EXPLANATORY MEMORANDUM TO

THE MERCHANT SHIPPING (PREVENTION OF AIR POLLUTION FROM SHIPS) (AMENDMENT) REGULATIONS 2010

2010 No. 895

1. This explanatory memorandum has been prepared by the Department for Transport and is laid before Parliament by Command of Her Majesty.

2. Purpose of the instrument

2.1 These Regulations amend the Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 (S.I. 2008/2924) ("the 2008 Regulations") and implement the marine fuel elements of the Sulphur Content of Liquid Fuels Directive, 1999/32/EC relating to a reduction in the sulphur content of certain liquid fuels, as amended by Directive 2005/33/EC (1999/32/EC as amended henceforth referred to as "the Directive").

2.2 The opportunity is being taken to make some other minor amendments to the 2008 Regulations.

3. Matters of special interest to the Joint Committee on Statutory Instruments

3.1 None.

4. Legislative Context

4.1 The UK is a party to Annex VI (Regulations for the Prevention of Air Pollution from Ships) to the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 ("MARPOL 73/78"). Annex VI contains provisions on the sulphur content of liquid fuels and is implemented by the 2008 Regulations.

4.2 The Directive, which also includes provision on the sulphur content of liquid fuels, places additional requirements on shipping operating within the European Union. These Regulations, which will implement the Directive, will only give effect to the requirements within the Directive insofar as they relate to marine fuels, which are not duplicated under Annex VI.

4.3 The heavy fuel oil land based elements of the Directive are now implemented in the following regulations: - the Sulphur Content of Liquid Fuels (England and Wales) Regulations 2007 (S.I. 2007/79), the Sulphur Content of Liquid Fuels (Northern Ireland) Regulations 2007 (S.R. 2007/272), the Sulphur Content of Liquid Fuels (Scotland) Regulations 2007 (SS.I. 2007/27).

4.4 The Scrutiny History for the Directive is attached at Annex A.

5. Territorial Extent and Application

5.1 This instrument applies to all of the United Kingdom.

6. European Convention on Human Rights

6.1 As the instrument is subject to negative resolution procedure and does not amend primary legislation, no statement is required.

7. Policy background

- **What is being done and why?**

7.1 Emissions from shipping due to the combustion of marine fuels with high sulphur content contribute to air pollution in the form of sulphur dioxide and particulate matter. This damages the environment through acidification and harms human health, property and cultural heritage, particularly around coastal areas and in ports. The Directive includes measures that regulate the sulphur content of marine fuels used by shipping in the EU and these Regulations implement the marine fuel elements of the Directive.

7.2 The Regulations deal with: –

- sulphur content of marine fuels used in sulphur oxide emission control areas;
- sulphur content of marine fuels used by passenger ships operating on regular services to or from Community ports;
- sulphur content of marine fuels used by inland waterway vessels and ships at berth in Community ports;
- the marketing of marine diesel oils with sulphur content exceeding 1.5% by mass;
- the marketing of marine gas oils with sulphur content exceeding 0.1% by mass; and
- trials and use of emission abatement technologies.

7.3 In addition to amending the 2008 Regulations to implement the Directive, the Regulations also make minor amendments to the 2008 Regulations including those listed below.

<u>Definition of “short voyage”</u>

7.4 The definition of “short voyage” in the 2008 Regulations has been amended to align it with Resolution A.997(25) adopted by the International Maritime Organization on 29 November 2007, in the context of MARPOL and other International Conventions. The Resolution refers in its definition of “short voyage” to 1,000 rather than 600 nautical miles. This definition is used in regulation 15(6) of the 2008 Regulations, which provides for a Certifying Authority to be able to extend the period of validity of a Certificate in respect of a ship engaged solely on short voyages.

7.5 The definition of short voyage is amended further to align it with MARPOL by removing the reference to being never more than 200 nautical miles from a port or place in which passengers and crew could be placed in safety.

Ships in ports and offshore terminals, and ships which are platforms

7.6 Regulation 3(6) of the 2008 Regulations relates to the application of regulation 16(6) to non-UK ships which are deficient. The amendment to 3(6) applies regulation 16(6) to UK waters and controlled waters as defined in the 2008 Regulations. Similar amendments have been made to regulations 26(3) which relate to where a ship can be inspected and regulation 28(4) which relates to where a ship can be detained.

Arbitration

7.7 Regulation 17 on arbitration has been amended to provide that where an applicant for a survey is dissatisfied with the outcome of that survey there is a default provision, as there is in Scotland, if the parties cannot agree on an arbitrator.

- **Consolidation**

7.8 The Regulations have not been consolidated on this occasion. Revisions to MARPOL Annex VI were adopted by the International Maritime Organisation in October 2008 and the intention is to consolidate the 2008 Regulations, as amended, when the UK seeks to implement the revisions to MARPOL Annex VI.

8. Consultation outcome

8.1 In view of advanced infraction proceedings against the United Kingdom by the European Commission, and the familiarity of industry with the Directive, these Regulations and Impact Assessment have been consulted on for six weeks from 25 May 2009 to 2 July 2009. This follows a consultation on the 2008 Regulations between July 2008 and August 2008.

8.2 Consultees included central Government, the devolved administrations, non-Governmental organisations, and industry bodies representing those affected by this legislation (such as the British Chamber of Shipping), and port and shipping companies.

8.3 Eleven responses were received to the consultation. A summary of the comments made, and the Maritime and Coastguard Agency's responses to them, are published on the MCA's website at:

http://www.mcga.gov.uk/c4mca/090709_scmfd_-_response_to_consultation.pdf

8.4 Key points raised in the responses include:

- the cost to industry of complying with the requirement that ships at berth in a UK port use marine fuel with a sulphur content not exceeding 0.10% by mass;
- that the requirement that ships at berth in a UK port use marine fuel with a sulphur content not exceeding 0.10% by mass will result in an increased risk of explosion in ships with boilers;
- clarification that the exhaust gas cleaning systems are defined as an emission abatement technology;
- clarification of the requirements for fuel changeover after a ship arrives at berth;
- clarification of the requirements for recording fuel changeover operations in ships' logbooks;
- clarification that fuels required for testing of engines are exempted from the Regulations;
- the difficulty of developing an accurate impact assessment;
- the use of market based instruments to substitute for the requirements to use low sulphur fuel;
- non-alignment of Directive provisions with those agreed as part of the revision of MARPOL Annex VI at the IMO in October 2008.

9. Guidance

9.1 A Merchant Shipping Notice and a Marine Guidance Note were published with the 2008 Regulations. The Directive states that for a ship on arrival at berth a period of time is allowed which is "sufficient" to allow the crew to complete any necessary fuel oil changeover operation. In the covering letter of the consultation the Maritime and Coastguard Agency ("MCA") proposed that the final decision as to what is 'sufficient' be left to the professional judgement of the particular surveyor concerned. As a result of the responses to the consultation additional guidance will be issued by MCA in Marine Guidance Note 400(M+F) on the term "sufficient time".

9.2 Marine Guidance Note 400(M+F) will also contain guidance on the meaning of hotelling in the context of operations by ships at berth.

10. Impact

10.1 The impact on business, charities or voluntary bodies is:

- for passenger ships operating on regular services to or from UK ports outwith sulphur oxide emission control areas, the increased variable cost of low sulphur fuel oil or capital cost of emission abatement technologies to remove pollutants from air emissions;
- for ships at berth in a UK port the increased variable cost of low sulphur fuel oil or capital cost of an exhaust gas cleaning system to scrub air emissions of pollutants;

- for inland waterway vessels the increased variable cost of low sulphur fuel oil, however, such vessels by and large use such fuel already; and
- for ships with emission abatement technology, where fitted, the cost of disposal of any waste residues.

10.2 The impact on the public sector is to require the MCA to make resources available for the following:

- inspection of non-UK ships on entering UK ports to ascertain compliance by those ships with the Regulations;
- follow up concerns raised by other national Administrations, industry or the public with ships suspected of breaching the Regulations;
- sampling and analysis of fuel oil to test compliance with the Regulations, and to report to the Commission annually the results of this sampling and analysis programme;
- enforcement action including prosecutions under the Regulations.

10.3 An Impact Assessment (IA) was produced for the amending regulations and is attached to this memorandum.

10.4 It is the view of the Department that the costs and benefits outlined in the IA are reasonable for these Regulations.

10.5 The impact on the various stakeholders, particularly small businesses, was extensively considered and a reasonable balance obtained.

11. Regulating small business

11.1 The legislation applies to all consumers of marine fuel including small business.

11.2 Whilst being mindful of a need to minimise impact of regulation on small business, those primarily affected by these Regulations are fuel oil suppliers and inland waterway vessel operators. Inclusion of these small businesses in the Regulations is required to achieve the policy outcomes.

11.3 Representative bodies for ship fuel oil suppliers and inland waterway operators were included in the consultation. The UK Petroleum Industry Association supports the Regulations.

11.4 After consultation it is not considered that small businesses will be unduly affected by these Regulations and that the Regulations will not competitively disadvantage small businesses.

12. Monitoring & Review

12.1 The impact of the policy will be kept under review and will be assessed in Autumn 2010 by the Maritime and Coastguard Agency.

12.2 These Regulations are being made at an intermediate stage of implementing international regulations seeking to reduce the impact of air pollution from ships. Further international legislation has been made by the International Maritime Organization. European Union legislation is likely to result in these Regulations being amended further and the intention will be to consolidate when that position is clear.

13. Contact

Dr Edmund Hughes of the Maritime and Coastguard Agency, an executive agency of the Department for Transport, (telephone 02380 329367 or e-mail: edmund.hughes@mcga.gov.uk) can assist with any queries regarding the instrument.

Annex A
Scrutiny history for Directive, 2005/33/EC

(1) EM 14933/02 of 16 January 2003

Commons:
Politically Important. Cleared 17 December 2003

Lords:
Sifted to Sub-Committee B on 8 January 2004 cleared 30th January 2004
SEM 14933/02 of 07 July 2003

Commons:
Not Cleared 16 July 2003. Awaiting refined estimates on RIA.
Politically Important - Cleared 17 December 2003 along with "2nd" SEM 12142/03

Lords:
Referred to sub Committee D on 15 July 2003.
Cleared 30th January 2004 by Sub-Committee B.

(2) EM 12142/03 of 17 September 2003

Commons:
Politically Important. Not cleared. 15/10/03

Lords:
Cleared by letter 20th November
SEM 12142/03 of 30 November 2003

Commons:
Politically Important Cleared 17 December 2003 along with SEM 14933/02

Lords:
Cleared from scrutiny 09 December 2003

Summary: Intervention & Options

Department /Agency:	Title:	
Maritime & Coastguard Agency	**Impact Assessment of The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2010**	
Stage: Implementation	**Version:** Final	**Date:** 15 March 2010
Related Publications: The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2010		

Available to view or download at:

http://www.mcga.gov.uk

Contact for enquiries: Edmund Hughes **Telephone:** 023 8032 9367

What is the problem under consideration? Why is government intervention necessary?

Emissions from shipping due to the combustion of marine fuels with high sulphur content contribute to air pollution in the form of sulphur dioxide and particulate matter. This damages the environment through acidification and harms human health, property and cultural heritage, particularly around coastal areas and in ports. Directive 2005/33/EC of the European Parliament and of the Council of 6 July 2005 amending Directive 1999/32/EC, the Sulphur Content of Liquid Fuels Directive, as regards the sulphur content of marine fuels regulates sulphur content of marine fuels used by shipping in the EU and the UK is required to implement this Directive. The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2010 seek to achieve this.

