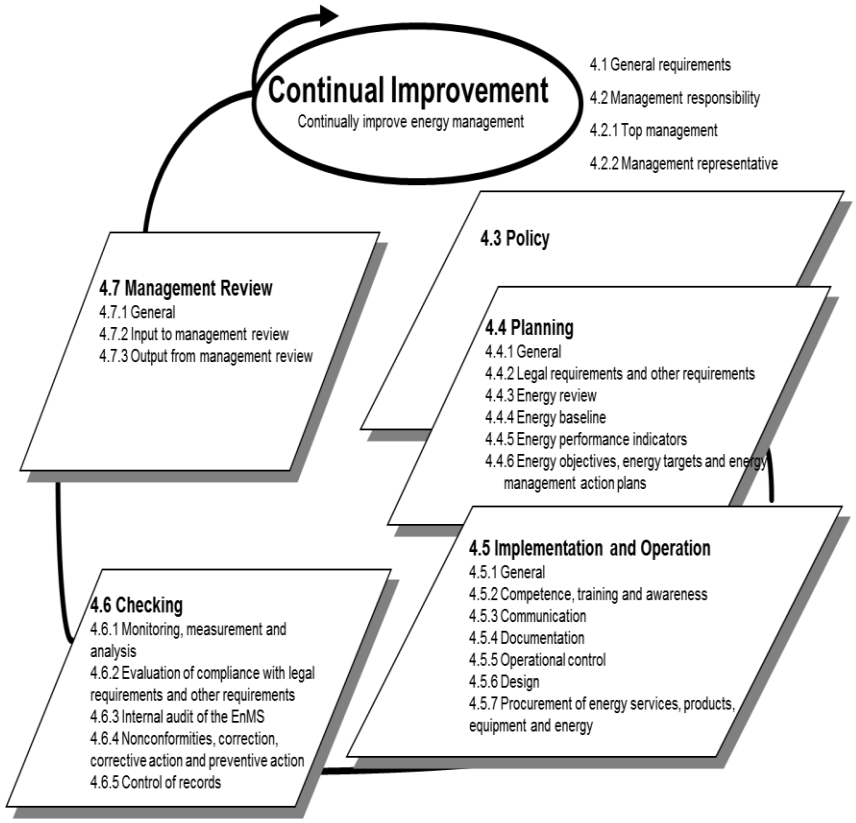
- Energy policy
- Energy planning
- Implementation
- Checking
- Management review




**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”.



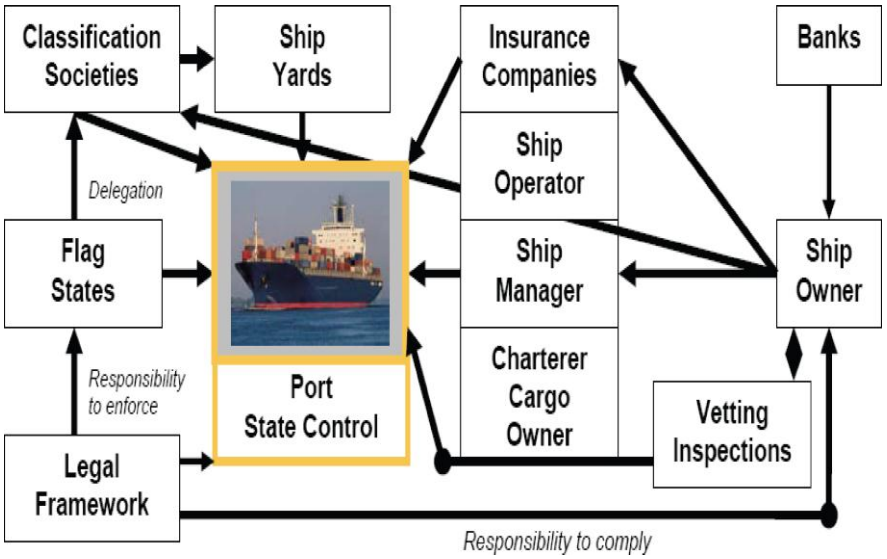
# Company Energy Policy

# 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?
- Etc.



# 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

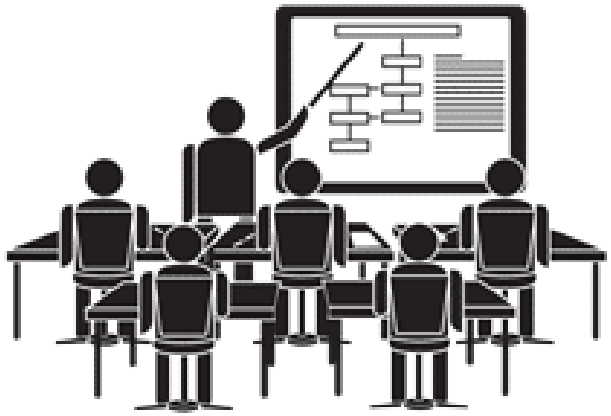
**Communication of energy efficiency policy**

- 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:**

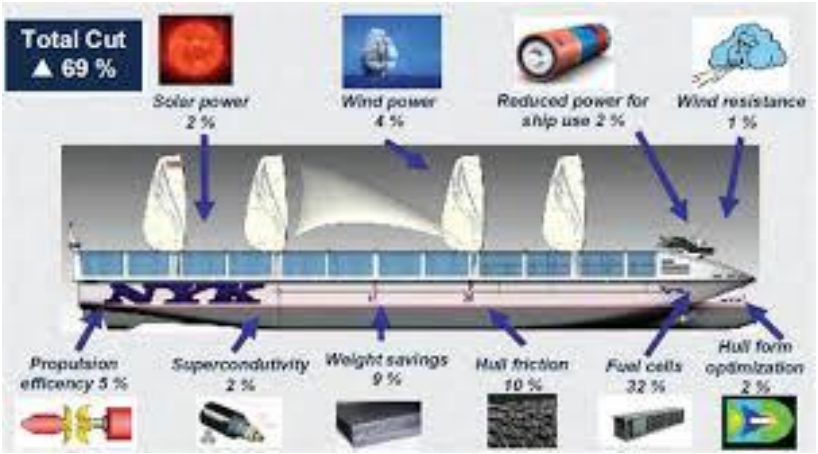
- Energy policy should show commitment to staff's training.



# 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?

ENVIRONMENTAL MANAGEMENT SYSTEM
ISO 14001

ISO 50001
Energy Managment System
ISO

# 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/

# Energy efficiency policy and maintenance

**Adequate resources for maintenance, repairs and energy efficiency projects**

- Poor maintenance means inefficient ship and machinery
- The technology upgrade is part of energy efficiency activities.
- Resources for these activities should be provided.

# Summary on energy efficiency policy content

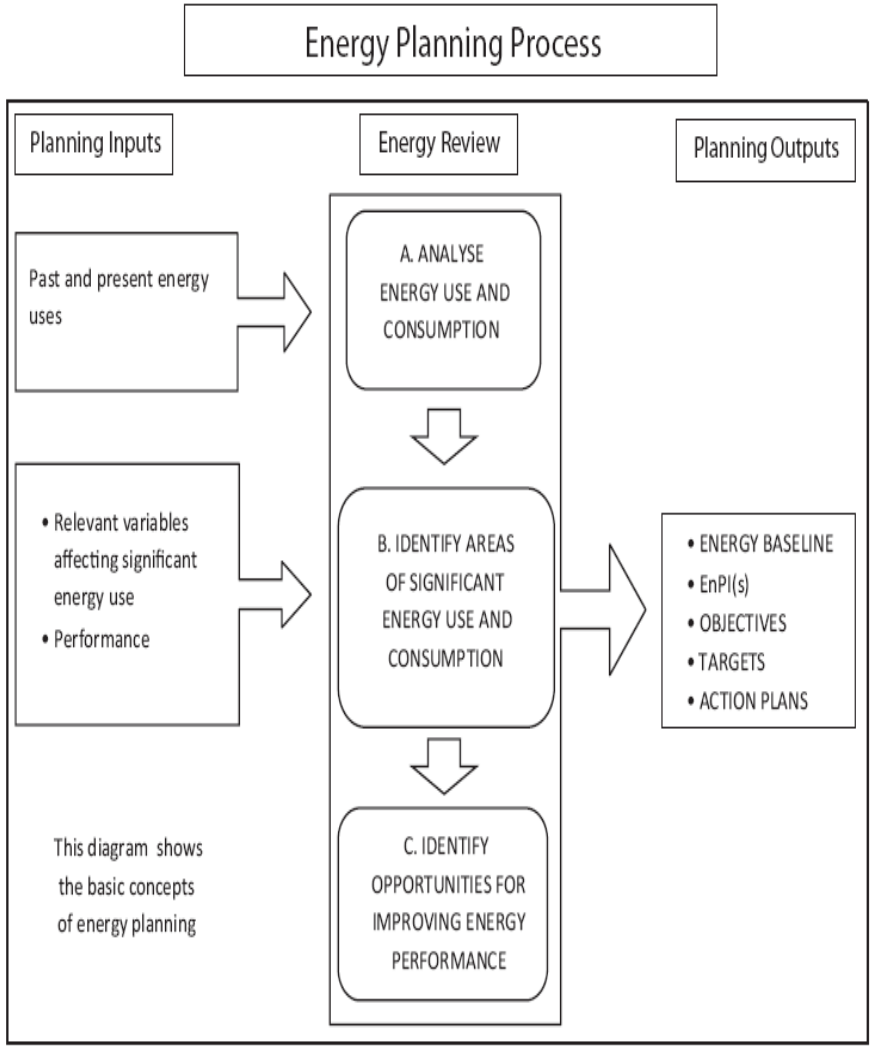
Includes the following for energy performance:

