Environmental, economic and social impacts of the use of sewage sludge on land

Final Report

Part II: Report on Options and Impacts

milieu ENVIRONMENTAL LAW & POLICY

WRc

RPA

This report has been prepared by RPA, Milieu Ltd and WRc for the European Commission, DG Environment under Study Contract DG ENV.G.4/ETU/2008/0076r. The primary author was Ms Rocio Salado. Additional expertise was provided by Daniel Vencovsky, Elizabeth Daly, Tony Zamparutti and Rod Palfrey. The views expressed herein are those of the consultants alone and do not necessarily represent the official views of the European Commission.

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Executive Summary

Introduction

Milieu Ltd, together with partners WRc and Risk & Policy Analysts Ltd (RPA), has carried out a contract for the European Commission's DG Environment, entitled *Study on the environmental, economic and social impacts of the use of sewage sludge on land* (DG ENV.G.4/ETU/2008/0076r).

The Sewage Sludge Directive (86/278/EEC) could be said to have stood the test of time in that sludge recycling has expanded since its adoption without environmental problems. Since its adoption, however, several Member States have put in place stricter national requirements. Moreover, EC legislation has evolved in many related fields, such as chemicals regulation. Any revision should aim to retain the flexibility of the original Directive which has permitted sludge recycling to operate effectively across the wide range of agricultural and other environmental conditions found within the expanded EU.

The aim of the study is to provide the Commission with the necessary elements for assessing the environmental, economic and social impacts, including health impacts, of present practices of sewage sludge use on land, provide an overview of prospective risks and opportunities and identify policy options related to the use of sewage sludge on land. This could lay the basis for the possible revision of Community legislation in this field.

This is the final deliverable of the study: the first was a review of literature on the topic, *Assessment of existing knowledge*. The second was the development of a baseline scenario to 2020 concerning the spreading of sewage sludge on land and an analysis of the relevant risks and opportunities. The project Interim Report reviewed the results of the first consultation.

This report provides the list of Options for the revision of Directive 86/278/EEC as well as an assessment of the impacts of these Options, including a cost-benefit analysis (CBA).

The Options

An initial set of five options for the revision of the Sewage Sludge Directive (Directive 86/278/EEC) was developed based on the review of literature and of regulations in Member States as well as comments received from Member States and stakeholders in the first consultation for this study and the first workshop. The options are as follows:

Option 1: do-nothing: keeping the Directive as it is;
Option 2: introduce certain more stringent standards, especially for heavy metals, standards for some organics and pathogens, and more stringent requirements on the application, sampling and monitoring of sludge;
Option 3: introduce more stringent standards across all substances and bans on application of sludge to some crops;
Option 4: total ban on the use of sludge on land; and
Option 5: repeal of the Directive.

The Options were formulated in discussion with the Commission, based on the interim project results. The specific components of the Options are detailed in section 1.2 of this report.

Approach to Data Gathering

The information used for the analysis was gathered in several stages. Report III provides the results of the information-gathering phase of the project, together with an overview of the results of the first consultation, held in July and August 2009. On this basis, a preliminary impact assessment was prepared: this was the subject of the second project consultation, held in December 2009 and January 2010. Results from this consultation, including additional information on costs, were used in revising the assessment.

In total, 39 responses were received in the second consultation, providing valuable information on the costs and benefits from the different options and the magnitude of impacts on sludge recycling. A summary of the responses is provided in Annex 1. The following table summarises the numbers and types of stakeholders that replied in the consultation. Some further information was gathered at a workshop held in Brussels in late January 2010.

Table 1: Project consultation 2: Number of responses by type of stakeholder

National authority (MS)	8
Regional authority (MS-R)	4
Statutory advisor, agency, public institution (MS-A)	3
International Professional association/federation (EF)	6
National Professional association/federation (NF)	7
Company/industry (IS)	8
Consultancy	1
Research/academic institute	0
NGO	1
Other	1

Comparison of the Options

An impact screening of the different options was one of the first steps of the assessment. This was carried out following the EC Impact Assessment Guidelines. The most important impacts identified in this screening were carried forward for detailed assessment. Table 2 sets out the results of this first assessment of the Options in qualitative terms (this assessment uses the information gathered throughout the project, including the responses provided in the second consultation). It should be noted that the original list was longer: only those impacts considered as significant are presented in the table below (other impacts, e.g. impacts on agricultural production, are considered to be limited; the consultation responses agreed with these judgements).

Table 2: Initial qualitative assessment

Option	Economic Impacts	Environmental Impacts	Social Impacts
Option 1 - Baseline Scenario	0	0	0
Option 2 – “moderate	Costs of alternative disposal (-) Obligation of treatment (-)	Environmental benefits from reduced application (?/+)	Human health benefits from reduced application (?/+)

Option	Economic Impacts	Environmental Impacts	Social Impacts
changes"	Changes to regulation: including costs of consultation (-) Policy implementation and control (-) Benefits/costs if meeting other related legislation requirements (i.e. WFD, Waste Directive) (?) Loss of use of sludge as a fertiliser and fertiliser replacement costs (-/?)	Environmental benefits/costs from alternative routes of disposal including climate change impacts from incineration, landfilling (-)	Human health costs from alternative routes of disposal, e.g. air pollution from incineration (-) Odour/amenity impacts (-/?)
Option 3 – more significant changes	As above but greater in magnitude		
Option 4 - Total Ban	Fertiliser replacement costs (--) Alternative routes of disposal for all sludge arisings (--)	Environmental benefits from reduced application (?/+) Environmental benefits/costs from alternative routes of disposal including climate change impacts (--)	Human health benefits from reduced application (?/+) Human health from alternative routes of disposal including climate change impacts (--) Odour/amenity impacts from increased landfilling and incineration (-/?)
Option 5 - Repeal of the Directive	Benefits from reduced policy monitoring and compliance (+)	Environmental benefits/costs from alternative routes of disposal including climate change (?) Potential environmental risks if a MS abandons all sludge regulation (?/--)	Human health from alternative routes of disposal including climate change (?) Potential risks to human health if a MS abandons all sludge regulation (?/--) Odour/amenity impacts from increased landfilling and incineration (-/?)
0: impact expected to be negligible; - : low/moderate negative impacts expected --: significant negative impacts expected +: low/moderate positive impacts ++: significant impacts expected			

This report presents a cost-benefit analysis (CBA) for a number of impacts. It should be emphasised, however, that not all impacts could be valued. The following table summarises which impacts are valued in the assessment.

Table 3: Overview of impacts considered and approach

Economic impacts	Stakeholder	Description	Quantified?	Qualitative assessment when no quantification/other comments
Costs of alternative disposal	Water and sludge management operators	As sludge recycling will be ended, there will be internal costs from its disposal	Yes	-
Obligation of treatment	Water and sludge management	Sludge will need further treatment to deal with new standards	Yes	-

Economic impacts	Stakeholder	Description	Quantified?	Qualitative assessment when no quantification/other comments
	operators			
Changes to regulation	Regulators	There will be costs from changing legislation and consultation (not monetised)	No	These are expected to be moderate in comparison with total costs
Policy implementation and control	Regulators	Costs from monitoring in order to check that legislation is being met	No	These are expected to be moderate in comparison with total costs
Benefits/costs if meeting related legislation requirements (e.g. WFD)	Regulators	Option 2 and 3 likely to influence positively meeting the objectives of WFD but may act against Waste Directive (especially Option 4)	No	Depends on the level of changes. A ban may compromise objectives of Waste Directive
Loss of use of sludge as a fertiliser and fertiliser replacement costs	Farmers	As sludge is no longer available, they will have to be replaced by fertiliser (this could be organic and/or mineral)	Yes (included under net internal costs)	-
Environmental impacts				
Environmental benefits from end to application	General public	Impacts on biodiversity, ecosystems, quality of water and groundwater from an end to application	Partly	Only some impacts from air emissions; other impacts, such as emissions to water and soil impacts could not be quantified.
Benefits/costs from alternative routes of disposal including climate change	General public	Impacts from increase in use of landfill and incineration for sludge	Partly	Values include externalities from air emissions (including energy recovery) but excludes impacts to the environment and human health through emissions to soil and water
Social Impacts				
Human health benefits from end to application	General public	Owing to national practices and standards, benefits uncertain due to lack of evidence	Partly	As above – Only some impacts from air emissions have been valued
Human health from alternative routes of disposal	General public	Values include human health externalities from emissions (including energy recovery)	Partly	As above – Only some impacts from air emissions have been valued

Comparison of the Options

Option 1 is the baseline: the costs and benefits of the other options are assessed in comparison with this one.

Options 2, 3 and 4 will reduce potential environmental and health impacts from spreading sewage sludge to land, but increase impacts from alternative disposal paths. While some of these impacts – e.g. climate change and air pollution impacts from greater incineration – can be assessed, this is not true for all. In particular, Options 2, 3 and 4 will reduce environmental and health impacts from spreading sludge on land.

Here, however, the project team has not found literature quantifying this reduction; nor did the responses to the first consultation provide relevant data. Much of the literature and many responses to the first consultation indicate that the current levels (Option 1) adequately protect environment and human health. However, some Member States have introduced more stringent requirements for precautionary reasons, and it is not possible to indicate the extent to which adequate protection is due to the Directive or to more stringent national requirements. **It is important to recognise that the potential environmental and health benefits resulting from more stringent sludge standards in Options 2 and 3 (as well as the total ban in Option 4) are not quantified in this CBA.**

For Option 5, the impacts are highly uncertain and the environmental and health impacts could be large. In a preliminary analysis, it appears that Option 5 is not acceptable on the basis of the precautionary principle. This has also been confirmed by responses to the consultation. A cost-benefit analysis has not been undertaken for this option on the basis of the uncertainty about the potential national reactions (i.e. how national legislation and practice would change).

Tables 4 and 5 below summarise the costs for the options, as calculated under this CBA.

It should be noted that the analysis faced a key problem. A major factor in terms of the economic costs is the proportion of sewage sludge that would not meet the more stringent limits under Options 2 and 3. This has been estimated for each major component of the new limits – i.e. for heavy metals, for organic compounds, pathogens and also for the monitoring and quality assurance requirements.

Most of the information available, however, is by individual component, and it has not been possible to estimate the cumulative effective of the different components in each option. Simply summing the separate shares of sludge failing each component's limits would in part double-count the results and thus would likely represent an over-estimate of the costs.

The analysis has instead used two scenarios, a high and a low estimate, for each option.

1. Scenario 1 (high estimate): the highest costs among the different components of each option is taken as an indicator of the total costs for the Option. For both Option 2 and Option 3, the most expensive component concerns the new limits on organics, which is the component leading to the greatest costs (followed by limits of PTEs in soil, with costs of similar magnitude);
2. Scenario 2 (low estimate): the lowest costs among the different options' component is taken as an indicator of the total cost for the Option. This reflects a situation when only quality assurance and monitoring requirements are changed.

While scenario 1 may underestimate the total costs of each option, it is believed that it will provide a good comparison of the costs among the different options.

This approach has an advantage: the detailed component by component analysis (provided in the full report) allows decision-makers to consider the separate costs for each component. This can help in weighing the individual components of each option and considering options that include only some of them. This may be an important consideration, as the consultation responses and workshop discussion indicated varying support for the different components.

As it can be seen from the Tables, Option 2 and Option 3 are significantly less costly than Option 4 for both scenarios. Among the three options, it appears that Option 2 will have the most limited cost implications. Option 3 is likely to affect a larger number of sewage treatment plants and a higher share of sewage sludge. The greatest economic costs are expected from Option 4, a total ban.

Table 4: Scenario 1 – Summary of Net costs of Options (against Option 1)

PV	**Option 2**	**Option 3**	**Option 4**
EU-TOTAL	2,174,438,000	4,540,742,000	7,964,555,000
Annualised Costs	**Option 2**	**Option 3**	**Option 4**
EU-TOTAL	222,780,000	465,217,000	816,001,000
PV discounted at 4% covering period from 2010 to 2020			

Table 5: Scenario 2– Summary of Net Costs of Options (against Option 1)

PV	**Option 2**	**Option 3**	**Option 4**
EU-TOTAL	8,040,000	48,242,000	7,964,555,000
Annualised Costs	**Option 2**	**Option 3**	**Option 4**
EU-TOTAL	824,000	4,943,000	816,001,000

Concluding notes

The estimates produced here are subject to many uncertainties and as a result should be only interpreted as an approximation of the costs each option. This is due to uncertainties regarding the amount of sludge affected, disposal options and also the scope of the costs and the uncertainties concerning the unitary values as well as, more importantly, uncertainties concerning the baseline (i.e. percentile distribution of sludge pollutants by MS, level of treatment and background concentrations of heavy metals in soil by MS). The results nonetheless provide an idea about the order of magnitude of these costs. Moreover, they incorporate the information provided through the second consultation and as a result represent the best estimate possible based on the information available.

