

The Future of Energy and Environmental Issues

A presentation of ideas how to significantly reduce the fuel consumption of fishing vessels during the next 20 to 25 years



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Introduction

The 20th century was a century of technological revolution and rapid progress, driven for the most part by inexpensive energy that allowed mankind to advance on all fronts. The primary energy source was oil, and for the last 150 years, extracting it from the ground has been relatively inexpensive. Oil is the fuel used in almost all modes of transport; in motor vehicles, aircraft, ships and machinery. It is also used in large quantities in the production of plastics and man-made fibres.

There are now storm clouds surrounding the oil industry as environmental matters are becoming prominent. Current indicators strongly suggest that oil production will reach a peak during the next five years then decline steadily with related price rises. The price increases that we have seen in recent months and years are said to indicate that peak production is approaching.

There are strong suggestions that oil consumption is linked to increased greenhouse effects and immediate action is necessary if we are to prevent permanent changes to the Earth's atmosphere. This can only be achieved with a reduction in the consumption of oil and other fossil fuels, more efficient use of oil and the introduction of methods and fuels that are environmentally more beneficial.

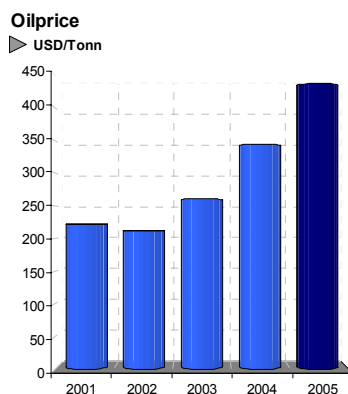
Today's extensive fishing fleet uses large quantities of fuel oil. The fishing industry must withstand constantly increasing fuel prices while at the same time it is expected to respond to the increasing emphasis being placed on environmental matters. Worldwide fish resources are limited and international competition in fishing and fish processing will reduce the scope for increasing income to offset higher operating costs. New ways must be found to maintain the industry's competitiveness, especially for nations dependent on the fishing industry.



Therefore, it is essential to reduce the fishing fleet's operating costs in the long-term and increase the value of catches. Technical innovation built on scientific research and advanced energy management technologies that use expensive fuels more economically are the most promising paths to achieving these goals.

Oil Production and Consumption

Current thinking suggests that crude oil production will reach a peak in the next five years after which it will decrease until stocks are exhausted in about 40 years time. (See *Out of Gas*, Goodstein, Norton, 2004). According to Goodstein, the demand for oil products will continue to increase while production capability decreases. Prices on world markets will continue to rise and any reductions in price will only be short-term. It is clear that price increases on world oil markets will have a serious effect on basic costs for the fishing industry and especially for energy intensive trawler fishing. Price increases will also have a harmful effect on the transport of goods, including seafood products.



International Oil Prices

The adjacent chart shows annual trends in the price of fuel for shipping on world markets. The average price in 2004 was USD 344 per ton, which was 32% higher than in 2003 and 62% higher than in 2002. In year 2005 the world price will rise as high as USD 450 per ton.

It is clear that savings in oil consumption will be highly beneficial. It appears likely that energy savings can largely offset predicted trends in oil prices on world markets



thus keeping fuel costs at acceptable levels for the fishing industry. Put another way, reductions in fuel consumption can help keep costs down in the face of increasing prices.

The Future of Fisheries and Energy Issues

High oil prices and the environment will become important issues for the fishing industry in the next few years. Although the industry can currently withstand the high and rising oil prices coupled with increasing emphasis on environmental issues, international concern for changes in the



atmosphere will bring increased pressure on the fishing industry to reduce emissions of carbon dioxide produced by oil combustion. It is therefore clear that the very survival of the fishing industry depends on reducing operating costs, developing an energy saving mindset and implementing new energy saving technologies.

The industry needs to play an active role in continuing development of energy saving techniques and to cooperate with ship architects in using modern methodologies when designing new vessels. A new ship's hull must be energy efficient and the energy intensive equipment installed on board must be as energy efficient as possible. The shipping industry as a whole must cooperate with engine and propeller manufacturers when searching for improved efficiency of their energy intensive products. The industry must demonstrate its support for research into the development of new techniques for saving energy.



