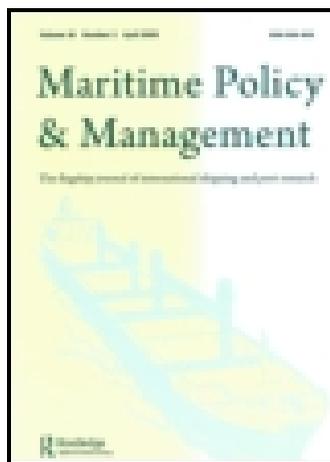


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Greener shipping? A consideration of the issues associated with the introduction of emission control areas

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Greener shipping? A consideration of the issues associated with the introduction of emission control areas

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This paper draws upon original research undertaken in the United Kingdom and Sweden. It considers the enforcement of regulations associated with the limitation of air emissions from shipping. Specifically, it considers the enforcement of regulations pertaining to the Baltic and North Sea emission control areas (ECAs). The paper outlines the steps that have been taken to ensure vessel compliance in these ECAs. It describes the effectiveness of such enforcement as well as current limitations and gives specific emphasis to the views of vessel operators. The paper ends with a series of recommendations that have been arrived at following discussion of the research findings with a select group of industry experts.

Keywords: regulation; globalisation; ports; pollution; environment; emissions

Background

The latter half of the twentieth century saw increased interest amongst academics in the problem of the environment, not least how to reconcile economic, social and environmental interests (Dobson 1996, 395). Within the maritime field concern with pollution, and the potential for shipping business to negatively impact on the marine environment and related biodiversity, has also grown. Marine pollution in the form of oil and chemical spills has attracted much media attention in the last 30 years as high profile incidents taking place in European waters (e.g. oil spills from the *Sea Empress*, *Braer*, *Erika* and *Prestige*) or particularly sensitive environments (e.g. *Exxon Valdez*) have hit the headlines. It has also attracted the attention of academics concerned to offer insight into risk mitigation and the role of regulation and of good governance in mitigating such impacts. For example, Radović et al. (2012) offer an analysis of the best strategies for the detection and assessment of oil and chemical spills arising from shipping incidents in support of more effective damage limitation, whereas Xu (2009) offers an analysis of liability in the event of pollution damage at sea. In the face of increased public and policy concerns, the shipping industry has sought actively to curtail the negative environmental externalities arising within the shipping sector, in particular that of marine pollution. The International Maritime Organisation (IMO) has dedicated annex VI of the MARPOL

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convention to regulations concerned with the limitation of air pollution including, but not exclusively, CO₂ emissions. Regulation 14 is specifically concerned with the regulation of sulphur dioxide (SO_x) and particulate matter, and in 2006, 2007, and 2012, emission control areas (ECAs) restricting the emission of SO_x were established in the Baltic, North Sea, and North American zones, respectively. While the pollution restrictions that were initially established by MARPOL were originally considered to be ineffective with regard to environmental impact by some commentators (Ringbom 1999) plans to restrict sulphur levels to 0.1% by 2015 in ECAs are thought by some to represent a ‘step change’ in practice.

These developments have been followed with some interest in the trade and wider press and they have continued to remain central to the news agenda (see for recent examples Green 2011; Eilperin 2012; World Maritime News 2012). They have also provided the focus for research in the academic community of a largely business oriented/technical nature. For example, Eide et al. have considered the cost-effectiveness of different measures which act to reduce CO₂ emissions. They conclude that according to the criteria they establish, ‘several measures are cost effective’ (Eide et al. 2009, 381), depending on the price of fuel, but that at the time of publication these excluded the use of solar panels, fuel cells and waste heat recovery due to the initial high investment costs associated with such technologies. In a similar vein, Longva and colleagues have considered energy efficiency design indexes (EEDI) and the establishment of associated targets (Longva, Eide, and Skjong 2010); Notteboom (2011) has considered the relationship between the use of low-sulphur fuel and competitiveness in the ro-ro sector; and Schinas and Stefanakos (2012) consider the economic and business implications of sulphur regulations.

This paper is written from a rather different perspective. In relation to any maritime regulatory regime, one of the concerns for ship operators is that regulations serve to create a ‘level playing field’ whereby socially responsible operators are not penalised for voluntary compliance with regulation whilst less scrupulous operators establish competitive advantage via regulatory avoidance. It is therefore essential that new regulations relating to the requirement for vessels to use expensive low sulphur fuel in specific ocean zones are effectively enforced. With its strong emphasis on the enforcement of emissions regulation, this paper therefore considers some of the issues that have arisen in conjunction with efforts to control air emissions in the North Sea and Baltic ECAs. It outlines the steps that have been taken to enforce compliance with the requirements of the ECAs and describes the limitations on the effectiveness of such enforcement. The paper further considers the responses of the industry to the introduction of ECAs and highlights the problems that some companies have had in ensuring compliance. It ends with some policy recommendations which have been arrived at following discussion of the research findings with a select group of industry experts (termed a Delphi group).

