Energy management in shipping – a researcher’s perspective

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Main points

• Increased energy efficiency is an instrumental pathway in the work to abate CO₂ emissions from shipping

• Present measures won’t be enough if we want to see a total emission \textit{reduction} from the shipping sector – we need to change fuels and introduce \textit{very} innovative ships. Possibly also change trade regimes, i.e. much slower speeds

• We will need to see more stringent regulation in the near future

• Work to increase energy efficiency from a shipping company point of view can be complex, not an immediate fit to some company structures

• The IMO has recently mandated that all ships carry an energy efficiency management plan (SEEMP)

• It may be an unclear best-practice and an inefficient policy instrument compared to other instruments

• Many business opportunities as well as research activities related to energy efficiency will come
Research background

- M.Sc. (Civ.ing.) in Engineering Physics & Industrial Ecology
- Now: 3 + 2 year PhD project (2010-2015), financed by the Swedish Energy Agency
  - First three years focused on implementation of energy management systems in two Swedish shipping companies
  - Joint project with Transatlantic, DNV and Laurin Maritime
  - Final two years on broadening the scope and generalizing results
- Publications to date
  - "The energy efficiency gap in shipping – barriers to improvement", IAME 2011
  - "Barriers to energy efficiency in short sea shipping – a case study", SSS 2012
  - “Will the IMO Ship Energy Efficiency Management Plan (SEEMP) lead to reduced CO2 emissions?”, IAME 2012
Implementing energy management systems in shipping

A joint industry-university collaboration project on implementing ISO 50001 and the IMO Ship Energy Efficiency Management Plan (SEEMP)

What is best-practice?
Shipping, energy efficiency and CO₂ emissions (1/2)

- Shipping emissions on the rise because of an ever expanding world economy dependent on trade of physical goods and raw materials
- CO₂ emissions = 

\[ \frac{GDP \times \text{transportation}_\text{work} \times \text{energy}}{GDP \times \text{transportation}_\text{work} \times \text{energy}} \times \text{emissions} \]

1. Ensure implementation of existing measures that increase energy efficiency
2. Invest in research, development and demonstration of more advanced measures to bring down costs
3. Switch to less carbon-intensive forms of energy (e.g. bioenergy)
4. Decouple economic growth and need for transportation
5. Move towards a steady-state economy
*MEPC 59/INF.10*
Shipping, energy efficiency and CO$_2$ emissions (2/2)

- Work to reduce CO2 emissions directed to the IMO through the Kyoto protocol
- Policy instruments in place, the Energy Efficiency Design Index (EEDI), and the Ship Energy Efficiency Management Plan (SEEMP)
  - Still emissions will double to 2050
- Further work stalled by the connection to international climate diplomacy – conflict between CBDR and NMFT-principles

What is an appropriate emission trajectory for the shipping sector during the coming century, given it’s role as facilitator of world trade?
There is room for improvement...

- IMO (2nd GHG Report, 2008): 25-75% possible through existing measures (including speed reduction)
- Lloyds and DNV (MEPC 63/INF.2, 2011): 30% possible through operational measures applicable to all ships
- Eide et al (2011) – 33% possible at zero cost
- Lindstad et al (2012) – increasing the world fleet to slow speeds but still transporting the same amount of goods would lead to 28% reduction, at zero net cost
- How can this potential be so large? What is keeping stakeholders from implementing these measures?
- Our starting point – shipping organizations are not fit for effectively working with energy efficiency
- In other words, there are other (transaction) costs associated with these measures.
"Barriers to energy efficiency"

- Research since oil crises of the 70s – there seems to be a vast amount of measures that appear cost efficient that is not implemented “fast enough”
  - Misplaced incentives (Blumstein et al., 1980)
  - An energy efficiency “gap” (e.g. Jaffe and Stavins, 1994)
  - Energy efficiency often a principal-agent problem
  - Swedish foundry industry (Rohdin et al., 2007), the Swedish paper and pulp industry (Thollander and Ottosson, 2008), the German commercial and services sector (Schleich, 2009), the Indian household sector (Reddy, 2003), the Greek industrial sector (Sardianou, 2008), the American department of defence (Umstattd, 2009), etc.