There are currently no magical solutions in sight concerning future energy sources that will replace fossil fuels and at the same time meet the requirements of both efficiency and environmental acceptability. Hydrogen has been mentioned as a new energy source and a possible successor to oil. Recent research has resulted in many innovations which should be monitored carefully. It is generally agreed that the development of solutions using hydrogen will take 30 years to reach public markets. It is unlikely that hydrogen will be a cheap replacement for oil and neither will other possible substances such as methane. Therefore “long-term” research in this field is important.

The message from the scientific community is that it is in the interests of us all, individuals and companies, to get our houses in order, eliminate energy waste and keep energy use to a minimum. **Energy management systems** that provide information about energy usage highlight areas of waste and find the most efficient methods; are clearly the most appropriate way forward towards achieving this objective. Efficient energy management together with new developed techniques will become an increasingly important issue in the near future.

Maximum Efficiency of Fishing Vessels by 2020

The author of this paper’s view is that it is possible to achieve effective oil savings and much improved energy usage by carefully inspecting every aspect of the design and operation of a fishing vessel. Applying the correct techniques during the design phase, choosing the correct equipment and installing an energy management system that can monitor all energy consumption and on board activities can help achieve more efficient energy use than has hitherto been known. New technical solutions that can reduce energy requirements are however still at the development or planning stage.

In the light of all that has been said, the author believes that the following items are the most important during the research, development and construction phases of energy efficient fishing vessels:



1. Hull Shape and propeller

Increased effort in research and development of fishing vessel hull shape is needed although much has been done concerning the hull shape. Research into the shape and design of ships' hulls is helping to reduce resistance and more energy efficient ships are being built. Wide ranging research in this field is being carried. It is assumed that it is possible to design more efficient hulls for fishing vessels than those in production today. The propellers need to be more efficient and therefore more research is needed to increase the efficiency as well as the interaction between the propeller and the hull. Improved hull shapes, more efficient propeller and better knowledge around the interaction between the propeller and the hull could result in as much as 5 – 10% savings on trawlers.

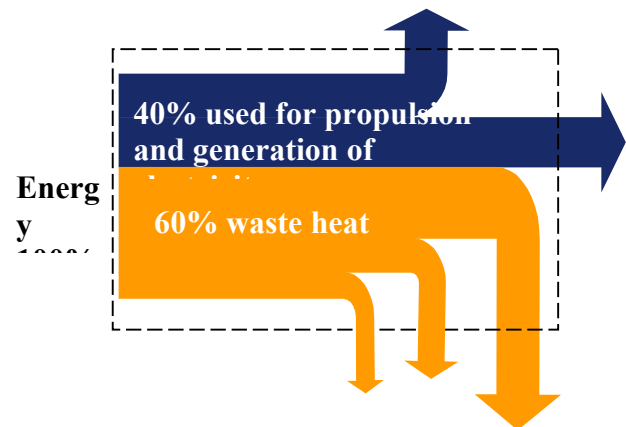
2. Energy Use (Waste Heat)

A traditional fishing vessel uses about 40% of the inherent energy of the oil used on board, meaning that 60% is lost in waste heat. Marginal work has been done to develop techniques to better use this waste heat on board fishing vessels.

Although some research has gone into

systems and methods to utilize the heat, substantial research and development is required in order to find practical solutions in this field.

Improving technology in this area to convert the heat into electricity or cooling systems could bring savings of as much as 15-20% in a ship's oil consumption. Methods of using the waste heat have been developed for onshore installations like absorption's systems, Kallina and steam generator methods are available. Developing these techniques for vessels can reduce the fuel cost of these vessels.





3. **Fishing Gear**

Fishing gear has been well researched. Work has been carried out to make equipment lighter and to reduce its resistance. However, these developments have been such that fishing gear continues to increase in size and weight so that design achievements have rarely resulted in energy savings.

Further extensive research is needed in response to this trend, with the object of making lighter gear that requires less energy during fishing operations. Although this would be a long process, the final savings could mean as much as 15 - 20% lower fuel consumption for large trawlers.