- 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

# ISO 50001:
# Energy planning process

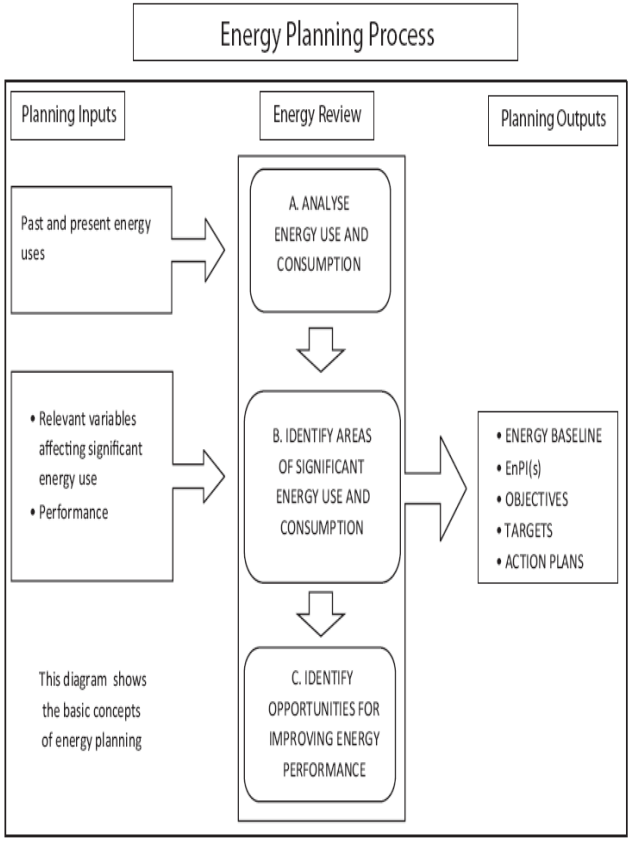
- Energy planning shall be consistent with the energy policy.
- Energy planning should lead to activities that continually improve energy performance.
- Energy planning shall involve a review of the organization's activities that can affect energy performance.
- Energy review forms the core of the planning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




**Source: ISO 50001:2011**

# ISO 50001: Energy review

- ISO 5001 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 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

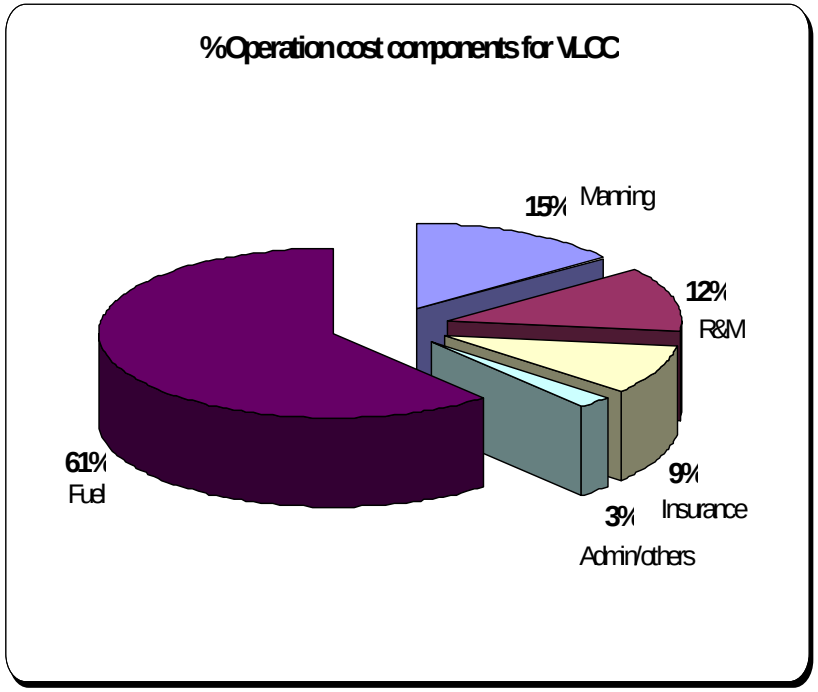
- Outputs from the management review are expected to be items such as:
  - Changes in the energy performance of the organization;
  - Changes to the energy policy;
  - Changes to the energy performance indicators;
  - Changes to objectives, targets or other elements of the EnMS.
  - Changes to allocation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

# Shipping Company Energy Management System (CEnMS)

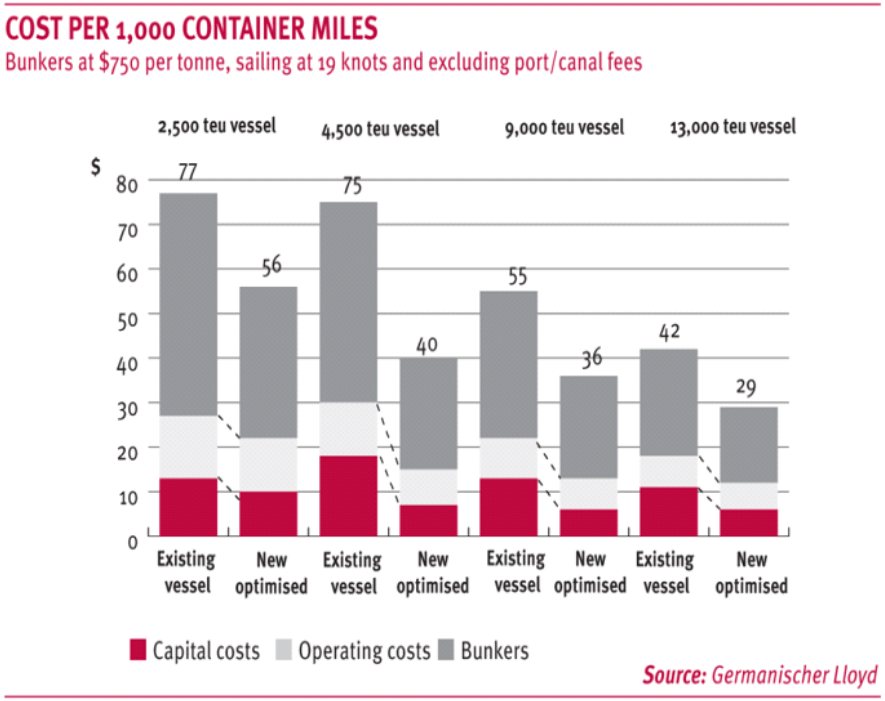
# Why energy management?

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

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



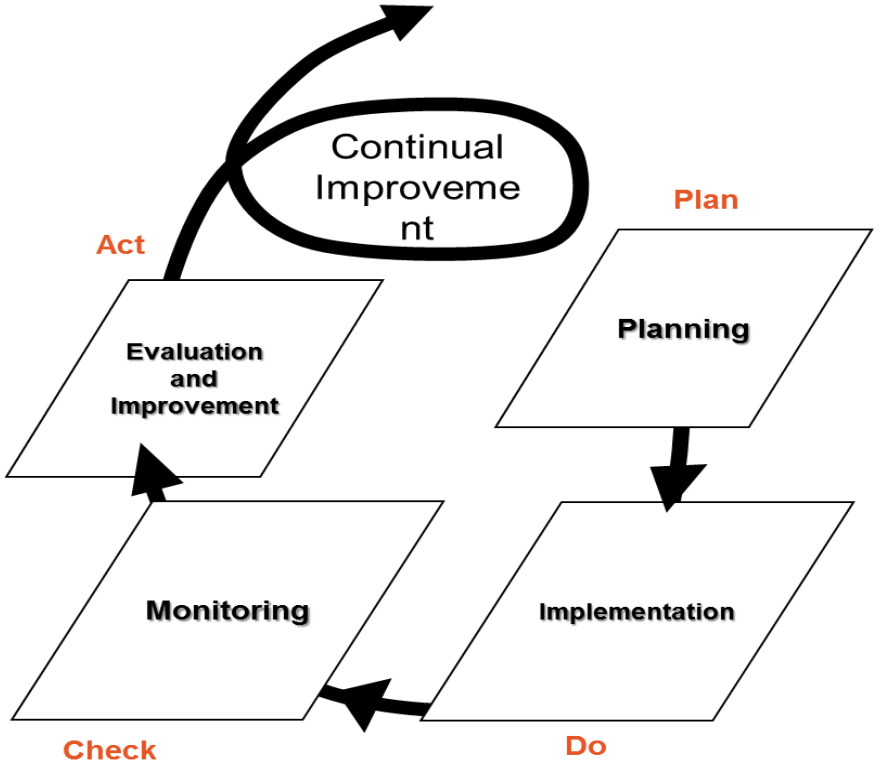

*(a) VLCC operational cost breakdown*




*(b) Containerships total cost breakdown*

# SEEMP framework

- The SEEMP works through four steps:
  - Planning,
  - Implementation
  - Monitoring, and
  - Self-evaluation
- The main features of the IMO SEEMP development was given under Module 2.
- Thus the subject of how SEEMP is developed, documented and implemented will not be discussed further.