What are the policy objectives and the intended effects?

1) Implementation of EC Directive 2005/33/EC as regards the sulphur content of marine fuel.

2) Reduction in sulphur and particulate matter emissions from shipping.

3) Will complement separate legislation set out in Directive 2001/81/EC obliging Member States to implement measures to comply with emissions ceilings for atmospheric pollutants.

What policy options have been considered? Please justify any preferred option.

Option 1: Implement the requirements of the Sulphur Content of Liquid Fuels Directive (the Directive) as it relates to the sulphur content of marine fuels (Preferred option).

Option 2: Implement the requirements of the Directive and, in addition reduce the sulphur content of marine fuels used in the UK SECA to 0.5% rather than the current 1.5%, 0.5% being the internationally agreed target for sulphur content of marine fuels used by all shipping by 2020.

A 'Do Nothing' option would not allow the UK to comply with the European Community Directive.

When will the policy be reviewed to establish the actual costs and benefits and the achievement of the desired effects? The policy will be reviewed in late 2010.

Ministerial Sign-off For implementation stage Impact Assessment:

I have read the Impact Assessment and I am satisfied that (a) it represents a fair and reasonable view of the expected costs, benefits and impact of the policy, and (b) the benefits justify the costs.

Signed by the responsible Minister:

Paul Clark

.....Date: 21 March 2010

Summary: Analysis & Evidence

Policy Option: 1	Description: **Implement the Sulphur Content of Liquid Fuels Directive (the Directive) as regards the sulphur content of marine fuels - sulphur content of marine fuels used in SECAs to 1.5%**

COSTS

ANNUAL COSTS		Description and scale of **key monetised costs** by 'main affected groups' 1.) Higher fuel costs (compared to the 'Do Nothing' option) will be borne by passenger ships operating a regular service between Community ports and, from entry into force, ships at berth and those operating on inland waterways. The range below reflects the uncertainty about the cost of this to the UK. 2.) There would be a small cost to the MCA.	
One-off (Transition)	**Yrs**		
£ 0	0		
Average Annual Cost (excluding one-off)			
£ 4 – 32 million	10	**Total Cost** (PV)	**£ 36 – 271 million**

Other **key non-monetised costs** by 'main affected groups' 1.) Some vessels may incur significant fuel tank modification costs.

BENEFITS

ANNUAL BENEFITS		Description and scale of **key monetised benefits** by 'main affected groups' 1.) HEALTH – Reduction in impacts to human health through reduced inhalation of sulphur oxides and particulate matter. The range below reflects the uncertainty surrounding this benefit. 2.) PROPERTY – Reduction in acid rain damage to buildings.	
One-off	**Yrs**		
£ 0	0		
Average Annual Benefit (excluding one-off)			
£ 7 – 15 million	10	**Total Benefit** (PV)	**£ 60 – 131 million**

Other **key non-monetised benefits** by 'main affected groups' 1.) ENVIRONMENT – Reduced harm to environment e.g., reduced acid rain damage to ecosystems, and reduction in nitrous oxide emissions. 2.) UK REGISTER – UK will maintain reputation as quality flag.

Key Assumptions/Sensitivities/Risks 1) All sulphur in the fuel is converted to sulphur dioxide on combustion. 2) The estimated monetised costs assume fuel switching by all vessels, however, other measures, such as sea water scrubbing equipment may be more cost-effective for some vessels. 3) A supply shortage of low sulphur fuel is a low risk. 4.) The net impact on greenhouse gas emissions is uncertain, but is expected to be insignificant. 5.) The estimated monetised costs and monetised benefits identified above are uncertain. 5.) It has not been possible to monetise a number of costs and benefits identified. 6.) The Best estimate of the Net Benefit below is based on the mid-point of the range of estimates of the Total Cost (PV) and the high estimate of the Total Benefit (PV).

Price Base Year 2006	Time Period Years 10	**Net Benefit Range** (NPV) **£ (-)211 to 95 million**	**NET BENEFIT** (NPV Best estimate) **£ -23 million**

What is the geographic coverage of the policy/option?			UK	
On what date will the policy be implemented?			April 2010	
Which organisation(s) will enforce the policy?			MCA	
What is the total annual cost of enforcement for these organisations?			£ 0.05million	
Does enforcement comply with Hampton principles?			Yes	
Will implementation go beyond minimum EU requirements?			No	
What is the value of the proposed offsetting measure per year?			£ n/a	
What is the value of changes in greenhouse gas emissions?			£ Insignificant	
Will the proposal have a significant impact on competition?			No	
Annual cost (£-£) per organisation (excluding one-off)	Micro	Small	Medium	Large
Are any of these organisations exempt?	No	No	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices) (Increase - Decrease)

Increase of £ 0 Decrease of £ 0 **Net Impact** £ 0

Key: **Annual costs and benefits: Constant Prices** **(Net) Present Value**

Summary: Analysis & Evidence

Policy Option: 2	Description: **Implement the Sulphur Content of Liquid Fuels Directive (the Directive) as regards the sulphur content of marine fuels - sulphur content of marine fuels used in SECAs reduced to 0.5%**

COSTS

ANNUAL COSTS		Description and scale of **key monetised costs** by 'main affected groups' 1.) Higher fuel costs (compared to the 'Do Nothing' Option and Option 1) will be borne by passenger ships operating a regular service between Community ports and, from the entry into force, ships at berth and those operating on inland waterways. The range below reflects the uncertainty about the cost of this to the UK. 2.) There would be a small cost to the MCA.	
One-off (Transition)	**Yrs**		
£ 0	0		
Average Annual Cost (excluding one-off)			
£ 7 – 49 million	10	**Total Cost** (PV)	**£ 63 – 425 million**

Other **key non-monetised costs** by 'main affected groups' 1.) Some vessels may incur significant fuel tank modification costs. 2.) UK SHIP OWNERS/OPERATORS – Loss of business due to competition effects since UK flagged vessels and vessels visiting UK ports would face higher fuel costs than competing EU vessels.

BENEFITS

ANNUAL BENEFITS		Description and scale of **key monetised benefits** by 'main affected groups' 1.) HEALTH – Reduction in impacts to human health through reduced inhalation of sulphur oxides and particulate matter. The range below reflects the uncertainty surrounding this benefit. 2.) PROPERTY – Reduction in acid rain damage to buildings.	
One-off	**Yrs**		
£ 0	0		
Average Annual Benefit (excluding one-off)			
£ 103 – 237 million	10	**Total Benefit** (PV)	**£ 885 – 2,032 million**

Other **key non-monetised benefits** by 'main affected groups' 1.) ENVIRONMENT – Reduced harm to environment e.g., reduced acid rain damage to ecosystems, and reduction in nitrous oxide emissions 2.) UK REGISTER – UK will maintain reputation as quality flag.

Key Assumptions/Sensitivities/Risks The key assumptions, sensitivities and risks are the same as for Option 1.

Price Base Year 2006	Time Period Years 10	**Net Benefit Range** (NPV) **£ 460 – 1,969 million**	**NET BENEFIT** (NPV Best estimate) **£ 1,788 million**

What is the geographic coverage of the policy/option?			United Kingdom	
On what date will the policy be implemented?			April 2010	
Which organisation(s) will enforce the policy?			MCA	
What is the total annual cost of enforcement for these organisations?			£ 0.05 million	
Does enforcement comply with Hampton principles?			Yes	
Will implementation go beyond minimum EU requirements?			Yes	
What is the value of the proposed offsetting measure per year?			£ n/a	
What is the value of changes in greenhouse gas emissions?			£ Insignificant	
Will the proposal have a significant impact on competition?			Yes	
Annual cost (£-£) per organisation (excluding one-off)	Micro	Small	Medium	Large
Are any of these organisations exempt?	No	No	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices) (Increase - Decrease)

Increase of £ 0 Decrease of £ 0 **Net Impact** **£** 0

Key: **Annual costs and benefits: Constant Prices** **(Net) Present Value**

Evidence Base (for summary sheets)

1. Title of the proposal

1.1. The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2010 to implement Directive 2005/33/EC as regards the sulphur content of marine fuels of the European Parliament of the Council of 6 July 2005 amending Directive 1999/32/EC, the Sulphur Content of Liquid Fuels Directive on the sulphur content of liquid fuels.

2. Purpose and intended effect of measure

2.1. *Objective*

2.1.1. The Sulphur Content of Liquid Fuels Directive[1] as amended by Directive 2005/33/EC as regards the sulphur content of marine fuels[2] (the Directive) has the aim of reducing emissions of sulphur dioxide (SO_2) from ships. There would also be reductions in primary and secondary particulate matter (PM). Benefits would include:

(i) significant health benefits from reducing exposure to sulphur dioxide (SO_2) and primary and secondary PM;

(ii) environmental benefits - reduced damage to ecosystems; and

(iii) reduced damage to UK buildings and materials.

2.2. *Background*

2.3. *Relationship to the International Maritime Organisation – MARPOL Annex VI*

2.3.1. The Directive is linked to Annex VI ('Regulations for the Prevention of Air Pollution from Ships') of the International Convention for the Prevention of Marine Pollution 1973/1978 Convention (MARPOL 73/78), of the International Maritime Organisation (IMO) which came into force on 19 May 2005 following its ratification by 15 states with greater than 50% of the world merchant shipping tonnage. Annex VI specifies limits on ship exhaust emissions of sulphur oxide and nitrogen oxide emissions as well as prohibiting the deliberate release of ozone-depleting substances. In the UK, the Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008, which came into force on 8 December 2008, implement the 1997 Protocol to the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) including Annex VI. The Maritime and Coastguard Agency (MCA) consulted separately on implementation of MARPOL Annex VI (see Section 3 below).

2.3.2. Annex VI contains provisions allowing for special 'SOx Emission Control Areas' (SECAs) to be established with more stringent control on sulphur emissions. The Directive also provides for these controls in the designated areas, where the sulphur content of fuel oil used on board ships must not exceed 1.5%. Alternatively, ships can fit an exhaust gas cleaning system or use any other technological method to limit SOx emissions. The proposed regulations require such alternative methods to be approved by an Administration (Flag State). The Baltic Sea is designated as a SECA area in the Protocol and therefore all ship operators must comply from 19 May 2006. The Marine Environment Protection Committee (MEPC) adopted amendments to MARPOL Annex VI in July 2005, including one to designate the North Sea and English Channel as a SECA. The IMO identified an entry into force date of 21 November 2007 for the North Sea

[1] Directive 2005/33/EC of the European Parliament and of the Council of 6 July 2005 amending Directive 1999/32/EC as regards the sulphur content of marine fuels

[2] The Sulphur Content of Liquid Fuels Directive (EC/32/1999) has been implemented into UK law already (see paragraph 2.8). This impact assessment is limited to the requirements made by Directive EC/33/2005 as regards the sulphur content of marine fuels only.

SECA, however, the EU Directive identifies 11 August 2007. The date of 11 August 2007 is treated as the entry into force date for the North Sea SECA.