The regulation of deep-sea shipping

In the twentieth century, the international shipping industry became increasingly regulated such that by 2013 two main bodies—the International Maritime Organisation (IMO) and the International Labour Organisation (ILO)—were responsible for formulating the bulk of international regulation pertaining to shipping. Such international regulations were

developed in addition to those introduced by specific nation states and regional bodies such as the European Union.

The same period witnessed the increased ascendancy of the transnational corporation and the phenomenon that is termed globalisation. Globalising processes are described as those that free capital from the confines of national boundaries (Held et al. 1999) producing 'footloose' capital that is free to 'scour the world' for cheap sources of labour (Hirst and Thompson 1999). In shipping, globalisation can be seen to have taken place with the flagging-out of national fleets to open registers (Sampson 2013). As such, by 2012, 57% of the world fleet was registered with the 10 largest open registers (UNCTAD 2012). Such flagging-out was undertaken in pursuit of competitive advantage (Bergantino and Marlow 1997) achieved as a result of freedom to recruit cheap labour from developing countries and regulatory avoidance (Alderton et al. 2004).

As a result of globalisation, and in spite of the expansion of the regulatory scope of the IMO in particular, the enforcement of international regulations pertaining to shipping has presented considerable challenges to those seeking to retain control over the industry. As ships flagged-out, the traditional means for enforcing regulations relating to shipping, via flag states, was eroded. New open registers were seen to exercise little regulatory control over their fleets (Donaldson 2007) and a series of shipping disasters with a considerable financial impact on tourism and aquaculture increased political concerns about marine governance and in particular standards pertaining to international vessels. The response by the IMO was to agree mechanisms by which nation states (also termed for this purpose port states) ratifying international regulations were free to enforce related standards in relation to all vessels calling at their ports rather than simply their own fleet of registered vessels. Port state control, as this was termed, came into its own in the latter part of the twentieth century as regional groups of port states began to collaborate with regard to inspection and the targeting of vessels for inspection. For example, the Paris Memorandum of Understanding was established amongst 14 participating states in 1982. It has subsequently grown to include 27 states and has been regarded as particularly effective in establishing higher standards for shipping and something akin to a 'culture of compliance' amongst operators whose vessels visit European ports (Bloor et al. 2013c). The website for the Paris Memorandum of Understanding on port state control describes the purpose of port state control as follows:

Port state control is a check on visiting foreign ships to see that they comply with international rules on safety, pollution prevention and seafarers living and working conditions. It is a means of enforcing compliance where the owner and flag State have failed in their responsibility to implement or ensure compliance. The port State can require defects to be put right, and detain the ship for this purpose if necessary. It is therefore also a port State's defence against visiting substandard shipping. http://www.parismou.org/organization/about_us/2010.12.28/Principles.htm accessed 28/05/2013

This broad regulatory overview provides the backdrop for the research described herein relating to the specific enforcement of pollution controls in European waters in the period 2010–2012.¹

Methods

The research which underpins this paper was funded by the UK Economic and Social Research Council. It was undertaken in the period 2010–2012. The research considered

both the North Sea and Baltic ECAs and, as such, fieldwork was focussed in both Sweden and the United Kingdom. In total 50 recorded semi-structured interviews were conducted with port state inspectors, regulators, ship operators and other key industry stakeholders. These augmented the fieldnotes that were made in the course of 16 ship inspections which were observed by researchers at 7 different port state control offices in the United Kingdom and Sweden. In addition, researchers analysed the records of Falmouth bunker deliveries, results of fuel sample tests taken in Sweden and Holland, the records of a large commercial fuel testing company and the results of a company in-house survey relating to the fleet experience of fuel sampling and testing by statutory authorities.

