Shipping and the environment.

An insightful look at the environmental issues that are affecting the shipping industry.

Lloyd's Register

LIFE MATTERS

21

of the 51 IMO Conventions relate to environmental issues

2.7%

– the proportion of global greenhouse gases caused by international shipping CO_2 emissions

95-98%

of a ship's lightweight is recycled

Environmental issues have never been higher on the shipping agenda. Today's marine industry is under increasing pressure to comply with evolving regulations and become cleaner and greener.

While climate change and carbon management grab the headlines, there is a host of other environmental challenges to be met; sulphur and nitrogen oxide emissions reduction, ship recycling and ballast water management among them.

At Lloyd's Register, we understand that environmental stewardship is only one obligation which the shipping community must meet. Owners and operators must also provide transparency, corporate responsibility and maintain profitability, all while operating safely.

We have been at the forefront of environmental initiatives in the marine industry for many years, from world-renowned exhaust emissions research in the 1990s to involvement in the development of the new Ship Recycling Convention in 2009.

Our contribution to the development of marine regulations and standards gives us the expertise to help businesses understand and meet their obligations, while our independence allows us to give impartial advice. At the same time, our global research and development network helps us deliver the services that enable businesses to operate more safely and sustainably.

A paradigm shift in the marine industry

Across the marine industry, we are witnessing a paradigm shift in operations and thinking.

There are many and varied reasons for this change – they include increases in the cost of marine fuels and continued globalisation, as well as environmental regulation and an increase in stakeholder expectations.

These factors have provoked a heightened focus on the environmental impact of shipping. In particular, fuel efficiency and exhaust emissions are driving the interest in alternative fuels and more efficient vessel designs.

Shipping has not seen this combination of issues in recent memory and certainly not a combination developing at the pace we see today.

The shipping industry has been through a number of paradigm shifts over the centuries. Lloyd's Register's Rules have followed these transitions; 250 years ago the main mode of propulsion was sail, but by 1835 we had introduced Rules for steam propulsion and our first Rules for diesel driven ships appeared in 1914. The graph (right) adapted from the 1950 Swedish Handbook of Sea Transport illustrates this progression.

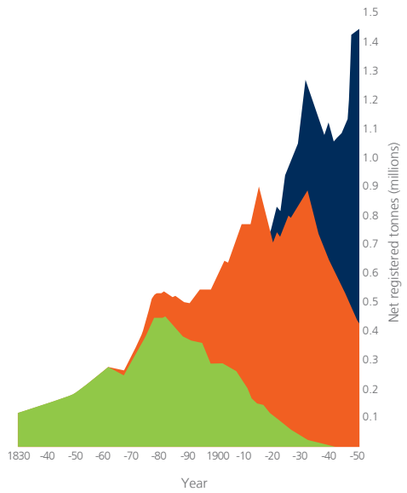
The marine industry has managed paradigm shifts before and has emerged stronger and well equipped to deal with the increase in world trade that they heralded.

Ship design, of course, is a key issue. For the last three or four decades most cargo ships have followed an orthodox, or commonly accepted, template of engine design – a large diesel power plant supported by three generators, burning heavy fuel oil. With the advent of statutory NO_X and SO_X emissions controls, this may well change; the entry into force of the revised MARPOL Annex VI this year has set the stage for how these controls will be applied on an international level up to and beyond 2020.

Concerns over emissions have also widened to include CO_2. Since at present it is far from clear how any regulation of CO_2 emissions will be applied, it is too early to speculate on how future ship design will be affected. However, it is clear that the long-term trend is that 'energy', in whatever form, is going to cost more. The shipping industry's commitment to fuel economy will continue to grow and it will inevitably seek to employ technical and operating measures to reduce fuel cost.

Add to the emissions debate the rise of retrospective legislation – as entry into force dates come and go before ratification of IMO Conventions is achieved – and the picture grows more complex. The Ballast Water Management and Anti-fouling Conventions, and Annex VI of the MARPOL Convention are three examples: all have implications for shipowners where retrofitting of environmental technology is concerned.

These are just some of the issues which make up the new paradigm, but it will be some time before new orthodoxies are reached. In the meantime, owners will need to make decisions with significant commercial consequences. Through our knowledge, insight, technical resources and global reach, Lloyd's Register is available to help provide assurance throughout this process.



The development of the Swedish merchant fleet from1830 to 1950.

Developing tomorrow's sustainable vessel

What will tomorrow's sustainable vessel look like, and how will it differ from other vessels? These are key questions in marine circles.

Of course, it's impossible to answer these questions in detail because science and engineering developments are happening so fast and simply can't be predicted.

But there are ways in which we can help drive and develop the key technologies which will shape the green ships of the future.

Research

Through our strategic research agenda, we are assessing and developing some of the technologies which may help the industry become more sustainable in the near future and for the long term. Though we can't actually predict what a future vessel will look like, we can be confident that ship design will focus on reuse and recycling, materials, hull design, propulsion and fuels, and these are the areas on which our research is focused.

Human factors

In addition, we have come to understand that in looking at the vessel of the future we need to consider the human element. People are widely accepted as the greatest source of operational risk to modern ships – fatigue, poor leadership, lack of experience and poor maintenance are just a few of the ways that the human element can impact on operations. Therefore, to make a business more sustainable, it needs a well-trained, well-motivated and effective workforce. Through our human factors services and publications we are working to help owners and operators incorporate this vital element into their operations.

Influencing legislation, promoting environmental protection

Of course, the vessel of the future won't be possible without legislation to guide its development and enforce compliance. We make sure we are involved in the development of forthcoming legislation so that we can influence the changes and reflect them in our Rules.

On the issue of SO_x and NO_x emissions, we participated in and led one of the IMO's Informal Cross Government/ Industry Scientific Groups of Experts, established to evaluate the effects of the different fuel options proposed under the revision of Annex VI of the MARPOL Convention. Its report helped the IMO to choose the right option to address prevailing concerns and adopt the changes to the Annex. We also assisted the industry in making considerable progress in the area of environmentally sound ship recycling by developing the first Green Passport based on the 2003 IMO *Guidelines on Ship Recycling*. This has subsequently become part of the Ship Recycling Convention as the Inventory of Hazardous Materials.