Based on the findings, the Commission may wish to include or exclude specific components from the Options or, alternatively, implement only the least costly components. Based on our analysis and the responses from the consultees, the most costly components appear to be the limits on organic compounds (in particular the limits on PAHs) and those on heavy metals in soil. The component with the smallest cost implications is that for quality assurance and/or increased monitoring (although the costs appear to vary significantly in range). The limits proposed under Option 2 concerning heavy metals in sludge seem to be achievable and most Member State and stakeholder responsdents called for this type of change on the basis that most national standards are already more stringent than the current Directive. As a result the costs of only introducing more stringent limits on PTEs in sludge (at levels such as those in Option 2) appear to be limited.

The above figures do not reflect all costs and benefits. In addition to the unquantifiable reduction in human health and environmental risks from reduced recycling, there may be additional benefits in terms of amenity and public perception from Option 2, 3 and 4. These are highly uncertain, however. One other benefit from Options 2, 3 and 4 is that in some geographical areas they could help meet other EU environmental objectives, such as those for the Water Framework Directive. A total ban, on the other hand, may act against the waste hierarchy set forth in the Waste Directive: this gives priority to the recovery and recycling of waste.

Such trade-offs will have to be borne into consideration in a decision on the revision of the Directive.

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List of abbreviations

AD	Anaerobic digestion
AOX	Total adsorbable organo-halogen
APD	Acid phase digestion processes
BAT	Best available techniques
BOD, BOD5	Biochemical oxygen demand
CBA	Cost-benefit analysis
CEN	Comité Européen de Normalisation
CHP	Combined heat and power plant
COD	Chemical oxygen demand
CoGP	Code of good practice
DEHP	Bis(2-ethylhexyl)phthalate
DG ENV	Directorate General Environment of the European Commission
DM	Dry matter, or dry solids, or total solids
DS	Dry solids, dry matter, total solids
ECJ	European Court of Justice
EEA	European Environment Agency
EoW	End-of-waste
EPA	Environmental Protection Agency
EQS	environmental quality standards
EU 12	The 12 Member States that joined the EU in 2004 and 2008
EU 15	The 15 Member States that joined the EU before 2004
EU 27	All 27 Member States since 2008
FAO	Food and Agriculture Organization
FWD	Food waste disposal
GHG	Green house gas
GWP	Global warming potential
HACCP	Hazard analysis and critical control point
IA	Impact Assessment
IPPC	Integrated pollution prevention and control
LAS	Linear alkylbenzene sulfonate
LCA	Life-cycle analysis
MAD	Mesophilic anaerobic digestion
MBT	Mechanical biological treatment
MS	Member State of the European Union
MSW	Municipal solid waste
Mt	Million tonnes
ND	Nitrate Directive
NP/NPE	Nonylphenol/Nonylphenol ethoxylate
NP/NPE	Nonylphenol/Nonylphenol ethoxylate
OC	Organic compounds / Organic contaminants
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls
PCDD/F	Polychlorinated dibenzodioxins and polychlorinated dibenzofurans
pe	population equivalent
PPP	Public private partnerships
PTE	Potentially toxic elements; refers to heavy metals
QA	Quality assurance

QMRA	Quantitative microbial risk assessment
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RED	Renewable Energy Directive
SEPA	Scottish Environmental Protection Agency
SSM	Safe sludge matrix
TD	Thermal Destruction
tDS	Tonnes of dry solids
THP	Thermal hydrolysis process
TOC	Total organic content/carbon
TRF	Toxicological reference value
TS	Total Solids, dry matter, dry solids
TSP	Total sludge production
UBA	Umweltbundesamt
UWWTD	Urban waste-water treatment
VOSL	Value of statistical life
WFD	Water Framework Directive
WI	Waste incineration
WWTP	Wastewater treatment plant

1. Introduction

1.1 Scope of this Study

The objective of the impact assessment was to inform the commission about the different impacts expected from a set of Options concerning the use of sludge on agriculture.

The options considered below are concerned only with sewage sludge as defined in Directive 86/278/EEC, i.e.:

i) *residual sludge from sewage plants treating domestic or urban waste waters and from other sewage plants treating waste waters of a composition similar to domestic and urban waste waters [..]*

Art.2 (a)

As for the uses the options are only concern with the use of sludge on agriculture, where agriculture means:

the growing of all types of commercial food crops, including for stock-rearing purposes

Art.2 (c)

Consultation proposed extending the scope to cover other industrial uses and the use of sludge on other land rather than agriculture, i.e. forestry. However, these aspects are believed to be outside the scope of this study as the options agreed did not concern expanding the scope of the Directive.

1.2 Overview of Options

An initial set of options for the revision of the Sewage Sludge Directive was developed based on the review of literature and of regulations in Member States, as well as comments received from Member States and stakeholders in the first consultation for this study and the first workshop.

The consultation on the previous report, the Interim Report[1], has revealed different opinions concerning changes to the Directive, with some member states (MS) favouring the status quo whilst others consider that changes to the Directive are required. The changes proposed included the following:

- Revision of current limit values for heavy metals;
- Introduction of limit values for organic pollutants;
- Introduction of pathogen concentration limits; and
- Introduction of a quality assurance system.

The project team developed a long list of options, which was reviewed with the European Commission. The original list included options which were deemed technically unfeasible or out of the scope of this study (for instance extending the boundary of the Directive to include uses such as reclamation, recreational and energy crops). As a result, five options were developed. The options carried out for this IA have also considered the previous Commission Communication in 2003[2]. There are five options as follows:

[1] WRc, Milieu and RPA (2009): Environmental, economic and social impact of the use of sewage sludge on land, Interim Report, October 2009.

[2] CEC (2003): Proposal for a Directive of the European Parliament and the Council on spreading of sludge on land, Brussels, 30 April 2003.

Option 1: do-nothing: keeping the Directive as it is;
Option 2: introduce certain more stringent standards, especially for heavy metals, standards for some organics and pathogens, and more stringent requirements on the application, sampling and monitoring of sludge;
Option 3: introduce more stringent standards across all substances and bans on application of sludge to some crops;
Option 4: total ban on the use of sludge on land; and
Option 5: repeal of the Directive.

A brief summary of each option is provided in Table 6.

Table 6: Option comparison by component

	Option 1 = Baseline Scenario	**Option 2 = Moderate changes (some standards more stringent)**		**Option 3 – More significant changes (more stringent standards)**		**Option 4 = Total Ban**	**Option 5 = Repeal of the Directive**
Limits on sewage sludge content							
Heavy metals	Retain existing limits (as given in Annex IB and IC)	More stringent standards		More stringent standards		Total ban	N/a
		PTE	mg/kg	PTE	mg/kg		
		Cd	10	Cd	5		
		Cr	1000	Cr	150		
		Cu	1000	Cu	400		
		Hg	10	Hg	5		
		Ni	300	Ni	50		
		Pb	750	Pb	250		
		Zn	2500	Zn	600		

	Option 1 = Baseline Scenario	Option 2 = Moderate changes (some standards more stringent)	Option 3 – More significant changes (more stringent standards)	Option 4 = Total Ban	Option 5 = Repeal of the Directive
Organics	No change – no limits	1-2 standards for "indicator" organics: PCB and PAH PAH 6mg/kg dry matter PCB 0.8 mg/kg dry matter	Introduce standards for organics for PAH, PCB, LAS, NPE, Dioxins, DEHP PAH3 6 mg/kg dry matter PCB4 0.8 mg/kg dry matter PCDD/F5 100 ng ITEQ/kg dry matter LAS6 5 g/kg dry matter NPE7 450 mg/kg dry matter	Total ban	
Pathogens	No change – no limits	Conventional treatment, i.e. any sludge treatment capable of achieving a reduction in Escherichia coli to less than 5x105 colony forming units per gram (wet weight) of treated sludge.	Advanced standard that sanitises sludge and achieves: a) a 99.99% reduction of Escherichia coli to less than 1·103 colony forming unit per gram (dry weight) of treated sludge; b) a 99.99% reduction in Salmonella Senftenberg W775 for sludge spiked with this micro-organism; c) no Ascaris ova; c) a sample of 1 gram (dry weight) of the treated sludge does not contain more than 3·103 spores of Clostridium perfringens; d) and a sample of 50 grams (wet weight) of the treated sludge does not contain Salmonella spp.	Total ban	
Nutrients	No change – no limits	No standards but provision of information on N:P and C content.	As in Option 2	Total ban	

[3] Sum of the following polycyclic aromatic hydrocarbons: acenapthene, phenanthrene, fluorene, flouranthene, pyrene, benzo(b+j+k)fluoranthene, benzo(a)pyrene, benzo(ghi)perylene, indeno(1, 2, 3-c, d)pyrene.

[4] Sum of the polychlorinated biphenyls components number 28, 52, 101, 118, 138, 153, 180.

[5] Polychlorinated dibenzodioxins/ dibenzofuranes.

[6] Linear alkylbenzene sulphonates.

[7] It comprises the substances nonylphenol and nonylphenolethoxylates with 1 or 2 ethoxy groups.

<table>
<tr><th></th><th>Option 1 = Baseline Scenario</th><th colspan="4">Option 2 = Moderate changes (some standards more stringent)</th><th colspan="4">Option 3 – More significant changes (more stringent standards)</th><th>Option 4 = Total Ban</th><th>Option 5 = Repeal of the Directive</th></tr>
<tr><td>Other changes concerning quality and aimed at prevention</td><td>No change</td><td colspan="4">Require stabilisation (or pseudostabilisation) to reduce methane emissions during storage and from land. A potential indicator is the lack of oxygen demand; use volatile solid (VS) reduction of 38% or specific oxygen uptake rate of less than 1.5mg/h/g total solids</td><td colspan="4">As in Option 2 and Hazard Assessment and Critical Control Points Assessment (HACCP)</td><td>Total ban</td><td rowspan="2"></td></tr>
<tr><td colspan="11">More stringent conditions on application of treated sludge to land</td></tr>
<tr><td colspan="11">Soil composition</td><td rowspan="15">N/a</td></tr>
<tr><td rowspan="9">Heavy metals</td><td rowspan="9">No change</td><td colspan="4">Heavy metal concentration (mg/kg)</td><td colspan="4">Heavy metal concentration (mg/kg)</td><td rowspan="9">Total ban</td></tr>
<tr><td>PTE</td><td>5<pH<6</td><td>6<pH<7</td><td>pH>7</td><td>PTE</td><td>5<pH<6</td><td>6<pH<7</td><td>pH>7</td></tr>
<tr><td>Cd</td><td>0.5</td><td>1</td><td>1.5</td><td>Cd</td><td>0.5</td><td>1</td><td>1.5</td></tr>
<tr><td>Cr</td><td>50</td><td>75</td><td>100</td><td>Cr</td><td>50</td><td>75</td><td>100</td></tr>
<tr><td>Cu</td><td>30</td><td>50</td><td>100</td><td>Cu</td><td>30</td><td>50</td><td>100</td></tr>
<tr><td>Hg</td><td>0.1</td><td>0.5</td><td>1</td><td>Hg</td><td>0.1</td><td>0.5</td><td>1</td></tr>
<tr><td>Ni</td><td>30</td><td>50</td><td>70</td><td>Ni</td><td>30</td><td>50</td><td>70</td></tr>
<tr><td>Pb</td><td>70</td><td>70</td><td>100</td><td>Pb</td><td>70</td><td>70</td><td>100</td></tr>
<tr><td>Zn</td><td>100</td><td>150</td><td>200</td><td>Zn</td><td>20</td><td>20</td><td>200</td></tr>
<tr><td>Organics</td><td>No change</td><td colspan="4">No limits , i.e. no change</td><td colspan="4">No limits, i.e. no change</td><td>Total ban</td></tr>
<tr><td>Pathogens</td><td>No change</td><td colspan="4">No limits, i.e. no change</td><td colspan="4">No limits, i.e. no change</td><td>Total ban</td></tr>
<tr><td>Nutrients</td><td>No change</td><td colspan="4">Information only</td><td colspan="4">As in option 2</td><td>Total ban</td></tr>
<tr><td>Conditions on application</td><td>No change</td><td colspan="4">Setting periods for harvesting for grassland and/or forage crops– Article 7.a
Make compulsory 10 month period for fruit, vegetable crops
Ban the application of untreated sludge – changes to Article 6 which currently allows MS to authorise under certain conditions the use of untreated sludge if injected or worked into the soil. Outright ban on the use of untreated sludge injected or worked into the soil – changes to Article 6
Liquid sludge may only be used if injected or immediately worked into soil.</td><td colspan="4">Ban of application of sludge for fruit, vegetable crops and grassland</td><td>Total ban</td></tr>
<tr><td>Other changes, i.e.</td><td></td><td>Quantity of</td><td colspan="3">Minimum number of analyses per year</td><td colspan="4">As in Option 2 but Option 3 could have more substances to be tested (organics)</td><td>Total ban</td></tr>
</table>

<table>
<tr><th></th><th>Option 1 = Baseline Scenario</th><th colspan="6">Option 2 = Moderate changes (some standards more stringent)</th><th>Option 3 – More significant changes (more stringent standards)</th><th>Option 4 = Total Ban</th><th>Option 5 = Repeal of the Directive</th></tr>
<tr><td rowspan="8">sampling and monitoring, Quality assurance scheme</td><td rowspan="8"></td><td>sludge (tDS/year/ plant)</td><td>Agronomic para-meters</td><td>Heavy metals</td><td>OCs (except dioxins)</td><td>Diox-ins</td><td>Micro-organ-isms</td><td rowspan="8"></td><td rowspan="8"></td><td rowspan="8"></td></tr>
<tr><td>< 50</td><td>1</td><td>1</td><td>-</td><td>-</td><td>1</td></tr>
<tr><td>50 – 250</td><td>2</td><td>2</td><td>-</td><td>-</td><td>2</td></tr>
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<tr><td>1000 – 2500</td><td>4</td><td>4</td><td>2</td><td>1</td><td>4</td></tr>
<tr><td>2500 – 5000</td><td>8</td><td>8</td><td>4</td><td>1</td><td>8</td></tr>
<tr><td>> 5000</td><td>12</td><td>12</td><td>6</td><td>2</td><td>12</td></tr>
<tr><td colspan="6">Ease the sampling and reporting requirements in case of QAS for separate discussion. Should be available for both option 2 and 3. Include CEN TC 308 procedures.</td></tr>
<tr><td colspan="11">Source: Adapted from CEC (2003): Proposal for a Directive of the European Parliament and of the Council on spreading of sludge on land. Brussels, 30 April 2003.</td></tr>
</table>

2. Approach to the Impact Assessment

2.1 Overview

A preliminary impact assessment was conducted in November 2009. This report was published for consultation with interested stakeholders. The report included a number of questions in order to check the assumptions and gather more data on the impacts. The level of response was substantial and a total of 39 responses were gathered around the 20 questions presented in the study. The list of respondents as well as a summary of responses is provided in Annex 1. The results of the consultation have helped in refining the previous assumptions and assessing the impacts on disposal.