A slightly different interview schedule was utilised in relation to each group of interviewees (e.g. regulators vs. ship operators) and the overall responses of each group of interviewees were compared with each other augmenting the initial intra-group analysis. Recorded interviews were transcribed and coded. Initial analysis and interpretation was augmented using the established technique of analytic induction (Cressey 1953; Bloor 1978). In this system, searches are made for deviant cases that do not fit with a working 'hypothesis' and these are considered in relation to the need to modify and extend the conclusions in order to deepen the analysis. Thus, in this paper we report the findings to reflect the nuances in the expressed views of stakeholders. Initially the coding of transcripts was undertaken manually by Bloor. Subsequently, in re-considering the findings in relation to the issues reported here, the transcripts were re-analysed and coded with the assistance of the software programme NVIVO by Sampson. In line with standard practice amongst qualitative researchers, no attempt is made here to quantify these data as this would not be appropriate. Thus, no 'trends' or statistics are reported as such. The transcripts from the study have been anonymised and placed in the ESRC archive where they can be referenced for re-evaluation and confirmation.

Towards the end of the research phase of the project, key findings were presented to a panel of experts (an electronic 'Delphi group') with the intention of arriving at a consensus relating to recommendations arising from the research. The Delphi group comprised one ship operator manager, one regulator, one port state control officer and one member of an environmental NGO. The recommendations which emerged as a result of this process are presented at the end of the paper and the process itself is further discussed in Bloor et al. (2013b).

The enforcement of regulations pertaining to emission control areas

Within the ECAs, an initial limit on the sulphur content of fuel was set at 1.5%. This reduced to 1% in July 2010 and it is set to be reduced further (to just 0.1%) in January 2015. Further to this, since January 2010, all vessels calling at EU ports have been required to burn fuel with a sulphur content of just 0.1% whilst at anchor within port limits or at berth. Where operators prefer, sulphur abatement technology may be deployed (in the form of scrubbers) as an alternative to the purchase and consumption of the relatively highly priced low-sulphur fuel.

The enforcement of the regulations relating to air pollution in the ECAs has been undertaken by port state control officers. Two primary methods have been adopted: the examination of paper records such as vessel log books and bunker fuel delivery notes and the analysis of fuel samples. Fuel samples are not extensively used however and in 2010

just 149 samples were analysed in Sweden. Other EU countries (e.g. Netherlands, Germany, Denmark) analyse similarly small numbers of samples annually whilst the United Kingdom does not generally make use of fuel sample analysis in its enforcement of air-pollution regulation.

In addition, experiments have been conducted with the analysis of samples taken from vessel exhaust plumes using aircraft and lasers mounted at the entrance to the port of Gothenburg. Whilst the Swedish Maritime Authority has discontinued its use of aircraft-mounted laser monitoring equipment, there is some evidence that such experiments have had a deterrent effect.

In Sweden, an incentives programme is in place such that more favourable fairway dues² (and to a lesser extent port charges) are levied from vessels demonstrating constant use of low-sulphur fuel. This measure complements and encourages compliance with low-sulphur fuel regulations but it does not substitute for local enforcement.

Problems for enforcement

The research highlighted several problems in relation to enforcement of the regulations. Of greatest concern is the difficulty for port state control officers in identifying fraudulent paperwork where this may exist. Bunker fuel delivery notes are generally checked in conjunction with log books in order to ascertain compliance with fuel usage in ECAs. As one port state control inspector described it, inspectors examine:

Mostly bunker delivery notes, which proves what type of bunker they are using and then you have the log book entry for the change over because normally they will burn high sulphur outside the ECA area. So when they are coming in, so like what time they change over.
[Inspector]

A second port state inspector confirmed this with his account:

We will be checking the bunker delivery note, it will be cross checking with oil record book, 2 entries. If the vessel is coming into the ECA area from outside, so then you would like to see the log book entries about the change over things, obviously change over time is depending on the type of the ship, type of engine and the arrangement of change over, also the capacity of the, if they are using the same bunker tank, service tank, then the capacity of the service tank and how long it will take, so there are some calculations to verify that they are burning the compliant fuel when they are inside the ECA, so that has to be demonstrated.
[Inspector]

Sulphur levels on bunker delivery notes are often hand written and are frequently illegible (not least because the carbon copy deteriorates in storage), whilst log books are open to inaccuracy. An inspector explained his concerns as follows:

I think the regulation for this bunker [...] is not fully implemented in this country because I think you will find [in] foreign countries [...] all this [is] closely controlled and monitored, which is not the case here. [Inspector]

Reliance on the checking of paperwork may not, as a result, be adequate in the face of deliberate contravention of regulations by unscrupulous ship operators. Furthermore, vessels which are transiting the ECAs rather than calling at ports within them may not be subject to such inspections and could escape detection.