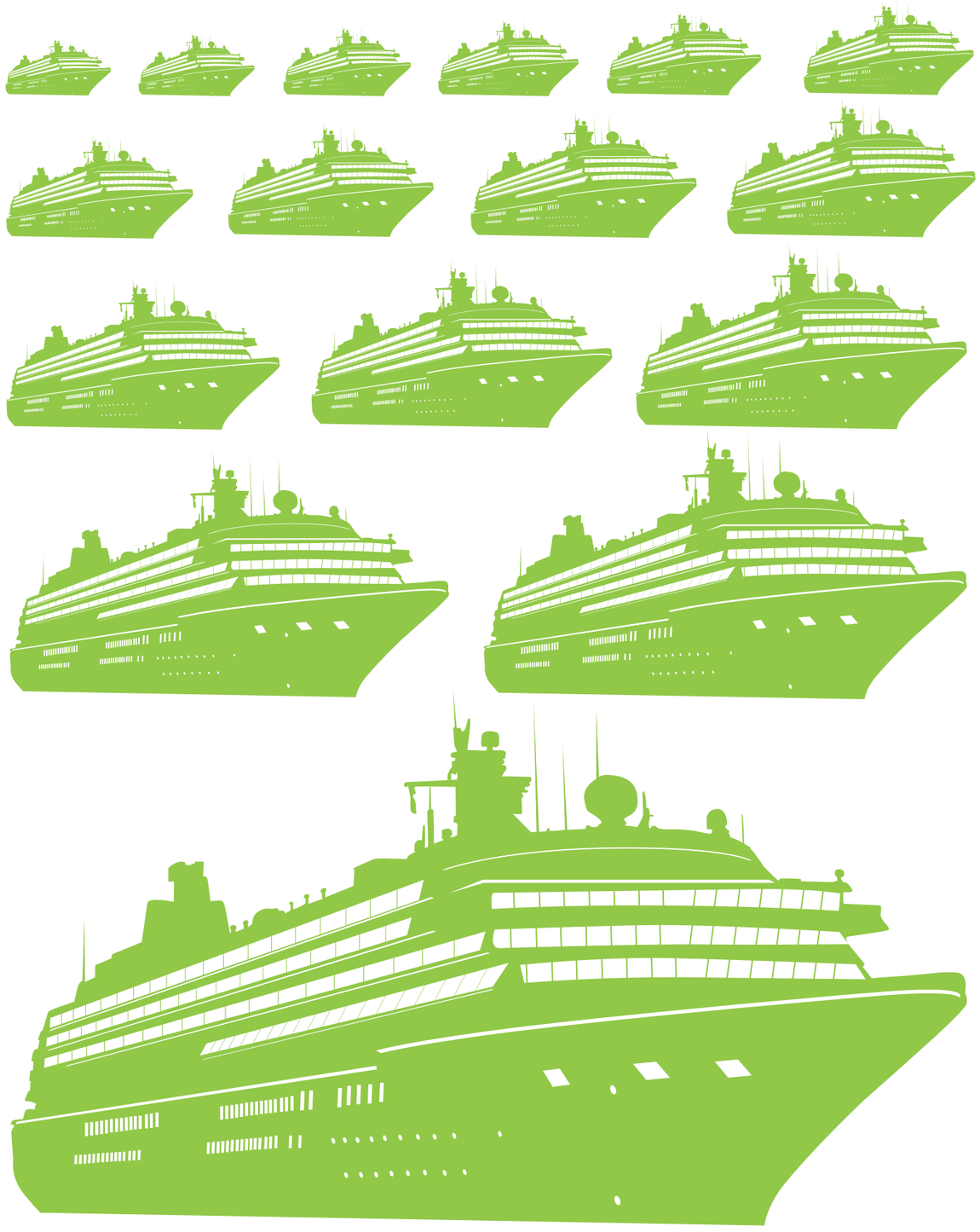
Now, we are using our experience and knowledge to address the latest challenge which shipping faces; climate change. As the IMO progresses on greenhouse gas issues, we are undertaking an IMO-commissioned study to assess the potential emission reduction resulting from implementation of the Energy Efficiency Design Index (EEDI) for new ships and the Ship Energy Efficiency Management Plan (SEEMP) for existing ships.

Standards

Lloyd's Register has been involved in international standardisation since the emergence of ISO 9001, the quality management system standard, in 1985. We contribute to standards development at both the national and international level, in some cases serving on committees and in working groups. We chaired the committee that drafted the first PAS 28000 on supply chain security and acted as Group leader for standards within the new ISO 30000 series – Management Systems for Ship Recycling.

Sustainability

Finally, no discussion of tomorrow's sustainable vessel of the future is complete without considering what we mean by the word 'sustainability'. Implicit in it is the recognition that environmental, social and economic considerations must be balanced. Without addressing social and environmental issues, a business experiencing short-term economic success cannot expect to remain successful into the future. Similarly, environmental initiatives will be threatened if they are not economically viable or do not take into consideration the well-being of those involved or affected.



Meeting the sustainable vessel challenge through research

At Lloyd's Register, we have a detailed research agenda which is addressing the sustainable vessel challenge.

This includes:

Green ship of the future

Low carbon shipping

Propulsion technologies:
- Propeller and system efficiencies
- Hydrogen fuel cells
- Nuclear power
- Battery-powered ships, gas-fuelled ships and onshore power supplies
- Fuels based on renewable energy such as bio-fuels.

Designs for ship recycling

A few of these projects are outlined here:

Design for ship recycling

We are conducting research on the concept of design for recycling, working with a world authority on recycling from a leading UK university and using their knowledge gained from land-based industries. The outcome will enable guidelines and rules to be drafted for implementation by designers and builders.

Low carbon shipping

Lloyd's Register, together with 16 industrial partners and five UK universities, is researching low carbon shipping. The project is analysing the shipping industry to develop a holistic understanding of the contractual, technological and financial issues involved in optimising future ship concepts to achieve maximum reduction of carbon emissions.

Propulsion technologies

We are reviewing potential improvements to current propulsion technologies. Early results include fuel efficiency gains of up to 20% by optimising the hull shape, while savings of about 8% have also been shown to be possible by applying appropriate coatings to the hull. Further potential fuel savings of up to 8% have been demonstrated by replacing an old turbo-charger, and by improving the fuel injection system, savings of between 5 to 7% have been shown to be feasible. While these technologies are available now, we have to establish that the savings can be achieved in real situations and that there is no impact on ship safety. The knowledge we gain will help inform the development of our Rules and Regulations.

Nuclear power

We are currently exploring the reintroduction of nuclear propulsion for merchant ships. Research is focused on the technical challenges of nuclear propulsion for tankers, bulk carriers, container ships and cruise ships, as well as refuelling and waste-disposal issues. The programme has been expanded to include public health, manning, training, operational, risk and regulatory requirements.

Bio-fuels

As world leaders continue to discuss carbon emission reduction goals, much consideration is being given to the role of bio-fuels in the transport sector. We are currently conducting safety reviews of the use of bio-fuels on existing ships with industry stakeholders and learning more about the potential future use of bio-fuel engines. Current research in the UK includes a project to power a fishing vessel on 100% bio-diesel and another fishing vessel on pure plant oil. We are also building our understanding of the different sources of bio-fuels and their implementation issues.

Research case studies:
Working with the industry to develop the green ship of the future

China

Lloyd's Register Classification Society (China) [LRCS] and Shenzhen-listed Shanghai Bestway Marine Engineering Design (Bestway) are jointly developing a new fuel-efficient bulk carrier in response to increasing pressure from owners and regulators for shipbuilders to offer environmentally friendlier and more cost-effective vessels.

The project will focus on finding energy-efficient alternatives for a 35,000 dwt 'Handysize' bulk carrier and will focus on two areas: energy-efficiency research into the ship's hull and systems, and technical approval and implementation of the proposed solutions. The research uses the IMO's Energy Efficiency Design Index as a benchmark.

Europe

Lloyd's Register is one of 26 partners to the Danish joint industry project 'Green Ship of the Future'. The project offers a framework within which technologies capable of obtaining a 30% reduction in CO_2 emissions and a 90% reduction in NO_X and SO_X emissions can be developed and demonstrated. (2007 emission levels are used as a baseline.)

Other projects

We are also working on 'green ship of the future' projects with other industry organisations in South America and Asia. The projects aim to tackle the sustainable vessel challenge by focusing on the following criteria:

- Safety of operations and crew
- Technical feasibility
- The balance between 'planet, people and profit'
- Cost effectivenes
- Life cycle thinking.

Human factors case study:
People and the environment – an audit for V.Ships

V.Ships, the world's largest ship manager, was looking to further improve its environmental risk management and asked Lloyd's Register to carry out an audit. What made this audit different was that it not only checked compliance with the international environmental Convention, MARPOL, but it also focused on the company's people and management culture. Together, we developed a year-long environmental audit – the first of its kind, it addressed human factors which could affect safety culture, such as issues around blame, motivation, communication and the need to lead by example.

We carried out in-depth interviews over 12 months with crew and shore-based management. These were analysed to provide the management team with a better insight into the steps necessary to foster a real and positive safety culture and move further away from a culture of simply doing enough to be compliant.

UASC owned *MAYSSAN*, which has been awarded Lloyd's Register's Environmental Protection notation.