The assessment of options follows a similar approach to the CBA conducted in 2002 (by Sede and Andersen; although there are differences in the limits proposed). This Impact Assessment (IA) aims to quantify all the impacts where data are available that allow initial estimates to be made of the costs and benefits. When impacts are not quantified, qualitative descriptions are provided.

2.2 Initial Screening

Table 7 shows the impact screening based on the IA Guidelines by the Commission for the different Options. When impacts are uncertain, they have been carried forward for the analysis. The greatest uncertainty applies to Option 5 as this will finally rely on any changes to national legislation and implementation at MS level.

Table 7: Impact Screening

	Option 1 - BAU	**Option 2 - moderate changes**	**Option 3 - more significant changes**	**Option 4 - ban on the use of sludge on land**	**Option 5 - Repeal of the Directive**
	Impacts likely?				
ECONOMIC IMPACTS					
Functioning of the internal market and competition	No	Uncertain	Uncertain	Uncertain	Uncertain
Competitiveness, trade and investment flows	No	Uncertain	Yes	Yes	Uncertain
Operating costs and conduct of SMEs	No	Yes	Yes	Yes	Uncertain
Administrative burdens on business	No	Yes	Yes	Uncertain	Uncertain
Public authorities	No	Yes	Yes	Yes	Uncertain
Property rights	No	No	No	No	Uncertain
Innovation and research	No	Uncertain	Uncertain	Yes	Uncertain
Consumers and household	No	Uncertain	Uncertain	Yes	Uncertain
Specific regions and sectors	No	Yes	Yes	Yes	Uncertain
Third countries and international relation	No	No	No	No	No
Macroeconomic environment	No	Uncertain	Uncertain	Uncertain	Uncertain
SOCIAL IMPACTS					
Employment and Labour markets	No	Uncertain	Uncertain	Uncertain	Uncertain
Standards and rights related to job quality	No	No	No	No	No

	Option 1 - BAU	Option 2 - moderate changes	Option 3 - more significant changes	Option 4 - ban on the use of sludge on land	Option 5 - Repeal of the Directive
Social inclusion and protection of particular groups	No	No	No	No	No
Gender equality, non-discrimination	No	No	No	No	No
Governance, participation	No	No	No	Uncertain	Uncertain
Public health and safety	No	Yes	Yes	Yes	Uncertain
Crime, terrorism and security	No	No	No	No	No
Access to social protection and health	No	No	No	No	No
Culture	No	No	No	No	No
Impacts on third countries	No	No	No	No	Uncertain
ENVIRONMENTAL IMPACTS					
The climate	No	Yes	Yes	Yes	Uncertain
Transport and the use of energy	No	Yes	Yes	Yes	Uncertain
Air quality	No	Yes	Yes	Yes	Uncertain
Biodiversity, flora, fauna and landscape	No	Yes	Yes	Yes	Uncertain
Water quality and resources	No	Uncertain	Uncertain	Uncertain	Uncertain
Soil quality and resources	No	Uncertain	Uncertain	Uncertain	Uncertain
Land use	No	Uncertain	Uncertain	Yes	Uncertain
Renewable and non-renewable sources	No	Yes	Yes	Yes	Uncertain
Environmental consequences	No	Uncertain	Uncertain	Uncertain	Uncertain
Waste production/generation/recycling	No	Yes	Yes	Yes	Uncertain
Likelihood of environmental risk	No	Yes	Yes	Yes	Uncertain
Animal welfare	No	No	No	No	Uncertain
International and environmental impacts	No	Uncertain	Uncertain	Uncertain	Uncertain

2.3 Identification of stakeholders

The range of stakeholders affected and types of costs and benefits considered are set out in Table 5. Consultation has helped to reassess the impacts, for instance, it has been confirmed that impacts on agricultural outputs are expected to be negligible as well as impact on employment in the agricultural sector. However, consultation has also highlighted that these impacts would be limited. On the other hand, the sector producing recycling equipment noted during consultation that they would be affected.

Table 8: Stakeholders and costs/benefits

Stakeholder	Economic impacts	Environmental Impacts	Social Impacts
Water and sludge management operators	Costs of alternative disposal Quality assurance – including reporting requirements Obligation of treatment *Distributional impacts	Environmental benefits/costs from changes in risk of application and alternative routes of	Amenity (odour) Reduction/increase in risk – human health Employment impacts in

Stakeholder	Economic impacts	Environmental Impacts	Social Impacts
Regulatory authorities	Changes to regulation –including costs of consultation Policy implementation and control Benefits/costs if meeting other related legislation requirements (i.e. WFD and Waste Directive)	disposal including climate change	related sector (recycling manufacture)
Farmers	Loss of use of sludge as a fertiliser and fertiliser replacement costs Loss of agricultural output/crops		
Consumers/Public	Increased bills (from water companies due to greater obligation of treatment) *Distributional impacts		
*: Distributional impacts are assessed separately under this IA based on total cost /benefit estimation. However, they come under the economic impact category in the Impact Assessment. We have included them separately in this IA.			

2.4 Approach to assessment of impacts

For all options, the approach to the impact assessment will involve the following steps:

- Step 1: Identification of MS affected by changes to the Directive, due to current national legislation and current practices;
- Step 2: Direct impact estimation when impacts are considered likely on recycling rates and changes in amount going to different disposal options; and
- Step 3: Indirect impacts from changes in the above in terms of costs and benefits to the different stakeholders (e.g. fertiliser replacement, costs of incineration, etc). The approach will then be the following:

Costs/Benefits = amount of sludge affected x impact (in quantitative term) x unit costs (€) for impact

The approach to the impact assessment has considered the impact of the new standards of the different treatment options as well as disposal. In this regard, the current management of countries have been taken into account to generate the estimates (with the help of consultation). Unitary costs have then been applied to account for the switch from recycling to different disposal options. The unitary costs and benefits considered in this IA are presented in Section 3.

Where impacts have not been quantified due to a lack of data, these are described qualitatively. When impacts are highly uncertain, ranges have been used or qualitative descriptions used. The below Table presents a summary of the impacts that have been quantified in this IA.

Table 9: Impact quantification

Impacts	Quantified	Comments
Economic impacts		
Costs of alternative disposal	Yes	These costs are the main costs stemming from the options when the new standards will affect the level of recycling
Loss of use of sludge as a fertiliser and fertiliser replacement costs	Yes	
Obligation of treatment	Yes	
Quality assurance – including reporting requirements	Yes	
Loss of agricultural production	No	Stakeholder identified that impacts in this regard are unlikely as sludge could be replaced by fertilisers (organic and mineral)

Impacts	Quantified	Comments
Employment impacts	No	Difficult to estimate with accuracy – some stakeholder have highlighted that there may be impacts should a ban or very stringent limits be implemented (i.e. manufacturers of recycling equipment) but others have highlighted negligible impacts
Amenity (increase in real or perceived value of land from reduced sludge application)	No	Highly uncertain, hence not estimated
Energy recovery	Partially	Market price of incineration and landfilling takes into account energy recovery. External benefits have not been quantified; however, in relation to incineration, this is perceived to be wholly or partially counterbalanced by the need for sludge drying
Impact on markets for mineral and other natural fertilizers	No	The impacts are considered low, as the fertilizer market is much larger in volume than sludge market (but impact might be greater under Option 4)
Increased water bills	No	Depend on national practices – some costs may be passed on to farmers and consumers in terms of increased waterbills but this may vary significantly among MS
Increased consumer confidence (linked to food sales)	No	Highly uncertain, hence not estimated
Innovation and research	No	Highly uncertain, hence not estimated
Environmental impacts		
Environmental benefits/costs from changes in risk from changes in quantity of recycled sludge: e.g. soil impacts, discharges to surface water and groundwater	Partially	Only some impacts from air emissions and reduced need to use fertiliser quantified; other impacts, such emissions to water and soil impacts could not be quantified.
Environmental benefits/costs from changes in risk from alternative disposal: • CO_2 emissions and impact on climate change • Other air pollutants • Discharges to water and groundwater	Partially	Some impacts linked to air emissions have been quantified and the results have been included in the impact assessment. However, some other impacts, such as discharges to water, could not be quantified.
Social impacts		
Amenity (odour)	No	Highly uncertain and variable among MS
Human health impacts from changes in risk from changes in quantities of recycled sludge	Partially	Some impacts from air emissions have been valued as these are included in the overall valuation of air emissions.
Human health benefits/costs from changes in risk from alternative disposal • Air emissions from incineration in particular	Partially	Health impacts linked to air emissions have been quantified as these are included in the overall impact valuation of air emissions.
Benefits if meeting other related legislation requirements (i.e. WFD)	No	Difficult to quantify. Significant data requirements on degree of implementation of relevant policies

The period for analysis is the same as that used in the Interim report: to 2020. The benefits and costs have been discounted at 4%.

3. Valuation methodology used to assess costs and benefits from different sludge management options

3.1 Overview

When the policy options are expected to affect the recycling route, impacts will be likely. In other words, there will be costs and benefits related to the increased incineration, landfilling and/or further treatment when the volumes of recycling are affected by the policy option or by any of the option components. In this Section, we explain the methodology used for estimating the benefits and the costs of changes to the different sludge management options.

The costs and benefits fall in two main categories:

1. **Financial benefits and costs** – also called "internal" benefits and costs. These costs are aimed to capture the financial costs and benefits as reflected in the market place. It is important to note that subsidies/taxes to the different management options, e.g. subsidies for recycling and or taxes on incineration are not included in the estimates. This is because such payments represent a transfer and as such they are not a net gain/loss to the economy; and
2. **External benefits and costs** – externalities are defined *as impacts on a party that is not directly involved in the transaction stemming from the action of another party who does not bear the costs*. In such a case, prices do not reflect the full costs or benefits in production or consumption of a product or service[8]. An example of an externality in this context is for instance the environmental impacts from air emission from incineration processes through deposition.

The valuation methodology in this report largely follows the methodology for valuing internal and external costs and benefits from sludge disposal routes developed by Sede and Andersen (2002). Unit costs given in Sede and Andersen (2002) have been updated to reflect the increase in average price levels since 2002 (using the retail price index[9]) and changes in EU-wide price levels as a result of EU enlargements in 2004 and 2007 (we estimate that this reduced the average price level by approximately 9%).

The remainder of this section provides an overview of the current disposal routes which have helped to estimate the impacts in the different MS as well as a summary of the unit costs used for their analysis; including the sources of uncertainty. All unit costs used for further analysis in this report are summarised at the end of this section.

3.2 Incineration

3.2.1 Overview of sludge incineration rates in EU Member States

Incineration is used as a treatment for a very wide range of wastes. The objective of waste incineration is to treat wastes so as to reduce their volume and hazard, whilst capturing (and thus concentrating) or destroying potentially harmful substances that are, or may be, released during incineration. Incineration processes can also provide a means to enable recovery of the energy, mineral and/or chemical content from waste.

8 An advantageous impact is called an external benefit or positive externality, while a detrimental impact is called an external cost or negative externality.

9 Prices updated by RPI (215.3/178.5)

Incineration of sludges can be performed in designated incinerators (mono-incineration) or in municipal solid waste incinerators (co-incineration). After pre-drying sludge can also be incinerated in cement kilns because they have a high calorific value.