- Rationale for governmental intervention
  - Information campaigns, labelling
  - Mandatory energy management systems part of many governmental programmes
  - Subsidized energy audits
Energy management systems

- Guidance for establishing an energy management system
  - "to enable organizations to establish the systems and processes necessary to improve energy performance, including energy efficiency, use and consumption" (ISO, 2011)
- Historical connection to Danish (DS 2403), Swedish (SS 62 77 50), etc. and European (EN 16001) standards
  - Specifically governmental energy efficiency programmes
Energy efficiency in shipping - regulation

• Regulated through the Energy Efficiency Design Index (EEDI) and the Ship Energy Efficiency Management Plan (SEEMP)
  — Resolutions MEPC.212(63), MEPC.213(63), MEPC.214(63) and MEPC.215(63))
• The EEDI is expected to have an impact in the longer-term, due to it slowly requiring increased energy efficiency in new-buildings
• … while the SEEMP is more noticeable in the short-term
SEEMP development process

- Introduced in **MEPC 58** (MEPC 58/INF.7) by an industry coalition
  - Included a list of measures. As for management aspects, it was to be ”an amplification of ISM requirements”
- Japan argued at the **2nd meeting of the GHG working group** (GHG-WG 2/4, p. 4) that it should include similar functional requirements as the ISM Code (policy, instructions and procedures, defined levels of authority and lines of communication, procedures for internal audits and management reviews)
- Joint proposal by USA and Japan at **MEPC 59** did not include these more strict requirements.
- Finalized as 2012 GUIDELINES FOR THE DEVELOPMENT OF A SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP) through resolution MEPC.213(63) at **MEPC 64**
The SEEMP in context

• What gaps exist between what is required in the SEEMP compared to ISO 50001 and the ISM Code?
• Main points
  – Ship specific – missing connection to over-all company management
  – The SEEMP lacks many aspects normally found in management systems (not a complete PDCA cycle)
    – Energy audit process missing
    – Monitoring, measurement and analysis processes could be more stringent
    – Design and procurement processes missing

An energy audit attempts provide a company with information on energy use and performance, and thus decision support on what measures are most cost-efficient to focus on.

This is important as energy efficiency competes with many other issues for scarce management attention (DeCanio, 1993).

Energy audits are often described as an integral part of energy management (Gordić et al., 2010, Engin and Ari, 2005) — and have been promoted through many governmental programmes (Anderson, 2004, Schleich, 2004).

An inclusion of such a procedure in a future SEEMP would increase administrative burden, but perhaps increase likelihood of success in energy management.

In practice, many companies tend to have an ad hoc and fragmented project portfolio.
SEEMP gaps – measurement systems

• The SEEMP and ISO 50001 both contain requirements on monitoring of performance. In ISO 50001, the scope is broader and includes a commitment to planned interval which the SEEMP lacks.

• Measuring, analysing and communicating energy use is not trivial (Sivill et al., 2012). Discussed in shipping for decades (Drinkwater, 1967; Journée, 1987; Petersen, 2011)

• ISO 50001 requires that each project (“action plan”) shall have a designated procedure for verifying improvement,
  — which is a much stronger requirement than the SEEMP, which only requires that the performance of the ship is monitored.

• This is a very interesting area, many solutions exist with different approaches. No full solution from measurements – analysis – KPIs – reporting? Large shipping companies develop in-house. Medium sized companies procure and co-develop. Small companies?
Interesting future areas to watch

• Performance monitoring, many companies being formed (many being built on PhD research)
  — No dominant design, no convincing “full” solution?
• Tools for evaluating performance of existing ships in procurement (T/C), and for newbuildings (unproblematic to fund more expensive but more fuel efficient ships?)
  — Claims from yards and vendors of eco-ships and solutions
  — It is not enough for the board of directors to see only a towing-tank result…
• Crew competence and involvement highlighted by many ship operators – DFDS refers to a “revolution in the engine room”
• Increased importance of technical know-how, new contracts and relationships being formed in the outsourcing business.
Wrapping up...

- Energy efficiency may be interesting in the short term (now) for ship operators and owners, cargo owners etc. but society’s interest will last this century
- A large technical potential exist, but structure of markets, institutions and organizations hinder development
- A first shot has been taken at regulating energy management in shipping (MEPC 58-63), though very little effort put in compared to EEDI
- We already see calls for improvement (MEPC 64)
- Many business opportunities, not only in actual gadgets and measures that increase efficiency but also in entire systems for performance monitoring
Thank you!

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