How can we help?
Human factors services

We provide human factors support to help ensure safe and effective performance of new and existing vessels through good ergonomics, working environments and working practices.

Technical Services
Design and assurance of physical ergonomics; cognitive ergonomics; and socio-technical systems.

Human Factors Integration
Assessment of the feasibility of the role of people in a system, the usability of human-machine interfaces and the sustainability of the required level of human performance.

Safety Culture Toolkit
Evaluates an organisation's safety culture with respect to key behavioural indicators to provide recommendations for improvement. The service involves interviews with staff.

Safety Culture Evaluation Toolkit
Provides an understanding of an organisation's relative strengths and weaknesses in achieving continual safety improvements. Through analysis of incidents, and survey and scenario-based interviews and workshops, we develop a safety culture profile and identify short-term and longer-term solutions for improvement.

For more information please visit:
www.lr.org/hf

Environmental Protection case study:
UASC shows the way

Middle East-based container ship operator United Arab Shipping Company (UASC) showed its commitment to environmental awareness by opting for our Environmental Protection notation on its largest Lloyd's Register classed box ships built to date.

Among the additional environmental features fitted to the UASC vessels in order to obtain the EP notation are:

– an electronically controlled main engine in accordance with MARPOL Annex VI NO_x requirements
– segregated low-sulphur bunker tanks
– a refrigerant leak detection system to continuously monitor leakage
– operational features to minimise the translocation of organisms in ballast water.

Speaking on the decision to opt for the EP notation for its vessels, UASC's Vice President – Fleet Technical, Mohammad Al Sayed, said: "As part of UASC's environmental planning and strategy, opting for Lloyd's Register's EP notation for these vessels provided a framework to enable us to work towards in meeting UASC's environmental vision."

How can we help?
Environmental Protection (EP) notation

Lloyd's Register's Environmental Protection service is designed to help shipowners and operators control operational pollution and demonstrate their proactive approach to clients and regulatory authorities.

The service is based on our voluntary *Rules for Environmental Protection*. These set standards for the design and operation of all ship types, covering areas such as NO_x and SO_x emissions, oil pollution prevention, refrigerants & fire-fighting agents, garbage handling and ballast water management. The Rules are formulated using environmental risk assessment techniques and are regularly updated to reflect operational feedback and any developments in technology and legislation.

With an Environmental Protection notation in place, an organisation can publicly demonstrate its commitment to running an environmentally sound business.

For more information please visit:
www.lr.org/ep

Standards case study:
Making ISO14001 relevant

The international standard, ISO14001, originally published in 1996 and revised in 2004, was developed by an international committee of experts which included Lloyd's Register representatives. During the revision process, we provided regular updates on developments to clients and also set up a group, in conjunction with Lloyd's Register Quality Assurance, to support the understanding of ISO14001 in the marine environment. Many shipowners, operators and builders use ISO14001, both for new builds and repair, as a means of managing their environmental impact and demonstrating their commitment to environmental protection.

How can we help?
ISO14001 Practical Pack

For standards to be of benefit to organisations, it is also important that they are explained clearly. To help the marine community implement ISO14001, we have developed a CD-Rom-based Practical Pack for Ship Operators. This provides shipping industry-specific guidance and advice on the ISO14001 environmental management standard and helps ship operators establish environmental management systems.

For more information please visit:
www.lr.org/pp

What's on the radar?
A look ahead at forthcoming international legislation

Since the 1970s, the answers to the environmental questions facing the maritime world have been spearheaded by the International Maritime Organization (IMO), the body which regulates shipping through international consensus.

During this time, the IMO has successfully adopted a number of international treaties, such as the MARPOL Convention with its six Annexes, the Anti-fouling Systems Convention and the Ballast Water Management Convention.

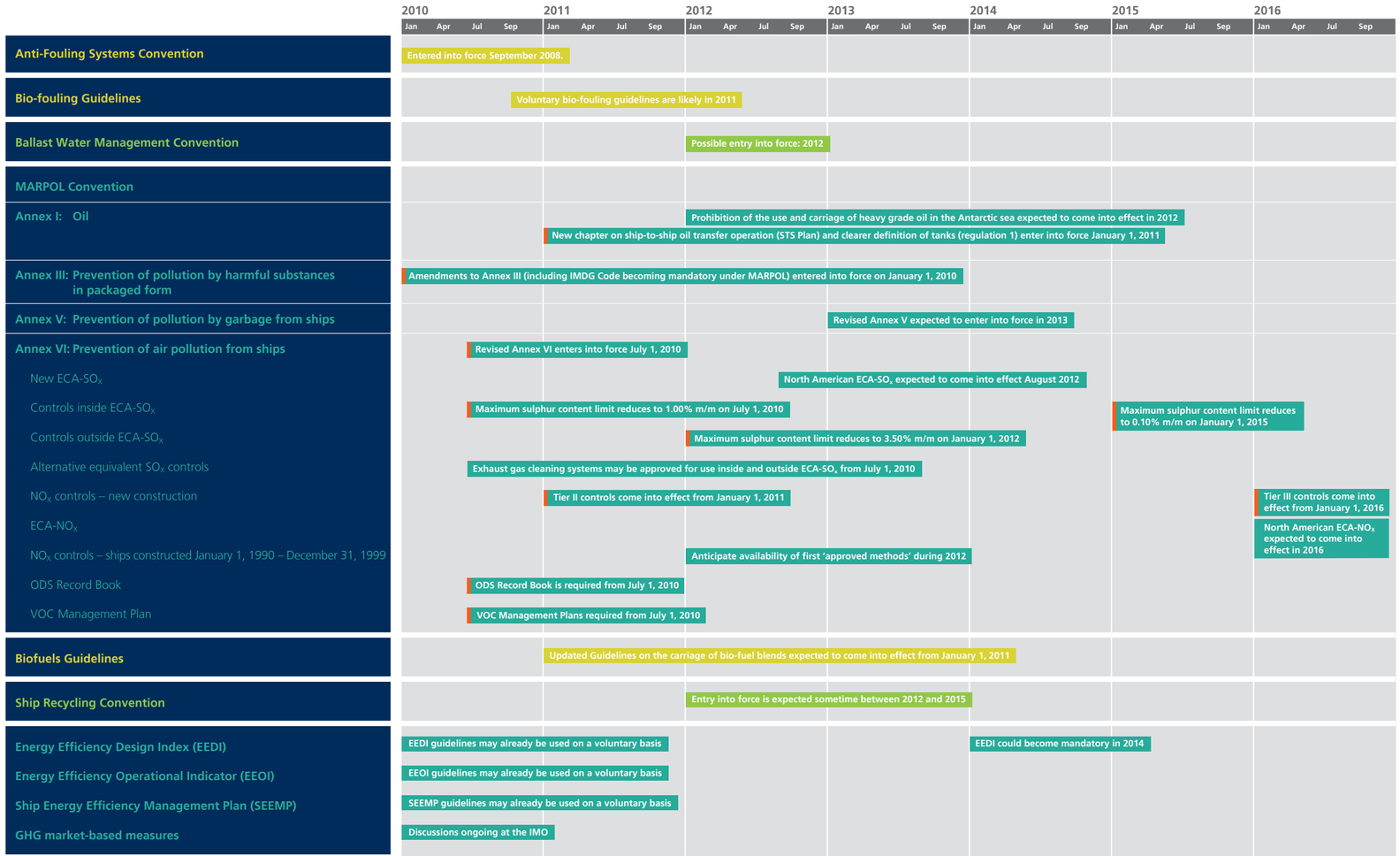
The majority of these are in force today and contributing to the protection of the environment both in water and in air, while others are on a steady course towards ratification. In fact, 21 of the 51 IMO Conventions relate to environmental issues.