Specific sludge incineration facilities have been operating for many years. However, the availability of these vary significantly according to Member States. Currently data are sparse about the incineration capacities in different MS. The following Table shows the number and total capacity of existing incineration plants (not including planned sites) for general waste and dedicated sewage sludge incinerators based on information from 2001[10]. No more recent information has been found available. As a result, this information is only presented to illustrate the split among MS and types of incineration. As it can be seen, a number of MS have been, in the past, at the forefront of mono-incineration, i.e. Germany, Denmark and the UK. However, from our consultation we believe that there are existing plans to develop incineration facilities in countries such as Portugal and the Czech republic.

Table 10: Number and total capacity of incineration plants

Country	Total number Of MSW incinerators	Capacity Mt/yr	Total number of dedicated sewage sludge incinerators	Capacity Mt/yr (dry solids)
Austria	5	0.5	:	1
Belgium	17	2.4	1	0.02
Denmark	32	2.7	5	0.3
Finland	1	0.07	:	:
France	210	11,748	1	:
Germany	59	13.4	23	0.63
Greece	0	na	:	:
Ireland	0	na	:	:
Italy	32	1.71	:	:
Luxembourg	1	0.15	:	:
Portugal(a)	3	1.2	:	:
Spain	9	1.13	:	:
Sweden	30	2.5	:	:
Netherlands	11	5.3	2	0.19
United Kingdom	17	2.97	11	0.42
Note: the ":" sign denotes no data are available.				

More recent data are available on the amount of sludge being incinerated across EU. The following Table shows information from Eurostat on the trends of sludge being incinerated up to 2007. However, it is not clear whether this is incinerated with other municipal waste or in specific incinerators.

Table 11: Sludge going to incineration (kt, DS)

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	16.2	18.0	18.2	:	55.1	66.4	71.0	28.1	36.2	:	:	:
Bulgaria	:	:	:	:	:	:	:	:	0.0	0.0	0.0	0.0
Czech Republic	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.0	0.0	0.0	0.0
Denmark	32.7	33.2	31.9	:	:	:	:	:	:	:	:	:
Germany	:	:	396.0	:	:	554.9	:	:	711.2	941.7	965.1	:
Estonia	:	:	:	:	:	:	:	:	:	0.3	0.3	0.3
Ireland	:	:	:	:	:	:	:	:	:	0.0	:	:
Greece	:	:	:	:	:	0.0	0.0	0.0	0.0	0.0	0.0	:

10 Available in CEC (2006): Integrated Pollution Prevention and Control Reference Document on the Best Available Techniques for Waste Incineration August 2006

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Spain	32.0	20.0	33.5	33.5	70.2	54.8	68.9	76.8	77.5	77.8	41.1	:
France	:	:	154.1	:	:	166.4	:	:	178.4	:	:	:
Italy	:	:	:	:	:	:	:	:	:	30.8	:	:
Cyprus	:	:	:	:	:	:	:	:	0.0	0.5	:	:
Latvia	:	:	:	:	:	:	0.0	0.0	0.0	0.0	0.0	0.0
Lithuania	:	:	:	:	:	:	:	:	:	0.0	0.0	0.0
Luxemb.	:	:	:	:	:	:	:	:	:	:	:	:
Hungary	0.0	0.1	0.5	:	:	:	:	:	:	0.0	0.0	:
Malta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	:
Netherl.	102.0	98.0	162.0	184.0	180.0	207.6	204.3	212.6	235.7	232.8	252.5	:
Austria	:	68.2	68.4	:	150.2	:	162.1	:	151.3	:	98.3	:
Poland	:	:	5.0	5.0	5.9	6.9	6.8	6.3	1.4	6.3	4.5	1.7
Portugal	:	:	:	:	:	:	:	:	:	:	:	:
Romania	:	:	:	:	:	:	:	:	:	0.0	:	:
Slovenia	:	:	:	:	:	:	:	0.0	0.0	0.0	5.2	5.1
Slovakia	0.0	0.0	0.0	:	:	:	:	:	:	:	0.0	0.0
Finland	0.0	0.0	0.0	0.0	0.0	:	:	:	:	:	:	:
Sweden	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	:
United Kingdom	:	:	:	:	:	241.2	305.8	314.3	273.2	281.9	:	:
Note: the ":" sign denotes no data are available**;** **"0"** less than half of the unit used**;** **"- "** not applicable or real zero or zero by default												

The next Table summarises the percentages currently going to incineration based on more recent data from our first consultation and projections of how these incineration capacities could be developed in the future. Again, the percentage of sludge going together with municipal solid waste (MSW) against special incineration is not clear.

Table 12 Disposal methods for sewage sludge in EU Member States as percentage incinerated (AMF 2007, Doujak 2007, Eureau 2006 reported by Smith 2008, IRGT 2005, Leonard 2008, COM personal communication, 2009) and projections for 2010 and 2020

Member State	Year of data	Incineration	2010 Projection	2020 projection
Austria	2005	47	40	85
Belgium			90	90
• Flemish Region	2005	76	:	:
• Walloon Region	2005	62	:	:
• Brussels region	2002	66	:	:
Denmark	2002	43	45	45
Finland	2000	:	:	5
France	2002	20	15	15
Germany	2003	38	50	50
Greece	:	:	:	
Ireland	2003	:	:	
Italy	2005	7	20	30
Luxembourg	2004	20	5	20
Netherlands	2006	60	100	100
Portugal	2005	0	30	40
Spain	:	:	10	25
Sweden	:	2	5	5
UK	2004	19.5	:	25
Bulgaria	2005	0	:	10
Cyprus	:	:	:	10

Member State	Year of data	Incineration	2010 Projection	2020 projection
Czech republic	2004	:	25	20
Hungary	2006	:	5	30
Poland	2000	:	5	10
Romania		:	5	10
Slovakia	2006	:	5	40
Slovenia	2006	:	5	70
Note: the ":" sign denotes no data are available.				

As it can be seen from the above Table, most of the countries will maintain and increase their incineration rates, with some of them showing a significant increase. Although the decision to mono incinerate or co-incinerate will depend on costs, other factors will also affect the choice of disposal. For instance, in case of co-incineration, the treatment capacity and treatment efficiency depend on the saturation of the incinerator by other solid waste streams and/or the ratio of sludge mass to solid waste mass.

The first consultation revealed that while several authorities and commercial stakeholders recognised the advantages of co-treatment of sludge, some regard mono-incineration as the preferred option in order to enable phosphorus recovery. Among the disadvantages of incineration are the air emissions and other externalities related to transport.

The incineration sector has undergone rapid technological development over the last years. Much of this change has been driven by legislation specific to the industry and this has, in particular, reduced emissions to air from individual installations[11]. Continual process development is ongoing, with the sector now developing techniques which limit costs, whilst maintaining or improving environmental performance. Despite this, incineration use, costs, energy benefits and emissions are contentious with strongly held views for and against the use of incineration and different estimates have been produced on the financial and external costs from incineration. These are described below.

3.2.2 Internal costs and benefits from incineration

Incinerators are normally capital intensive and probably only warranted on the basis of large volumes of material to be incinerated. The following costs categories are considered "internal costs" to incineration process:

- Costs of storage systems;
- Costs of furnace;
- Treatment of off-gas and other incineration residues, i.e. bottom ash, fly ash, clinker;
- Operating costs;
- Transport costs to the treatment site; and
- Quality control.

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[11] The Waste Incineration Directive (WI Directive) sets emission limit values and monitoring requirements for pollutants to air such as dust, nitrogen oxides (NOx), sulphur dioxide (SO2), hydrogen chloride (HCl), hydrogen fluoride (HF), heavy metals and dioxins and furans. The Directive also sets controls on releases to water in order to reduce the pollution impact of waste incineration and co-incineration on marine and fresh water ecosystems. Most types of waste incineration plants fall within the scope of the Directive, with some exceptions, such as those treating only biomass (e.g. vegetable waste from agriculture and forestry). Many of the plants that are covered by the WI Directive are also covered by the Integrated Pollution Prevention and Control (IPPC) Directive.

There are a number of sources in the literature that report different costs of co-incineration. More limited is the information on the costs of mono-incineration. Sede and Andersen estimated that the costs could be of the following magnitude:

- co-incineration: €290 t/DS[12]
- mono- incineration: €374t/DS

Other costs are summarised in the next Table. As it can be seen from the Table, the costs can vary significantly; however, it is not always certain what is included under operating costs.

Table 13: Incinerator Cost Information (€2009)

Co-incineration	**Mono-incineration**	**Type of costs considered**	**Specific assumptions**	**Source**
c. €290/tDS	c. €374/tDS	Capital costs Operating costs (includes labour, energy and other consumable), transportation, disposal of residues.	€2009 prices Investment costs assessed and annualised (6% discount rate). Life of equipment ranging from 8 to 15 years depending on equipment.	Sede and Andersen (2002)
€191 - €271 /tDS	€281/tDS to €478/tDS	Capital costs and operating costs, including final disposal of residues	€2009 prices Up to 5,000 tonnes of dry material per year, representing stations from 200,000 to 800,000 pe	EEA (1998)[13]
6,500–8,500(USD/kW)	nd	Typical current investment costs	Plant size: 10–100 MW Using a 10% discount rate Other assumptions uncertain – year of value assumed 2008	IEA[14]
€486 – €1164/tpa capital costs €32 – €74/t running costs	nd	Capital Operating costs	€2004 values Size range from 40 ktpa to 450ktpa	Murphy and McKeogh[15]
€46m to €137m capital costs c. €30 to c. €70/tonne operating costs	nd	Capital Operating costs	Assumes energy recovery Costs depend on capacities ranging from 100 ktpa to 400 ktpa	Last[16]
~€190€/tDS		Capital + Operating costs	(2009)	WRc

The costs of incineration are highly variable to design aspects (and especially for mono-incineration the sensitivity of these costs were estimated to vary by around ±50% in Sede and Andersen, 2002). Assumptions regarding energy recovery from incineration have an important impact on results of analyses comparing alternative options for managing waste. From the economic point of view, energy recovery is an

[12] Prices updated by RPI (215.3/178.5)

[13] Sludge treatment and disposal, management practices and experiences

[14] International Energy Agency (2008), Deploying Renewables. Principles for Effective Policies.

[15] Murphy, J.D. and McKeogh; E. (2004), Technical, economic and environmental analysis of energy production from municipal solid waste, Renewable Energy 29, pp 1043-1057.

[16] Last, S (2008), An Introduction to Waste Technologies, The processes Used to Recycle, Treat, and Divert Municipal Solid Waste Away from Landfills, Waste Technologies UK Associates.

important aspect, as sales of both electricity and heat can generate substantial revenue that can cover part of the incineration costs. Information on the current trends for energy recovery, however, is not available in order to calculate the revenues from selling electricity, heat and/or both.

As newer technologies develop maximising energy recovery it is expected that the marginal costs may decrease, also responding to economies of scale. A lower estimate of such costs could be illustrated by the current costs of pyrolisis or gasification (as highlighted by the stakeholders) although this is not yet common practice and these processes are currently at the development stage. The capital costs of the plants can be smaller at £19m to £93 m (based on Lust, 2008) for a 100,000 tpa plant. Information on operating costs, however, is not available although they could be expected to be similar to those of a mono-incineration plant.

For the valuation of impacts, we have chosen to use unit costs of sludge incineration that are based on an update of data provided by Sede & Andersen (2002). Sede & Andersen's valuation includes capital and operational costs of incineration which is based on the market price of incineration and thus includes all relevant costs and benefits, including that of disposal of residues and energy recovery. The internal unit costs of sludge incineration are summarised in the below Table[17].

Table 14: Internal cost of incineration used for further analysis in this study (€/t DS)

Type of cost	Co-incineration	Mono-incineration
Internal cost - investment	113	161
Internal cost - operational	177	213
Total cost	**290**	**374**

3.2.3 External costs and benefits from incineration

Incineration generates emissions into the air (particles, acid gases, greenhouse gases, heavy metals, volatile organic compounds, etc.), soil (disposal of ashes and flue gas treatment residues to landfill, atmospheric deposition of air emissions) and water (flue gas treatment wet processes). Emissions into the air may be reduced thanks to flue gas treatment. From an environmental point of view, recovered energy displaces alternative energy production and related environmental impacts. Operation of an incineration plant may also produce noise, dust, odour and visual pollution.

The environmental impacts from incineration are summarised in the next Table.

Table 15: Environmental impacts from incineration

Emissions	Impacts
Energy production	Displaced emissions of pollutants to air
Emissions of pollutants to air via smoke stack	Human health impacts Ecosystem degradation Climate change Building degradation
Emissions of wastewater to surface water	Human health Decrease in surface water quality
Emissions of leachate to soil from landfilling of ash	Human health impacts Soil micro-organisms reduction Decrease in groundwater quality
Emission of leachate to water (landfilling of ash)	Human health impacts Decrease in surface water quality
Visual intrusion	Social acceptance

[17] These values are inferred from a figure available in the report.