2.3.3. The impacts of the Directive were originally assessed by Defra in "Full Regulatory Impact Assessment for implementation of: Directive 2005/33/EC of the European Parliament and of the Council of 6 July 2005 amending Directive 1999/32/EC as regards the sulphur content of marine fuels"[3]. This impact assessment considered implementation of MARPOL Annex VI alongside the options presented here.

2.3.4. In this impact assessment Option 1 and Option 2 are assessed against a counterfactual of MARPOL Annex VI implementation.

2.3.5. SO_2 emissions from the maritime sector in Europe are projected to surpass SO_2 emissions from all land-based sources by 2020 according to the European Commission's *Clean Air For Europe* (CAFE) emission estimates[4], assuming that no action is taken in the maritime sector. This is due in a large part to considerable reductions made by shoreside industry and other terrestrial sources. To address the significant health and environmental impacts of ship emissions, the European Commission adopted a European Union strategy in November 2002 to reduce such emissions.[5] The aim of the strategy is to define the contribution made by seagoing ships to atmospheric emissions and environmental problems in the European Union as well as to set out a broad series of objectives, actions and recommendations for reducing these emissions over a 10 year time period.

2.3.6. One result of the Commission's strategy is Directive 2005/33/EC [6] which came into force on 6 July 2005 amending the existing 1999 Directive)[7]. 2005/33/EC limits the sulphur content in gas oil (including marine gas oil) to 0.2% (by mass) and to 0.1% (by mass) from 1 July 2008, and for heavy fuel oil the sulphur content shall not exceed 1% by mass. However, the Directive does not apply to other liquid fuels used by ships, that is, those fuels used primarily for combustion.

2.3.7. In 2000, it is estimated that ships emitted, across European waters, a total of 2,691 kilotonnes (2,691,000 tonnes) of SO_2 and, 336 kilotonnes (336,000 tonnes) of particulate matter. This is estimated to rise to 3,146 kilotonnes of SO_2 and 393 kilotonnes of particulate matter, in 2007.[8]

2.3.8. <u>UK emissions of sulphur dioxide</u>

2.3.8.1. Table 1 gives the UK SO_2 emissions for other industrial sectors. Emissions from shipping are included under "other trans/machinery".

[3] This drew extensively upon "Regulatory Impact Assessment for Implementation of the Directive on the Sulphur Content of Marine Fuels Final Supporting Report for DEFRA" undertaken by Entec UK Ltd.

[4] http://ec.europa.eu/environment/archives/cafe/general/keydocs.htm#baseline

[5] http://europa.eu/legislation_summaries/environment/tackling_climate_change/l28131_en.htm

[6] Directive 2005/33/EC of the European Parliament and of the Council of 6 July 2005 amending Directive 1999/32/EC as regards the sulphur content of marine fuels

[7] Directive 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC

[8] Quantification of emissions from ships associated with ship movements between ports in the European Community. Entec, 2002.

Table 1 UK emissions of SO_2 by UN/ECE[9] source category (kilotonnes)

	1970	1980	1990	1996	1997	1998	1999	2000	2001	2002	2003	2003%
BY UN/ECE CATEGORY												
Combustion in Energy Prod.												
Public Power	2919	3012	2733	1326	1031	1079	776	821	742	680	677	69%
Petroleum Refining Plants	242	262	153	144	134	98	93	84	72	66	63	6%
Other Combustion & Trans	229	23	7	3	6	7	9	10	8	5	5	1%
Combustion in Comm/Inst/Res												
Residential Plant	522	226	110	73	65	55	54	48	49	42	27	3%
Comm/Pub/Agri Combustion	422	201	85	51	43	31	24	17	16	10	9	1%
Combustion in Industry												
Iron & Stell Combustion	330	88	31	24	24	23	22	20	19	15	11	1%
Other Ind. Combustion	1514	814	393	248	224	189	146	121	140	125	121	12%
Production Processes	119	93	67	51	48	48	45	36	40	32	31	3%
Extr./Distrib. Of Fossil Fuels	5	5	16	7	6	6	1	1	1	1	1	0%
Road Transport	50	46	63	37	27	23	14	6	3	3	3	0%
Other Trans/Machinery[10]	89	55	38	39	35	32	28	24	19	17	26	3%
Waste	8	8	7	3	1	1	1	1	2	1	1	0%
Total	**6456**	**4841**	**3711**	**2014**	**1653**	**1598**	**1219**	**1194**	**1118**	**1002**	**979**	**100%**

2.4. *Rationale for Government intervention*

2.4.1. The Directive has been adopted by European Union member states. The UK Government supported the Directive and, is legally required to implement its requirements.

2.4.2. A Europe-wide approach to reducing these pollutants from ships and their impacts is required because firstly, such pollutants can travel long distances from their sources before being deposited onto land, surface waters or oceans and secondly, ship movements are such that measures are more practicable at an EU rather than Member State level. There is also a strong economic argument for reducing SO_2 (and particulates) because of the economic impacts resulting from poor health and a degradation of the environment. The Directive builds on benefits derived from the implementation of MARPOL Annex VI.

2.5. *Why the European Union adopted the Directive*

2.5.1. The combustion of marine fuels containing sulphur gives rise to emissions of sulphur dioxide (SO_2), particulate matter (PM) and nitrogen oxides ($NO_{x,}$) (the Directive does not aim to control NO_x - the reduction of NO_x would be a secondary benefit of implementation). SO_2 emissions can damage human health and the built environment, and contribute to acidification, damaging sensitive ecosystems. PM emissions can damage human health. NO_x emissions contribute to acidification, and to the formation of ground-level ozone, which can harm human health and vegetation.

[9] UK emissions reported in IPCC format (Baggott et al, 2005) differ slightly due to the different source categories used.

[10] Including railways, shipping, naval vessels, military aircraft and off-road sources.

2.5.2. The UK was required to implement the Directive by 11 August 2006. Our failure to implement the Directive lead to the receipt of two reasoned opinion letters from the European Commission. The UK has become subject to a hearing in the European Court of Justice with the potential for the imposition of substantial penalties (% of GDP) until the Directive is implemented.

2.6. *Obligations of the Directive*

2.6.1. The basic obligations of the Directive include:

(i) A 1.5% sulphur limit for fuels used by all ships in the SOx Emission Control Areas of the Baltic Sea, from 11 August 2006 and, the North Sea and English Channel from 11 August 2007;

(ii) A 1.5% sulphur limit for fuels used by passenger ships[11] on regular services[12] between EU ports, from 11 August 2006;

(iii) A 0.1% sulphur limit on fuel used by inland waterway vessels[13] and by ships at berth[14] in EU ports, from 1 January 2010;

(iv) A ban on the marketing of marine diesel oils with sulphur content exceeding 1.5% by mass, from 11 August 2006, and;

(v) A ban on the marketing of marine gas oils with sulphur content exceeding 0.1% by mass, from 1 January 2010.

2.6.2. As an alternative to the use of low sulphur marine fuels to comply with Articles 4a and 4b of the Directive, member states can allow trials of unapproved and, use of approved, emission abatement technologies as an alternative to low sulphur fuel provided that these ships:

> *'…continuously achieve emission reductions which are at least equivalent to those which would be achieved through the limits on sulphur in fuel specified in this Directive.'* (Article 4c, paragraph 4)

2.6.3. In addition to the requirements described, the European Parliament negotiated a stronger review of the Directive in 2008 requiring the Commission to consider a second phase limit of 0.5% (dependent upon progress at the International Maritime Organisation) for the sulphur content of fuels used in SECAs. The Commission should also consider the designation of additional SOx Emission Control Areas and alternative or complementary measures.

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[11] 'Passenger ships' are defined in the Directive as '…*ships that carry more than 12 passengers, where a passenger is every person other than:*

a. the master and the members of the crew or other person employed or engaged in any capacity on board a ship on the business of that ship, and

b. *a child under one year of age.*'

[12] 'Regular services' are defined in the Directive as '…*a series of passenger ship crossings operated so as to serve traffic between the same two or more ports, or a series of voyages from and to the same port without intermediate calls, either:*

a. according to a published timetable, or

b. *with crossings so regular or frequent that they constitute a recognisable schedule*.'

[13] The definition of 'inland waterway vessel' in the Directive means '…*a vessel particularly intended for use on an inland waterway as defined in Council Directive 82/714/EEC of 4 October 1982 laying down technical requirements for inland waterway vessels which carry:*

(i) *a community inland navigation certificate, as defined in Directive 82/714/EEC*

(ii) *a certificate issued pursuant to Article 22 of the Revised Convention for the Navigation of the Rhine.*'

The UK has no inland waterways as defined under the Directive.

[14] 'Ships at berth' are defined in the Directive as '…*ships which are securely moored or anchored in a Community port while they are loading, unloading or hotelling, including the time spent when not engaged in cargo operations*'.

2.7. *Difference between MARPOL Annex VI and the Directive*

2.7.1. MARPOL Annex VI aims to reduce emissions of several pollutants, for example, ozone depleting substances and nitrogen oxides (NO_x), as well as SO_2. However, it is important to note that when reference is made to the control of pollutants under MARPOL Annex VI and, especially when comparisons are made with the Directive, this is only in respect of SO_2. The Directives purpose is to reduce emissions of SO_2.

2.7.2. **In addition** to requirements similar to those of MARPOL Annex VI, the SCLF Directive has the following requirements:

(i) All passenger ships[6] on regular services[7] between EU ports must use fuels with a sulphur content not exceeding 1.5% by mass, from 11 August 2006;

(ii) A 0.1% sulphur limit on fuel used by inland waterway vessels[8] and by seagoing ships at berth[9] in EU ports, from 1 January 2010;

(iii) A ban on the marketing of marine diesel oils with sulphur content exceeding 1.5% by mass, from 11 August 2006, and;

(iv) A ban on the marketing of marine gas oils with sulphur content exceeding 0.1% by mass, from 1 January 2010.

2.8. *UK implementation of the Directive*

2.8.1. Section 2.7 outlines the additional requirements of the Directive as compared to the requirements of MARPOL Annex VI. The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 implement the MARPOL Annex VI requirements. Therefore the Regulations to implement the Directive will only give effect to the requirements within the Directive, as they relate to marine fuels, which are not duplicated under MARPOL Annex VI.

2.8.2. **Land-based provisions - the Sulphur Content of Liquid Fuels Directive (1999/32/EC) and amendments to it by 2005/33/EC**

2.8.2.1. The Sulphur Content of Liquid Fuels Directive 1999/32/EC was implemented in England and Wales through the Sulphur Content of Liquid Fuels (England and Wales) Regulations 2000, Statutory Instrument 2000 No. 1460 and the equivalent regulations within the devolved administrations for Scotland (the Sulphur Content of Liquid Fuels (Scotland) Regulations 2000 SSI No.169) and, Northern Ireland (the Sulphur Content of Liquid Fuels Regulations (Northern Ireland) 2002 - S.R. 2002 No. 28).

2.8.2.2. The 1999 directive was mainly concerned with controls on fuels which are used in land-based installations, for example, emergency generators (small combustion plants). The basic obligations of this Directive are:

(i) An obligation to use heavy fuel oil on or after 1 January 2003 with a sulphur content not exceeding 1% by mass, subject to certain exceptions;

(ii) An obligation to use gas oil or marine gas oil on or after 1 July 2000 with a sulphur content not exceeding 0.2% by mass and to use such oil on or after 1 January 2008 with a sulphur content not exceeding 0.1% by mass;

(iii) An obligation to check by sampling that the sulphur content of fuels used complies with these requirements.