Our environmental roadmap outlines the key existing and forthcoming environmental legislation from the IMO up to the end of 2016, identifying future compliance dates and emerging regulations. While we are only looking at international legislation here, there are of course many national and regional requirements affecting owners and operators, such as EU Directives, the California Air Resources Board (CARB) regulations and other local or port-specific requirements.

21

of the 51 IMO Conventions relate to environmental issues

Environmental roadmap



Key effective/compliance dates. Length of bar does not indicate time-scale

A deeper look

The arena of environmental compliance in shipping is vast, but there are some key areas currently presenting the marine industry with critical challenges and questions. Here we take a deeper look at six of these – fuels and exhaust emissions, ballast water management, ship recycling, energy, volatile organic compounds and hull coatings – and the key issues and legislation surrounding them. >

Annex VI and future ship design – the impact of exhaust emission controls

The revised MARPOL Annex VI sets out substantial changes in exhaust emission controls which will have far reaching effects on shipping.

Up to now, however, the initial controls have not really resulted in any particular differentiation within the industry or between ships.

Those ships currently subject to the NO_X controls have generally been fitted with certified engines, while for ships currently subject to SO_X controls (which really means ships operating within the existing North Sea and Baltic SO_X Emission Control Areas (SECAs)), compliance has been achieved through the bunkering and use of fuel oils manufactured to meet the initial 1.5% sulphur limit.

The Annex's global fuel oil sulphur limit of 4.5% has not really been a factor; the IMO's fuel oil sulphur monitoring programme (which has been running since 1999) shows that, even before Annex VI came into force in 2005, fuel oil sulphur content as bunkered never exceeded 4.5% by more than a fraction of one per cent – a situation which is continuing to date.

The first stage reductions, while important, do not represent a radical change either. The July 1, 2010 reduction to 1.00% within Emission Control Areas established to limit SO_X and particulate matter emissions (ECA-SO_X – as the existing SECAs are restyled under the revised Annex) will be met by increasing the low-sulphur blend ratio. The reduction outside ECA-SO_X to 3.50%, meanwhile, is not a major challenge – even now less than 12% of the fuels in the IMO sulphur monitoring programme are over that limit, and only just over 2% exceed 4.0%. Under these circumstances, the drive to employ secondary controls, such as exhaust gas cleaning systems (which are now a potential compliance option both inside and outside ECA-SO_X) may be limited. Similarly, the reductions in the NO_X limits to the Tier II levels will, it is expected, continue to be met using in-engine controls.

It is the dramatic second stage of NO_X and SO_X reductions which will see major changes arising in the options for compliance. It is clear that there will be a distinction between ships built before or after January 1, 2016; the SO_X controls will apply to all ships, while the Tier III NO_X controls will apply only to ships built in 2016 or later when operating in Emission Control Areas established to limit NO_X emissions – ECA-NO_X. Further distinctions will occur based on areas of intended operation; some ships will never enter, or never leave, either SO_X or NO_X ECAs, while others will operate both inside and outside them for some of the time. How much time may well change during a ship's lifespan and is further complicated by the potential for new ECAs to be established. Already, the North American ECA (covering both SO_X and NO_X) has been accepted by the IMO and there is a high likelihood that other areas will seek similar status.

Additionally, while SO_X controls may be either operational (bunkering a fuel oil of the required sulphur content) or equipment-based (using an exhaust gas cleaning system), the Tier III NO_X controls will, in all probability, require systems to be fitted at the time the engine is constructed.

"The existing 'one-size-fits-all' approach will not apply in future."

So where does this leave the industry? Well, taking into account the various factors (only some of which are known or at least reasonably predictable) – ship construction date; known and likely trading areas; the establishment of further ECAs; technology availability and performance; payback potential of capital investments; petroleum fuel price and availability; and alternative fuel and engine types – a range of radically and fundamentally different primary or secondary control options for compliance will become available.

Consequently, the fuel and machinery configuration used by the majority of ships for the last few decades will change. The existing 'one-size-fits-all' approach will not apply in future – instead, shipowners considering new orders or scheduling drydockings for existing ships will need to carefully assess the available compliance options and select the one that works best for them – and for the future value of the ship.

Legislation: **Annex VI of the MARPOL Convention**

The revised MARPOL Annex VI comes into force on July 1, 2010. The principal amendments are step changes to the limits for NO_X and SO_X emissions. The revised Annex also introduces the concept of Emission Control Areas (ECAs) – as opposed to the previous SECAs. ECAs may be NO_X, SO_X or both NO_X and SO_X control areas.

NO_X emissions

NO_X requirements continue to apply only to installed diesel engines over 130 kW. Different tiers of control have been introduced based on ship construction date, with the limit value determined on the basis of engine rated speed. However, in the case of additional or non-identical replacement engines the applicable Tier will be set by the installation date. Tier III limits apply only inside NO_X Emission Control Areas.

Tier	Ship construction date on or after	Total weighted cycle emission limit (g/kWh) n = engine's rated speed (rpm)		
		n < 130	n = 130–1999	n ≥ 2000
I	January 1 2000	17.0	45.n-0.2	9.8
II	January 1 2011	14.4	44.n-0.23	7.7
III	January 1 2016*	3.4	9.n-0.2	2.0

*Depending on the outcome of a review (to be concluded in 2013) as to the availability of the required technology, this date could be deferred.

Existing engines over 5MW, of 90 litres and above per cylinder, installed on ships constructed between January 1, 1990 and December 31,1999 are required to limit NO_X emissions to Tier I levels – if a so-called 'approved method' for NO_X emission control is commercially available.

SO_X and particulate matter emissions

The revised Annex introduces a number of changes to the maximum allowable sulphur content of fuel oil, both inside and outside SO_X and particulate matter Emission Control Areas. Compliance using alternative means such as exhaust gas cleaning systems is also allowed.

Fuel oil sulphur limits outside SO_X and particulate matter ECAs	Fuel oil sulphur limits inside SO_X and particulate matter ECAs
4.50% m/m before January 1, 2012	1.50% m/m before July 1, 2010
3.50% m/m on and after January 1, 2012	1.00% m/m on and after July 1, 2010
0.50% m/m on and after January 1, 2020*	0.10% m/m on and after January 1, 2015

*Depending on the outcome of a review (to be concluded in 2018) as to the availability of the required fuel oil, this date could be deferred to January 1, 2025.

Case study:
The next generation of fuel monitoring: FOBAS Onboard with Lab-On-A-Ship™

We have been working with NanoNord A/S of Aalborg, Denmark, on an innovative approach to ensuring that fuel oils are adequately pre-treated and then burned in the most efficient manner.

Lab-On-A-Ship™ is an onboard fuel oil, lubricating oil and exhaust emission monitoring system. It allows ships' engineers to take the actions necessary to optimise both fuel oil treatment and use on a truly informed basis with the benefit of further support through shore-based trend and event analysis.

The pilot application of Lab-On-A-Ship™ on the ships of Lauritzen Bulkers AS, Copenhagen is a key project. As a first step, the Lab-On-A-Ship™ systems were installed on two of Lauritzen's ships – *Sofie Bulker* and *Amine Bulker*. In parallel, Lloyd's Register's FOBAS team was commissioned to provide in-depth fuel oil management training to the ship's engineers, superintendents and technical management.

Lauritzen is positive that Lab-On-A-Ship™ will enable it to optimise its ships' operations, thus reducing both their environmental impact and operating costs. Lauritzen Technical Manager, Poul Martin Kondrup, commented: "Our goal is to extend the onboard measurement capability to encompass the highly variable fuels and lubricant quality issues encountered by shipping. This will represent a substantial step forward in making the correct machinery management decisions which enable targeted action, the minimisation of waste and impact on the environment."