Emissions	Impacts
	Public anxiety
Transportation	Exhaust emissions due to transportation
Source: adapted from Sede and Andersen 2002	

A number of impacts from the above list are expected to be minimised on the basis of existing legislation. These include for instance lanfilling of ash (and this is subject to stricter legislative requirement than conventional waste); as a result impacts from leachate are expected to be negligible. Some other impacts will not be subject to valuation in this study, i.e. visual intrusion as this will depend on site specifics and other perception issues that are not subject to modelling. Other impacts may be considered negligible, i.e. transportation, as sludge transportation is considered to be very low in comparison with the total traffic. In addition, it will depend on local conditions.

More detailed discussion of individual environmental impacts from sludge incineration and of the method for their valuation (or of the reasons for not valuing them in this study) is given below.

Energy production

Incineration of sludge and/or wastes generates excess heat which may be used as such or converted into electricity. Energy recovery could therefore be considered as an external benefit of sludge incineration, considering the saving of non-renewable resources. Currently however there is limited information on the energy recovery from incineration, including anaerobic digestion.

Several studies have calculated the benefits from energy reduction ranging from €0 to €100/tonne waste. The following Table summarises the benefits from energy recovery in a number of studies.

Table 16: Valuation of energy recovery (reduced emissions) from incinerators (€2009/tonne waste/MSW)

Source	Valuation of savings from energy recovery (€2009/tonne waste)
CSERGE et al (1993)	6.55 - 22.47
Powell and Brisson (1994)	10.46 - 14.32
Enosh (1996)	8.14
EMC (1996)	8.14
EC (2000)	0 - 109.51
Dijkgraaf and Vollebergh (2003)	21.54
Source: Eshet et al (2006): Valuation of externalities of selected waste management alternatives Assumes $1=€0.88 (2003), updated to €2009 with HPCI	

COWI (2000)[18] also considered that the benefits of displaced emissions could vary significantly according to the type of waste being considered and the type of incineration. The values for various types of incineration plants are replicated in the following Table.

[18] European Commission, DG Environment A Study on the Economic Valuation of Environmental Externalities from Landfill Disposal and Incineration of Waste Final Main Report October 2000.

Table 17: Valuation of energy recovery (reduced emissions) (€2009)

I1.	I2.	I3.
-87 (-141 – -23)	-26 (-36 – -5)	0 (-)
I1. Energy recovered will generate electricity and heat (CHP), which normally implies a high recovery percentage. This percentage is assumed to be 83%. **I2.** Energy recovered will generate electricity only, which normally implies a lower recovery percentage. This percentage is assumed to be 25%. **I3.** The flue gas cleaning technology is an electrostatic precipitator. There is no energy recovery.		

The above values however reflect energy recovery from general waste. In the context of sludge however, this will have to be dried prior to the incineration process. The 2002 report by Sede and Andersen was based on the assumption that energy production from sludge incineration is counterbalanced by energy needs of reduction of the water content of sludge, and as a result the net benefit was considered to be negligible. For this reason, this type of benefit was not valued by Sede and Andersen. This approach is also followed here although owing to more recent technologies the costs may represent an overestimate of the real cost in this context.

Human health

Incineration can impact human health directly and indirectly. The former is related to exposure to flue gas inhalation, containing compounds such as heavy metals, dioxins, HCl, NOx, SO2, or particulate matter. The latter may be due to ingestion of contaminated vegetal or animal products. Human health may also be affected by waste water produced during the wet treatment of flue gas if this is emitted to surface or groundwater. Generally though, human health risk from wet treatment of flue gas may be minimised on the basis of available legislation. The risk from contamination is also expected to be limited.

Incineration of sludge however could be regarded as carbon neutral. This is line with the approach on biowaste[19] incineration in the meaning of the renewable energy directive and the proposed Directive on the promotion of the use of energy from renewable resources. This is also the new approach by the IPCC. Under international GHG accounting methods developed by the Intergovernmental Panel on Climate Change (IPCC), non-fossil CO_2 is considered to be part of the natural carbon balance and therefore not a contributor to atmospheric concentrations of CO_2. The rationale behind the IPCC's decision is that non-fossil carbon was originally removed from the atmosphere via photosynthesis, and under natural conditions, it would eventually cycle back to the atmosphere as CO_2 due to degradation processes. Given this, CO_2 emissions from combustion of biomass fuels should not be included in totals for the energy sector. As a result, CO_2 is not considered here under the air emissions below.

The following Table shows emissions to air from incineration.

Table 18: Air emissions from sludge incineration (unit g/tDS unless otherwise stated)

Emission type	Mono-Incineration	Co-incineration
CH_4(kg/tDS)	0	0
NO_x	1,253	1,233
CO	331	610
SO_2	1005	841
HC	20	1394
PST	85	216

[19] Although sludge is not considered a biowaste, it is believed that the same principles for carbon accounting apply here.

HCl	50	50
HF	5	5
Cr	1	1
Cu	1	1
Ni	1	1
Pb	1	1
Zn	1	1
Note: includes exhaust emissions from transportation		

COWI valued the external impacts from incineration arising from air emissions, based on ExternE. These however included environmental and health impacts. The ranges reflect the fact that different studies used different valuation methods and in some cases different impacts were valued.

Table 19: Valuation estimates for air emissions (€/kg emissions)[20]

Emission type	Best estimate	Low estimate	High estimate
CH_4	0.184	0.086	0.372
NO_x	19.631	4.037	26.325
SO_2	11.043	5.005	16.191
HC	1.840	-	-
PST	29.447	-	-
HCl	0.000	-	-
HF	0.000	-	-
Cr	613.484	163.187	1175.436
Cu	0.000	-	-
Ni	12.270	3.681	24.539
Pb	0.000	-	-
Zn	0.000	-	-

Combining the above cost with the air emissions, the human health costs from incineration can be estimated.
The following estimates have been used in further analyses in this report.

Table 20: External costs of emissions to air from incineration (€/tDS)

Emission type	Mono-incineration	Co-incineration
CH_4	0.0	0.0
NO_x	24.6	24.2
SO_2	11.098	9.287
HC	0.037	2.566
PST	2.503	6.361
HCl	0	0
HF	0	0
Cr	0.613	0.613
Cu	0	0
Ni	0.012	0.012
Pb	0	0
Zn	0	0

[20] Valuation estimates are

Ecosystem degradation

As above, ecosystems may be impacted directly or indirectly following sludge incineration by the emission of flue gas to air, or by the emission of wastewater following the wet treatment of flue gas.

Heavy metals, dioxins, NOx, SO2, HCl, and particulate matter are contained in flue gas which may have an impact on plants and crops due to air deposition and/or absorption. These may further contaminate livestock and wild fauna via ingestion of contaminated plants. Emission of waste water to surface water may also have an impact on wild fauna and flora, especially on aquatic organisms. Such impacts, however, are difficult to model and are expected to be minimised on the basis of existing legislation. On the other hand, the COWI values take into account impacts linked to air emissions so these have been used as a surrogate of the impacts, although they may be an undervalue.

Buildings degradation

Flue gas produced following sewage sludge incineration contains SO2 and NOx which are known to have an impact on buildings due to acidic deposition on materials. The COWI coefficients above, however, include such impacts (however, according to Sede and Andersen, it is not clear whether all impacts related to buildings degradation are included in the valuation methodology developed by COWI and used by Sede and Andersen).

Climate change

When sludge is incinerated, flue gas is produced, containing greenhouse gases (GHG) such as CO_2 and NO_x. The following Table shows the range in emissions of greenhouse gases and NOx (which is seen as contributing to climate change in an indirect manner) for the different types of incineration. On the other hand, due to the nature of sludge, the CO2 emissions are not considered here (as it is deemed carbon neutral).

Table 21: Emissions from sludge incineration (unit g/tDS unless otherwise stated)

Emission type	**Mono-Incineration**	**Co-incineration**
CH_4(kg/tDS)	0	0
NO_x	1,253	1,233
Notes: includes exhaust emissions from transportation		

GHGs are known to have both environmental and human health impacts. Human beings may be affected directly, by gas inhalation, or indirectly, following ingestion of contaminated vegetable or animal products. The environmental impacts are related to:

- loss of crops (due to SO_2 and O_3); and
- impacts on buildings and materials.

The following cost estimates are used in Sede and Andersen (2002) and based on COWI (in turn based on ExternE). The ranges reflect different studies using different valuation methods and in some cases not valuing the same impacts. Due to the difficulties in assessing dose-response data from environmental impacts, the values are mainly linked to human health impacts (95% of the total costs, especially mortality).

Table 22: Valuation estimates for air emissions (€/kg emissions)[21]

Emission type	Best estimate	Low estimate	High estimate
CH_4	0.184	0.086	0.372
NO_x	19.631	4.037	26.325

Combining the emissions from incineration with the COWI estimates, the following estimates can be produced for the external costs of incineration in terms of climate change.

Table 23: External costs of emissions from incineration (€/tDS)

Emission type	Mono-incineration	Co-incineration
CH_4	0.0	0.0
NO_x	24.6	24.2

The above estimates have been used in the assessment of policy options in this report. It is important to note however that such costs are included under the net external costs for this disposal route, and more specifically in the valued given in **Table 23**).

Summary of external costs from incineration

Information presented above shows that external costs of sludge incineration are around € 44 per tDS for mono-incineration and around € 48 per tDS for co-incineration.

The external costs for incineration as estimated by Rabl *et al* (2008)[22] and based on the results of ExternE range from about €4 to €21/tonne waste and damage costs. However, these costs do not include the cost of dewatering since they are estimates produced for municipal solid waste (MSW). Amenity impacts are not included either. These costs therefore may be an under-estimate of the total costs of incineration in the case of sludge. The above costs are thus considered to be more appropriate.

3.2.4 Summary of approach to valuing impacts from sludge incineration

Internal costs have been monetised based on an update of the market price of sludge incineration given in Sede and Andersen (2002). External unit costs have been valued based on updated unit costs developed by COWI (2000) and reproduced in Sede and Andersen (2002); these include the health and other impacts (such as buildings degradation) which occur due to air emissions from incineration.

The unit costs of sludge incineration for mono-incineration and co-incineration are given separately in Table 24. Sensitivity analysis will be undertaken on the unitary costs to reflect the uncertainties surrounding the estimates (Sensitivity on Unitary costs and benefits).

Table 24: Net cost of sludge incineration (€/tDS)

Cost	Mono-incineration	Co-incineration
Internal cost – investment	161	62
Internal cost – operational	213	228
External cost	37	41
Total cost	**417**	**339**

[21] Valuation estimates are

[22] Rabl *et al* (2008): Environmental impacts and costs of solid waste: a comparison of landfill and incineration, Waste Management and Research, Vol 26, Fasc 2, pg 147-162.

3.3 Sludge recycling

3.3.1 Overview of sludge recycling rates in EU Member States

The purpose of using sludge in agriculture is partly to utilise nutrients such as phosphorus and nitrogen and organic substances for soil improvement. Sludge can be spread on farmland if it fulfils the quality requirements (heavy metals, pathogens, pre-treatment) laid down by the European and national legislation. Most often, the amounts of sludge allowed to be spread are limited by the amount of nutrients required by the plants and the total amount of dry solids.

The amount of sludge produced and recycled is replicated below.

Table 25: Recent sewage sludge quantities recycled to agriculture in the 27 EU Member States (Doujak 2007, EC, 2006, EC, personal communication, 2009, IRGT 2005, Eurostat 2007(as reported by France-need to check), DSD/DPS 2009, personal communication)

Member State	**Year**	**Agriculture**	**As a percentage of sludge production**
		(t DS)	**(%)**
Austria	2005	47,190	18
Belgium			
• Brussels region	2006	0	0
• Flemish region	2008	0	0
• Walloon region	2007	10,927	35
Denmark	2002	82,029	59
Finland	2005	4,200	3
France	2007	787,500	70
Germany	2007	592,552	29
Greece	2006	56.4	0
Ireland	2003	26,743	63
Italy	2006	189,554	18
Luxembourg	2003	3,300	43
Netherlands	2003	34	<0
Portugal	2002	189,758	46
Spain	2006	687,037	65
Sweden	2006	30,000	14
United Kingdom	2006	1,050,526	68
Sub-total EU 15		***3,701,406***	***42***
Bulgaria	2006	11,856	40
Cyprus	2006	3,116	41
Czech republic	2007	59,983	26
Estonia	2005	3,316	?
Hungary	2006	32,813	26
Latvia	2006	8,936	37
Lithuania	2007	24,716	32
Malta	-	nd	nd
Poland	2006	88,501	17
Romania	2006	0	0
Slovakia	2006	0	0
Slovenia	2007	18	0
Sub-total for EU 12		***233,255***	***19***
Total		**3,934,661**	**39**

Although the advantages of sludge application have been recognised by the stakeholders consulted for this study (with this including among others the utilisation of nutrients and organic substances for improvement of the humus layer of the soil, i.e. soil improvement) there are also a number of disadvantages (e.g. investments in storage facilities in farms, through legislative controls, public perception issues, etc). The costs and benefits from sludge recycling that will be quantified in the impact assessment for each policy option are described further below.

