Ship Energy Audit

- Do the least

Seeba Ann Mathew

24-04-2015
The real motivation?

- Save money
- Save the planet
- Be a good citizen
The real motivation!

- Save money
- Save the planet
- Be a good citizen
- Your neighbors are doing better
Survey results:
Why strive for an energy efficient operation?

Regulations – Money – Reputation – Sleep
Survey results:
- So what is stopping us...

Barriers to implementation of energy efficiency measures:

- Charter agreements
- Lack of specific know-how
- Lack of incentives
- Complexity of operation
- Complexity of installation
- Technical maturity
- Safety of crew and ship
- Cost of operation
- Cost of installation

Lack of Money or Knowledge (certainty)
A number of fuel efficient measures are available. However, shipowners for various reasons may or may not be able to climb up this entire ladder, be it retrofit or new build ships.
Improvement potential (theory)
Breakdown of the 15% saving potential

(4.6%) Shipowner controlled at no or low cost
(5.8%) Charterer controlled at no or low cost
(4.8%) Shipowner controlled, but with some cost
Reported data:
In Transit – Overall fuel decrease of 16.2%

Measures
- Logistics planning
- Speed management
- Propeller polishing
- Trim and draft optimization
- Enhanced focus on communication with crew and charterer

Rolling average MDO cons. per nm [tonn/nm] ——— Expon. (Rolling average MDO cons. per nm [tonn/nm])
Reported data:
Offshore – Overall fuel decrease of 5.3%

Measures
- DP-operation
- LED lighting
- Enhanced focus on communication with crew and charterer

Rolling average MDO cons. per hour [ton/hour] — Expon. (Rolling average MDO cons. per hour [ton/hour])
Reported data:
In Port – Overall fuel decrease of 7.8%

Measures
- LED lighting
- Enhanced focus on communication with crew and charterer
Identify your cost drivers

Repair and Maintenance

Planned Maintenance

- Time spent on planned maintenance (overtime)
- Spares used
- Service supplier cost

5 - 20%

Damages*

- Replacement cost of equipment
- Repair team cost
- Deductible from insurance
- Consequence cost

5 - 20%

Unplanned Maintenance

- Time spent on unplanned maintenance (overtime)
- Spares used
- Service supplier cost

5 - 20%

Optimising maintenance activities give cost savings of 10 ~ 15%

*Typical cost picture tanker Moore Stephens
**CO$_2$, SO$_x$, ballast water & recycling are in public discussion, but in the end it’s energy that really matters**

<table>
<thead>
<tr>
<th>Relevant dimensions</th>
<th>Regulatory status</th>
<th>Market demand</th>
<th>Vessel value driver</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emissions to air</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- CO$_2$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- SO$_x$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- NO$_x$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Particulate matter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Ozone depleting substances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Emissions to water</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Ballast water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Bilge water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Wastewater (sewage, shower/kitchen, holds)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Coatings/Anti fouling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Waste emissions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Cargo residues</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Oil sludge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Noise emissions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Outside/inside</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ship recycling</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Pollutants/IHM$^1$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 IHM = inventory of hazardous materials

- Regulation expected
- To be implemented or tightening expected
- Already implemented
Today’s vessels will have to compete against vessels that are 30% more fuel efficient in the future

Transportation costs, USD/TEU/1000 NM

<table>
<thead>
<tr>
<th>Year</th>
<th>Profitable vessels</th>
<th>Unemployed vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2025</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Efficiency increase of new vessels ca. 2,7% p.a. (=30% in 13 years)\(^1\)

\(^1\) IMO with respect to required EEDI improvement (MEPC 60/4/14)
Ranking of the selected vessel with its peer group is given before and after applying retrofitting measures

World container fleet based on USD/1,000 TEU Nautical Miles

- Peer group size of vessels with +/-15% TEU capacity is compared to vessels performance before and after retrofitting
- Peer group size can be set individually
- Ranking is based on all vessels sailing at the given operating profile

Ranking before retrofitting (50 of 79)

Ranking after retrofitting (14 of 79)