The Lab-On-A-Ship™ project is also being piloted on three other ships. Initial findings are expected during 2010.

How can we help?
Fuel and exhaust emissions services

Lloyd's Register's FOBAS services help shipowners and operators to manage fuel quality and comply with emissions controls.

Fuel Oil Bunker Analysis
Through our collaboration with Intertek, the leading global fuel testing laboratory, we can offer rapid independent verification of fuel quality against international standards and environmental legislation, helping businesses manage the risk from poor quality fuel.

FOBAS Engine
FOBAS Engine analyses eight key indicators to gain an insight into the operational performance of marine engines. Through this holistic approach, we provide practical guidance to help correct any issues and achieve efficient engine performance.

Fuel System Audit
Our fuel system audit tests the effectiveness of a vessel's treatment system. In a fuel quality or machinery damage dispute, it can help establish that a system is well maintained.

Fuel Change-over Plan
The Fuel Change-over Plan provides step-by-step guidance covering all aspects of change-over to low-sulphur fuel, helping ensure compliance with international, regional and local SO_x requirements.

Exhaust emissions services
We provide a wide range of services in this challenging area. In addition to providing advice and practical guidance on regulations and compliance options, we evaluate exhaust gas measurement proposals to help meet your needs and objectives.

For more information please visit:
www.lr.org/fobas

Legislation:
At berth requirements – providing the answers

The 'at berth' requirements of EC Directive 2005/33/EC have been the cause of considerable interest and uncertainty. In force since January 1, 2010, the Directive requires that ships burn fuel oil with a maximum sulphur content of 0.1% when 'at berth'. However, considerable concerns still exist as to compliance, associated technical issues and how the requirements are likely to be enforced.

To assist shipowners and others in understanding the operational realities of compliance, we have prepared a set of frequently asked questions (FAQs). These provide clarification and guidance on around 60 different issues, including:

Do the requirements apply whenever a ship is anchored in EU waters?
Since the requirement is given as '…ships at berth in EU ports…' it would be considered that if a ship anchors within EU waters but outside a zone controlled by a particular port or navigation authority (i.e. to effect repairs or awaiting orders) then the requirement does not apply.

Does the change-over requirement apply to ships which are 'at berth' for less than two hours?
Yes. The 'two hours' given in the Directive only applies where there is a published timetable which gives the time 'at berth' as less than two hours (i.e. in the case of ferries on scheduled services). There is not a general exemption for ships which will be 'at berth' for less than two hours.

On arrival at an EU port if a ship first goes to anchor and then later moves to a berth alongside is it required to use a 0.1% m/m maximum sulphur fuel oil during that passage from anchorage to berth?
If the particular EU member state considers that anchorage to be part of the 'port', thereby making change-over necessary while at anchor, the ship is not required to use a 0.1% m/m maximum sulphur fuel oil during the passage from anchorage to berth.

What will happen if it is necessary for a ship to have certain modifications to machinery, storage arrangements, piping or control systems before being able to use a 0.1% m/m maximum sulphur fuel oil but those modifications have not yet been installed?
This very much depends on the range of views which will be taken by the individual member states. As indicated by the European Commission's Recommendation, published December 29, 2009, compliance is still required; it is up to the member state, if they wish to be so guided, to consider the degree to which actions have been taken to prepare the ship and its equipment when deciding what penalty to apply in particular cases.

The full FAQs can be downloaded at www.lr.org/fobas

Looking ahead at retrofitting – the challenges of retrospective legislation

The International Ballast Water Management Convention is not yet in force and, since the process is dependent on government ratification, it is difficult to predict when it might happen.

Nevertheless, shipowners need to think ahead as they will, at some stage in the not too distant future, be required to install and use ballast water treatment systems.

While this presents a challenge for any owner, the Convention's requirement for systems to be retrofitted on existing vessels means it is those with ships in service who will potentially find achieving compliance most onerous.

This retrospective aspect is one which is being seen more often, as compliance dates pass before Conventions are ratified. For owners, it means looking ahead and assessing the options as soon as possible.

The feasibility of retrofitting ballast water treatment technology encompasses a host of issues. Owners will need to research available treatment systems and their associated costs (including initial outlay, installation and running costs) and power consumption, as well as availability of consumables and service agents.

They will also need to consider whether retrofitting can be carried out at sea or if a repair yard is required. If it can be done at sea, can the work be wholly or partly carried out by the ship's staff? The logistics of installation, including access to the chosen location, are also a vital consideration.

For newbuilds, while a system must still be researched and identified, the challenges are perhaps more straightforward.

Owners should ensure that there is space on board to fit a treatment system, and enough available power (some have quite large power requirements). They should also make provision for control systems, such as control air or fresh water supplies, storage of chemicals that may be used in the system and any fire protection and extinction measures that may be required. For tankers, owners must consider whether the system is certified as gas safe.

The recommendation from Lloyd's Register is, if possible and if a suitable approved system is available, to install one at new build or at the very least to design the vessel so that retrofit is simplified.

While owners consider these questions, another aspect of the Convention – the interim provision for ballast water exchange, which will be phased out according to ballast water capacity – is already an accepted part of operations for many internationally trading vessels. There is now a large number of national, and some regional, requirements which require that ships undertake exchange – some mandatory and some voluntary. These are largely similar, stipulating that exchange takes place at a minimum distance from land in a specified depth of water, and that a ballast water management plan is prepared and kept on board. And while ballast water exchange does have some safety implications, these are well understood and can be mitigated with good planning and crew training.

Ballast water exchange remains a temporary solution, however. For owners and operators, planning for the installation and use of treatment systems should start now.

How can we help?
Ballast water management services

Lloyd's Register offers a comprehensive range of ballast water management services that cover:
– development and approval of ballast water management plans (and the bwmp notation)
– approval of treatment systems.

We can help develop a safe, practical strategy to reduce the risks associated with ballast waste management and meet environmental responsibilities. By adopting our systematic procedures, businesses can be confident of meeting national regulations and the IMO's Ballast Water Convention and its associated guidelines.

Our ballast water management plans are specific to each ship and draw on our wide experience and research. Each ship's plan will address and account for all key ballast water issues while helping to ensure that overall structural integrity and operational safety of the ship is not compromised.

For those businesses that have a ballast water management plan in place already, we can review and approve it against the Lloyd's Register Group assessment procedure and the IMO guidelines. Wherever we find that a satisfactory plan is in operation, we issue a ballast water management plan certificate, accompanied by the appropriate descriptive note, demonstrating to relevant authorities and organisations that the ship has a documented, verified procedure for ballast water management.

Understanding treatment technology
Our *Guide to Ballast Water Treatment Technology* provides an independent appraisal of commercially available and developing ballast water treatment technologies and their testing and approval status.

For more information please visit:
www.lr.org/bwm

Legislation:
The Ballast Water Management Convention

The International Convention for the Control and Management of Ships' Ballast Water and Sediments will come into force 12 months after ratification by 30 states, representing 35% of world merchant shipping tonnage. At the time of writing, 22 states, representing more than 22% of the world's tonnage, have ratified the Convention.

The Convention will apply to all ships engaged on international voyages that carry ballast water. Initially ships will be required to treat or exchange ballast water, but a mandatory requirement to install and use a ballast water treatment system is being phased in based on the timescales set out below.

Ballast capacity	Year of ship construction			
	Before 2009*	2009+	2009-2011	2012+
< 1500 m^3	BWE or BWT until 2016; BWT only from 2016	BWT only		
1500 – 5000 m^3	BWE or BWT until 2014; BWT only from 2014	BWT only		
> 5000 m^3	BWE or BWT until 2016 BWT only from 2016		BWE or BWT until 2016; BWT only from 2016	BWT only

*These ships need to comply at the first intermediate or renewal survey after the anniversary of the date of delivery in the year of compliance.