In order to detect contravention of the regulations, by vessels transiting an ECA, the use of laser monitoring equipment might appear to be ideal, although thus far the intention has only been to use this technology as a screening device to identify potential

candidates for fuel sampling and testing. As previously noted, experiments with airborne laser detection equipment have been discontinued. This was due to the hazards presented to aircraft in attempting to capture samples from vessel plumes. Such technical problems are compounded by the relatively high cost of such measures although the presence of ‘sniffer planes’ sends a powerful message to vessels and could act as a very useful deterrent.

Finally in relation to the sampling of fuel, there are a couple of problems which are worth noting. The first issue relates to the time which is generally taken when samples are sent away to independent laboratories for testing. By the time that the results of the sample analysis are available to port state control officers, it is highly likely that a vessel will have sailed. Some port state control officers have access to fuel testing procedures that offer them rapid results. However, in the United Kingdom it was reported that such samples were rarely, if ever, taken. An inspector commented that:

[...] they tell me that they get, once they reach the continent places like Germany in particular and to a lesser extent Denmark and Holland, they are having samples of their service tanks taken, and they some of them have been taken to court and they feel it is over the top, but as far as anything about what we do here none at all. [Inspector]

The response of ship operators to the introduction of ECAs and problems of compliance

Incentives to avoid regulation

A major financial incentive currently exists with regard to the avoidance of regulations pertaining to the use of low-sulphur fuel in ECAs. This results from the high price differential between low-sulphur fuel and higher-sulphur alternatives which, at time of writing (May 2013), is \$23.00 per tonne. Once the 0.1% sulphur limit comes into force in ECAs in 2015, this incentive to non-compliance will be considerably increased, since (unless vessels have fitted scrubbers) they will have to operate continuously within ECAs on distillate fuel, currently costing \$280 per tonne more than high-sulphur fuel.

Logistical reasons for non-compliance

Another reason that companies may fail to comply with regulations is more logistical in as much as vessels with single service tanks may experience problems with fuel changeover. This is likely to be particularly the case when vessels are only intermittently trading in an ECA and where companies and chief engineers are inexperienced in making the requisite changeover. In well-established companies, procedures for fuel changeover are generally established by the company in consultation with chief engineers who are then expected to follow company procedure for changeover and demonstrate such compliance with procedure to port state control officers. Not only does this mean that ECA regulations should be effectively complied with, it also prevents the kind of engine damage that can occur if fuel changes are attempted too quickly. An operator explained:

We have company procedures that they must follow [...] And that is part of our SMS with DOC as well, because you will get asked that on the audit. The audit they can ask me for, we have just had Isle of Man now [the flag state], and he said show me your changeover procedure and I will then go into the technical manual, show our actual PDF on this of what we would do, and he will say show me your chief doing it, and I will have to go back

and look into the records and extract and say this vessel was going into Long Beach you can see what the chief did. [Employer]

But not all vessels follow an invariant changeover procedure and in the course of an observed PSCO inspection, a chief engineer remarked that he was following a different changeover procedure from that which had been logged by his predecessor. Changeovers on single-service-tank vessels, which involve flushing through the service tank with low-sulphur fuel oil, may result in inadvertent non-compliance since only very small quantities of high-sulphur fuel need to remain in the service tank for the additional low-sulphur fuel oil (which frequently has a sulphur content of 0.98%, 0.99% or 1.00%) to be thrown 'off-spec'.

Problems of off-spec fuel and bunker fuel delivery notes

There was some confidence expressed in the major suppliers of bunkers in as much as operators did not expect such suppliers to be found to be guilty of providing fuel that was different to the specification of the order (off-spec fuel). One such view was expressed as follows:

It wouldn't be because it was off-spec when it was delivered because it is tested and guaranteed to be spec as per that note, as per that refinery, as per those people we are working with every day. [Employer]

Such confidence may have accumulated as a consequence of the regular practice in many major shipping firms of sending samples of the bunkers provided for analysis at their own choice of laboratory. If such analysis demonstrated that the fuel was off-spec with regard to sulphur content, operators suggested that they would immediately be in touch with their flag state administration and any other relevant authorities.