Ship-specific → Includes a number of EEM → Implementation oriented

# 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

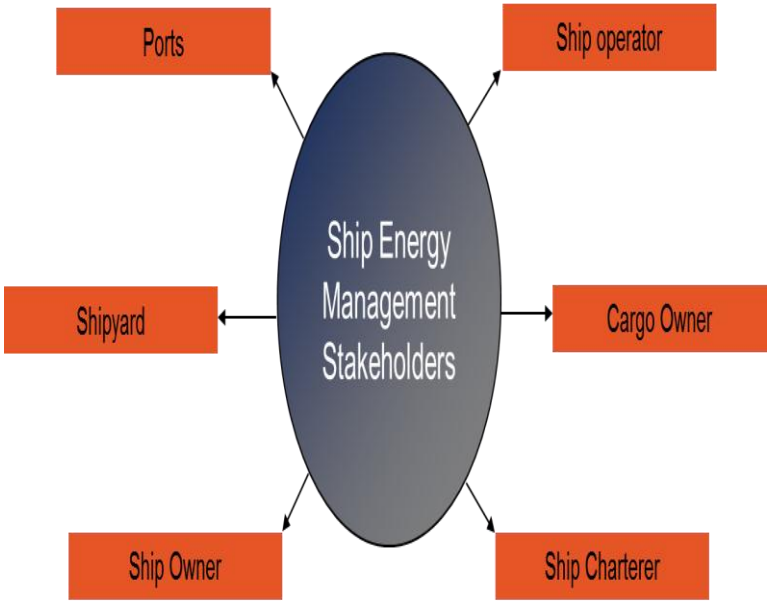
- Application domain:
  - SEEMP is “ship specific “.
  - CEnMS is “company specific” and includes the fleet.

- 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



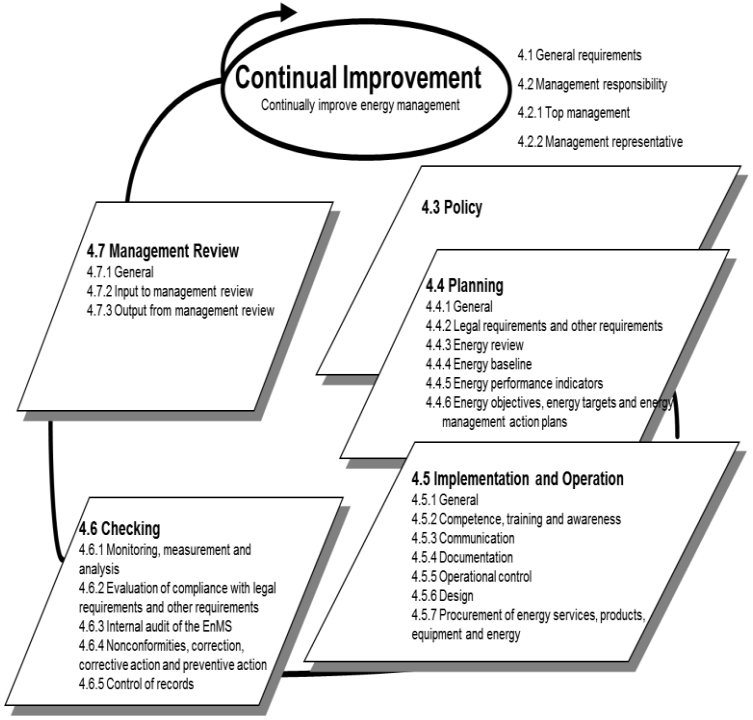

**All the above stakeholders have impact on a ship's fuel consumption and its environmental footprint**

# 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**

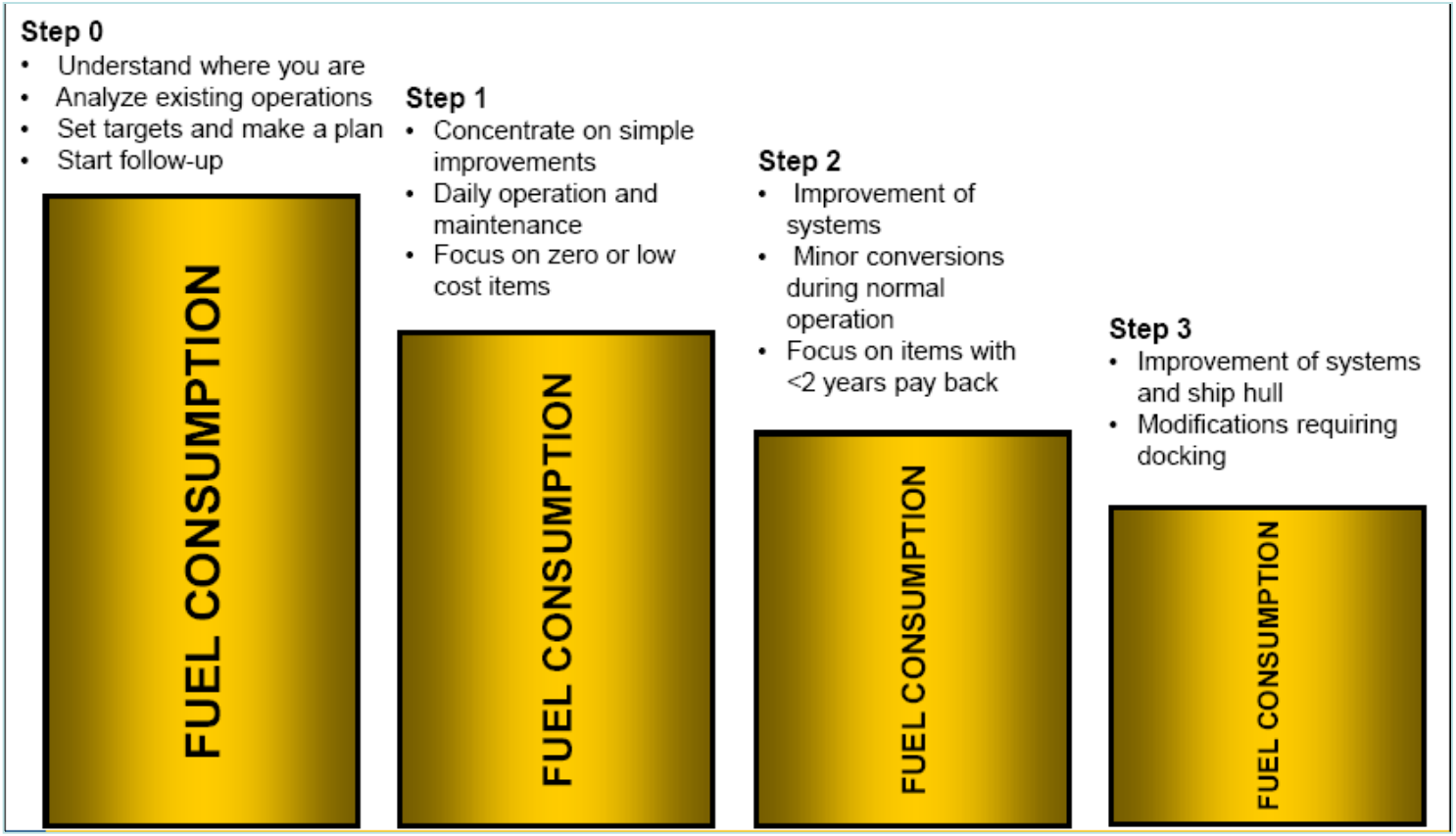
# Summary on CEnMS scope

- As discussed, the following aspects should be reflected in the CEnMS:
  - Energy policy development for the company (inclusive of ships).
  - Energy planning activities for both CEnMS and SEEMPs.
  - Definition of monitoring system and relevant KPIs, baselines, data collection and data analysis systems.
  - Establishment of a reporting system for energy efficiency data.
  - Methods for the self-evaluation of both all the SEEMPs plus the CEnMS itself.
  - Coordination and collaboration with the major external stakeholders that influence fleet's operation.
  - All aspects relating to training and investment projects.