BWE – ballast water exchange
BWT – ballast water treatment

Due to the uncertainty regarding the availability of approved ballast water treatment systems, the IMO adopted a resolution which recommends that, for ships constructed in 2009 with a ballast water capacity of less than 5000m^3, a treatment system need not be fitted until the second annual survey under the Convention or by December 31, 2011, whichever is earlier. For ships built in 2010, it is considered that sufficient systems will be available. However, the IMO will review the situation in October 2010.

At present there are eight fully approved ballast water treatment systems available on the market. Approximately 20 additional systems are activity pursuing approval and a further 30 or so systems are at various stages of development. A number of systems have already been installed on ships voluntarily or to comply with local regulations.

Shipbuilders and owners should consider installation of ballast water treatment systems for ships scheduled to be built in 2010 and later. As a minimum, owners should ensure that new vessels can retrofit the required treatment systems when the Convention comes into force.

Waiting for ratification – life before the recycling Convention

Today, most ship scrapping takes place in South Asia – mainly in India, Bangladesh and Pakistan where demand is high for steel scrap. Some 95-98% of a ship's lightweight is recycled.

Over the last ten years, from being the concern only of buyers and sellers of old ships, the end-of-life process for ships has attracted interest from many concerned about safety and environmental impact during the process and afterwards.

If ship recycling has been efficient in terms of providing a ready supply of steel and other metals for re-use, there has been a cost in terms of lives lost and local environmental impact.

Cutting apart big steel structures is a complex and hazardous business. Even though a high proportion by weight of the ship's structure is re-usable, there are significant amounts of plastics and other materials that should be handled carefully and appropriately. Noting 'the growing concerns about safety, health and the environment and welfare matters', the Ship Recycling Convention was adopted by the IMO last year.

However, while the industry waits for the Convention to enter into force, the most significant regulatory framework affecting ship recycling remains the Basel Convention. This came into force in response to the shipping of hazardous waste to developing countries and to Eastern Europe by 'traders' seeking to circumvent expensive and closely regulated waste disposal in their own countries. However, it was not specifically drafted to include the concept of ships themselves being defined as 'hazardous waste'.

In some cases, ships have been identified as 'hazardous waste' by concerned authorities. A recent example was the 50,700 ton LNG carrier, *Margaret Hill*. In early August 2009 the ship was detained by the UK Environment Agency as she attempted to sail to India (she has since been released and is reported to be waiting at a shipyard for a conversion project). This was a clear example of a merchant ship destined for scrap being designated as 'dangerous goods' or 'hazardous waste' by an OECD government. It sets an interesting precedent since the *Margaret Hill* was unlikely to be dissimilar in terms of construction materials to any other ship of her type and generation.

For most shipping companies, their end-of life solution policies have yet to change, but there are a growing number of companies who are seeking safer and more environmentally friendly methods of recycling ships. These owners are reviewing their end-of life policies or actively managing the demolition and recycling process. Maersk is one such company. It has now recycled 20 ships in one yard without serious injury to the yard workforce. Such experiences have helped spur the formation of the International Ship Recycling Association (ISRA) which is building a body of ship recyclers to help provide confidence to owners looking for more control over the recycling process. China has become a destination of choice for many of these owners seeking more control of the demolition facilities.

95-98%

of a ship's lightweight is recycled

Old lighting ballasts on a ship may be contaminated with polychlorinated biphenyls (PCBs), which are persistent environmental pollutants.

Additionally, shipowners in the vanguard of environmental compliance are also adopting the requirements for the Inventory of Hazardous Materials (IHM) which will be mandatory under the Recycling Convention.

Today, and for the immediate future, a combination of factors needs to be weighed up and a decision made by the owners involved. The application of international conventions is, of course, often uneven. Safe and environmentally sound ship recycling is essentially in its infancy and there is no such thing as just one acceptable technique. The Industry Working Group on Ship Recycling has produced guidance for owners to help them decide what to do in this interim period.

Legislation: **The Ship Recycling Convention**

On May 15, 2009, at a diplomatic conference in Hong Kong, the International Convention for the Safe and Environmentally Sound Recycling of Ships was adopted by 63 member states of the International Maritime Organization (IMO).

The Convention will enter into force when it has been ratified by 15 states, representing 40% of the world fleet – something that is likely to occur between 2012 and 2015. Its aim is to lay down legally binding and globally applicable ship recycling regulations for international shipping and for ship recycling facilities, and it will have serious ramifications for shipowners, builders, repairers and breakers.

Overall, the Convention can be described as a response to the lack of regulation and standards in ship breaking practice – especially where safety, environmental and quality standards are concerned. It covers the entire ship life cycle, from design and construction, through in-service operation to dismantling and requires:

– ships to have an Inventory of Hazardous Materials (IHM) – also known as the Green Passport
– new builds to exclude certain hazardous materials
– ship recycling facilities to be authorised by the national authority
– ship recycling facilities to provide an approved 'ship recycling plan' detailing how the ship will be recycled
– ships flying the flag of Parties to the Convention to be recycled only in authorised recycling facilities
– ship recycling facilities which are located in Parties to the Convention to recycle only ships which they are authorised to recycle.

Associated regulatory requirements include:

– The ILO requirements for Safety and Welfare in Ship Recycling Facilities
– The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
– The European Waste Shipment Regulations (and other regional equivalents).

Gulf Castle is one of 11 GEM tankers with a Green Passport.

FLOPEC's *Pichincha*, a 105,000 dwt Aframax tanker, was the first Lloyd's Register-classed ship to be delivered in 2010.

Case study:
Significant demand for the Green Passport

Many shipowners are adopting the Ship Recycling Convention requirements. Among them, FLOPEC, Gulf Energy Maritime (GEM) PJSC, Wallenius Marine AB, Odfjell Management AS and Caledonian Maritime Assets Ltd (CMAL) have all attained a Lloyd's Register approved Inventory of Hazardous Materials (Green Passport) for ships in their fleets, demonstrating an ongoing commitment to safeguarding the environment and early compliance with the legislation.

Here are some of their comments on obtaining a Green Passport and on environmental compliance in general:

FLOPEC
Rear Admiral Aland Molestina, President of the FLOPEC Board: "…as an environmentally conscious company, one of our priorities was to ensure compliance with the environmental requirements of our traditional trading areas."

"We are pleased to have Lloyd's Register on our team to help us implement Green Passports in the best possible way."

Helge Olsen
Senior Vice President, Ship Management, Odjfell

How can we help?
Ship recycling services

Inventory of Hazardous Materials approval and verification (Green Passport)
In 2004, Lloyd's Register was the first classification society to issue an independently verified Green Passport – now known as the Inventory of Hazardous Materials and a key requirement of the Ship Recycling Convention. Through this service, we help owners and operators achieve compliance with the Convention. We also provide a list of companies that can assist in compiling the Inventory, helping to control costs. The Inventory can help to promote better hazard management on board ship and enable better long-term liability planning. It also helps companies to demonstrate their commitment to improving environmental standards and provides measurable and achievable objectives for ISO14001 certified companies.

Our *Guide to the Inventory of Hazardous Materials (Green Passport)* was published in May to help prepare the industry for the new regulations.

Assessing recycling standards
Through Lloyd's Register Quality Assurance (LRQA) we provide certification to the international ship recycling standard – ISO30000.

Audit during dismantling
We discuss the requirements for controlling the dismantling process, and provide: consultancy services before the dismantling starts; an assessment of the facility (against agreed standards); and supervision of the dismantling process in co-operation with the recycling facility.

For more information please visit:
www.lr.org/greenpassport

GEM
Captain Robert Ferguson, Head of Marine Safety and Environment: "Any useful 'tools', such as Green Passport, are welcome to a responsible shipping company in the successful environmental operation of the vessel and show commitment to environmental protection."