It is interesting to note however that despite the confidence expressed by some operators in the major suppliers of bunkers, this practice of sampling fuel had developed in the context of experience of less trustworthy suppliers.³ One operator told of a case when 4.5% sulphur fuel oil was bunkered (unknowingly) by one of their vessels in Denmark. He explained how:

We had this once last year, the vessel bunkered off the coast of Denmark and the fuel was 4.5 sulphur, how or why 4.5% MGO was even in Denmark in the first place we don't know, it could have come from someone as a bad batch, it could have got in somewhere and they thought let's get it out and we ended up taking it onboard the ship. And the danger I had was she burnt the fuel, the chief made a mistake in his calculations, he didn't come to me and he was burning the fuel. I went to the vessel in Latvia and it came through and I said 'chief whatever you do, do not burn that fuel', he had 80 ton of it, I said 'do not burn that fuel', and he said 'but I only have 25 ton left sir'. I said 'what do you mean you have only got 25 ton left?', and he said 'I have been burning it'. So she had burnt 50 ton of fuel in the Baltic region, and if the Port State had gone onboard and said let me see the sample...! [Employer]

Such experiences had led to the alternative view that bunker suppliers could not always be trusted and that some would, as a consequence, be open to propositions from operators seeking to avoid compliance with ECA regulations via the use of fraud in the form of the provision of fraudulent bunker fuel delivery notes. One operator put it this way:

We deal with um, yeah we see ‘bad’ bunkering companies on a daily basis. There is no... around the world there is no trick that they haven’t tried, I mean they have a huge bible of how to cheat shipping companies for their fuel. So it’s really about the BDN [bunker fuel delivery note]—you can easily forge the BDN if that’s what you want to do. [Employer]

The potential for fraud was increased by what was acknowledged to be the very poor standard of bunker fuel delivery notes.⁴ As one operator put it, the standard of bunker fuel delivery notes was:

Very poor, very, very poor. [...] it depends where you are, [...] But even Europe sometimes it is very poor, it is kind of sometimes a barge turns up and he throws the line and he pumps it off and away he goes, no one really cares you know and it is very poor to be honest. I think that the standard should be a lot better really. [Employer]

This produced a view amongst some operators that enforcement of the ECA regulations actually had to be ‘beefed up’ and tightened rather than ‘watered down’. As one operator described:

There really has to be a much more elaborate system in place to ensure that there is going to be compliance. This is really what we want to opt for going forward. [Employer]

However, this view was not universally held and there were concerns expressed about the establishment of greater surveillance, particularly in the form of the sampling of fuel by port state control officers.

A different problem was brought to our attention by one ship manager whose contracts with charterers provided that it was the charterers rather than the ship managers who organised the supply of bunkers to vessels. Regardless of where the supply was sourced from, the ship manager sent samples to a single company for testing and reported that whilst they had sometimes been assured by a charterer that the fuel supplied was compliant, their tests had revealed that this was not the case. An interviewee explained:

Everything is sampled through the [company name] but we source our bunkers from where ever the charterer will see fit to bunker which also causes us problems sometimes where the charterer will say this type of fuel is ok and acceptable we will bunker, I will then look at the sample and say ‘no, no, we can’t burn this for sulphur reasons, or I can’t burn this because it is the wrong fuel for the engine’, obviously we have to protect that as well. [Employer]

Concerns over the fuel supply had resulted in this company taking very elaborate steps to ensure that the fuel they had delivered was compatible with all of their requirements. Given the length of time that it normally took to get sample results back from the laboratory⁵, it seemed that their measures involved them in very careful forward planning. The following extended extract describes their procedures for testing and the time lag between the time of bunkering and the time when the fuel is cleared for use and some of the consequences of this strategy for planning and for profits:

We bunkered this up in Peterhead. That will go into the ship storage tank then, we will not burn that fuel. I wait then because when the barge, the barge will come on and he will give a sample of the fuel with ticket details and everything, that then is presented to us on the fuel sample. But I won’t go off that sample, I take a secondary sample then, when they are bunkering on the manifold we take it from out manifold, 10 minutes into the delivery so you know you are getting a good grade of fuel. That will then go for

sampling, I will wait for the 2 sample data's to come back to myself and I look at the first sample from the barge or the truck, and then our sample, and I will look then at the sulphur quantity, the densities, the viscosities, firstly because you want to see you haven't been short measured, but then you are looking at all the contaminants underneath. And when I have looked then and I am satisfied with what quantities I see or contaminants then I will contact the ship as well because the email will be sent over to them with the attachment and we will say to the guys you know this fuel is acceptable to burn and you are ok to do that.[...] It is within 2 weeks normally, it is quite a long process. [...]The charterer can't be greedy and just say you need to bunker the fuel now or we are going to leave it to the last minute you put the fuel on and now you have to burn it, they can't do that. [Employer]

This example is particularly interesting because it highlights the extent to which the monitoring of bunkers is already practiced by companies because of concerns relating to fuel contaminants and quality which would seem to indicate that careful monitoring of sulphur levels to guarantee compliance with sulphur-content requirements need not necessarily place an additional operational burden on vessels.