# Practical Aspects of Implementation

# Step by step approach to energy management

- Step 0 (initial planning)
- Step 1 (low cost measures)
- Step 2 (medium cost measures)
- Step 3 (high cost measures)



# Technical challenges of energy performance monitoring

- Performance monitoring is a difficult area and need particular attention.
- For monitoring of major EEMs and dealing with a large number of fleet wide EEMs, the monitoring could be more of a technical challenge
- It would involve provision of KPIs and their trends to identify how various ships are performing in relation to energy efficiency.
- In most cases, one or each set of EEMs (e.g. hull maintenance) will have its own methods and KPIs for monitoring purposes.

# Training, raising awareness: How?

- Increasing awareness and incentives of staff are key to successful implementation of management systems.
- This can be done in a number of ways:
  - Training on ship energy efficiency.
  - The company may consider distance-learning, ‘Computer Based Training (CBT)’ programs
  - Poster campaign.
  - Regular on-board meetings on the subject.
  - Ideas of best practice to be received from the seafarers, documented, highlighted and implemented.
  - Develop competition for energy efficiency, e.g. between ships..
  - Familiarisation with energy policy via effective communications
  - Use of company magazine or other publicity documents for raising awareness and interest .

# Ship Energy Audit and Review

# Energy review / energy audit

- As part of SEEMP and CEnMS developments, there is a need to do energy reviews or audits.
- These techniques are useful for both planning and monitoring phases.
- For planning, the end result of energy review / audit would be a set of Energy Efficiency Measures (EEMs).
- For monitoring, the main aim would be to check if the implementation of various EEMs have been successful.
- Conducting an energy review and audits involves a number of activities.
- In this part, energy audit techniques are described. The same methodology may be applied to energy reviews.

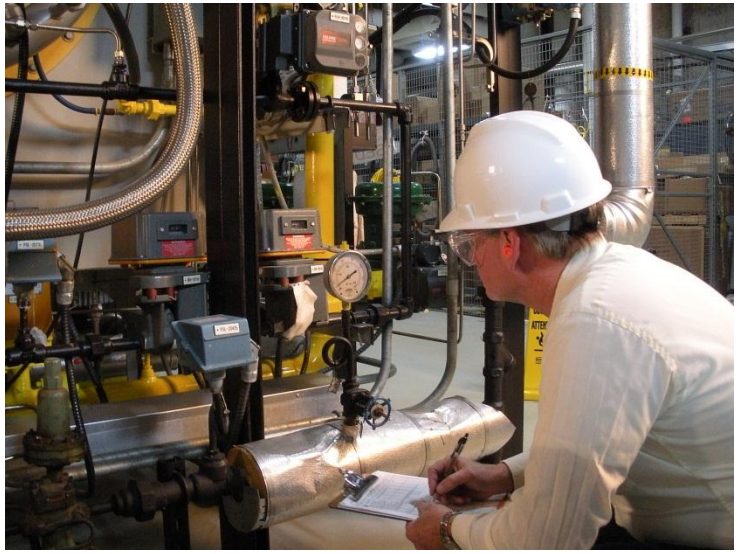
# Types of energy audits

- Preliminary (walk through) energy audit.
- Detailed (investment grade) energy audit.

**Select Type of Energy Audit**

- Preliminary energy audit
- Detailed energy audit

- Type of energy audit chosen depends on
  - **Function and type of industry**
  - **Depth to which final audit is needed**
  - **Potential and magnitude of cost reduction desired**



# Preliminary energy audit purposes

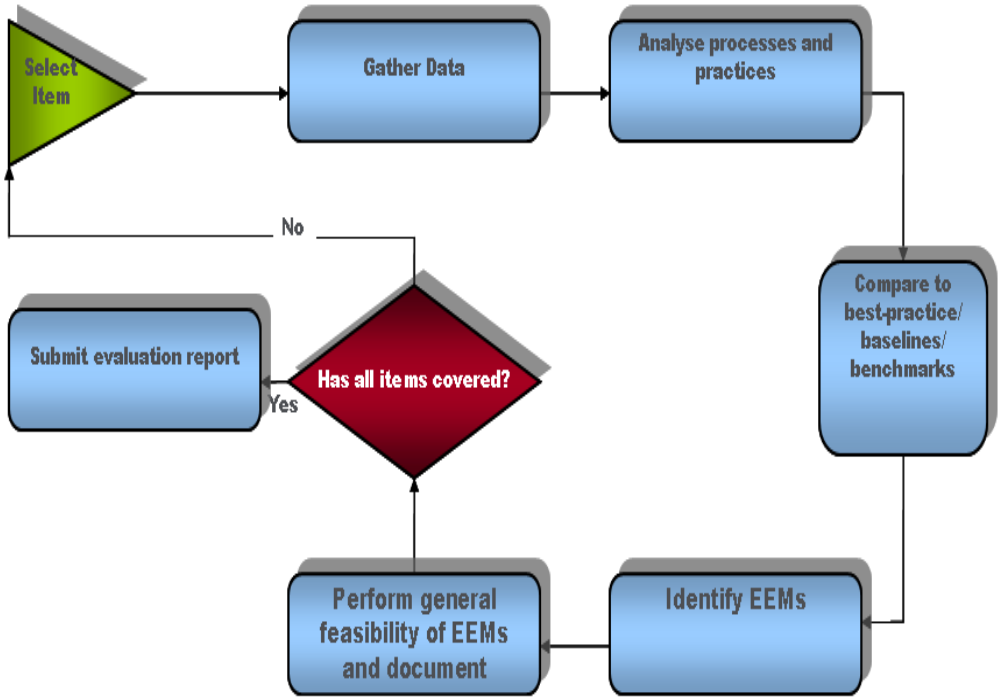
- Establish overall energy consumption and its profile.
- Estimate the scope for energy saving.
- Identify energy efficiency measures and their priority ranking.
- Identify areas for more detailed study/measurement or subsequent assessments.
- For preliminary energy audit, normally existing or easily obtainable data are used and does not include any independent measurement campaign.

# Detailed energy audit purposes

- Same as the preliminary energy audit but more detailed, **PLUS**
- It aims to provide enough information to enable decision making process or development and planning of energy saving projects.
- It effectively evaluates all major energy using systems.
- This type of audit offers the most accurate estimate of energy savings and cost. Detailed energy cost saving calculations and project costs.
- Establish energy baselines
- The analysis will involve system modelling for various estimations.

# Ship energy audit/review

- Could be used as part of planning or monitoring.
- Main objective is to identify energy efficiency measures.
- For a ship, various aspects (items) could include:
  - Hull and propeller
  - Engines
  - Machinery utilisation
  - Lighting
  - Voyage
  - Trim
  - Training, etc.



# Ship energy audit: Example assessment areas

**Energy awareness**

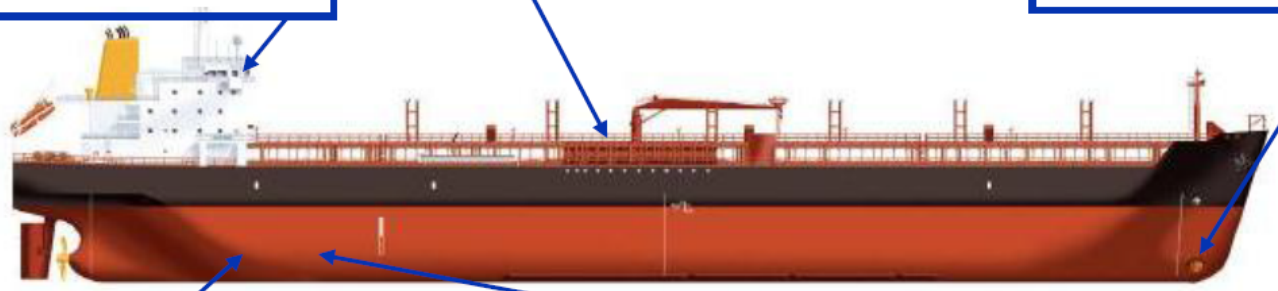
- Interview with ship staff with the objective of assessing the implementation of procedures and the general level of awareness related to energy efficiency.
- Witnessing of normal operation of vessel during different modes and documentation of overall impressions during voyage
- Assessment if current performance reporting is fit for purpose

**Cargo discharge performance**

- Assessment in fuel consumption for boiler for one discharge compared to new condition
- Assessment of loss in steam system including cargo pumps

**Ship performance**

- Measurement of hull and propeller performance at different speed, which include alternation of the ship's course for a short period of time during data collection
- Measurement of vessel speed at 4-5 different trim condition and comparison with normal trim at given load condition



**Primary consumers**

- Performance test and calculation of SFOC for ME and AEs at 3 – 4 different loads, compared with sea trial / shop test
- Evaluation of AE usage at different operating modes
- Performance test of boiler by measuring steam mass flow, temperature and pressure compared to fuel usage

**Secondary consumers**

- Comparison of electrical powering table with readings from Power Management System. Any deviation will be investigated.
- Operational assessment of key consumers, e.g. temperature in settling tank, use of separators, pressure in starting air receivers, use of ER fans, recirculation of HT cooling water across cooler etc.