3.3.2 Internal costs and benefits from recycling

The main costs related to the application of sludge on land stem from treatment by waste water treatment facilities in order to meet the new standards.

3.3.2.1 Obligation of treatment

Some MS will have to treat the sludge to higher standards in order to meet some new limits, i.e. standards on pathogens. The total costs will depend not only on the type of treatment but also on the percentage of sludge that will have to be treated. The types of treatment considered for this IA are described in the following Table.

Table 26: Advanced treatments (CEC, 2003)

Type of advanced treatment	**Description of process**
Windrow composting	All material maintains a temperature of at least 55°C for at least four hours between each turning. The heaps shall be turned at least three times and in any case a complete stabilisation of the material shall be reached. The costs of sludge composting in Germany are between 100 and 200 €/Mg of dry matter for windrow composting[23]
In-vessel composting	All material maintains a temperature of at least 55°C for at least four hours and reaches complete stabilisation.
Thermal drying	Temperature of the sludge particles reaches at least 80°C for ten minutes and moisture content reduced to less than 10%.
Thermophilic aerobic or anaerobic stabilisation	Temperature of at least 55°C for a continuous period of at least four hours after the last feed and before the next withdrawal. Plant should be designed to operate at a temperature of at least 55°C with a mean retention period sufficient to stabilise the sludge.
Thermal treatment of liquid sludge	For a minimum of ten minutes at 80°C or 20 minutes at 75°C or 30 minutes at 70°C followed by mesophilic anaerobic digestion at a temperature of 35°C with a mean retention period of 12 days
Conditioning with quicklime (CaO)	Reaching a pH of at least 12.6 or more and maintaining a temperature of at least 55°C for two hours. The sludge and lime shall be thoroughly mixed.

However, there is limited information as to the costs of such treatment, especially due to the variability of costs among MS. Some information on costs is presented in the next Table.

[23] Martin Kraner, Gerold Hafner, Ingrid Berkner, Ertugrul Erdin (2008) Compost from sewage sludge – a product with quality assurance system.

Table 27: Advanced treatment Costs

Type of advanced treatment	Capital, €k/tRwDS/d	Operating for 15tRwDS/d, €k/year	Costs (€/tRwDS)
Pre-pasteurisation + digestion	667 - 935	400 – 534 (less energy income)	74 – 93 (less energy income)
Drier to agriculture	400	667 – 801	134
Lime treatment	80 - 200	467 – 1067	80

Our consultation asked stakeholders about the current practices and costs to deal with pathogens. Consultees' responses varied significantly, with some stating that lime application is not currently widespread practice while some others saying that this was common. Similarly the costs of adding lime were reported to vary significantly, from €22/tDS to €160/tDS (including capital and operating costs). A recent study published by our Federal Environment Agency (UBA - Umweltbundesamt) in 2009 indicates the following costs for hygienisation, depending on plant size[24]:

- o 207-1.100 € per ton of DS (lime hydrate treatment of wet sludge)
- o 84-167 € per ton of DS (unhydrated lime treatment of dewatered sludge)

This second estimate is closer to the estimates in Sede and Andersen of applying solid and digested semi-solids. From experience, the consultants estimates are c. €90/tDS. Owing to the uncertainties surrounding the costs the following bounds have been taken to develop our estimates.

Table 28: Costs €/tDS for enhanced treatment

Lower	Upper
€90	€160

3.3.2.2 Quality assurance

Quality assurance system costs were estimated by Andersen and Sede (2002) at €15/tDS; i.e. €18/tdS (2009).
Prior consultation suggested that CEN TC 308 procedures should be introduced. TC 308 concerns the standardization of the methods for characterising and classifying sludges and products from storm water handling, night soil, urban wastewater collection systems, wastewater treatment plants for urban and similar industrial waters (as defined in EC directive 91/271/EEC1), water supply treatment plants, but excluding hazardous sludges from industry. The sampling methods included are the physical, chemical and microbiological analyses required for characterising these sludges with a view to facilitating decisions on the choice of the treatment procedures and of the utilization and disposal. Included is the drafting of good practice documents in the production, utilization and disposal of sludges. The Scope of the TC considers all sludges that may have similar environmental and/or health impacts. Quality assurance systems will have to be applied to all sludge recycled; so costs are likely to be significant. Another quality control could be a Hazard Analysis and Critical Control Point (HACCP) system with monitoring and measurement as appropriate.

Consultees were asked about their experience with such management systems as well as costs information that could aid in the assessment. Some consultees stated that HACCP is not a widespread practice, as it stems from the food processing industry, but suggested alternative quality assurance systems. The costs provided by the consultees vary significantly. A UK company noted that the costs of HACCP are of the

[24] This was quoted by one of the consultees.

region of £5,000 to £8,000 per treatment per year, equivalent to €5,700 to €9,200. A German company provided costs of around €2-3/tDS to implement quality assurance systems.

The following range has been applied in our estimates for quality assurance costs: €3/tDS, lower bound, and €18/dDS.

There are a number of other costs that will determine its use in agriculture. These are set out in the following box.

Table 29: Costs from sludge recycling

- Transport costs from treatment plant to storage
- Storage investments and operating costs
- Transport costs from storage to farmer
- Investments in spreading equipment (can often be omitted as the farmer uses his own equipment)
- Expenses for spreading and ploughing (can often be omitted as the farmer uses his own equipment)
- Expenses for analysis of sludge quality
- Expenses for analysis of soil quality
- Administrative expenses for e.g. declaration of sludge, conclusion of agreements with farmers and control of application.

3.3.2.3 Summary of net internal costs

Net costs from the use of sludge on land have been estimated earlier at around €96 to €255/tonne of sludge, with 20% dry solids (EEA, 1998[25]). But the prices are reported to vary considerably depending on local conditions, e.g. price of sludge itself, price of alternative fertilisers (including availability of other organic fertilisers), distance, etc.

Sede and Andersen (2002) differentiate internal costs according to the type of sludge applied. The following Table summarises the internal costs from application of sludge in its different forms; both capital and operational costs (these costs have been updated to take account of increased price levels in 2009 and to take account of EU enlargements in 2004 and 2007). As it can be seen, the first three types of application are of similar order of magnitude to the upper range of the costs provided in the EEA report. On the other hand, the costs of composting significantly increase the internal costs of sludge recycling.

Table 30: Internal costs from sludge application in agriculture (€/tDS) (€2009)

Type of sludge	Land-spreading of semisolid	Land-spreading of semisolid digested	Land-spreading of solid	Land-spreading of composted
Internal cost – investment	68	68	74	120
Internal cost – operational	125	125	174 (incl. 32 for extra drying)	245 (incl.124 for composting)
Internal costs - total	**193**	**193**	**248**	**365**

The costs of composting sludge are reported to vary significantly. Costs for France have been reported up to range from €175 to €335/tonne (EEA, 1999[8]). The upper range, however, is not far off from the Sede and Andersen (2002) estimate.

There are a number of financial benefits from recycling sludge. The main benefits include:

[25] Prices given in DEM 1999 values. Converted using 1999 conversion rates and updated by HICP (1DEM (1999)= €0.64(2009))

- benefits to waste operators in terms of reduced costs from alternatives routes of disposal; and
- benefits to farmers as sludge is a "cheap" fertiliser.

The current practices in EU Member States in terms of charging for sludge vary. In some countries/regions sludge is charged[26] whereas in others, e.g. Scotland, it is believed to be given for free to the farmers or given as symbolic price. On the other hand, it is expected that even in the case of a charge this will not be significant. The internal benefits from the replacement of fertilisers were given in Sede and Andersen (2002) but varied according to the type of sludge being applied. However, it is not certain from the study which type of alternative fertiliser was considered although due to the high figures one may consider that this is mineral fertiliser.

Table 31: Internal benefits from sludge application in terms of saving in fertiliser (€/tDS)

Land-spreading of semisolid	Land-spreading of semisolid digested	Land-spreading of solid	Land-spreading of composted
-63	-63	-63	-92
Negative sign indicates a benefit			

Consultation for this study however has suggested that other organic bio-fertilisers and other organic resources rather than mineral fertilisers could be increased as a replacement should sludge not be available. Generally, these are expected to be cheaper than mineral fertilisers (although the prices are also reported to range according to the level of treatment). However, the consultants believe that when such organic fertilisers are readily available these are currently being used as opposed to sludge (as these are less contentious and likely to be more available to farmers). Because of this, we believe that the above costs are generally applicable for estimating the marginal impacts; these cost estimates will be used in the impact assessment of policy options presented later in this report. Sensitivity analysis will also be undertaken on such estimates.

3.3.3 External costs and benefits from recycling

Humans and the environment could be affected by sludge borne pollutants from application on land. The impacts from recycling are summarised in the next Table.

Table 32: Impacts from recycling of sludge on land

Emissions	**Impacts**
Pollutant volatilisation to air	Human health impacts Ecosystem degradation
Emissions of pollutants to surface water	Human health Decrease in surface quality
Emissions of pollutants to soil	Human health impacts Livestock health Ecosystem degradation Soil micro-organisms reduction Decrease in groundwater quality Decrease is soil value
Odour	Social acceptance Amenity impacts Public anxiety
Transportation	Exhaust emissions due to transportation
Source: adapted from Sede and Andersen (2002)	

[26] Prices range from around £1.50 per tonne for sludge cake (conventionally treated sludge) to around £12.00 per tonne for sludge pellets (enhanced treated) in the UK. This broadly reflects the differing fertiliser value and cost of treatment.

A number of impacts reported are difficult to value, e.g. decrease in soil value from application and impacts from odour. This depends on the perception of the landspreading practice, which varies over time in each Member State, even in each region, and is therefore not predictable. Such impacts cannot be modelled within this study with accuracy. Transportation costs are expected to be limited as sludge is only expected to be transported short-distance and represent a very low percentage of total traffic.

The Sede and Andersen (2002) report considered that the impacts of recycling on the value of land were difficult to estimate (as it will depend on the level of contamination of the land and the perception of the landspreading practice). Similarly, social acceptance and public anxiety are not subject to valuation.

Human health

Humans may be affected by the application of sludge on land through different exposure routes, i.e.:

- Soil: by dermal contact with soil or volatile compounds inhalation and consumption of contaminated foodstuff;
- Surface and groundwater: through water ingestion and consumption of animal products; and
- Sludge manipulation by workers and inhalation of particles and/or pollutants by the general public.

The main problem with the valuation of impacts from the application of sludge on land however stem from the fact that at to this time there is no evidence of such impacts from contamination of surface waters and/or soils. However, it is uncertain whether this is due to the existing directive or the current practices. Previous work to this study on gathering the evidence on impacts has revealed that the dose-response data in terms of ecosystem degradation, human health (from consumption of contaminated foodstuff) and impacts on livestock are also limited. As a result, valuation of impacts is not feasible at the time of writing. **Quantification of environmental and human health impacts from sludge recycling through the aquatic and terrestrial environmental compartments is thus at the time of writing not feasible, due to the lack of dose-response data.**

However, impacts that can be quantified relate to human health and the environment (i.e. building degradation) from airborne emissions. The basis for valuation is information given in Sede and Andersen (2002) based on the COWI (2000) study, in turn based on ExternE values. Please note that these data include both emissions from transportation[27] and pollutant volatilisation to air; however.

Table 33: External costs of emissions to air from recycling (€/tDS unless otherwise stated)

Emission type	Land-spreading of semi-solid	Land-spreading of solid	Land-spreading of composted	Land-spreading of semi-solid digested
CO_2	0	3.62	2.41	7.24
PST	1.21	1.21	2.41	1.21
SO_2	1.21	1.21	3.62	1.21
NO_x	1.21	1.21	2.41	1.21
CH_4	0	0	0	0
CO	0	0	0	0
HC	0	0	1	1
HCI	0	0	0	0
HF	0	0	0	0

27 No information is available on the transport distances considered for the valuation so assumptions cannot be checked.

Emission type	Land-spreading of semi-solid	Land-spreading of solid	Land-spreading of composted	Land-spreading of semi-solid digested
H_2S	0	0	0	0
As	0	0	0	0
Cd	0	0	0	0
Cr	0	0	0	0
Ni	0	0	0	0
Dioxins	0	0	0	0
Total[28]	**2**	**7**	**13**	**11**
Note: includes exhaust emissions from transportation				

The EFAR report (2007) concluded that global risk based on the results of the quantitative risk assessment was acceptable under the following:

- limits proposed under Annex III of the CEC (2003) communication;
- Bis(2-ethylhexyl) phthalate (DEHP) limit of 100mg/kg DM; and
- Lower limit for lead of 500mg/kg DM (as opposed to 750 mg/kg).