Concerns over bunker tests by port state control

Although operators were keen to have a 'level playing field' in relation to competition with other shipping lines, and while they believed that such a level playing field was best established with effective enforcement of sulphur regulations, they were nevertheless anxious about the idea of port state control officers sampling directly from their tanks. One employer outlined his concerns that these might not be a 'fair' test as follows:

So then we took it, it was .95 on the bunker note, it was .95 when it came out of the refinery, it might settle in the tanks, that tank might not be used for a few days that could then come into the service tank and port state control officers, again I have heard them go into the bottom of the tank, you know which if there is anything anywhere from you know previous parcels it might be towards the bottom of a tank, yeah? [Employer]

The interviewee is referring here to the phenomenon known as 'stratification' whereby blended low-sulphur fuel oil may undergo partial separation in storage, which can result in inadvertent non-compliance, when a sample is taken by port state from the vessel's service tank. Subsequently, this operator went further in outlining his view that he did not wish to see port state control being exerted except in a highly targeted manner which would be likely to exempt his company's vessels from scrutiny. This appeared to be part of a general view that regulation should be minimal which of course militates against the establishment of a 'level playing field' and is therefore in contradiction with his express wish for the establishment of such. As he put it:

The people who openly breach regulations should be caught and should be, you know when they are willingly trying to get around regulations, but things are in place for that and the regime that is already here is very adequate for that. I don't think there is a need for the European commission or for member states to do more port state control than what they already do, I don't think there is a need because the regime is, it is an intelligence led regime, like the customs. [Employer]

Where operators were more enthusiastic about the use of fuel sampling, they nevertheless acknowledged that what was required was a system providing very rapid results. As one explained:

They [currently utilised laboratories] can provide the test results after seven days and this does not work. In order to be able to hold back the vessel you need the test maybe four hours back... [Employer]

They were therefore relatively supportive of the test kits that were being utilised by some port state control officers (e.g. in The Netherlands). Although these tests were generally acknowledged to be less reliable than ‘send away’ laboratory tests, they were nevertheless supported by some who held the view that:

No, I’ve just been looking it up when I was talking to them. I don’t know what the reliability of those test kits is but I somehow doubt that it can be that bad otherwise they wouldn’t be using it. [Employer]

Future concerns

Ship operators were anxious about the forthcoming tightening of the sulphur regulations which were due to come into effect in the ECAs in 2015. The additional costs to shipping fuel with a sulphur content of 0.1% or less was felt likely to threaten the competitiveness of the shipping industry. The price differentials were characterised as a ‘step change’ by one operator who estimated that it would result in a substantial increase in fuel costs. He suggested that:

The change from 1% to 0.1 is a step change, it is not a straight line, it is a step change. And what it means is you have to burn distillate marine gas oil instead of residual fuel oil. And the price premium for that is 70–80%. [Employer]

In relation to this price hike there were fears that the new regulation would precipitate a ‘modal shift’ in the transport of freight. This was because it was felt that the change in fuel would increase operator costs so significantly (a 20% increase was estimated by one operator) that freight hauliers would not be able to meet the extra costs. As the above employee went on to observe, such a modal shift would not only damage the shipping industry, as some companies would inevitably fail, but could carry with it negative consequences for ambient environmental quality.

We have some concerns mainly in relation to the 0.1% in 2015 which takes place within the emission control areas. We believe, in the big picture that will cause a modal shift, it’ll change flows of traffic, that can have the effect of putting more freight onto the roads. [...] it could well be that freight hauliers choose to travel in their trucks [...] to Dover and use the very short sea crossing or the tunnel in preference to using the longer sea transit. So we can see, not only in the UK but across Europe significant change to flows of traffic and that could actually have an adverse environmental effect putting more cargo on the roads as opposed to carrying it by sea—a less efficient mode of transport, overland freight as opposed to at sea. [Employer]

Favoured regulatory checks

As has already been noted, not all operators were in favour of stronger enforcement of the regulations relating to air emissions in ECAs. However, those operators who were keen to make sure that competitors did not get away with avoiding the regulations in order to establish competitive advantage acknowledged that regulatory enforcement was not a simple matter.