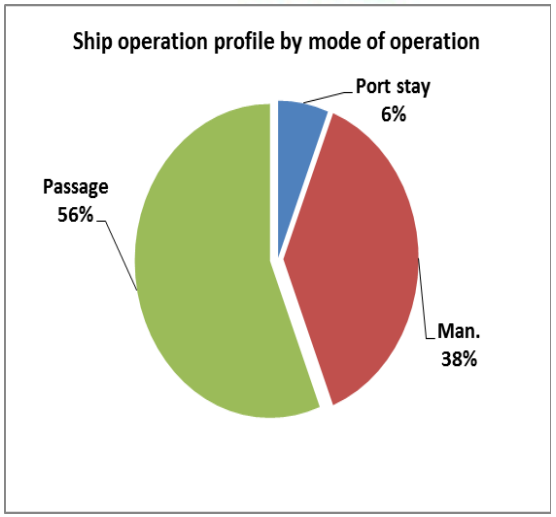
Source: DNV

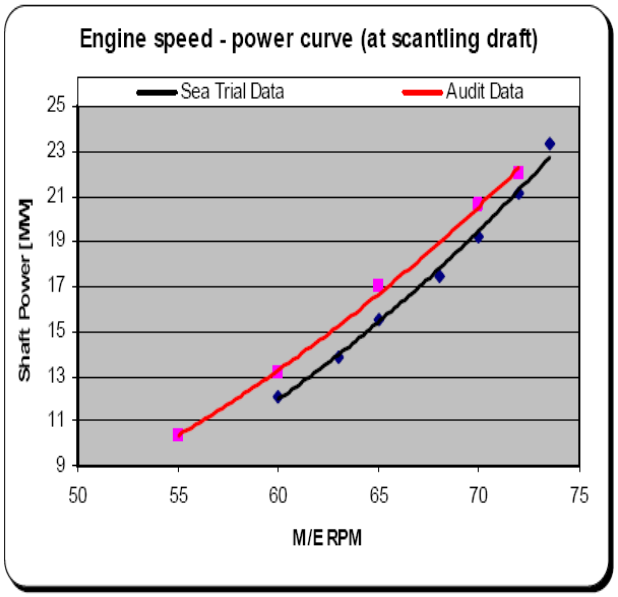
# Ship energy audit phases

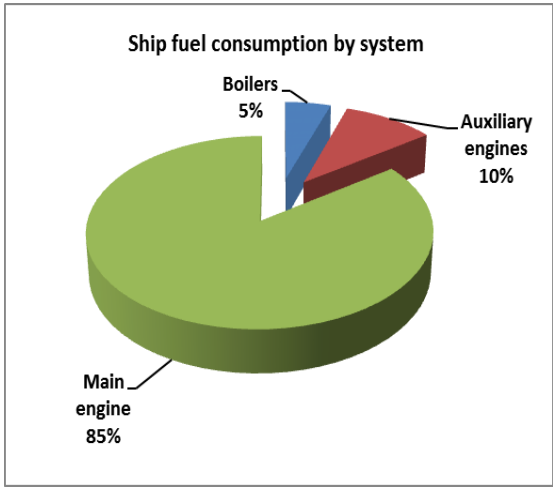
- A ship energy audit may involve a number of phases.
- **Phase I – Pre-survey activities:**
  - Preliminary data gathering
  - Initial data review
- **Phase II - Survey:**
  - The ship is visited and the planned survey activities are carried out, facilitated by ship personnel.
- **Phase III – Analysis and reporting**
  - Data analysis
  - Energy audit report

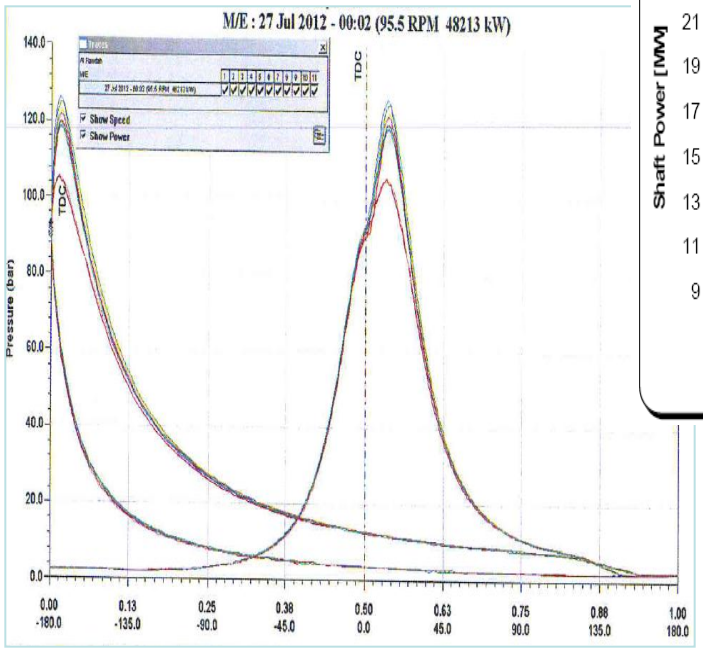
# Ship energy audit
# Typical data analysis – Examples

- Ship operation (voyage) profile
- Ship fuel consumption profile
- Hull performance assessment
- Engine performance assessment



# Techno-economic feasibility

- Energy audit should identify EEMs and make concrete recommendations

- It is essential to come up with EEMs that are:
  - Technically feasible
  - Economically cost effective

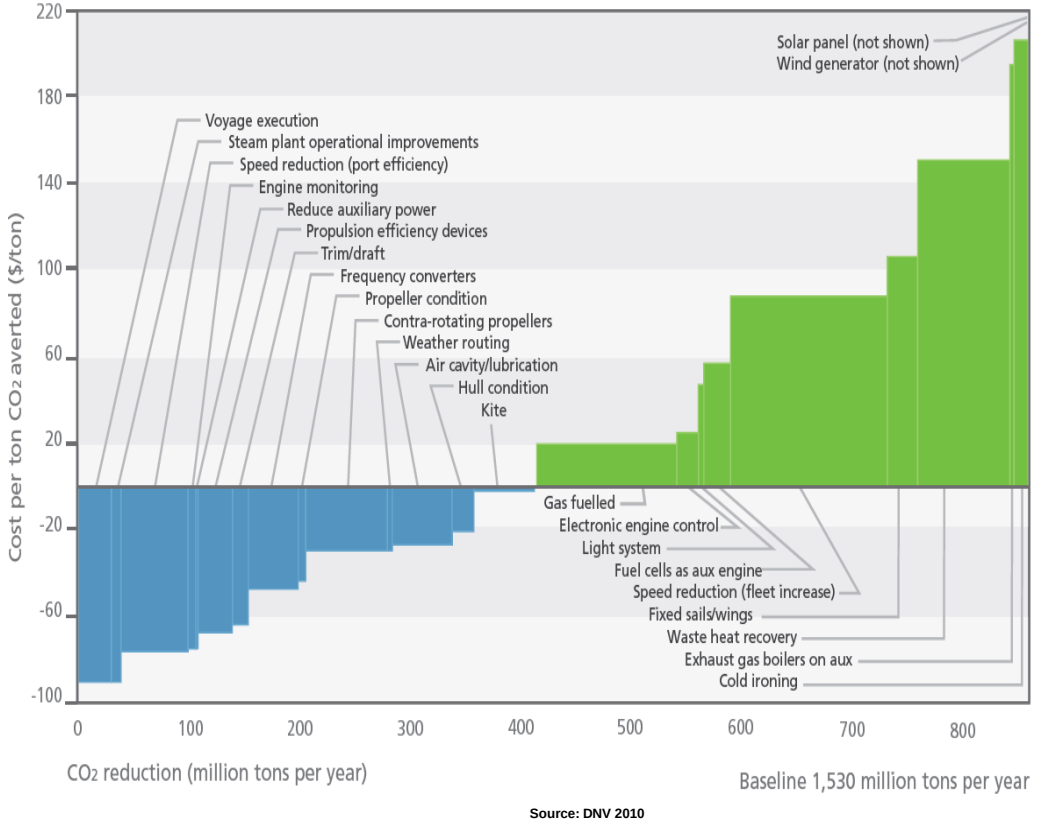
- Cost effectiveness can be measured using:
  - Pay back period
  - Net Present Value (NPV)
  - Internal Rate of Return (IRR)

$$\text{Payback period} = \frac{\text{Investment required for a project}}{\text{Net annual cash inflow}}$$

$$NPV = R_0 + \sum_{t=1}^{T} \frac{R_t}{(1+i)^t}$$

# What about cost-effectiveness of technologies?

- Marginal Abatement Cost Curves (MACC).
- A simple and effective presentation of cost effective analysis results.
- MACC shows:
  - The reduction potential (tonne/year) - X axis
  - Abatement cost ($cost/tonne CO2 reduction) – Y axis




Source: DNV 2010

**Thus to generate a MACC:**

- **A full analysis of energy saving levels and cost of implementation for each EEM is required**

# MACC development

- Step 1 – Identify EEMs and their energy saving levels.
- Step 2 – Calculate the cost of implementation of the EEMs.
- Step 3 - From fuel consumption reduction, estimate annual CO2 reductions (X axis).
- Step 4 - From steps 2 and 3 calculate, the cost-effectiveness that is the MAC ($cost per tonne CO2 reduced) (Y-axis).
- Step 5 – Rank the EEMs from lowest MAC to highest MAC (i.e. lowest cost EEM to highest cost EEMs).
- Step 6 – Plotting the MACC. Use the ranking system, each EEM represented by a rectangle where its vertical side is the MAC and the horizontal side is the CO2 reduction level.