2.8.2.3. For clarity the Sulphur Content of Liquid Fuels Regulations were repealed in 2007 and new regulations made for England and Wales, Northern Ireland and Scotland, which include the amendments made by the Directive which apply only to heavy fuel oils used in land-based activities and, exclude provisions which relate only to the marine (ships) elements (see paragraph 2.8.3 below) **-** The Sulphur Content of Liquid Fuels (England and Wales) Regulations 2007, The Sulphur Content of Liquid Fuels (Northern Ireland) Regulations 2007, The Sulphur Content of Liquid Fuels (Scotland) Regulations 2007.

2.8.3. **Marine provisions of the Directive**

2.8.3.1. The Directive contains new provisions in respect of marine fuels for ships and where those fuels may be used – sea areas within SECAs which fall under UK jurisdiction. To avoid confusion, the marine provisions of the Directive will be implemented through separate regulations to those provisions which relate to land-based fuels and activities.

2.8.3.2. There are also practical considerations relating to implementation of the marine provisions of the Directive. The marine provisions would be difficult to implement if separate regulations were made for each area of the UK – within England and, the devolved administrations for Northern Ireland, Scotland and, Wales:

(i) a ship would need to know whether they were in a sea area which fell within the jurisdiction of England, Wales, Scotland or Northern Ireland and adhere to the appropriate legislation.

(ii) each legislative instrument would need to define the exact areas of sea which fell within each jurisdiction.

2.8.3.3. For these reasons, the provisions within the Directive which relate to marine fuels and ships will be implemented by one set of Regulations covering England, Scotland, Wales and Northern Ireland **-** The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2010.

3. Consultation

3.1. In order to have powers to make The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 the Government made The Merchant Shipping (Pollution) Act in 2006 which was subject to a public consultation in 2005. A further consultation on The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 to implement MARPOL Annex VI regulations was undertaken between July 2008 and August 2008. The consultation documents and the response, is available from the MCA's website at:

http://www.mcga.gov.uk/c4mca/mcga07-home/shipsandcargoes/consultations/mcga-consultations-archive/consultations-started-2008/consultations-annex_vi-letter.htm

3.2. The key comments received from the consultation on The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008, and the MCA's response is available from the MCA's website at:

http://www.mcga.gov.uk/c4mca/annex_vi_air_pollution_-_response_to_consultation-2.pdf

3.3 No major amendments to the Regulations were required. Clarification of points raised by consultees was achieved mainly through amendments to the Merchant Shipping Notice and Marine Guidance Note. Key points raised in the responses include:

- generally supportive of the proposals;
- suggested amendments to bring the terminology relating to seafarer qualifications in line with that used by the IMO Convention on Standards of Training, Certification and Watchkeeping (STCW);
- clarification within the Merchant Shipping Notice on the timelines for withdrawal of Ozone Depleting Substances;
- clarification that platforms and drilling rigs are not generally exempt from the Regulations;
- clarification on how the Regulations are to be enforced on ships operating outwith UK waters;
- concern expressed by ship fuel oil supply industry on sampling method prescribed when fuel oil is delivered to ships.

3.4 The consultation documents for The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2010 can be found on the MCA's website at:

http://www.mcga.gov.uk/c4mca/mcga07-home/shipsandcargoes/consultations/mcga-consultations-archive/consultations-closed_started-2009/con-dms-eq-fuelsulphur.htm

3.5 The consultation raised the following responses:

- the cost to industry of complying with the directive requirement that ships at berth in a UK port use marine fuel with a sulphur content not exceeding 0.10% by mass;
- that the Directive requirement that ships at berth in a UK port use marine fuel with a sulphur content not exceeding 0.10% by mass may result in an increased risk of explosion in ships' with boilers;
- clarification that the exhaust gas cleaning systems under MARPOL Annex VI are defined as an emission abatement technology under the Regulations implementing the directive;
- clarification of the requirements for fuel changeover after a ship arrives at berth;
- clarification of the requirements for recording fuel changeover operations in ships' logbook;
- clarification that fuels required for testing of engines are exempted from the directive;
- the difficulty of developing an accurate impact assessment;
- the use of market based instruments to substitute for the requirements to use low sulphur fuel;
- non-alignment of Directive provisions with those agreed as part of the revision of MARPOL Annex VI at the IMO in October 2008.

3.6 The draft regulations were amended for clarification and a Marine Guidance Note will be issued when the regulations are published to provide guidance on what is "sufficient time" to allow fuel changeover when a ship is at berth and the term "hotelling". The costs and benefits in the impact assessment for the two options have also been revised.

4. 'Do Nothing' Option

4.1. *Current position: MARPOL Annex VI*

4.1.1. The UK has implemented MARPOL Annex VI but this does not meet its obligations under the Directive. This is therefore a baseline against which the other options are assessed.

4.1.2. MARPOL Annex VI requires:

(i) A 1.5% sulphur limit for fuels used by all ships in the SOx Emission Control Areas of the Baltic Sea, from 11 August 2006, and the North Sea and English Channel SECA, from 12 months after the entry into force of the International Maritime Organisation designation, whichever is the earlier.

(ii) Outside of SECA areas a maximum of 4.5% sulphur in marine fuel

(iii) Restrictions on NOx output and operation of incinerators that do not relate directly to the Directive.

4.1.3. This option would:

- Not meet the UK's legal obligations under this Directive.
- Leave the UK open to legal action by the European Commission.

5. Options

5.1. The Government's preferred implementation option is Option 1. Under this option the UK would fully implement its legal obligations under the Directive.

5.2. *Option 1: Implement the requirements of the Directive (preferred option)*

5.2.1. Under Option 1, the UK would fully implement its legal obligations under the Directive but with only the minimum required to meet those obligations, that is, implement the requirements not duplicated under MARPOL Annex VI. The additional requirements of the Directive over and above MARPOL Annex VI are listed in Section 2.7.

5.3. *Option 2: Implement the requirements of the Directive and, in addition reduce the sulphur content of fuel to 0.5% in SECAs (rather than 1.5%) and for passenger ships*

5.3.1. The European Parliament negotiated a stronger review of the Directive in 2008 requiring the European Commission to consider a 2nd phase limit of 0.5% for the sulphur content of fuels used in SECAs. In October 2008, the IMO adopted a revised MARPOL Annex VI which is due to come into force on 1 July 2010, and would see the sulphur content of marine fuels used in SECAs reduced to 1.0% by 1 July 2010 and to 0.1% by 1 January 2015. Due to industry concerns over the available supply capacity of 0.1% marine fuel, 0.5% would be a reasonable interim measure in that it would reflect a future global limit of 0.5% that is required on or after 1 January 2020 under MARPOL Annex VI. Under this option the UK would fully implement the requirements of the Directive (Option 1) and in addition, implement a tighter sulphur content requirement (0.5% instead of 1.5% with immediate effect (revision of MARPOL Annex VI will require 1.0% from 1 July 2010)) for SO_x Emission Control Areas and passenger vessels.

6. Costs and Benefits

6.1. *Sectors and groups affected*

6.1.1. The following sectors and groups are likely to be affected by the Directive:

- Crude oil providers;
- Petroleum refineries and their industry associations;
- Bunker suppliers, traders and brokers;
- Port authorities and their industry associations;
- Shipping operators and their industry associations;
- Abatement equipment suppliers; and,
- Competent authorities (including the Maritime & Coastguard Agency, Environment Agencies, local authorities and the Port Health Authorities of which there are approximately 86 in the UK).

6.1.2. In addition, the Directive would lead to improved public health as emissions from ships are reduced. This would benefit a proportion of the UK population, particularly populations living along the coast and close to ports where emission reductions will be greatest.

6.1.3. **Equity and fairness**

6.1.3.1. This proposal is unlikely to have a disproportionate impact on different groups. The race equality impact of the policy has been considered and the policy is not considered to have any impact on race equality.

6.2. *Benefits assessed*

6.2.1. The benefits that have been considered in this IA include:

- The reduction in human health impacts arising from exposure to SO_2 and particulates;
- The reduction in materials damage from SO_2 emissions; and,
- The reduction in ecosystem area at risk of acidification due to SO_2 emissions.

6.2.2. These have been assessed separately for each option.

6.2.3. In 2000, it is estimated that ships emitted, across European waters, a total of 2,691 kilotonnes (2,691,000 tonnes) of SO_2 and 336 kilotonnes (336,000 tonnes) of particulate matter. This is estimated to rise to 3,146 kilotonnes of SO_2 and 393 kilotonnes of particulate matter in 2007.[15]

6.2.4. Table **2** details the results of the estimations of emission reductions of SO_2 and primary PM by each of the options compared to the baseline for all vessels calling at UK ports of which UK flagged vessels are assumed to represent a sub-set. The emission reductions associated with each option have been calculated based on a spatially disaggregated ship emissions inventory for Europe[16]. The emission estimations are represented for the EMEP (European Monitoring and Evaluation Programme) area covering all European waters.

6.2.5. **Table 2 Overall impact of scenarios on SO_2 and PM emissions**

	Reduction in SO_2 emissions from all ships in all sea areas (emissions across all European waters), kt	**Reduction in SO_2 emissions from ships calling at UK ports (emissions across all European waters), kt (Note 1)**	**Reduction in SO_2 emissions from all UK flagged ships (emissions across all European waters), kt (Note 1)**	**Reduction in total primary PM emissions from ships calling at UK ports (emissions across all European waters), kt (Note 1)**	**Reduction in total primary PM emissions from all UK flagged ships, (emissions across all European waters) kt (Note 1)**
Option 1 (preferred option)	207	24	6	1	0.4
Option 2	469	55	13	3	0.6

Note 1:
1. Ships calling at UK ports are estimated to contribute to total emissions across European waters by approx. 11.6%. UK flagged vessels are estimated to contribute to total emissions across European waters by approx. 2.8%[17]

6.2.6. Modelled emissions data has been used to estimate changes in the exposure of the UK population to SO_2, primary and secondary PM. The impacts of each option on human health have been estimated by applying exposure-response relationships to the modelled change in population exposure and appropriate valuation estimates based on the standard methodologies recommended by the Interdepartmental Group on Costs and Benefits (IGCB)[18].

6.2.7. The recommended values and sensitivities which have been utilised in this study are summarised in Table 3 below.

[15] Quantification of emissions from ships associated with ship movements between ports in the European Community. Entec, 2002.
[16] Quantification of emissions from ships associated with ship movements between ports in the European Community. Entec, 2002.
[17] Ship Emissions: Assignment, Abatement and Market-based Instruments. Entec, 2005. http://europa.eu.int/comm/environment/air/transport.htm
[18] Further details are available at: www.defra.gov.uk/environment/airquality/forum/meetings/240505/pdf/p02.pdf

Table 3 Defra Air Quality Strategy, July 2007 valuations for monetising health benefits[19]

Health Effect	Form of measurement to which the valuations will apply	Valuation (£ 2004 prices) (Note 1)	
		Central Value	Sensitivity
Acute Mortality	Number of years of life lost due to air pollution (life years) – assuming 2-6 months loss of life expectancy for every death brought forward. Life-expectancy loses assumed to be in poor health.	£15,000	10% and 15% of life years valued at £29,000 instead of £15,000 (to account for avoidance of sudden cardiac deaths in those in apparently good health)
Chronic Mortality	Number of years of life lost due to air pollution (life years) - Life-expectancy loses assumed to be in normal health.	£29,000	£21,700 - £36,200 (sensitivity around the 95% confidence intervals)
Respiratory Hospital Admissions	Case of a hospital admission - of average duration 8 days.	£1,900 – £9,100	£1,900 – £9,600
Cardiovascular Hospital Admissions	Case of a hospital admission - of average duration 9 days.	£2,000 – £9,200	£2,000 – £9,800
Notes: Note 1: These values are presented at 2004 prices and have therefore been scaled to 2006 prices for use in this Impact Assessment.			