In spite of the perceived difficulties inherent in an ‘auditing’ solution involving checks on bunker fuel delivery notes and samples of bunkers from service (or ‘day’) tanks, such a solution was seen as more practical than the implementation of technical solutions

requiring vessels to carry on board emissions monitoring equipment that could be scrutinised by inspectors. As one interviewee explained, technical solutions seemed difficult:

I mean if you just see it from applicability point of view, to install such a [monitoring] system on I don't know, 40,000 vessels it just doesn't seem feasible. So the testing I believe has to happen while you're in port. [Employer]

This operator favoured an auditing solution involving paper checks and fuel samples. It was acknowledged however that testing in port did not resolve the problem of how to ensure compliance amongst vessels in transit (i.e. going through an ECA but not calling at a port in an ECA):

Of course you would have to figure something out on how to police transiting vessels. That we don't really know how one would handle yet but... [Employer]

Policy recommendations

A variety of policy recommendations arise from this study and these are detailed fully in a report from the study which has been published on line (Bloor et al. 2013a). Three main recommendations may be regarded of particular interest here however.

The first is specific to inspection practice in the United Kingdom and relates to fuel testing and the piloting of 'sample kits' as utilised in Germany, Holland and Sweden. The pilot would provide the opportunity to establish the accuracy of different sampling/testing methods with a view to the introduction of such sampling and testing in the future within the United Kingdom. The United Kingdom (and other EU member states) will be obliged to comply by 18 June 2014 with a revised EU sulphur directive issued on 21 November 2012 which requires member states to undertake frequent fuel sampling and testing (European Union 2012).

The second recommendation relates to the publication of information on the Equasis website about vessels non-compliant with the EU regulations on sulphur levels of fuel burnt in EU ports. Currently, this will only occur if the port state control officer noting the deficiency records it as a deficiency in conjunction with the vessel's safety management system in breach of the IMO-ISM code. Such publication is seen to act as a major deterrent to non-compliance and the recommendation is thus to extend the publicity attendant to regulatory breaches.

The third recommendation relates to the development of the bunker fuel delivery note. It is suggested that this document should always be written in English, should record the sulphur content of fuel delivered (already an IMO requirement, but not always complied with), should record the registration number of the supplier and that it should be easy to determine if any fraudulent alterations have been made to the note.

Conclusions

Currently it is possible to identify a number of difficulties relating to the enforcement of emissions control regulations as they pertain to the North Sea and Baltic ECA. Such difficulties relate to problems with fuel testing, the reliability of bunker fuel delivery notes and technical problems associated with available laser 'plume testing' equipment.

Notwithstanding these difficulties, at the current time it would appear that most companies are complying with current regulations and that at least some non-compliance may be inadvertent (produced as a result of the supply of 'off-spec' bunkers or associated with poor fuel changeover techniques on vessels with single service tanks). Companies expressed a desire for a level playing field to be established in relation to exhaust emissions from ships and yet some companies nevertheless resisted the idea that inspection should increase. Those companies in favour of greater inspection saw auditing solutions such as the inspection of bunker delivery notes and oil record books alongside fuel sampling as more practical than the installation of on-board emissions-monitoring equipment. In relation to the strengthening of existing enforcement, recommendations arising from the research include suggestions for improvements to the bunker delivery note, developing effective fuel sampling techniques following experimental 'piloting' and the 'naming and shaming' of companies that do not comply with EU emission regulations on the 'Equasis' website.

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Notes

1. The paper does not focus on regulation of bunker suppliers per se which may be fertile ground for future investigation. This paper is concerned with the broader enforcement of regulations pertaining to ship emissions.
2. Fairway dues are charged to defray the costs of ice-breaking and coastal lights.
3. We note that inadvertent contamination of bunker supplies may occur due to incomplete tank cleaning processes between deliveries of parcels of fuel of different specification in terms of sulphur content.
4. We note that small profit margins may act as an incentive for fraud on the part of bunker suppliers although we did not establish any direct evidence of such fraud nor of the potential drivers for it within this study.
5. The operator told us that if they were 'desperate' they could get test results back faster and as quickly as within a day but that this had cost implications so that standard practice was not to do this.