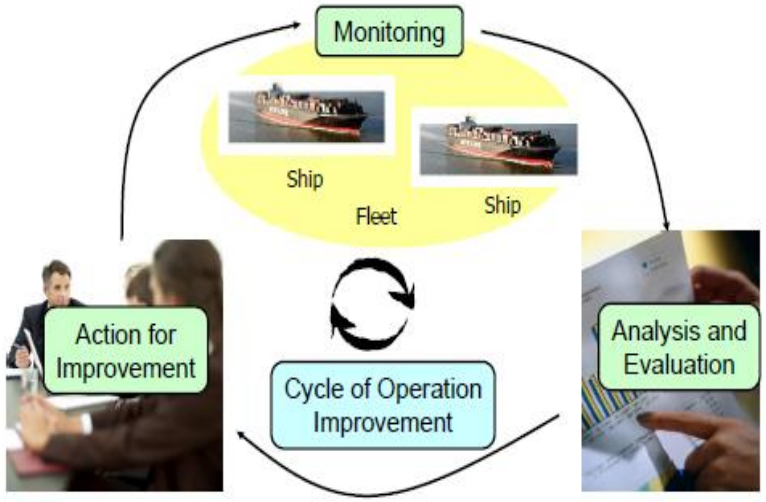
# Ship Performance Monitoring and Reporting

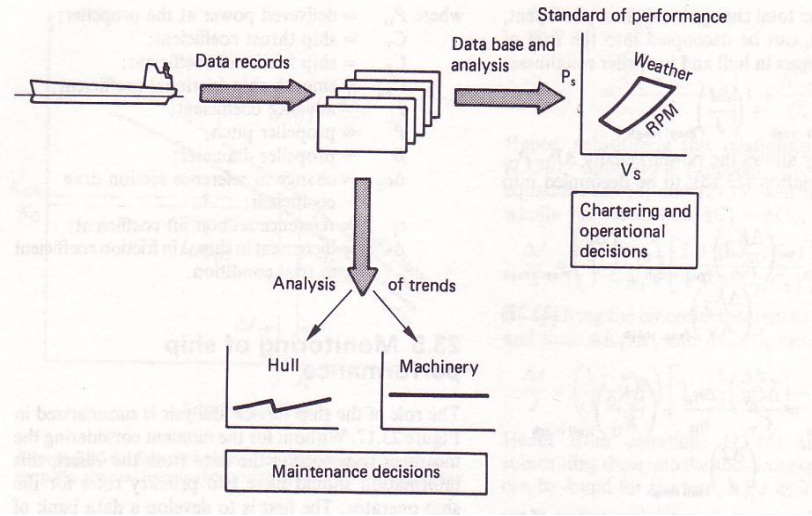
# Why performance monitoring: Main benefits

- **Assessment of hull condition:** For assessment of hull roughness, hull fouling, the quality of coatings and paints.
- **Assessment of engine condition:** For assessment of engine tuning options or identification of engine faults
- **Feedback to a better ship design**
- **Improved commercial aspects** for chartering and technology upgrade: A more accurate estimate of the ship performance for charter party agreements.
- **Long term operational optimisation:** Historical data are great for long term performance optimisation.
- **Environmental assessment:** For regulatory data reporting and MRV purposes.

# Performance monitoring system design

- Scope of monitoring could include one or all:
  - Ship voyage and operation
  - Hull and propeller
  - Engines
  - Auxiliary machinery
  - Emissions and environmental features
  - Etc.
- Big data analysis capability
- Ship-shore communication
- Advanced sensors and data communication technologies.



# Types of monitoring systems

- Division mainly on the basis of data collection and analysis methods.
- Manual: Systems with manual data logging, data analysis and reporting (for example once every 24 hours)
- Automatic: Systems with automatic data logging, data analysis and reporting:
  - Sampling every 1 sec or above
  - Analysis can be either scheduled, continuous or on demand.
- Hybrid: Hybrid systems with some manual and automatic elements.
- In practice, most are hybrid with some level of manual or automatic features.

# Manual: Relies on more traditional logbook data: Issues

- **Uncertainty in the used instrumentation:**
  - Redundant sensors with differing outputs.
  - General aspects of sensors' reliability, maintainability and accuracy.

- **Wrong data collection timing:**
  - Normally time lag exist with manual data collection.
  - These may lead to data for different set of conditions.
  - Some data are very to operating conditions.

- **Human errors in observations:**
  - Human factor for manual data collection is an issue
  - Some parameters (e.g. state of sea condition) will require observation.
  - Accuracy depends on experience of officers and engineers.

# Manual: Relies on more traditional logbook data: Issues

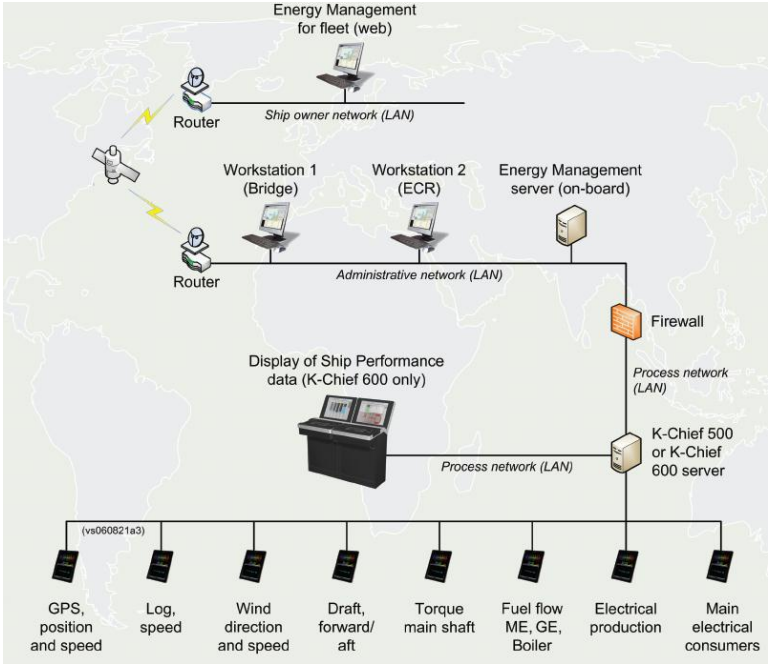
- **Inaccurate data collection:**
  - Average versus spot measurement may get mixed.
  - Tendency to enter higher or lower observations
  - For example, it is normal practice to enter higher sea states.

- **Limited logging frequency:**
  - Due to high workload it is not possible to do frequent manual measurement on board.

- **Errors in data entry:**
  - Experience indicates that logbooks frequently contain data inconsistencies;
  - Wrong manual entry
  - Mixing up of parameters, for example ship speed through water and over ground.

# Automatic systems advantages

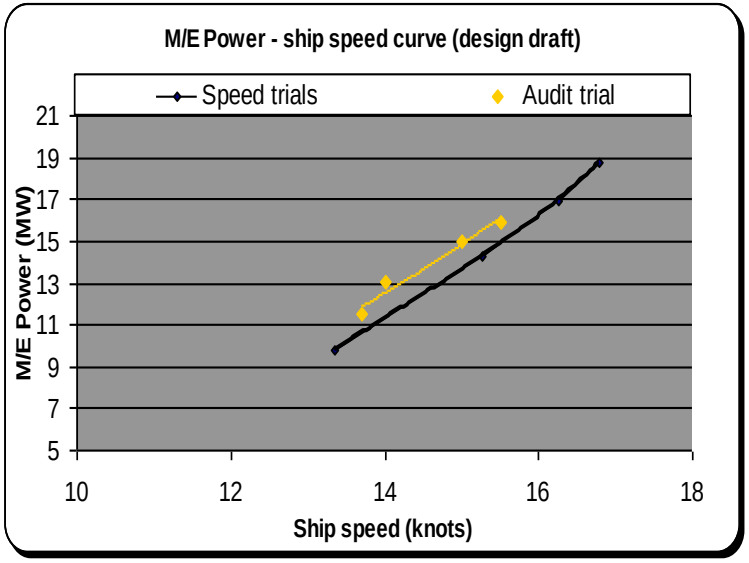
- Contributes significantly to the improvement of data quality.
- Allows signal validation, filtering and averaging for increased accuracy and reliability
- Real time and synchronous data collection
- Allows real-time data analysis in support of decision making, e.g.:
  - Alarm system
  - Routine vessel operation
- Issue: The amount of data could be daunting; thus require good data management.