Source: DNV GL
Energy management can be conducted on technical and management dimensions

**Technical**

**Ship performance**
- Hull condition
- Propeller condition
- Autopilot & rudder
- Trim and draft
- Cargo capacity

**Main and AUX engines**
- Main engine efficiency
- Auxiliary engine efficiency (including generators)
- Dual fuel preparation

**Consumers**
- Cargo handling operations
- Ventilation, HVAC, cooling/freezing, lights
- Thruster operations
- Climate control
- Miscellaneous consumers

**Management**

**Voyage management**
- Fleet planning and schedule assessment
- Chartering/booking
- Voyage execution
- Speed Management
- Port efficiency
- Trim optimization

**Fuel management**
- Fuel quality and quantity
- Bunkering procedures
- Fuel sampling
- Inventory management
- Supplier management

**Management system (enabler)**
- Organizational setup, roles, responsibilities
- Policy, process/procedures
- Communication and training
- Reporting, review and follow-up
Implementing energy management generates sustainable savings

**Technical**

<table>
<thead>
<tr>
<th>Ship performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hull condition</td>
</tr>
<tr>
<td>• Propeller condition</td>
</tr>
<tr>
<td>• Cargo capacity</td>
</tr>
<tr>
<td>• 2-7% bunker savings</td>
</tr>
<tr>
<td>• 1-24 months payback</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Main and AUX engines</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Main engine efficiency</td>
</tr>
<tr>
<td>• Auxiliary engine efficiency</td>
</tr>
<tr>
<td>• 2-5% bunker savings</td>
</tr>
<tr>
<td>• 1-12 months payback</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cargo handling operations</td>
</tr>
<tr>
<td>• Ventilation, HVAC, cooling/</td>
</tr>
<tr>
<td>• Climate control</td>
</tr>
<tr>
<td>• Miscellaneous consumers</td>
</tr>
<tr>
<td>• 0,5-1% bunker savings</td>
</tr>
<tr>
<td>• 1-12 months payback</td>
</tr>
</tbody>
</table>

**Managerial**

<table>
<thead>
<tr>
<th>Voyage management</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fleet planning and schedule assessment</td>
</tr>
<tr>
<td>• Chartering/booking</td>
</tr>
<tr>
<td>• 2-7% bunker savings</td>
</tr>
<tr>
<td>• 3-24 months payback</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuel management</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fuel quality and quantity</td>
</tr>
<tr>
<td>• Bunkering procedures</td>
</tr>
<tr>
<td>• 1-3% bunker savings</td>
</tr>
<tr>
<td>• 12+ months payback</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Management system</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Enabler/anchoring of achieved savings</td>
</tr>
<tr>
<td>• &lt;3 months payback</td>
</tr>
</tbody>
</table>
Indicative energy forms and demands onboard ships
Ship Energy Audit (SEA)

Objective:
Optimisation of auxiliary machinery

Audit Scope:
Perform tailored ship energy audits on high priority vessels.
SEA includes:

a) Review of current fuel use onboard

b) Onboard survey, observation of normal operations, interviews with crew, measurement of ME and AuxE performance, sampling of fuel

c) Comparison with design specifications and identification of specific fuel and CO2 reduction opportunities
## Onboard audit scope

### 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 of current performance reporting if fit for purpose

### Primary consumers
- Performance test and calculation of SFOC of ME and AEs at 3-4 different loads, compared with sea trial and ship 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.

### Other consumers
- Other ancillary consumers
- Performance testing of the following will also be carried out: all pumps, heat exchangers, waste heat recovery systems, exhaust gas economiser, air compressors, boilers, cargo handling, ventilators, cooling systems

### Cargo discharge performance
- 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 of current performance reporting if fit for purpose

### Ship performance
- Measurement of hull and propeller performance at different speeds which include alteration of the ship's course for a short period of time during data collection
Energy system definition with its input and output streams
Thank you!

Seeba Ann Mathew
Seeba.Ann.Mathew@dnvgl.com
+65 9837 5353

www.dnvgl.com

SAFER, SMARTER, GREENER