This would suggest that when the limits are not set at this level, there could be limited benefits in terms of reduced health risk. When national limits are more stringent and/or the quality of the sludge complies with such limits, the benefits in terms of health risk are expected to be negligible. The current limits on DEHP seem highly variable and appear to be unlinked to other substances. A European range is of 0.095 to 47mg/kg DS, median 7.2. Other limits include:

- UK: 0.3 to 1020 mg/kg with median of 110 mg/kg;
- Norway: 17 to 178 mg/kg with median of 53 mg/kg; and
- N Rhine: 0.93 to 110 mg/kg with median of 22 mg/kg and 90%ile of 57 mg/kg.

As a result there may be benefits in some specific regions. Thus, although we believe these impacts may be an underestimate of the total environmental and human health risks from application, no further data has been provided to estimate these impacts with more accuracy.

Ecosystems degradation

Because sludge contains heavy metals, pollutants and pathogens, sludge landspreading may have an impact on ecosystems.

It may be assumed that current regulatory provisions and codes of practice implemented in Member States reduce the risk of exposure to pathogens. In particular, plant pathogens have in general low optimum growth temperature, so that disinfection will be achieved at a lower temperature than for mammalian pathogens. Sludge treatment will therefore reduce the application of plant pathogens to soil.

On the other hand, wild fauna and flora may be contaminated by heavy metals and organic pollutants released into the environment. Aquatic organisms could also be affected by those pollutants if they are transferred to surface water following run-off. As above, however, the evidence on such impacts is sparse.

[28] There is a slight divergence between the total values and values for individual pollutants. This is believed to stem from Sede and Andersen (2002) presenting rounded figures. Therefore, updating of data to 2009 prices results in a discrepancy between the total costs and costs for individual pollutants. Where such discrepancies occurred, the updated totals were used in the impact assessment presented later in this report..

As a result, quantification of such impacts is not feasible at the time of writing. In addition, other fertilisers may also contain heavy metals, which may have the same impact on ecosystems as those contained in the sludge-borne ones so marginal impacts in this regard are considered negligible.

Climate change

Impacts due to emissions of greenhouse gases (CO_2 and CH_4) and NOx are included in the valuation done for air emissions above.

Fertiliser replacements

Sede and Andersen (2002) also quantify external benefits from sludge replacing fertiliser. These data are given in the Table below. A negative sign indicates a net benefit. As it can be seen although there are benefits these are not expected to be significant. This is in line with recent findings concerning externalities from the production of mineral fertilisers (which state that emissions from fertilisers equal represent a very little proportion of GHG[29]).

Table 34: External cost from recycled sludge replacing fertiliser (€/tDS of sludge)

Land-spreading of semi-solid	Land-spreading of solid	Land-spreading of composted	Land-spreading of semi-solid digested
-6	-7	-6	-6

Summary of external costs from sludge recycling

The impacts quantified relate to human health and the environment (i.e. building degradation) from airborne emissions, as for incineration. Although we believe these impacts may be an under-estimate due to the lack of readily available data on environmental risks that may be due to current application practices, these are deemed to be the best estimates to date on the net external costs from recycling[30].

Data on external costs from air emissions can thus be combined with data on external benefits from fertiliser replacement to derive the net external costs from sludge recycling. These data are given in the Table below.

Table 35: Total external cost from recycled sludge; negative sign indicates benefits (€/tDS)

Land-spreading of semi-solid	Land-spreading of solid	Land-spreading of composted	Land-spreading of semi-solid digested
-4	0	7	5

Other impacts of recycling, such as impacts on the value of land, were difficult to estimate (as it will depend on the level of contamination of the land and the perception of the landspreading practice).

3.3.4 Summary of approach to valuing impacts from sludge recycling

The unit costs of sludge recycling have been valued for the different types of landspreading. All costs have been monetised based on updated unit costs from Sede and Andersen (2002). External unit costs include

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[29] International Fertiliser Industry Associations (IFIA) (2009): Fertiliser, Climate Change and Enhancing agricultural Productivity Sustainibly, Paris.

[30] The dose-response data in terms of ecosystem degradation, human health (from consumption of contaminated foodstuff) and impacts on livestock are also limited. Valuation of impacts on soil micro-organism was not feasible either due to the lack of valuation studies and dose-response data.

impacts from air emissions on human health and other types of impacts (such as buildings degradation) and benefits from avoided fertiliser use. Internal costs include investment and operational costs of landspreading, dewatering (where applicable), and benefits from avoided fertiliser use. All costs have been updated to 2009 prices.

The total of internal and external cost, per tonne of DS of sludge recycled, which will be used for the purpose of the assessment of policy options later in this report is detailed in the Table below.

Table 36: Net costs and benefits from sludge recycling (€/tDS) (€2009)

Type of sludge	Land-spreading of semisolid	Land-spreading of semisolid digested	Land-spreading of solid	Land-spreading of composted
Internal cost – investment	68	68	74	120
Internal cost – operational	125	125	174 (incl. 32 for extra drying)	245 (incl.124 for composting)
Internal benefits - fertiliser replacement	-63	-63	-63	-63
External costs	2	11	7	13
External benefits – fertiliser replacement	-6	-6	-7	-6
Total costs	**126**	**134**	**185**	**280**

3.4 Landfill

3.4.1 Overview of sludge incineration rates in EU Member States

Although landfilling of sludge was a favoured method in the past, the amount of sludge going to landfill has been decreasing in the last decade not only due to legislation but also due to more limited capacities and pressure to utilise these from other sources. The following Table shows this trend. As it can be seen from the Table, and also reflected by the consultation, the reduction is more significant in some countries (e.g. in the UK and Sweden) than others.

Table 37Estimates of annual sludge production and percentages to disposal routes, 1995 – 2005

Country	**1995**		**2000**		**2005**	
	total sludge	**landfill**	**total sludge**	**landfill**	**total sludge**	**landfill**
	tds/a	**%**	**tds/a**	**%**	**tds/a**	**%**
Austria a)	390,000	11	401,867	11	238,100	5
Belgium	87,636	32	98,936	14	125,756	4
Denmark	166,584		155,621	2	140,021	
Finland	141,000		160,000		147,000	
France	750,000	20	855,000	20	1,021,472	13
Germany	2,248,647		2,297,460	3	2,059,351	2
Greece	51,624	95	66,335	95	116,806	95
Ireland	34,484	43	33,559	54	59,827	17
Italy	609,256	30	850,504	30	1,074,644	31
Luxembourg	7,000		7,000		8,200	0
Netherlands	550,000		550,000		550,000	
Portugal	145,855	70	238,680	84	401,017	44
Spain	685,669	54	853,482	47	986,086	46
Sweden	230,000	50	220,000	44	210,000	4
United Kingdom	1,120,000	10	1,066,176	5	1,510,869	1
Bulgaria	20,000	100	20,000	100	33,700	60

Country	1995		2000		2005	
	total sludge	**landfill**	**total sludge**	**landfill**	**total sludge**	**landfill**
	tds/a	**%**	**tds/a**	**%**	**tds/a**	**%**
Cyprus	4,000	100	4,000	100	6,542	48
Czech Republic	146,000	50	210,000	30	220,700	10
Estonia b)	15,000		15,000		26,800	
Hungary	30,000		30,000		125,143	25
Latvia	20,000		20,000	38	28,877	40
Lithuania	48,000	90	48,000	90	65,680	6
Malta	0		0			
Poland	340,040	56	397,216	50	495,675	18
Romania			171,086	100	134,322	97
Slovakia					56,360	30
Slovenia			8800	85	16,900	56
EU12 % of total EU	8	4	11	6	12	4
EU15 % of total EU	92	15	89	16	88	13
EU27 % of total EU	100	19	100	22	100	17

3.4.2 Internal costs from landfill

The internal costs from landfill include the following costs categories:

- the capital costs for the site. Such costs will include site assessment, acquisition, site development, restoration and aftercare. The main variable will be the size of the site as site acquisition is one of the main factors affecting the cost of a landfill;
- operating costs: these relate mainly to labour costs and the cost of operating equipment but also to the needed treatment of sludge prior to final disposal and transport.

The main issue with the estimation of landfill costs across the EU is that these are highly variable among MS. Notwithstanding landfill taxes, which are not part of this analysis, the costs will vary significantly according to transportation distances and dewatering requirements. Stabilisation costs can also vary significantly. Sede and Andersen estimated costs were of €300/tDS across Europe (updated to 2009 values). The study however noted that the variation between the maximum costs and the average could reach 80%.

Although we believe that these cost may be an underestimate, they are adopted on the basis that as energy can be recovered from landfilled sludge (if landfill gas is utilised) these internal benefits may be offset by the cost from drying (although the cost will fall onto different stakeholders).

The relevant costs from Sede and Andersen (2002) are presented below (updated to 2009 values).

Table 38: Internal costs from landfilling of sewage sludge (€/tDS) (€2009)

Investment	44
Operational costs – dewatering	47
Operational costs – landfilling (incl. transport)	209
Total	**300**

3.4.3 External costs from landfill

The impacts from landfill are summarised in the next Table.

Table 39: Impacts from landfill

Emissions	Impacts
Emissions of landfill gas to air	Human health impacts Ecosystem degradation Climate change
Emission of leachate to soil	Human health Soil micro-organisms reduction Decrease in groundwater quality
Emissions of untreated or treated leachate to water	Human health impacts Ecosystem degradation Decrease in surface water quality
Emissions from transport	Human health impacts Ecosystem degradation Climate change Amenity impacts
Odour	Social acceptance Amenity impacts Public anxiety
Visual intrusion	Social acceptance Amenity impacts Public anxiety
Transportation	Exhaust emissions due to transportation
Source: adapted from Sede and Andersen (2002)	

Impacts from leachate would be limited on the basis of regulatory requirements on landfills to use best available technologies. Similarly the impacts from transportation are considered negligible (in comparison with the total volume of traffic).

Although the social costs and benefits such as unpleasant odours, the fears associated with the perception of environmental or health risks are key factors to be considered in assessing the overall impact and costs of landfill, these factors were not quantified as this would require significant data requirements concerning location and management practices so they cannot be modelled within this study.

Energy production

As noted above there may be benefits from the recovery of energy from landfill gas. Currently however there is limited information as to the number of landfills with energy recovery for these impact to be valued.

Human health

Human beings may be directly affected by landfill gas inhalation, or indirectly following ingestion of contaminated vegetal or animal products. Human health may also be affected by leachate if this is emitted to surface or groundwater. No study is available in the literature enabling to assess the sludge-borne pollutants concentration in the surface water and the soil, the resulting increased concentration in the food chain, and the human exposure to those pollutants. Moreover, as noted earlier these are expected to be limited in the case of a landfill complying with regulation. Thus direct impacts on health are not expected.

The following Table shows emissions to the air from landfilling.

Table 40: Air emissions from landfilling of sludge (unit g/tDS unless otherwise stated)

CO_2	791
CH_4	23

NO_x	0.003
CO	57
SO_2	-10
HC	382
PST	26
H_2S (kg/tDS)	10
HCl	4
HF	1
Note: includes exhaust emissions from transportation	

As a result, the impacts values from landfill relate to the human health (and other impacts) from airborne pollution, as calculated in ExternE, and other environmental impacts. These are replicated below.

Table 41: External costs of air emissions from landfill (€/tDS unless otherwise stated)

Emission type	Cost
CO_2	3.82
CH_4	2.50
NO_x	0.087
PST	1
SO_2	1
CO	0
HC	0
HCI	0
HF	0
H_2S	0

Ecosystem degradation

Some emissions following disposal of sludge to landfill may have an impact on ecosystems. Those considered herein are the emissions of landfill gas to air, or the emission of leachate to surface water.

Landfill gas contains pollutants that may have an impact on plants and crops due to air deposition and/or absorption. It may further contaminate livestock and wild fauna after ingestion of contaminated plants. These impacts however are included in the costs given above under health (based on the valuation from ExternE).

Emission of leachate to surface water may also have an impact on wild fauna and flora, especially on aquatic organisms. In addition to those direct impacts on species, emissions may induce changes in their biotope following eutrophication or acidification. This impact arises mainly in old landfills without a bottom liner to retain and collect leachate and without gas collection and treatment. It may however be considered as negligible when considering landfills complying with regulatory requirements and using best available technologies.

Buildings degradation

As before, the building degradation is given in the above estimates for air emissions.

Climate change

The impacts in terms of climate change stem from landfill gas. There is information on the impacts in terms of air borne emissions from landfill (point 4) as well as information on costs (point 5). **Table 42** sets out the emissions from landfill in terms of GHGs.

Table 42: GHG emissions from sludge landfilling (kg/tDS)

Emission type	Best estimate(kg/tDS)
CO_2	791
CH_4	23
NO_x	0.003
Note: includes exhaust emissions from transportation	

The same cost estimates that have been introduced in the section on valuing costs from incineration (please see this section for more details on what is included in these cost estimates) are used to derive the following external costs from emission of GHG and NOx emissions from landfill.

Table 43: External costs of emissions from landfilling of sludge (€/tDS)

Emission type	€/tDS of emissions
CO_2	3.82
CH_4	2.50
NO_x	0.087

The above costs however are included in the net costs of landfill.