6.2.8. The values in Table 3 can then be used to apply a monetary value to the health benefits realised with each option. Benefits have been discounted (3.5% each year declining to 3% after 30 years and 2.5% after 75 years) and uplifted (2% each year[20]) over a 100 year period and the present value and annualised present value estimated.

6.2.9. The long-term effects of particles on mortality have been calculated using the methodology used by the Defra Air Quality Strategy. This is based on the assumption that there is now sufficient evidence of a link between mortality and long term exposure to particles. However, the exact link in terms of the size of the impacts is still uncertain. The Strategy recommended a concentration-response function for estimating the impacts on mortality of long-term exposure to $PM_{2.5}$ based on the American Cancer Society studies of Pope et al (2002)[21]. This is equivalent to a 0.6% reduction in mortality rate per $\mu g/m^3$ drop in $PM_{2.5}$ concentration. Therefore figures for the impacts on life years saved have been calculated and presented based on 0.6% reduction in mortality rate as recommended by the Strategy.

6.2.10. There is also uncertainty concerning the exact time lag between a change in concentration and any chronic health impacts. The impacts of each option on life years saved have been estimated based on a 0-year and a 40-year lag period. Although there is only limited evidence available, Defra considered evidence that a greater proportion of benefits are likely to occur in the years following a reduction in pollutant concentrations rather than later (i.e. closer to 0 rather than 40 years)[22]. Therefore, the benefits are likely to be closer to the higher end of the range of values presented in this section rather than the lower values.

6.2.11. The reductions in primary and secondary PM emissions and Population Weighted Mean Concentrations (PWMCs) have been assumed to equate to $PM_{2.5}$ to calculate chronic health benefits.

[19] Economic analysis to inform the Air Quality Strategy, DEFRA, July 2007.

[20] This reflects the assumption that Willingness-To-Pay (WTP) will rise in line with economic growth.

[21] Pope, C.A.III, Burnett, R.T., Thun, M.J., Calle, E.E., Krewski, D., Ito, K. and Thurston, G.D. (2002): Lung cancer, cardiopulmonary mortality and long term exposure to fine particulate air pollution. JAMA. **287**(9), 1132-1141.

[22] Committee on the Medical Effects of Air Pollutants (COMEAP): Quantification of the Effects of Air Pollutants on Health in the UK, Interim Statement, 18th January 2006. Available at: http://www.advisorybodies.doh.gov.uk/comeap/pdfs/interimlongtermeffects2006.pdf

6.2.12. Benefits to ecosystems have been assessed by considering critical load exceedances for acidity and nutrient nitrogen. The critical load is defined as the level of exposure of a natural system to pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur. Results of critical load exceedance analysis express percentage of the environment considered that exceeds the critical pollutant load. The change in critical load exceedances for the UK as a result of implementing the various policies has been assessed using the SO_2 emissions across the whole EU.

6.2.13. The benefits to the UK arising from human health impacts have been estimated based on reductions in emissions from vessels as a result of each option. For Option 1, this includes a reduction in emissions for UK flagged or vessels calling at UK ports such as passenger vessels and those at berth. For Option 2, this includes, in addition to UK flagged or vessels calling at UK ports, costs to non-UK registered vessels passing through UK waters but not calling at UK ports. Costs on non-UK registered vessels passing through UK waters but not calling at UK ports have not been estimated for Option 1 as those vessels are already required to comply with MARPOL Annex VI.

6.2.14. Finally, it should be stressed that the monetised benefit estimates do not include those benefits that are considered secondary benefits resulting from implementation of the directive to minimise emissions of sulphur dioxide, or we have not been possible to monetise due to time and cost restrictions. These include:

- health and environmental benefits to other Member States;
- ecosystem benefits;
- any chronic impacts of pollutants apart from PM;
- impacts of reductions in primary PM and SO_2 emissions beyond 50km from the UK coastline; and,
- impacts of fuel switching on other pollutants apart from SO_2 and PM, e.g. heavy metals and NOx
- reduction in carbon dioxide emissions as a consequence of reduced burning of fuel sludge waste on ships using marine diesel oil instead if residual fuel oil (para. 6.7.5).

6.2.15. Because of these potential additional categories, the numbers presented in this Impact Assessment should therefore be seen as a sub-total of overall benefits.

6.2.16. **Damage to buildings and materials**

6.2.16.1. The total reduction in SO_2 emissions in UK ports and UK waters have been used as the basis on which to calculate the costs savings associated with a reduction in damage to buildings and materials. Based on data derived in the ExternE project[23], an exposure-response relationship for the cost of materials damage per tonne of SO_2 is estimated to be €592/te (1995 prices). When inflated to 2006 prices and converted to £ the figure is £522/te.

6.2.16.2. In this study, the figure has been adjusted to take into account the fact that some of the deposition of pollutants from ships in-port and at sea will be over the sea and will therefore not impact on UK land-based materials. It has been assumed that roughly 50% of emissions from ships in port and roughly 10% of ships in UK waters will be deposited on UK materials. Therefore the figure of £522/te has been adjusted to give £261/te for in-port emissions and £52/te for at sea emissions (2006 prices).

[23] European Commission. ExternE: Externalities of Energy

6.3. *Benefits - Option 1: Implement the requirements of the Directive (preferred option)*

6.3.1. **Human health impacts**[24]

6.3.1.1. Option 1 has been estimated to reduce, each year, the number of:

- deaths brought forward by approximately 41, and;
- Respiratory Hospital Admissions (RHAs) by approximately 30, and;
- Cardiovascular Hospital Admissions (CVHAs) by approximately 4.

6.3.1.2. The number of life years saved has been estimated to be between 21,000 – 40,000 (over a 100 year period).

6.3.1.3. The Annualised Present Value of the health benefits to the UK associated with Option 1 has been estimated to be around £3 million to £16 million per year.

6.3.2. **Reduction in damage to buildings and materials**

6.3.2.1. The Annualised Present Value of the impacts of the Directive (Option 1) on reducing damage to buildings and materials in the UK has been estimated at approximately £8 million per year.

6.3.3. **Benefits to ecosystems**

6.3.3.1. The Directive (Option 1) is expected to reduce the area of critical load exceedance by 0.07 per cent.

6.4. *Benefits - Option 2: Implement the requirements of the Directive and, in addition reduce the sulphur content of fuel to 0.5% rather than 1.5%*

6.4.1. **Human health impacts**

6.4.1.1. Implementation of the Directive with a more stringent fuel sulphur limit of 0.5% for the sulphur content of fuels used in SECAs (Option 2) has been estimated to reduce, each year, the number of::

- deaths brought forward by approximately 109, and;
- Respiratory Hospital Admissions (RHAs) by approximately 102, and;
- Cardiovascular Hospital Admissions (CVHAs) by approximately 60.

6.4.1.2. The number of life years saved has been estimated to be between 362,000 – 691,000 (over a 100 year period).

6.4.1.3. The Annualised Present Value of the health benefits to the UK associated with Option 2 has been estimated to be around £151 million to £361 million per year.

6.4.2. **Reduction in damage to buildings and materials**

6.4.2.1. The Annualised Present Value of the impacts of Option 2 on reducing damage to buildings and materials in the UK has been estimated at approximately £11 million per year.

6.4.3. **Benefits to ecosystems**

6.4.3.1. Option 2 is expected to reduce the area of critical load exceedence by 0.56 per cent.

6.4.4. **Summary of estimated monetised benefits**

[24] The benefits were presented as part of a draft impact assessment undertaken by Defra in May 2006, see footnote 3. The figures for that draft impact assessment were calculated as part of a project by ENTEC for Defra who reported their findings in March 2006. The raw data and analysis is now unavailable, however, the figures are considered as valid, and the cost of redoing the analysis as not providing value for money.

6.4.4.1. Table 4 summarises the overall estimated Annualised Present Value of the total monetised benefits to the UK (compared to the baseline) associated with each option including the impacts on human health and damage to buildings and materials avoided due to the reduction in emissions. A range of values are presented to reflect the uncertainty in the valuation of acute effects and morbidity impacts: benefits are likely to be closer to the higher end of the range.

Table 4 Summary of estimated monetised benefits

	Annualised Present Value of benefits based on 100 year appraisal period (Note 1) (£million)
Option 1 (preferred option)	11 - 24
Option 2	162 - 372
Note 1 – Based upon a reduction in mortality rate of 0.6% per μg/m^3. [25]	

6.4.5. The Annualised Present Value of the total monetised benefits to the UK of implementing the Directive (Option 1) over and above MARPOL Annex VI have been estimated at between approximately £11 and £24 million per year. The Annualised Present Value of the total monetised benefits of implementing the Directive with the more stringent limit on the sulphur content of fuel (Option 2) have been estimated at between approximately £162 and £372 million per year.

6.4.6. For the purposes of the 'Summary: Analysis & Evidence' sheets, the Present Value of the total monetised benefits identified in this Impact Assessment has been estimated over a 10 year appraisal period using the estimates from Table 4. For Option 1, the Present Value of the monetised benefits has been estimated at between approximately £60 and £131 million. For Option 2, the Present Value of the monetised benefits has been estimated at between approximately £885 and £2,032 million. The ranges reflect the uncertainty in the valuation of acute effects and morbidity impacts as above.

6.5. *Costs*

6.5.1. Costs have been estimated primarily on the assumption that the majority of vessel operators will choose to switch to lower sulphur fuels rather than take up the option of installing alternative emissions abatement equipment to comply with the Directive[26]. In addition to fuel switching costs, costs are presented for the installation of seawater scrubbing and shoreside electricity however these are relatively uncertain as the technologies involved are fairly new to the market, are limited in number and are not yet fully developed.

6.5.2. The main costs will be incurred by vessel operating companies who will be required to switch to lower sulphur fuels (or install alternative emissions abatement equipment) by the specified deadlines. In addition there will be further regulatory costs incurred by the competent authorities as sampling of fuels may have to be increased. Petroleum refineries and bunker suppliers will also be affected as the Directive includes mandatory requirements relating to the sulphur content of marine diesel oil (1.5%) and marine gas oil (0.1%) that may be placed on the market within the EU (Articles 4a paragraph 7 and 4b paragraph 3) although the cost implications of this are unclear. Compliance with the legislation is assumed to be through re-distribution of existing fuels and, for the tightest limits in Option 2, switching from marine heavy fuel oil to marine gas oil (rather than expensive desulphurisation at the refinery) (see also Section 6.5.9).