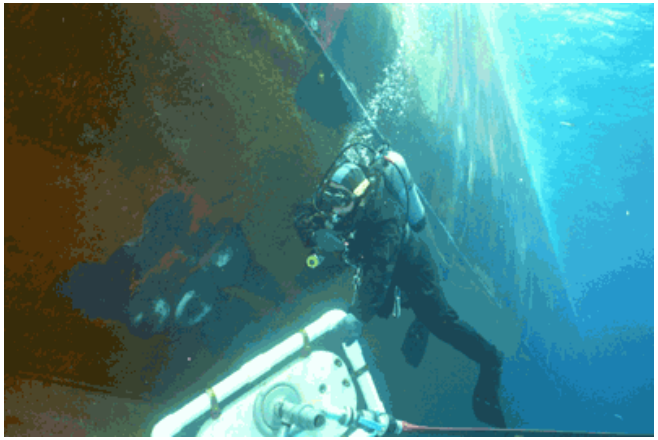

Kongsberg

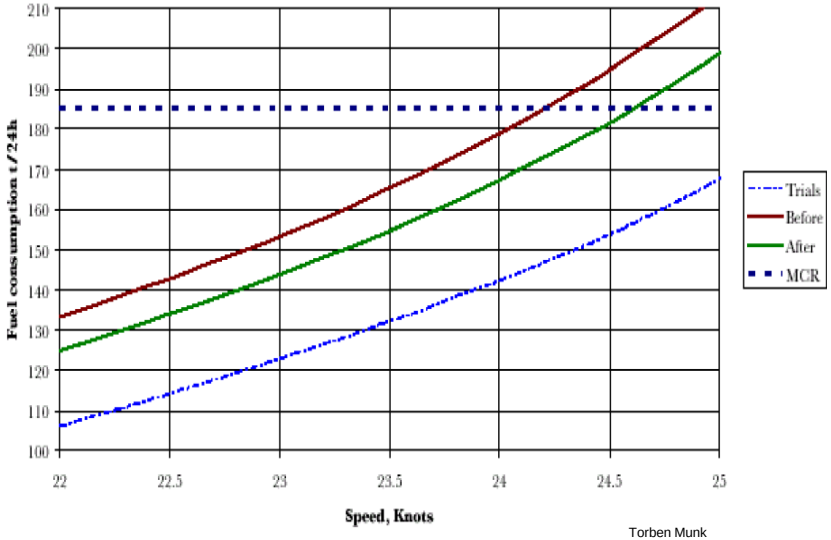
# Hull performance monitoring

- Various techniques are used.
- Assessment of ship speed-power curve relative to a baseline.
- Assessment of level of added resistance relative to a baseline
- Use of divers to visually inspect the hull and propeller conditions




Bazari 2012

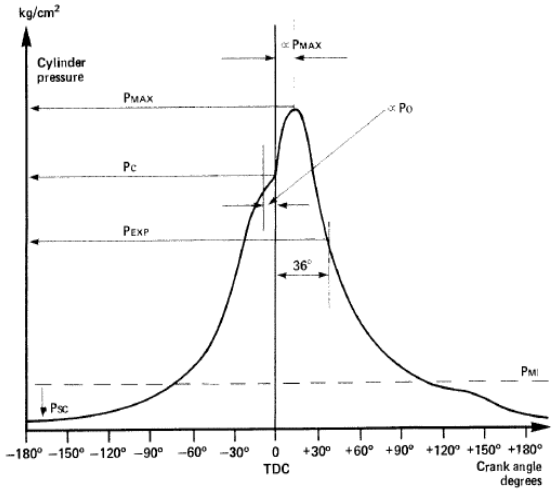




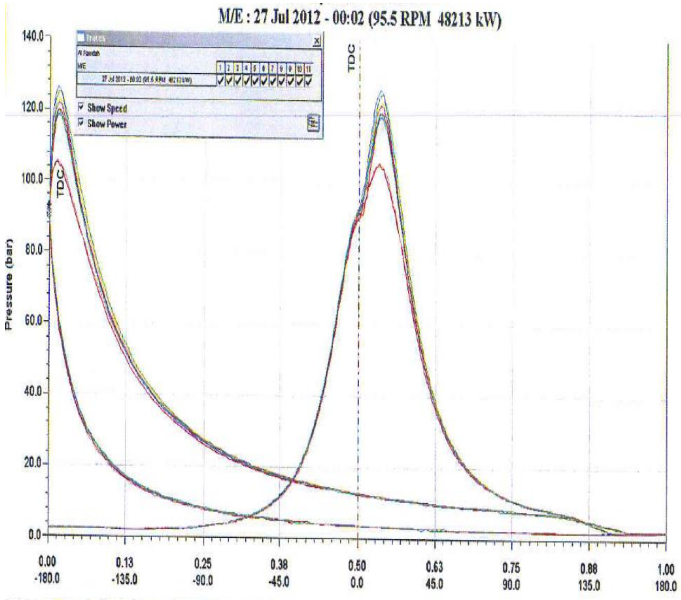

Torben Munk

# Engine performance monitoring

- Based on analysis of cylinder pressure data plus other process data.
  - Maximum cylinder pressure (Pmax)
  - Angle of Pmax.
  - Cylinder compression pressure (Pcom)
  - Ignition angle – The angle at which combustion starts.
  - Indicated power as measured on top of the piston.

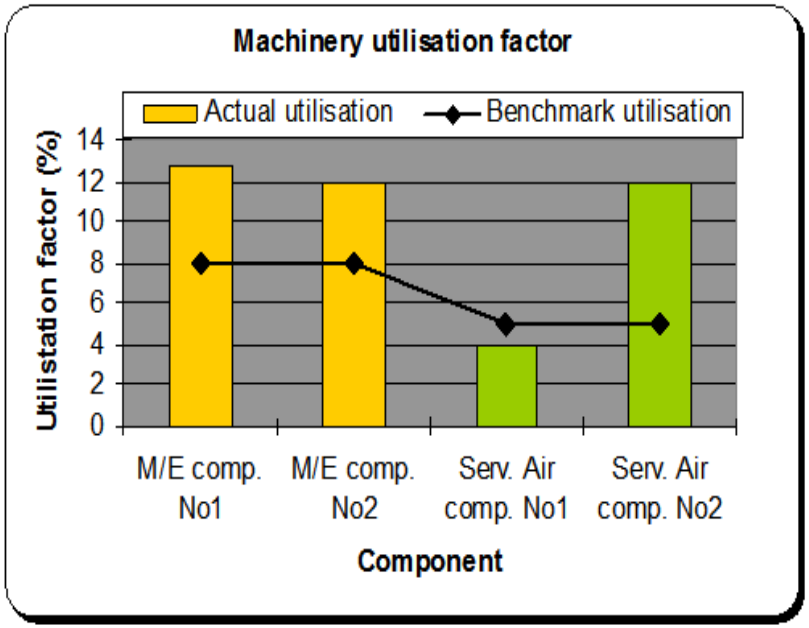



- In addition, current day systems collect other data such as:
  - Engine rpm
  - Engine brake power
  - Scavenge pressure
  - Fuel injection pressure diagram and relevant information such as injection timing.
  - Turbocharger rpm, etc.