Wallenius
Per Tunell, Head of Environmental Management: "...we always try to be well ahead of coming rules and regulations that concern environmental issues. In fact, it is one of our principles. Therefore it was completely according to our strategy to start working with Inventory of Hazardous Materials at an early stage."

Odfjell
Helge Olsen, Senior Vice President Ship Management in Odfjell: "For Odfjell, Green Passport underpins our commitment to people's health and the environment. We are pleased to have Lloyd's Register on our team to help us implement Green Passports in the best possible way."

Caledonian
Guy Platten, Managing Director of CMAL: "We are constantly looking for new ways to address environmental issues, whether it's looking at alternative fuels for the ferries of the future or how best to recycle ferries safely at the end of their operational life. The Green Passport is a great example of proactively working with industry colleagues to take action now to help assure environmental protection in the future."

Wallenius Marine AB attained a Lloyd's Register-approved Green Passport for its vehicle carrier, *Tristan*.

Putting theory into practice – making the IMO energy efficiency tools effective

The non-shipping world is looking critically at the marine industry's contribution to greenhouse gas (GHG) emissions and asking how they can be reduced.

It's a complex discussion and there are different views on how best to reduce greenhouse gas emissions from shipping.

It is estimated that shipping (both domestic and international) contributes 2.7% to global CO_2 emissions annually – a similar amount to that emitted by Germany or Japan. To limit global temperature increase to around 2°C, it is thought that global GHG emissions will need to be reduced by 50% across the world, with developed countries reducing their GHG emissions by 80% compared to 1990 levels.

The IMO's Energy Efficiency Design Index (EEDI), in conjunction with the proposed Ship Energy Efficiency Management Plan (SEEMP) and Energy Efficiency Operational Indicator (EEOI) should help the industry achieve fuel efficiencies and a consequent reduction in greehouse gas emissions. The potential for improvement is quite significant: industry consensus points to a 50% overall increase in the energy efficiency of shipping in the long term.

However, these tools are voluntary, and may not yield the expected savings unless they are translated into mandatory regulation. As such, it is expected that the IMO will in future move to a statutory Energy Efficient Design Index in order to further advance reduction in CO_2 emissions from new ships. Before this happens, the industry will need to evaluate the options to ensure a smooth transition to low-carbon shipping. The IMO is also discussing various market-based measures.

To make the EEDI mandatory and effective, baselines or control limits will need to be agreed for various ship types, something which IMO will be deliberating at future Marine Environmental Protection Committee meetings.

And there are other issues which will also need to be addressed during the voluntary application period. Some of the concerns expressed by industry include:

– Optimisation of EEDI at the design stage for a specific operational speed may conflict in practice with the requirements of operational modes, leading to poor design decisions and higher subsequent energy consumption.

– EEDI as defined now may lead to lower power margin ships which would increase potential safety risks (during operation in heavy seas, for example). This concern has been raised for some specific ship types such as ro-ro vessels.

– EEDI will lead to slower ships. Reducing speeds could lead to cargo modal shifts that could potentially have a negative impact on overall transport-related emissions.

– EEDI verifications will often require data interpolation at the trials stage where the ship cannot be tested in the fully laden condition. Standard methods need to be developed for such cases.

– Specific fuel consumption will be obtained from engine builders data files but these may have been generated for NO_X rather than CO_2 and may require some interpretation.

Addressing these issues is critical to make sure the eventual statutory EEDI is as robust as possible. In the meantime, some operators are already making use of the tools, showing that the industry is already embracing the concept while mandatory instruments are forthcoming.

"The potential for improvement is quite significant: industry consensus points to a 50% overall increase in the energy efficiency of shipping in the long term."

Legislation: **Energy efficiency tools from the IMO**

The IMO has developed a range of voluntary measures aimed at helping the marine industry achieve fuel efficiencies and a reduction in emissions.

Energy Efficiency Design Index (EEDI)
This is intended to stimulate improved energy efficiency in new ships at the design stage. Interim guidelines for its application and verification will be applied on a voluntary basis for a trial period to assess the practicalities of their application. IMO member governments and observer organisations will be encouraged to provide feedback so that the guidelines can be improved and subsequently upgraded to a statutory instrument.

Energy Efficiency Operational Indicator (EEOI)
The EEOI is intended to standardise fuel efficiency assessment for ships in service and is directly related to bunker consumption. It has been devised to help shipowners and operators evaluate ship performance with regard to CO_2 emissions so they can improve fuel efficiency over time. Unlike the EEDI, the Indicator is not set to become mandatory.

Ship Energy Efficiency Management Plan (SEEMP)
In conjunction with the above measures, the IMO has released guidance for the development of a Ship Energy Efficiency Management Plan which incorporates best practice for fuel efficient ship operations. Although this may form part of a company's environmental management system, it is not mandatory at this stage. The EEOI can be used to check SEEMP effectiveness.

2.7%

– the proportion of global greenhouse gases caused by international shipping CO_2 emissions

Finding ways to save energy

Our ship energy audit service helps owners identify potential energy savings in a wide variety of ways, from analysis of operating systems to the cultural practices that govern them.

Case study:
Bright ideas

On a big passenger ship, lighting consumes a lot of energy. Since incandescent light bulbs convert more than 90% of the energy they use to heat, the choice of bulbs and their efficiency play a major role in energy conservation. We investigated the lighting systems on board a Panamax passenger ship, recording the number of lights and their type and rating to analyse their approximate daily electrical consumption. The audit identified that extensive use of 50 watt halogen spotlights and a lack of lighting control in certain areas (passenger cabins, for example) were adding to the ship's energy consumption.

We concluded that the use of energy saving lighting and the retrofitting of smart lighting control devices, together with an improved load factor, would lead to a reduction in power consumption of more than 300 kW and an estimated saving of $183,000 per year. In addition, the reduction in heat generated by the lighting would reduce the HVAC (heating, ventilating and air conditioning) system load, resulting in additional savings. Following the audit, the owner installed energy saving lighting as part of the company's energy conservation programme.

Fuel consumption reduction:
457 metric tonnes (MT) per year

CO_2 reduction:
1,440 MT per year

Estimated saving:
$183,000 per year (@ $400 per MT)

Estimated cost:
$130,000

Payback:
8.5 months

How can we help?
Ship energy services

We provide a range of ship energy services which can be customised according to a business's needs. Working closely with each organisation, we aim to improve energy efficiency across the fleet in a number of ways:

– Ship energy audit
– Ship performance monitoring
– Fleet energy management support
– Design optimisation support
– Advice on alternative technologies.

Our services can assist in determining your CO_2 emissions footprint, calculating ship energy efficiency indices and implementing energy efficiency measures (including the EEDI, EEOI and SEEMP).

For more information please visit:
www.lr.org/ses

"Working closely with your organisation, we aim to improve energy efficiency across the fleet."

Case study:
Investigating shipboard power management culture

In order to insure against blackout, two auxiliary engines are often operated in parallel for long periods at less than half load. This is common practice in port, at anchor and during tank cleaning and ballast exchange operations. The operation of diesel engines at low loads tends to lead to more maintenance and higher fuel consumption.

On board an aframax tanker, we evaluated the prevailing shipboard practices, paying particular attention to: the engines' load factor trends; the extent to which the PMS (power management system) was used; and the ship's electrical demand management. We found that the engines were often being operated manually, leading to situations where both were running at low loads.

While there are times when two generators are required, the audit showed that both were being used even in calm weather during normal passage. This could have been attributed to the engine room team being reluctant to rely on the PMS to start additional generators when required. Through our findings, we were able to demonstrate that the PMS was capable of effectively managing the auxiliary engines in automatic mode, which included a load-dependent start and stop set up.