[25] Considered most likely based on research by Committee on the Medical Effects of Air Pollutants (COMEAP): Quantification of the Effects of Air Pollutants on Health in the UK, Interim Statement, 18th January 2006. Available at: http://www.advisorybodies.doh.gov.uk/comeap/pdfs/interimlongtermeffects2006.pdf

[26] Based on discussions with vessel operating companies undertaken as part of this IA and on previous studies for Defra relating to this legislation ('Investigation into costs and emission reductions of proposals on the sulphur content of marine fuels', April 2003).

6.5.3. Option 2 has a potential competition impact in that it implies higher costs for UK flagged vessels, and those visiting UK ports, than that faced by their international competitors. This is discussed in section 8.

6.5.4. There is a significant risk that vessels entering the English Channel from the Western Approaches, and which are not scheduled to stop at a UK port, will fail to changeover to low sulphur fuel before entering the SECA. Unless a ship has a dedicated fuel tank, successful fuel changeover can take several hours. A ship stopping to take on bunkers before entering the SECA probably has adequate time to changeover to low sulphur fuel, however, ships without a dedicated low sulphur fuel tank and not stopping probably do not.

6.5.5. The costs associated with fuel switching have been estimated based on the associated price premium for switching to lower sulphur fuels. The values used in the calculations are summarised in Table 5. These prices were inflated to 2006 prices and then applied to fuel consumption figures for all vessels visiting UK ports and UK flagged vessels to calculate the overall costs associated with each option. There is a risk of double counting as some UK flagged vessels will also call at UK ports. The price premiums are applicable for all options and is dependent on what type of fuel is currently used when switched to 'compliant fuel'.

Table 5 Summary of price premium for low sulphur fuel assumed for this study (£/tonne 2000 prices inflated to 2006 prices – see paragraph 6.5.5)

Switching from 2.7% Residual Oil (RO) to 1.5% RO (Note 1)	Switching from 2.7% RO to 0.5% RO (Note 1)	Switching from 2.7% RO to 0.1% Marine Distillate (MD) sulphur content (Note 1)	Switching from 0.2% MD to 0.1% MD sulphur content (Note 2)
34	44	89	1

Note 1: Figure taken from Entec (2005): Service contract on ship emissions: assignment, abatement and market based instruments.
Note 2: Figure taken from BeicipFranlab (2002) – based on the additional premium between switching from 1.5% RO to 0.2% and 0.1% MD.

6.5.6. In March 2005 the oil companies' European association for environment, health and safety in refining and distribution (CONservation of Clean Air and Water in Europe - CONCAWE) suggested an alternative cost distribution between the different desulphurisation levels than that contained in previous reports for the Commission by Beicip Franlab[27]. However, these costs were not agreed and have therefore not been used in this IA.

6.5.7. In accordance with the methodology used for calculating costs under the Air Quality Strategy Review, costs have been projected over 100 years based on a discount rate of 3.5% (declining to 3% after 30 years and 2.5% after 75 years). Annualised costs have then been calculated based on the present value of costs divided by the sum of the discount factor over 100 years.

6.5.8. There may be some further costs incurred by vessel operators if they choose to install additional fuel tanks or split existing tanks to store lower sulphur fuels. The majority of passenger ferries, cruise ships and coastal tankers are expected, based on discussions carried out during previous work on this Directive, to switch fully to lower sulphur fuel rather than install additional or modify existing fuel tanks. For other vessels, such as container ships and cargo ferries, the situation is less clear as installing additional fuel tanks would lead to reduced storage space and therefore a less profitable ship. The potential costs associated with the installation of new or splitting of existing tanks have not been included in the analysis as it is unclear to what extent this may be carried out.

[27] http://europa.eu.int/comm/environment/air/pdf/note_concawe.pdf

6.5.9. **Petroleum refineries**

6.5.9.1. Previous studies[28] for Defra concluded that a consensus is emerging that it is expected to be achievable for the refining sector to supply 1.5% sulphur HFO bunkers to meet needs for SECAs and passenger vessels. Compliance with the legislation is assumed to be through re-distribution of existing fuels and, for the tightest limits in Option 1, switching from heavy fuel oil to marine gas oil (rather than expensive desulphurisation at the refinery). Re-distribution between SECAs and areas outside SECAs would lead to an estimated increase in sulphur of 0.3% in fuels used outside SECAs, but this has been included in calculations within this IA. In terms of the proposed limit for vessels at berth, due to the limited demand for marine gas oil, this would be expected to be met by the supply of land-based gas oil (e.g. heating oil or off-road diesel), which already complies with the 0.2% sulphur limit to comply with the Sulphur Content in Liquid Fuels Directive (1999/32/EC).

6.5.9.2. Evidence from INTERTANKO[29] indicates that by 2011 new refinery capacity (660 mt/year) will be sufficient to meet the demands for low sulphur fuel (MDO).

6.5.10. **Costs for vessel operators**

Vessel operators have three key approaches to complying with the directive: fuel switching, seawater scrubbing, and/or use of shoreside electricity. The costs associated with each approach are appraised below.

6.5.10.1. ***Fuel switching***

6.5.10.1.1. The costs associated with each option have been estimated based on the assumption that all ships would choose to switch to low sulphur fuels in order to comply with the legislation. Table 6 summarises the annualised present value of costs for each option for all ships visiting UK ports as well as UK flagged vessels. Costs for option 2 have not been estimated for other vessels which pollute the UK but do not call at UK ports. The estimated fuel tonnage that would be affected by each option (i.e. would need to be switched to a fuel with a lower sulphur content) is also presented. The costs have been calculated in line with the methodology used for the Air Quality Strategy Review, e.g. calculated over 100 years and annualised.

Table 6 Summary of annualised present value of costs associated with each option based on fuel switching

	Quantity of fuel for ships calling at UK ports (million tonnes) (Note 1)	**Quantity of fuel for UK flagged ships (million tonnes) (Note 1)**	**Annualised Present Value of costs for ships calling at UK ports (£million) (Note 2)**	**Annualised Present Value of costs for UK flagged ships (£million) (Note 2)**	**Annualised Present Value of costs for UK owned, UK flagged ships (£million) (Note 2)**
Option 1 – Implement the Directive (preferred option)	0.7	0.1	26	6	4
Option 2 – 0.5%	0.7	0.1	40	10	7

[28] Report for Defra - Investigation into Costs and Emission Reductions of Proposals on the Sulphur Content of Marine Fuels, Entec UL Limited, April 2003.

[29] Informal Cross Government/Industry Scientific Group of Experts to evaluate the effects of the different fuel options proposed under the revision of Annex VI – Explanatory note on a report to assess (a) the number of ships in the world fleet; ship type and installed power; (b) total volume of bunkers being consumed (residuals and distillates); (c) ship emissions, including CO2 emissions, INTERTANKO, 5 November 2007.

Notes:
Note 1: Based on emissions and fuel consumption data from previous Entec studies for the European Commission, assuming ships calling at UK ports are estimated to be approximately 11.6% of the total fleet and approximately 2.8% of the total fleet are UK flagged.
Note 2: Only a proportion of UK flagged ships are UK owned (approx 70%). It is likely that these costs will only be directly incurred by a UK firm when the relevant ships are UK owned. However, it is possible that a proportion of these costs could also be indirectly passed on to other firms and consumers in the UK.

6.5.10.2. *Seawater scrubbing*

6.5.10.2.1. One of the most promising emissions abatement technologies that could be installed as an alternative to switching to lower sulphur fuels is sea water scrubbing, due to sea water's natural alkalinity. Furthermore, sea water already contains large quantities of sulphur (around 0.1% on weight) and can be considered as a safe sulphur reservoir. The basic principle of operation for a Sea Water Scrubber relies on hot exhaust gases mixing in a turbulent cascade with seawater whereupon SO_2 in the exhaust is transferred to the seawater. The seawater is re-circulated, and the solid particles removed from the exhaust gas are trapped in a settling or sludge tank where they are collected for disposal by either burning the sludge in the ships incinerator, or disposing of the sludge ashore – costs are included in the estimated costs given in Table 7.

6.5.10.2.2. The use of abatement technology was requested by industry and subsequently included in the Directive. Several sea trials have been undertaken to develop sea water scrubbing for marine applications. Two rounds of commercial trials have been carried out with scrubbers onboard the P&O Line's passenger ferry *Pride of Kent.* These trials took place during autumn 2004 and winter 2005. During the autumn trial, with a 2.5% sulphur fuel, SO2 reduction rates of 68-94% have been achieved. The scrubbing efficiency is linked to the flow rate of sea water making contact with the exhaust. A reduction efficiency rate of 75% for SO_2 is assumed in this study and a conservative estimate of particulate removal would be 25%. The quality of the discharge water has demonstrated compliance with the appropriate environmental legislation[30].

6.5.10.2.3. Under the draft Regulations, operators would need to apply to the Secretary of State who would authorise use of approved, or trials of unapproved, abatement technology – Article 4c of the Directive.

6.5.10.2.4. Estimates for the overall cost of installing seawater scrubbing as an alternative to fuel switching have been calculated based on the assumption that all ships would install the technology. The costs have been calculated in line with the methodology used for the Air Quality Strategy Review, e.g. calculated over 100 years and annualised.

6.5.10.2.5. Operating and capital costs have been presented in Entec UK Ltd's study[31] for the European Commission and are summarised in Table 7. These figures are based on the outcome of the autumn and winter trials in which scrubbers were fitted on four 1.2 MW auxiliary engines. Cost estimates per kW installed (capital costs) and per MWh (operating costs) have been calculated based on this study. These costs have then been scaled up to estimate the total operating and capital costs for different sized vessels (based on their installed capacity and annual average activity). These estimates therefore represent the total costs associated with installing the technology on the auxiliary and main engines of each vessel.

Table 7 Summary of annual operating and capital costs of seawater scrubbing for different size vessels

		Small	Medium	Large
Annual capital costs	**Applied to New Vessels**	26	83	209

[30] Information from Entec's report for the European Commission published in 2005 -Ship Emissions: Assignment, Abatement and Market-based Instruments – SO2 - available at http://europa.eu.int/comm/environment/air/pdf/task2_so2.pdf

[31] Information from Entec's report for the European Commission published in 2005 -Ship Emissions: Assignment, Abatement and Market-based Instruments – SO2 - available at http://europa.eu.int/comm/environment/air/pdf/task2_so2.pdf

(£thousand per year)	**Retrofitted to Existing Vessels**	42	137	343
Annual operating and maintenance costs (£thousand per year)		9	19	23

6.5.10.2.6. The figures in Table 7 have been used to calculate the annualised present value of costs based on all ships installing the equipment but only operating at a level necessary to bring about the required reduction in emissions equivalent to that which would be achieved through fuel switching for each option. These figures are summarised in Table 8. The figures for compliance with MARPOL Annex VI are included as this is an option available to operators under the current regulations and so the additional costs for compliance with the Directive need to be compared[32].

Table 8 Summary of estimated annualised present value of costs associated with installing seawater scrubbing on all ships to achieve the required emissions reduction under each option when compared to costs under MARPOL Annex VI (Note 1)

	Annualised Present Value of costs for ships calling at UK ports (£million)	**Annualised Present Value of costs for UK flagged ships (£million)**
MARPOL Annex VI	145	35
Option 1 - Implement the Directive (preferred option)	147	36
Option 2 – 0.5%	152	37
Note 1: Assuming all UK-flagged vessels are a sub-set of all ships calling at UK ports.		