References

- Alderton, T., M. Bloor, E. Kahveci, T. Lane, H. Sampson, M. Thomas, N. Winchester, B. Wu, and M. Zhao. 2004. *The Global Seafarer: Living and Working Conditions in a Globalised Industry*. Geneva: ILO.
- Bergantino, A., and P. Marlow. 1997. *An Econometric Analysis of the Decision to Flag Out*. Cardiff: SIRC.
- Bloor, M. 1978. "On the Analysis of Observational Data: A Discussion of the Worth and Uses of Inductive Techniques and Respondent Validation." *Sociology* 12: 545–552. doi:10.1177/003803857801200307.
- Bloor, M., S. Baker, H. Sampson, and K. Dahlgren. 2013a. *Effectiveness of International Regulation of Pollution Controls: The Case of the Governance of Ship Emissions*. Cardiff: SIRC. ISBN 1-900174-44-8.
- Bloor, M., S. Baker, H. Sampson, and K. Dahlgren. 2013b. "Useful but No Oracle: Reflections on the Use of a Delphi Group in a Multi-Methods Policy Research Study." *Qualitative Research*. doi:10.1177/1468794113504103.
- Bloor, M., H. Sampson, S. Baker, D. Walters, K. Dahlgren, E. Wadsworth, and P. James. 2013. "Room for Manoeuvre? Regulatory Compliance in the Global Shipping Industry." *Social & Legal Studies* 22: 171–189. doi:10.1177/0964663912467814.
- Cressey, D. 1953. *Other People's Money: A Study in the Social Psychology of Embezzlement*. Belmont, CA: Wadsworth.
- Dobson, A. 1996. "The Green Scene: Academics on the Environment." *Sociology* 30 (2): 395–403. doi:10.1177/0038038596030002013.
- Donaldson, L. (2007) "Safer Ships, Cleaner Seas: Report of Lord Donaldson's Inquiry into the Prevention of Pollution from Merchant Shipping." *House of Commons Parliamentary Papers Online*.
- Eide, M., Ø. Endresen, R. Skjong, T. Longva, and S. Alvik. 2009. "Cost-Effectiveness Assessment of CO₂ Reducing Measures in Shipping." *Maritime Policy & Management* 36 (4): 367–384. doi:10.1080/03088830903057031.
- Eilperin, J. (2012) "Cruise Ship Lines, Alaska Officials Question New Air Pollution Limits." *Washington Post* 22 July. Accessed February 18. http://articles.washingtonpost.com/2012-07-22/national/35489385_1_sapphire-princess-cruise-ship-sulfur-dioxide
- European Union. 2012. "Directive 2012/33/EU of the European Parliament and Council of 21 November 2012." *Official Journal of the European Union* 30: 111–123.
- Green, R. 2011. "In the Greening of Our Seas Speed Is of the Essence." *Asian Conversations*. Accessed February 18. <http://www.asianconversations.com/GreenShipping.php>
- Held, D., A. McGrew, D. Goldblatt, and J. Perraton. 1999. *Global Transformations: Politics, Economics, and Culture*. Cambridge: Polity Press.
- Hirst, P., and G. Thompson. 1999. *Globalisation in Question*. 2nd ed. Cambridge: Polity Press.
- Longva, T., M. Eide, and R. Skjong. 2010. "Determining a Required Energy Efficiency Design Index Level for New Ships Based on a Cost-Effectiveness Criterion." *Maritime Policy & Management* 37 (2): 129–143. doi:10.1080/03088830903533759.
- Notteboom, T. 2011. "The Impact of Low Sulphur Fuel Requirements in Shipping on the Competitiveness of Roro Shipping in Northern Europe." *WMU Journal of Maritime Affairs* 10: 63–95. doi:10.1007/s13437-010-0001-7.
- Radović, J., D. Rial, B. Lyons, C. Harman, L. Viñas, R. Beiras, J. Readman, K. Thomas, and J. Bayona. 2012. "Post-Incident Monitoring to Evaluate Environmental Damage from Shipping Incidents: Chemical and Biological Assessments." *Journal of Environmental Management* 109 (Oct): 136–153. doi:10.1016/j.jenvman.2012.04.042.
- Ringbom, H. 1999. "Preventing Pollution from Ships – Reflections on the 'Adequacy' of Existing Rules." *Reciel* 8 (1): 21–28.
- Sampson, H. 2013. *International Seafarers and Transnationalism in the Twenty-First Century*. Manchester: Manchester University Press.
- Schinas, O., and C. Stefanakos. 2012. "Cost Assessment of Environmental Regulation and Options for Marine Operators." *Transportation Research Part C: Emerging Technologies* 25: 81–99. doi:10.1016/j.trc.2012.05.002.

- UNCTAD (United Nations Conference on Trade and Development). 2012. *Review of Maritime Transport 2012*. New York: United Nations Publication. ISBN 978-92-1-112860-4, ISSN 0566-7682.
- World Maritime News (2012, August 17) “EU Regulations Drop Ship Emissions by 66pct Since 2010.” Accessed February 18. <http://worldmaritimeneeds.com/archives/63479>
- Xu, J. 2009. “The Law and Economics of Pollution Damage Arising from Carriage of Oil by Sea.” *Maritime Policy & Management* 36 (4): 309–323. doi:10.1080/03088830903056942.