4. **Energy management and information technology**

Energy Management Systems are important when reducing oil consumption. They support the ship's crew in decision-making and in operating the vessel in the most economical way possible. Ship's officers are provided with information about the cost of a range of operations and they receive advice on the most fuel-efficient method of performing each operation. In Iceland where Energy Management Systems have been installed they have shown to result in at least 10% less oil consumption.

Integration of energy systems

Many individuals have carried out research in this field in recent years. The latest ones has been presented in Masters and Ph.D theses where methodologies have been developed that seek to simplify the design process of ships in the pre-design phase. The projects that have been handled with this technology have attained savings of up to 20 to 25% in annual fuel consumption through improvements to the ships' design.

Even though the list above is far from complete, it is clear that there is a lot of work to be done and much potential for improving the efficiency of fishing vessels. The items mentioned above are at



differing stages of development with some almost reaching the market while others are still pure research. However, with concentrated research and development followed by decisive action by design companies, universities and institutions – especially in the Nordic region – we can expect new technologies and methodologies that will significantly change the operating costs of fishing companies. If the items listed above are developed and applied it is quite possible that savings in oil consumption could amount to as much as 25 to 35%.

The most serious problem is the length of time needed to develop technological solutions; current projections put project lengths at as much as 15-20 years. Research and development in these areas must be given the highest priority and the projects must get under way as soon as possible.

Specialist Knowledge

When focussing on specialist knowledge in this field, it is evident that a lot has been done in the research and development of better hull shape and propeller design i.e. companies have been working on the hull shape and the propeller design to improve the overall efficiency of the ship.

Studies of using the waste heat on board have been limited to production of water and the room heating. Based on the great opportunity to save energy by using the waste heat, surprisingly little has been done in the research field of absorption cooling and steam/ammonia turbines onboard fishing vessels.

Regarding fishing gear, the tendency is that when improved fishing gear comes to the market and is purchased by the owners, the fishing gear is heavier than before resulting in no energy savings.

Advanced energy management systems are produced today.



Proposed Action plan

The author believes that energy sources other than fossil fuels will not come onto the market for another 30-50 years and that as a result, every opportunity for making economies in fuel consumption on board ships must now be taken and new solutions and products must be developed. Furthermore, it is important that shipping operators are educated and trained in energy savings and actively participate in the development of new solutions as mentioned above.

Based on specialist knowledge it is important to focus on projects that can accelerate the development toward more energy efficient fishing vessels. The following projects should be put forward:

1. Research on the hull and propeller design to minimise the resistance of the hull and toward maximising the propeller and nozzle efficiency. This is a short-term project (5 years).
2. Research on the possible use of waste heat onboard to produce electricity and cooling. This is estimated as a medium-term project (10 years) thereof 5 years for developing industrial solutions and testing them onboard.
3. Research on fishing gear focussed on new materials giving less resistance when trawling. This is a medium-term project (10 years) thereof 5 years on developing products and testing.
4. Increased focus on research in alternative fuels is important. This is a long-term project (30 to 50 years) and without doubt the most expensive when compared with the others above.

Encouraging the owners to buy the most economical and environment friendly fishing vessel instead of the cheapest one would speed up the research in the above mentioned areas. Equally important are the partnerships across borders that are fundamental and can accelerate research in this field. It is also important is to connect companies, universities and research institutes so that existing knowledge can become a foundation for the further research in this field. It is of vital



importance that companies that are currently involved in design of fishing vessels are involved in such work, and that it is not purely academic parties involved in such work research.

Financial impact

The financial impact is mentioned in the introduction stating that the increasing oil prices and international focus on the environment will become the main threat to the fishing industry in the years to come. The industry has to participate in the research and development and be open for installing new solutions and new techniques to improve the fishing vessel's efficiency. The high return on investment for the industry, especially for the trawler and purse seiner fleet, will help in this matter. As an example a purse seiner 70 meters long buys fuel for 8 to 12 million NOK annually. This means that solutions and methods giving 5 -10% annual saving are interesting for the owners because of the short pay-back time.