We proposed specific corrective actions for the engines' load and recommended more effective use of the PMS and the introduction of specific instructions concerning manual engine operation. Our recommendations also included the introduction of benchmarks to help ensure that compliance with the proposals was monitored.

Fuel consumption reduction:
29 MT per year

CO_2 reduction:
92 MT per year

Estimated saving:
$11,600 per year (@ $400 per MT)

Estimated cost:
None

Payback:
Immediate

On a big passenger ship, lighting consumes a lot of energy.

The human element is a key consideration when conducting ship energy audits.

Cleaner air and more oil in the tank

Teekay, one of the world's leading tanker operators, has been working hard to reduce the amount of crude oil lost as vapour during loading and transportation.

Commonly designated Volatile Organic Compounds or VOCs, these hydrocarbon gases are low level pollutants which over time break down to CO_2, becoming greenhouse gases. With worldwide trade in crude oil at around 20 million barrels a day and the fuel's nature as a long-haul cargo, VOCs are a significant contributor to the industry's carbon emissions.

Teekay has considerable experience of operating ships in compliance with strict Norwegian VOC management requirements on behalf of the VOC Industry Cooperative. The Cooperative consists of the owners of offshore loaded fields (approximately 27 oil companies) in the Norwegian sector. The Cooperative works to implement VOC recovery systems on shuttle tankers, ensuring air is cleaner and a higher proportion of crude oil remains in the tanks. Currently, 17 shuttle tankers operated or owned by Teekay have VOC recovery systems on board.

The total investment by operators to date has been in the region of US$250 million, with annual operating expenses for these systems at around US$20 million. These systems are all installed on a retro-fit basis on board ship to reduce VOC emissions during loading. Reductions in VOC emissions in Norwegian shuttle operations have been around 75%. This is a relatively small fleet and affects emissions from a tiny percentage of total crude oil shipments.

Better management of VOCs across the global crude oil supply chain could make a big difference even if much simpler and cheaper means are employed. Worldwide seaborne transport of crude oil is around 20 million barrels daily. Crude oil is mostly a long haul cargo; its tonne per mile proportion of world seaborne trade is high. Teekay's work in this area has identified a potential for reducing VOC emissions by 1–2 million tonnes annually. Such a development would require a large collaborative effort in the industry, but would result in a noticeable reduction in the carbon footprint of crude transportation by sea.

How can we help?
Assisting owners and operators in preparing VOC Management Plans

We have produced a model VOC Management Plan and a checklist to assist owners in preparing plans for their ships.

These can be downloaded at:
www.lr.org/documents/181174-draft-voc-management-plan.aspx
www.lr.org/documents/181175-voc-plan-checklist.aspx

Legislation:
VOC Management Plan

Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects.

The revised MARPOL Annex VI introduced a new mandatory requirement (regulation 15.6) regarding Volatile Organic Compounds (VOC) emissions control. This will apply to all tankers carrying crude oil.

With effect from July 1, 2010, every tanker carrying crude oil will be required to have on board and implement a ship-specific VOC Management Plan, approved by the Administration. The Plan should be prepared taking into account guidelines contained in resolution MEPC.185 (59) and MEPC.1/Circ.680. The purpose of the Plan is to ensure that VOC emissions resulting from tanker operations to which regulation 15.6 applies are prevented or minimised as much as possible.

A ship-specific VOC Management Plan must at the least provide written procedures for minimising VOC emissions during:

– loading of cargo
– sea passage, and
– discharge of cargo.

Additionally, VOCs generated during crude oil washing need to be considered.

If tanker design modifications (such as increasing the pressure of the cargo tanks) are to be made to minimise VOC emissions, strength aspects need to be considered and comprehensive calculations have to be carried out to confirm the structural strength and other related issues. This information must be provided within the VOC Management Plan when submitting it for approval.

20 million
barrels of crude oil traded daily, worldwide

Marine fouling – old problem, new solutions

Keeping ships' hulls and seawater piping systems free from marine fouling has been a tremendous challenge throughout maritime history.

Fouling increases friction drag and blocks piping systems, affecting ship speed, fuel consumption and manoeuvrability.

It also contributes to the spread of invasive alien species. Over the years, various materials and methods have been tried in the fight against fouling, including manual scrapping, use of copper sheathing, and the application of organic coatings with added biocides.

Organotin-based anti-fouling coatings were proven to be effective in controlling marine fouling on ships' hulls and were widely used from the 1970s onwards.

Their success, however, was short-lived. Because organotin compounds leached from anti-fouling coatings were found to cause persistent toxicity to marine ecosystems, their use in anti-fouling systems was banned worldwide by the IMO's International Convention on the Control of Harmful Anti-fouling Systems on Ships (the AFS Convention) which came into force in 2008.

In recent years, copper-based anti-fouling coatings, mostly with booster biocides added, have successfully replaced the organotin-based products while low surface energy fouling releasing coating products, either silicone or fluoropolymer-based, have also found increased use on commercial vessels.

Marine fouling also causes blockages and corrosion in seawater pipes, valves, pumps and heat exchangers, resulting in costly repair and maintenance. Electrochemical methods using aluminium and copper anodes are widely used, while good monitoring and maintenance of the systems are also essential.

How can we help?
Marine coatings expertise

Lloyd's Register provides marine coatings and corrosions expertise in the areas of material selection, failure investigation and research. In recognition of the importance of using environment friendly anti-fouling systems, we award our EP(A) notation to ships applied with biocide-free anti-fouling systems.

We also publish a comprehensive list of recognised anti-fouling coating products on ClassDirect Live, providing information on paint manufacturers, anti-fouling products and the biocides used.

For more information please visit:
www.lr.org/ep and **www.cdlive.lr.org**

Various fouling species found on a test panel without anti-fouling coating after a 12-month exposure.

Fouling on a ship's hull can lead to increases in fuel consumption of up to 40%. Research has shown that without the use of anti-fouling coatings, fuel use would rise by 200 million tonnes a year and carbon dioxide and sulphur dioxide emissions would rise by 640 million and 12 million tonnes respectively[1].

Today, new environmental regulations and increased awareness of environmental protection are pushing anti-fouling technology further. Shipowners are demanding high fuel efficiency, low ship gas emissions and longer maintenance cycles while paint makers continue to reduce the VOC content of paints and the toxic impacts of biocide release into the environment. The latest efforts are being directed at developing not only coating systems which combine effective anti-fouling performance with low or no toxicity to the marine environment, but also greener and more natural anti-fouling mechanisms which mimic the fouling resistance of many marine organisms.

[1]Akzo Nobel, The Global Coatings Report, 2006, page 40

Legislation:
The Anti-fouling Systems (AFS) Convention

The International Convention on the Control of Harmful Anti-fouling Systems on Ships (the AFS Convention) entered into force on September 17, 2008.

It applies to all ships regardless of size and prohibits the application of organotin anti-fouling systems. It also requires that existing organotin anti-fouling systems are either removed from ships' hulls and replaced with organotin-free systems, or sealed to form a barrier to prevent leaching.
In Europe, the Convention is translated into law by EU Regulation (EC) No. 782/2003 on the Prohibition of Organotin Compounds on Ships.

Research has shown that without anti-fouling coatings:

Fuel use would rise by

200

million tonnes per year

Carbon dioxide emissions would rise by

640

million tonnes per year

Sulphur dioxide emissions would increase by

12

million tonnes per year

Get in touch

We are continuously monitoring, researching and influencing developments in relation to the environmental opportunities and challenges facing the marine industry.

We can help you to:
– understand emerging and existing environmental regulations
– comply with environmental requirements, whether regional or IMO-related
– demonstrate your environmental credentials to stakeholders.

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