6.5.10.2.7. The figures calculated and presented in Table 8 are significantly higher than those calculated based on fuel switching alone. However, seawater scrubbing has the potential to be cost effective on an individual ship basis[33]. The figures above have been calculated based on all ships installing seawater scrubbing which is unrealistic as no attempt has been made to optimise the choices for individual ships. Clearly each ship operator will assess the cost effectiveness of the two options and choose the more cost effective option. For a ship operating mainly in a SECA, the costs of sea water scrubbing should be less than fuel switching and vice versa. If more SECA's are designated then the number of vessels operating within these areas will increase and the installation of seawater scrubbing will become more viable. The main cost component is the initial capital cost of installing the equipment whilst the operating costs are relatively small. The costs assume that ships would operate their equipment only at the level required to achieve an equivalent emissions reduction. They do not take into account the fact that ships could install seawater scrubbing and operate at a higher rate but use higher sulphur fuel. This may lead to potential cost savings as higher sulphur fuel may cost less.

6.5.10.3. ***Shoreside electricity***

6.5.10.3.1. While in port, ships use their Auxiliary Engines (AE) to produce electricity for hotelling, unloading and loading activities. One measure to reduce emissions from AEs while at berth is to provide electricity to the ships from the national grid. To provide ships with electricity, a shore-side electricity supply arrangement is required. There are currently only a limited number of examples of shore-side electricity in use around the world.

6.5.10.3.2. Estimated emission reduction efficiencies of Shore Side Electricity for engines using 2.7% sulphur content of fuel, are 96% for SO_2 and 96% for PM[34]. The cost of supplying

[32] It would be misleading to express these costs as additional to MARPOL Annex VI as this would assume installation to meet MARPOL Annex VI.

[33] Information from Entec's report for the European Commission published in 2005 -Ship Emissions: Assignment, Abatement and Market-based Instruments.-SO2 - available at http://europa.eu.int/comm/environment/air/pdf/task2_so2.pdf

[34] Entec, 2005 - Ship Emissions: Assignment, Abatement and Market-based Instruments – shore-side electricity, available from http://europa.eu.int/comm/environment/air/pdf/task2_shoreside.pdf

shore-side electricity infrastructure to a port varies widely from port to port. The major factors affecting costs include:

- whether the port infrastructure is existing and the installation is therefore retrofitted, or whether the infrastructure can be installed at the time of construction in a new build terminal/berth; and
- electricity infrastructure near the port, including number of electrical substations which need upgrading to supply the additional electricity to the port.

6.5.10.3.3. Detailed costs for shoreside electricity have not been estimated since the uncertainty is high (>50%) and it is considered unlikely to be implemented in the UK in the near future on any significant scale. More details of estimated costs, including estimated capital and operating costs for different size vessels and different types of ports, specific costs (€/kW capital, €/MWh operating) and total costs scaled up for all EU berths with EU-flagged vessels on regular service are given in the 2005 EC report[35] on shoreside electricity.

[35] Entec, 2005 - Ship Emissions: Assignment, Abatement and Market-based Instruments – shore-side electricity, available from http://europa.eu.int/comm/environment/air/pdf/task2_shoreside.pdf

6.6. *Greenhouse Gas Emissions*

6.6.1. During debates about the use of low sulphur fuel by the shipping industry the oil industry has raised concerns that switching to low sulphur fuel (Marine Diesel Oil) will impact on the environment as additional CO_2 emissions will be produced from the refining process required to produce the additional MDO.

6.6.2. Oil industry data (CONCAWE) for the average of CO_2 emissions in tonnes for producing one tonne of products given as 0.212 (MDO is an average product in terms of energy used to produce it), it is possible to compare carbon dioxide emissions, in million tonnes (Mt), for refining and ships using MDO respectively.

6.6.3. For refineries to produce MDO to replace 150Mt to 200Mt of RESIDS[36], the estimated CO_2 emissions are between 32Mt to 42Mt (residual fuels are blends between RESIDS from refineries and cutter stocks (light products) and so the counting of additional CO_2 emissions from refining has to account for the amount of MDO to replace the amount of RESIDS only).

6.6.4. Use of MDO only by all ships will result in a reduction of CO_2 emissions. There are various reasons for lower CO_2 emissions from ships using MDO only. The main CO_2 emissions reduction comes from the engine combustion process. Marine engines are fed with fuel oil by volume but the CO_2 emissions are counted by weight. Since the MDO has a density some 10% lower than the density of the residual fuels (HFO), at same volume of fuel used by engines, the amount in tons of MDO used is lesser than the amount in tons of the correspondent volume of HFO. However, there are some factors which reduce the 10% saving in tons from density values to half. These factors are mainly linked to the specific caloric values and the slightly different carbon to CO_2 factors on MDO and HFO. Thus the estimated saving in CO_2 emissions from combusting MDO only in engines in that calculation is some 29 Mt.

6.6.5. A secondary consideration, that is not negligible, is that ships using MDO only will significantly cut down on the onboard waste production. The waste comes from the treatment and cleaning of the residual fuel before it is delivered into the engine. The amount of waste varies and it is has never been measured. However, one of the MARPOL Unified Interpretation's assumes the waste produced is 0.5% of the total fuel burned. Assuming the assessed total of 324 Mt of residual fuels used by all ships over one year, the total of waste will be of 1.7 Mt. Currently that waste is fed and burned using onboard incinerators. The carbon to CO_2 factor is 3, thus potentially an additional 5 Mt of CO_2 would not be produced.

6.6.6. Additional savings include less fuel to be stored on board ship, and therefore energy used to carry, because MDO does not need to be heated and treated before burning. It was concluded that there would be no significant impact on CO_2 emissions if ships switch to use of MDO only.

6.7. *Compliance costs*

6.7.1. In addition to the costs incurred by vessel operators associated with switching to lower sulphur fuels there will be an increased burden on the Maritime & Coastguard Agency (MCA) to ensure that the requirements under each of the options are complied with. The Directive places a number of requirements on Member States that are in addition to those required under MARPOL Annex VI including the regulation of the types of fuels in terms of their sulphur content that may be placed on the market. Additional sampling may be required at marine fuel suppliers as well as from ships. Costs by other enforcement agencies e.g., Port Health Authorities, have not be included as these would have been considered under implementation of the Directive.

6.7.2. Cost estimates have been estimated based on the assumption that approximately 7000 MARPOL ships of greater than 400GT visit UK ports per year of which some 25% are targeted for inspection. Of ships targeted for inspection under Port State Control the aim would be to sample 80 ships per year. There will be a further requirement to sample fuel from approximately 20 UK flagged ships and inland waterway vessels. A total of 100 samples taken and tested

[36] RESIDS – product of refining that cannot be used as a fuel oil without the addition of another product.

costing approximately £400 per sample (this includes the logistical support required) will give an enforcement cost of some £40,000 per year.

6.7.3. Article 7 of the Directive requires Member States to submit a report to the Commission annually on the sulphur content of liquid fuels falling within the scope of the Directive. Defra, as lead department for UK air emissions, are responsible for submitting this report by 30 June of each year. The MCA being responsible for marine fuels intends to submit a report to Defra for inclusion in their report by 30 April each year. In addition to the sample data collected during inspections there is a need to include in the report data on samples of fuel oil supplied to ships in UK ports. This data is gathered by commercial organisations and the cost of sourcing this information by the MCA has been estimated at £10,000 per year.

6.7.4. Table 9 summarises the annualised costs for the Maritime & Coastguard Agency under each of the options. The MCA will review compliance mechanisms on an ongoing basis and consider innovative approaches including, if appropriate, remote sensing of ship emissions.

Table 9 Summary of regulatory costs

	Additional sampling required	**Annualised Present Value of Costs (£million)**
Option 1 (preferred option)	Sampling and analysis, including transportation, of 100 samples of marine fuel oil used on non-UK flagged ships entering UK ports, inland waterway vessels and UK flagged ships wherever they may be.	0.05
Option 2	Sampling and analysis, including transportation, of 100 samples of marine fuel oil used on non-UK flagged ships entering UK ports, inland waterway vessels and UK flagged ships wherever they may be.	0.05

6.8. *Summary of estimated monetised costs*

6.8.1. Table 10 summaries the estimated Annualised Present Value of the estimated total incremental costs of each option for all ships calling at UK ports and all UK flagged ships based only on fuel switching, plus estimated regulatory costs.

Table 10 Summary of annualised present value of costs associated with each option based on fuel switching	**Annualised Present Value of Costs for ships calling at UK ports (£million) based on 100 year appraisal period (Note 2)**	**Annualised Present Value of Costs for UK flagged ships (£million) based on 100 year appraisal period (Note 2)**	**Annualised Present Value of Costs for UK owned UK flagged ships (£million) based on 100 year appraisal period (Note 2)**
Option 1 – Implement the Directive (preferred option)	26	6	4
Option 2 – 0.5%	40	10	7
Notes: Note 1: Based on emissions and fuel consumption data from previous Entec studies for the European Commission, assuming ships calling at UK ports are estimated to be approximately 11.6% of the total fleet and approximately 2.8% of the total fleet are UK flagged. Note 2: Only a proportion of UK flagged ships are UK owned (approx 70%). It is likely that these costs will only be directly incurred by a UK firm when the relevant ships are UK owned. However, it is possible that a proportion of these costs could also be indirectly passed on to other firms and consumers in the UK.			

6.8.2. For the purposes of the 'Summary: Analysis & Evidence' sheets, the Present Value of the estimated monetised costs identified in this Impact Assessment has been estimated over a 10 year appraisal period using the estimates in Table 10. For Option 1, the Present Value of the monetised costs has been estimated at between approximately £36 and £271 million. For Option 2, the Present Value of the monetised costs has been estimated at between approximately £63 and £425 million. The upper end of these ranges reflects the estimated monetised costs for ships calling at UK Ports, and UK owned UK flagged ships. The lower end of these ranges reflects the estimated monetised costs for UK owned UK flagged ships only.

7. Small Firms Impact Test

7.1. A Small Firms Impact Stage I Impact Test was undertaken based on the guidance available from the Small Business Service (SBS)[37]. A series of telephone interviews were undertaken by DEFRA in 2006 building on interviews previously carried out for earlier Regulatory Impact Assessments relating to this Directive.

7.2. The majority of smaller vessels are unlikely to encounter any difficulties with complying with the 1.5%, and possibly the 0.5%, limit as they operate on marine diesel oil or gas oil which is already below the limit. Discussions with firms who lease vessels to private companies and/or individuals suggests that the requirement, and associated price premium, for the use of low sulphur fuel will be passed onto the customer (i.e., included in any contracts).

7.3. Overall, it is unlikely that following the implementation of MARPOL Annex VI there will be a significant impact on small and medium sized enterprises (SMEs) as the majority of firms should already comply. It is also important to note that the UK delegation to IMO played a major role in the securing agreement on MARPOL Annex VI. The UK delegation included representatives from regulatory bodies and all sections of the shipping industry, including smaller firms.

7.4. *Option 1: Implement the requirements of the Directive (preferred option)*

7.4.1. Overall, the Directive is also unlikely to have any significant impacts upon small firms as many of them will already be compliant and will have to comply with MARPOL Annex VI.

7.5. *Option 2: Implement the requirements of the Directive and, in addition reduce the sulphur content of fuel to 0.5% rather than 1.5%*

7.5.1. The main impacts may be faced with Option 2 and a potential tightening of the fuel sulphur limits used in SECAs by all vessels and, passenger vessels in all areas. Those firms not already compliant may face a relatively high cost for the purchase of lower sulphur fuels.