# Auxiliary machinery monitoring

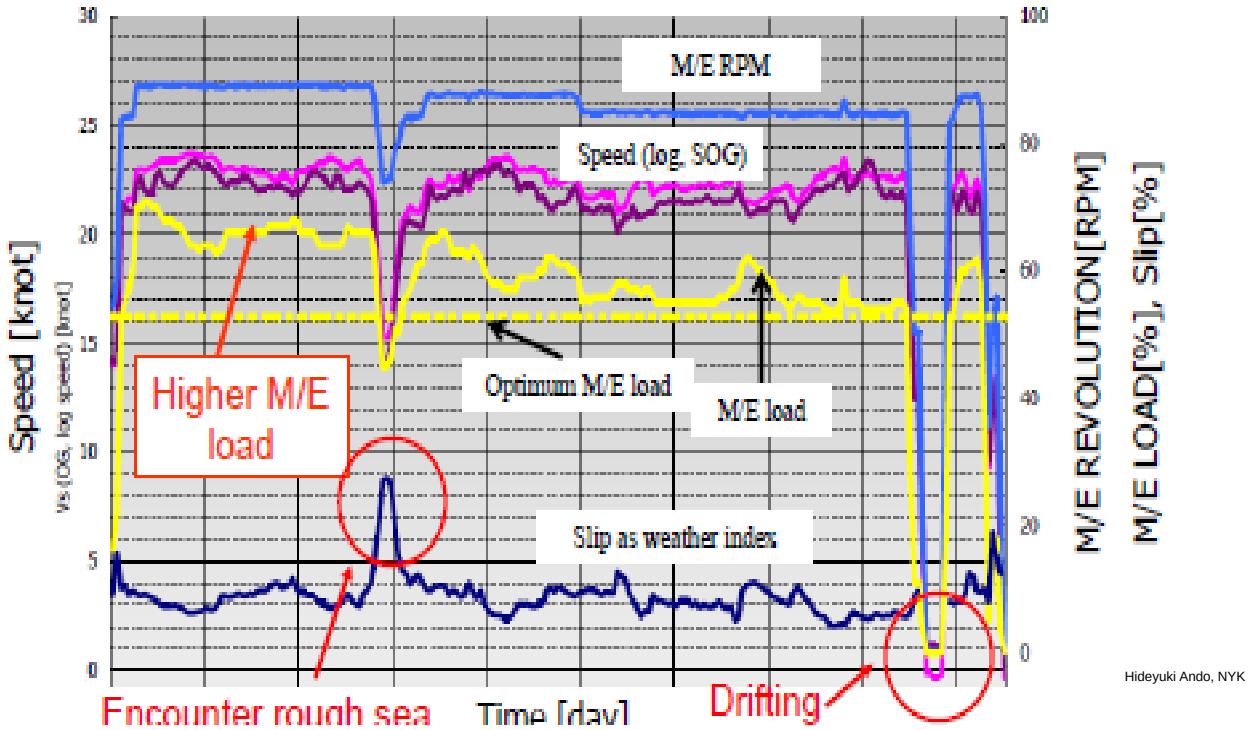
- Mainly through monitoring of machinery load factors and utilisation factor.
- Relatively simple using the machinery run hours.
- Benchmarking is part of the process




**Machinery utilisation facto calculation and benchmarking** [Bazari 2012]

# Voyage monitoring

- All the timing of ship operation needs to be monitored.
- Analysis of ship operation profile.
- Continuous recording and demonstration of the ship data as below.




Hideyuki Ando, NYK

# Data Collection and Reporting to External Bodies

- IMO Data collection
- EU MRV

# Monitoring and reporting to external bodies

- For a variety of reasons.
  - Regulatory compliance to future IMO data collection.
  - Regulatory compliance to EU MRV
  - Part of company's reporting on social corporate responsibility.
  - Environmental reporting.

# IMO data collection system

- Currently under development by the IMO MEPC Working Group on "further energy efficiency measures".
- The approach advocates "data collection" as applied to ship fuel consumption and possibly other parameters.
- The system will have three main elements:
  - (1) Data collection by ships
  - (2) Flag State functions of data verification
  - (3) Establishment of a centralised database at the IMO.

# IMO data collection system: Some features

- Main aspects of IMO data collection was introduced in Module 1 including:
  - Applicable to ships greater than 5000 GT.
  - Annual reporting with no need for voyage data.
  - IMO number for ship identification
  - Registered owner responsible for submission of data.
  - Flag Administration responsible for data verification.
  - Compliance through having a Statement of Compliance (SOC)

# EU MRV overview

- EU advocates for a major reduction in GHG emissions from international shipping.

- In this area, the EU plan of action is a phased approach:

  - Phase 1: Establish a technical IMO regulatory framework.
  - Phase 2: Implement an MRV scheme to establish the fuel consumption and CO2 emissions from international shipping.
  - Phase 3: Identify whether the efficiency standards are achieving the EU's desired absolute CO2 emissions reductions and what else should be done, e.g. (MBM).

MRV

- Within EU MRV, a reporting system is regulated that aims to provide accurate data for subsequent policy making.

# EU MRV applicability

- Applicable to ships >> 5,000 GT; with voyages into, out of and between EU ports.
- It requires per-voyage and annual monitoring of CO2 emissions.
- Other parameters including energy efficiency indicators and amount of cargo carried, etc. are included.
- Annually emissions are reported (for the previous year).
- Ships are exempted from the obligation to monitor:
  - If they operate in EU ports all the time
  - Or if they have more than 300 voyages within the reporting period.
- The exceptions are warships, naval auxiliaries, fish catching or processing ships, etc.

# EU MRV - Data reporting requirements

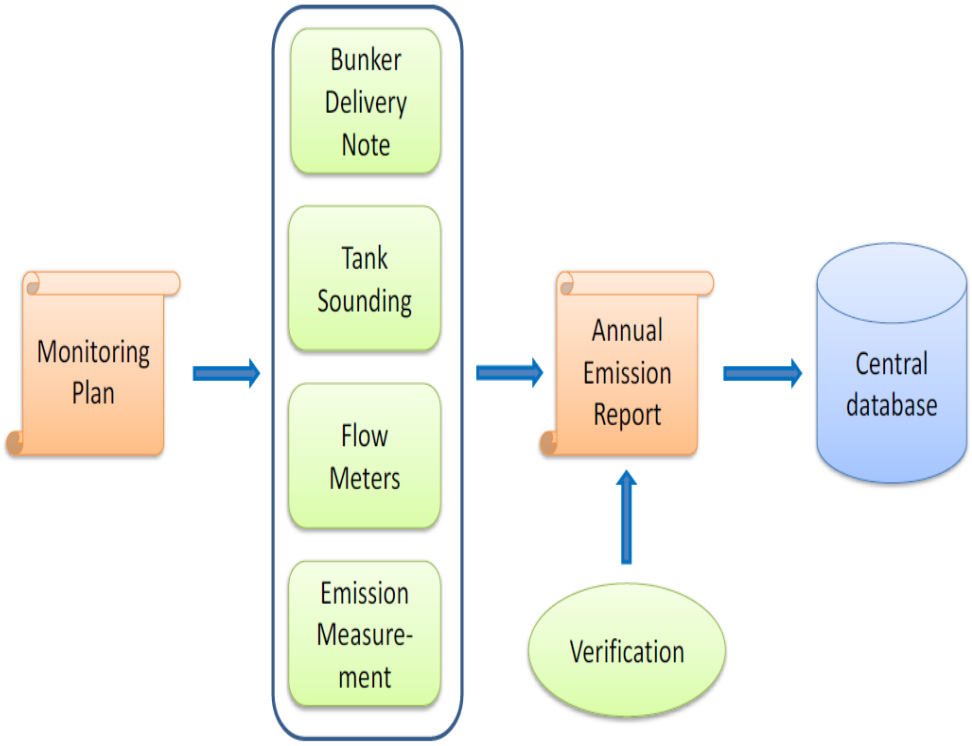
| Annual reporting requirements | Per voyage reporting requirements |
|---|---|
| Aggregated annual CO2 emissions from all voyages between, from and to ports under a Member States' jurisdiction | Ports dates and times in and out. |
| Details of the method used for emissions monitoring | |
| Technical efficiency of the ship (EEDI or EIV as applicable) | |
| Vessel identification | |
| Total annual amount/weight of cargo carried | |
| Annual average efficiency (e.g. EEOI, fuel consumption per distance and cargo carried) | |
| Total annual fuel consumption | |
| Total CO2 emitted | CO2 emitted |
| Total distance travelled | Distance travelled |
| Total time spent at sea and at berth | Time spent at sea |

**EU MRV monitoring requirements** [Lloyd's Register 2015]

**Further guidelines/procedures will be developed to clarify how various activities should be done.**

# EU MRV overview

- Plan is needed.
- Fuel consumption measurement: 4 methods are acceptable.
- Annual emissions reports must be verified
- Reports will be collected in a database.
- Verification must be carried out.




**EU MRV monitoring requirements** [Lloyd's Register 2015]

# EU MRV
# Verification and certification

- Verification and certification is a requirement.
- Tasks will be done by accredited third party verifiers.
- A Document of Compliance (DOC) will be issued.
- The EU Regulation (EU) 2015/757 sets out guidance on the requirements for verification:
  - Verifying conformity of the monitoring plan.
  - Verifying conformity of the emission report.
  - Ensure that emissions and other climate-related data have been determined according to planned.
  - Making recommendations for improvement to the monitoring plan.
- The EU MRV regulations will not be a flag State requirement; instead it will be enforced through Port State Control within European ports.

Thank you for your attention

# ANY QUESTIONS?

**For more information please see:**
**www.imo.org**