8. Competition Assessment

8.1. The potential impacts of each option on competition have been assessed in accordance with the Office of Fair Trading *Guidelines for Competition Assessment*. In accordance with these guidelines, the competition filter test has then been applied to the market sectors most likely to be affected by the legislation. Consideration has been given both to effects upon competition in the UK (relating to potential market distortions) and to effects upon UK competitiveness. For the latter, the analysis relates to the potential for any higher costs for UK firms as compared to those faced by other EU firms and also by non-EU firms. Consideration is also given in turn to competition issues and the question of potential impacts on competitiveness.

8.2. As with MARPOL Annex VI, the Directive and the 0.5% limit could affect a number of different markets including petroleum refineries, bunker suppliers, shipping operators and

[37] Small Firms Impact Test: Guidance for Policy Makers, September 2008. Available at: http://www.berr.gov.uk/files/file48295.doc

potentially manufacturers and suppliers of ships and abatement technologies. It would not be expected to affect market structure significantly, nor create significant barriers to entering/exiting the market (though new firms may face higher initial capital outlay).

8.3. Whilst it has not been possible to obtain detailed information on bunker suppliers, ship operators and ship and abatement technology manufacturers & suppliers, the results of the competition filter plus discussions by Defra, which is responsible for regulation of land sourced air pollution, with affected organisations suggest that a detailed assessment is not required.

8.4. In relation to effects on competitiveness with countries outside of the UK the impacts of the Directive are likely to be minimal. The Directive will apply to all ships operating in European waters and docking in European ports.

8.5. For some operators, MARPOL Annex VI already creates disparities between those vessels operating in SECAs and those operating outside. As a large proportion of the UK coast is situated in a SECA the majority of UK flagged vessels operating within these zones will have to use 1.5% or lower sulphur fuel. However, where, for example, a fishing vessel from another country operates outside of a SECA it will not have to switch to lower sulphur fuels. This will reduce their operating costs relative to vessels in SECAs and potentially allow them to sell their produce at a lower rate thus reducing the competitiveness of the UK market. These impacts are likely to be minimal as the majority of smaller vessels use marine diesel/gas oil and are therefore will already in compliance with the Directive.

8.6. Both Options have the potential to distort the flow of trade through SECAs, and possibly the UK, as operators seek alternative routes or modes of transport (for example, by road). However, there is little evidence to indicate a significant modal shift would occur as the SECAs contain key trade routes and the UK has a significant position in the market.

8.7. Option 2 would introduce a Sulphur Content limit for UK flagged vessels that was stricter than that faced by vessels trading within the SECA at non UK ports. UK flagged vessels would face higher costs than their European counterparts also trading within the SECA, reducing their international competitiveness.

8.8. Option 2 might have a potential to encourage modal shift, over and above Option 1, since vessels could be deterred from entering the UK through a SECA as this would entail the additional cost of operating on low sulphur fuel. The incentive to switch to a 0.5% sulphur fuel content when only the UK has the requirement would be much less than under Option 1, where member states act multilaterally. Possible implications of this might include modal shift to rail/road as vessels seek to avoid calling at UK ports, with an associated environmental cost and, conceivably, higher import costs for UK consumers, since they must arrange transhipment of goods from the continent. Both could have negative consequences for overall UK competitiveness.

9. Gender and Disability Equality Assessment

9.1. Potential higher prices for affected consumer products (e.g. products transported by ships and passenger services) will affect everyone and so it is not anticipated that the implementation of the Directive will have any impact specifically:

- on a particular ethnic group
- on the disabled
- on a particular gender
- to human rights.

10. Enforcement, sanctions and monitoring

10.1. MARPOL Annex VI already places a number of requirements on the UK including the maintenance of a register of local suppliers of marine fuel, ensuring full documentation of the sulphur content of all marine fuels sold (bunker delivery notes) and used (logbooks), and taking action against non-compliant marine fuel suppliers and users. The Directive would place

additional requirements on the regulation of the types of fuels in terms of their sulphur content that may be placed on the market in the UK, and require passenger vessels and inland waterway vessels to use low sulphur marine fuel wherever they may be.

10.2. In the UK, Port Health Authorities (PHA) carry out sampling of marine fuels under the existing Directive, in association with the Environment Agency (England and Wales), Scottish Environmental Protection Agency (Scotland), Environment and Heritage Service (Northern Ireland) and local authorities. Additional monitoring may be required to ensure compliance with the legislation in ports and other relevant areas, although a regulatory regime is already in place under the existing legislation relating to the sulphur content of fuels. Additional sampling may be required at fuel distributors as well as at the point of use within ports (see Section 6.6 regarding compliance costs). Enforcement would be risk-based in line with the Hampton[38] principles.

10.3. If vessel operators were to choose to install abatement equipment as an alternative to switching to low sulphur fuels then continuous emission monitoring equipment would also need to be fitted. There would be further requirements on the PHA to ensure that an equivalent emissions reduction relative to the reductions achieved through fuel switching is achieved. As a minimum, this may only require checking of the monitoring results.

10.4. Defra, as the UK department with policy lead for air pollution, and the Devolved Administrations would be responsible for reporting to the Commission each year a short report on the sulphur content of liquid fuels used within the UK including information on fuel sampling and enforcement.

10.5. The Maritime and Coastguard Agency (MCA) would be specifically responsible for collating and submitting information and data to Defra for forwarding to the Commission as it relates to the sulphur content of marine fuels. MCA intend to source the information and data from commercial marine fuel sampling and testing organisations.

10.6. It is assumed that there is a zero impact on administration burdens baseline figure provided at the bottom of page 2 as there are no new reporting costs in terms of a register of fuel oil suppliers and documentation of sulphur content, including the time taken by industry to provide documentation such as bunker delivery notes and logbooks. These are requirements under MARPOL Annex VI and have been implemented already. Whilst the Directive extends the requirements for low sulphur fuel to be used on inland waterway vessels there will not be an additional administrative burden as they will not be required to retain bunker delivery notes nor complete a fuel-changeover logbook.

11. Post implementation review

11.1. The monitoring requirements in the Directive require that member states undertake each of the following means of sampling, analysis and inspection as appropriate, to ensure compliance with the requirements of the Directive.

11.2. For the marine provisions:

- sampling of the marine fuel for on-board combustion while being delivered to ships, following IMO guidelines, and analysis of its sulphur content;
- sampling and analysis of the sulphur content of marine fuel for on-board combustion contained in tanks, where feasible, and in sealed bunker samples on board ships;
- inspection of ships' log books and bunker delivery notes.

11.3. On the basis of the results of the sampling, analysis and inspections, a short report must be provided to the European Commission annually (see 9.4). The reporting requirements therefore provide for a method which enables the effectiveness of the implementing regulations to be reviewed.

[38] http://www.hm-treasury.gov.uk/hampton_review_regulatory_inspections_enforcement.htm

11.4. The Maritime & Coastguard Agency will continue to appraise new technologies for use in monitoring and enforcement of the Directive as it relates to sulphur content of marine fuels.

12. Summary and recommendation

12.1. Reductions in emissions of sulphur dioxide from ships will have benefits to the UK. There are also additional benefits arising from the associated reductions in primary and secondary particulate matter. The benefits of the Directive (preferred - option 1) in the UK from action involving all vessels calling at UK ports and in UK waters, are estimated to be in the range of around £7 million - £15 million per year in the 10 year appraisal period on average[39].

12.2. Option 2 would implement the Directive and in addition, impose a tighter sulphur content requirement (0.5% instead of 1.5%) for SOx Emission Control Areas and passenger vessels. This reflects progress made at the International Maritime Organisation where a revised MARPOL Annex VI was adopted in October 2008 and means that from 2020 all ships wherever they are will need to comply with a sulphur limit of 0.5%. Benefits for Option 2 are estimated to be in the range of around £103 million - £237 million per year in the 10 year appraisal period on average[40].

12.3. Whilst Option 2 gives a higher benefit to cost ratio, Option 1 is preferred. This is because implementation of Option 2 would require regional agreement on implementation and enforcement of the lower sulphur content of marine fuels in the SECA prior to 2015. Currently there is no mandate for this. As identified in the Competition Assessment implementation of Option 2 could make the UK flag less attractive to ship owners and operators, as well as see ships seek to avoid entering UK waters.

12.4. IMO adopted a revised Annex VI of MARPOL in October 2008. This revision requires the sulphur cap for fuels in Emission Control Areas to reduce to 1.0% from 1 July 2010. Further IMO targets suggest a global sulphur cap of 3.5% in 2012 and 0.5% in 2020, with Emission Control Areas set to have a 0.1% cap by 2015. The implementation of the Directive is thus a stepping stone towards these goals.

12.5. Finally, it is stressed that a number of potential benefits for which it has not been possible to monetise, are not included, for example, health and environmental benefits to other member states; any chronic impacts of pollutants apart from particulate matter, and; ecosystem benefits. For this reason the total benefits could be significantly higher than stated above.

12.6. Costs of Option 1, over and above MARPOL Annex VI, are estimated to be around £4 million per year for UK flagged UK owned vessels, and around £32 million per year for vessels visiting UK ports and UK owned UK flagged vessels[41]. Option 2 is estimated to cost, over and above MARPOL Annex VI, around £7 million per year for UK owned UK flagged vessels, and around £49 million per year for vessels visiting UK ports and UK owned UK flagged vessels [42].

[39] This has been estimated based on an annualised present value of benefits of £11-24 million over 100 years
[40] This has been estimated based on an annualised present value of benefits of £162-372 million over 100 years
[41] This has been estimated based on an annualised present value of costs of £4-30 million over 100 years
[42] This has been estimated based on an annualised present value of costs of £7-47 million over 100 years

Table 11 Summary of estimated Annualised Present Value of monetised benefits and monetised costs for the different implementation options (including regulatory costs).

	Annualised Present Value of Monetised Benefits and Monetised Costs (£ million per year)		
	Benefits in UK[43] (Note 3)	**Costs: (Note 1 & 2)**	
		UK owned UK flagged vessels	Vessels visiting UK ports
Option 1 – Directive (preferred option)	11 - 24	4	26
Option 2 – Directive + stricter 0.5% sulphur limit in SECA	162 - 372	7	40

Notes:

1. Estimates taken from Table 10
2. Costs include compliance costs.
3. Estimates taken from Table 4

[43] Based on 6% mortality rate and calculation using 0.6% coefficient, as recommended by COMEAP. Committee on the Medical Effects of Air Pollutants (COMEAP): Quantification of the Effects of Air Pollutants on Health in the UK, Interim Statement, 18th January 2006. Available at: http://www.advisorybodies.doh.gov.uk/comeap/pdfs/interimlongtermeffects2006.pdf

Specific Impact Tests: Checklist

Type of testing undertaken	***Results in Evidence Base?***	***Results annexed?***
Competition Assessment	Yes	No
Small Firms Impact Test	Yes	No
Legal Aid	No	No
Sustainable Development	No	No
Carbon Assessment	Yes	No
Other Environment	Yes	No
Health Impact Assessment	Yes	No
Race Equality	Yes	No
Disability Equality	Yes	No
Gender Equality	Yes	No
Human Rights	Yes	No
Rural Proofing	No	No