3.4.4 Summary of approach to valuing impacts from sludge landfilling

The unit costs of sludge landfilling are, again, based on an update to 2009 values of estimates given in Sede and Andersen (2002). External unit costs include impacts from air emissions on human health and other types of impacts (such as buildings degradation). Internal costs include investment and operational costs of landfilling including transport and dewatering. The total of cost of sludge landfilling that will be used for the purpose of the assessment of policy options is detailed in the Table below.

Table 44: Total cost of sludge landfilling (€/tDS) (€2009)

Type of cost	€/tDS
Internal cost – investment	44
Internal cost – operational	256
External cost	9
Total	**309**

3.5 Summary of cost and benefit valuation methodology used in this Impact Assessment

The amount of information on the costs of the different disposal methods for sludge is plentiful. More often than not, the costs are of similar order of magnitude, as revealed above. However the costs are highly variable according to a number of sensitivities such as:

- type of process and technologies used;
- storage duration;
- specific equipment;
- transport distances.

The Sede and Andersen (2002) estimates of the financial costs and the external costs and benefits are considered to date the best estimates of the costs and benefits from the different disposal methods. Generally, although the costs were collated for 2002, consultants' experience and the review of the literature have shown that the relative positions do not significantly change, and that adjustments for such guidance assessments can be made using inflation indices within reasonable periods of the initial assessments. This also applied to the externality costs.

The costs used in this IA are set out in the next Table. The estimates produced in 2002 were calculated for the EU-15. Although Sede and Andersen appear to have used variation across MS for the internal costs, it has not been possible to verify such assumptions. Instead, new published figures on prices levels[31] have been used to estimate the variation among MS (noting however that these only apply to the internal costs). The net costs by MS are replicated in **Table 46: Net Cost by MS of Different Disposal Methods**).

Table 45: Summary of unit costs used in the impact assessment (€2009)

Type of Costs	Landspreading of semisolids	Landspreading of semisolid digested	Landspreading of solid	Landspreading of composted	Landfilling	Co-incineration	Mono-incineration
Internal costs	193	193	248	365	300	290	374
Internal benefits (savings in fertiliser)	-63	-63	-63	-92	0	0	0
Net internal costs	**129**	**129**	**185**	**273**	**300**	**290**	**374**
Quantifiable external costs (EU15 average)	2	11	7	13	9	41	37
Quantifiable external benefits (use of fertiliser)	-6	-6	-7	-6	0	0	0
Net external costs	-4	5	0	7	9	41	37
Net internal and external costs	**126**	**134**	**185**	**280**	**309**	**332**	**411**

[31] http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/2-16072009-AP/EN/2-16072009-AP-EN.PDF

Table 46: Net Cost by MS of Different Disposal Methods

Net costs - internal and external by MS	Land-spreading of semisolids	Land-spreading of semisolid digested	Land-spreading of solid	Land-spreading of composted	Landfilling	Co-incineration	Mono-incineration
Austria	121	129	178	269	298	320	396
Belgium	128	136	188	284	314	336	417
Denmark	163	172	238	359	397	416	519
Finland	145	153	211	319	353	374	465
France	128	136	188	284	314	336	417
Germany	120	128	176	267	295	318	393
Greece	108	116	159	242	268	291	359
Ireland	147	155	215	324	358	379	472
Italy	121	129	178	269	298	320	396
Luxembourg	134	142	196	297	328	350	434
Netherlands	118	127	174	264	292	315	389
Portugal	100	108	147	224	248	273	335
Spain	110	118	162	247	273	296	365
Sweden	132	140	193	292	322	344	427
United Kingdom	114	122	167	254	281	304	376
New MS							
Bulgaria	57	65	86	134	149	177	211
Cyprus	103	111	152	232	257	281	345
Czech Republic	82	90	122	187	207	233	283
Estonia	88	96	130	199	221	246	300
Hungary	79	88	118	182	202	227	276
Latvia	85	94	127	194	215	241	293
Lithuania	76	84	113	174	193	219	266
Malta	89	97	132	202	224	249	304
Poland	78	86	117	179	199	225	273
Romania	70	78	105	162	180	206	249
Slovakia	79	88	118	182	202	227	276
Slovenia	95	103	140	214	237	262	321

In order to estimate the costs however is it important to consider the costs of the switch for sludge failing and going to other disposal options. As there is not enough information on the type of recycling occurring by MS, the average of recycling has been taken in order to estimate the costs of switching disposal routes.

Table 47: Costs Differences in Sludge Management Methods (€/tDS)

MS	From land-spreading to landfill	From land-spreading to co-incineration	From land-spreading to mono-incineration
Austria	124	146	222
Belgium	130	152	233
Denmark	163	183	286
Finland	146	167	258
France	130	152	233
Germany	122	145	220
Greece	111	135	202
Ireland	148	169	261
Italy	124	146	222
Luxembourg	136	157	242
Netherlands	121	144	218
Portugal	104	128	190
Spain	114	137	206
Sweden	133	155	238
United Kingdom	117	140	211
New MS			
Bulgaria	64	91	126
Cyprus	107	131	195
Czech Republic	87	113	163
Estonia	93	118	172
Hungary	85	111	160
Latvia	90	116	168
Lithuania	81	107	154
Malta	94	119	174
Poland	84	110	158
Romania	76	102	145
Slovakia	85	111	160
Slovenia	99	124	183

4. Option 1: Do-nothing

4.1 Overview of Option

This Option will be the business as usual scenario. This will be the baseline for estimating the amount of recycled sludge affected and is based on the analysis presented in project report 2, updated by the information and comments on this report given during consultation.

The impacts of the existing legislation however need to be taken into account when describing the baseline. The results of previous consultation show that respondents expect only limited effects on the amount of sludge recycled onto agricultural land by some regulation. For the REACH regulations, although there is an expectation that metals and organic contaminants are likely to reduce, some believe that the effect would be insufficient to achieve the level of purity they would find acceptable. The WFD may affect the location and frequency of return to available land but this has not been identified as a significantly increased cost.

Existing local restrictions have already driven the rate of agricultural recycling and there is no expectation of further significant changes based on sludge quality being driven by other regulations.

The most significant other drivers identified by respondents are the amounts of sludge being produced as sewerage collection systems are developed, increased rates of sludge production due to more stringent sewage effluent quality consents, and reduction in the availability of landfill disposal for sewage sludge.

The following Table (based on consultation) shows the predicted increase in sludge production from 2010 to 2020. The projections are based on projections about population connected as well as sludge production per capita as estimated by the stakeholders (as explained in the baseline report). As can be seen, the majority of the increase is due to the newer MS. These figures will be the basis for considering the marginal impacts from the Options.

4.2 Assessment of the option

Option 1 will have limited impacts on the MS as it will not involve any changes to the Directive.

Under this Option, the amount of sludge produced and recycled will depend on national legislation and practices. More information on the current legislation and practices is available on our baseline report.

There may be a risk with some of the newer MS who may introduce limits complying with the Directive but not conservative enough to reduce the risk to the extent now considered desirable by many consumers as well as regulatory bodies. These could give rise to greater environmental and human health risks than those present in other EU member states. On the other hand, this option may not preclude some MS from undertaking pollution prevention measures to improve sludge quality based on public perception issues and/or other legislative drivers at national level, as noted above.

Only few respondents to our consultation document seem to agree with this Option; mostly on the basis of subsidiarity.

Table 48: Future forecasted (2010 and 2020) sludge arisings in the EU27

Member State	2010 ($x10^3$ tds pa)	2020 ($x10^3$tds pa)
Austria	270	280
Belgium	166	166
Denmark	140	140
Finland	155	155
France	1,300	1,600
Germany	2,060	2,060
Greece	290	290
Ireland	135	135
Italy	1,500	1,500
Luxembourg	15	15
Netherlands	560	560
Portugal	420	420
Spain	1,280	1,280
Sweden	250	250
United Kingdom	1640	1,640
EU15	***10,181***	***10,491***
Bulgaria	30	180
Cyprus	9.8	17.6
Czech Republic	260	260
Estonia	33	33
Hungary	130	250
Latvia	25	50
Lithuania	80	80
Malta	10	10
Poland	520	950
Romania	165	520
Slovakia	55	135
Slovenia	20	50
EU12	***1,338***	***2,485***
EU27	**11,519**	**12,977**

Notes: As working estimates 2010 production rates have been taken to be the same as 2020 production for states expected to be in full compliance in 2010. For non-compliant states rounded 2006 production rates have been used – see text in Annex 2 for detail.
The estimate for Belgium includes 110,000 tds for the Flemish region; 50,500 tds for the Walloon Region and 5,000 tds for the Brussels region.

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4.2.1 Environmental Impacts

Few respondents from the first consultation considered that the risks to be associated with PTE and OCs in sludge outweighed the benefits from nutrients and soil conditioning that could be achieved by using suitable and treated sludge.

Although the 2003 communication highlighted the risk that the Directive was not conservative enough to take into account the long-term accumulation of metals to the topsoil, as for the time of writing, there is no scientific evidence (as distinct from news stories) that describes adverse effects when the conditions of the Directive have been met. However, this could be due to the fact that many MS have adopted more stringent standards than those given in the Directive. Indeed most MS including Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Malta, Netherlands, Poland, Romania, Slovakia, Slovenia, and Sweden have limit values for metal concentrations more stringent than the lowest limits set in the 1986 Directive. Some MS have also additional standards for pathogens, metals and organics.

4.2.2 Social Impacts

Both the recent consultation and EC's Communication in 2003 regarding possible changes to the provisions of the Directive have highlighted that Directive 86/278 has proven quite effective in preventing the spread of pathogenic micro-organisms to crops and outbreaks of epidemics in humans, in reducing the amount of heavy metals brought to the soil when using sewage sludge as well as in harmonising the pieces of national legislation existing before 1986 (CEC, 2003[32]).

While no evidence of health risks related to the current directive has been found, we also note that this may be influenced by the more stringent standards set by some Member States. Moreover, some respondents to the first consultation strongly opposed the application of sewage sludge to land for precautionary reasons.

In these circumstances, it is not possible to quantify any health impacts for the Baseline Scenario.

[32] CEC(2003): Proposals for a Directive of the European Parliament and of the Council on spreading of sludge on land, Brussels, 30 April 2003.

5. Option 2: more stringent standards (moderate change)

5.1 Overview

Option 2 will consist of the following:

- Changes to the limits on heavy metals concerning the quality of the sludge (as given in the CEC (2003)) and in soil;
- Setting limits for PCBs and PAHs for sludge quality;
- Introduce standards for treatment compatible with CEC (2003) conventional treatment;
- Provision of information on nutrients;
- More stringent conditions on application; and
- Small changes to sampling and monitoring requirements.

The main issue associated with this Option relates to the limitations on sludge use by restrictions that require higher standards in areas where there is no added value in terms of human health and the environment.

This Option is expected to impact the availability of sludge for application (percent of sludge produced that is failing the standards). This is likely to have economic, environmental and human health implications. Economic impacts will stem primarily from further treatment and the internal costs of alternative disposal options. The environmental and human health impacts will be related to the impact from the alternative routes of disposal and also from the potential reduction in environmental and human health risk from recycling.

Overall, when the national limits are less stringent than the new limits the percentile sludge quality distribution will help to assess the quantity of sludge failing to meet the requirement. We have limited information on the percentile sludge distribution in different MS however. Information is available on the average sludge content. Thus we produced estimates on the amount of sludge affected. These estimates have been backed up by consultation. For a summary of impacts valued under this Option please refer to **Table 9: Impact quantification**.

5.2 Heavy metal content in sludge

5.2.1 Step 1: Identification of MS affected by changes to the Directive

As noted earlier, most MS have set more stringent standards than those in the current Directive. The current MS regulatory standards for heavy metals are given in Table 36. The Table sets out which MS may be affected by the limit on heavy metals under Option 2. Shaded in grey are the national limits that would have to be tightened. These MS will have to amend their national legislation so this will have some costs implications. The costs of changing the legislation are not expected to be significant in comparison with the costs that may arise from changes in disposal[33].

[33] Although they will vary according to national procedures, information on the administrative costs of changes to legislation are not widely available.

Table 49: Proposed limit values on Potentially Toxic Elements (PTE) in sewage sludge

PTE	**CEC 2003** (mg/kg)
Cd	10
Cr	1000
Cu	1000
Hg	10
Ni	300
Pb	750
Zn	2500

Table 50: Countries with national limits less stringent than those proposed under Option 2 e.i. setting limits on Maximum level of heavy metals (mg per kg of dry substance) - in grey

PTE	Cd	Cr	Cu	Hg	Ni	Pb	Zn
New limits	10	1000	1000	10	300	750	2500
Bulgaria	30	500	1600	16	350	800	3000
Cyprus	20-40	-	1000-1750	16-25	300-400	750-1200	2500-4000
Denmark	0.8	100	1000	0.8	30	120	4000
Estonia	15	1200	800	16	400	900	2900
France (4)	10	1000	1000	10	200	800	3000
Germany (1)	10	900	800	8	200	900	2500
Greece	20-40	500	1000-1750	16-25	300-400	750-1200	2500-4000
Hungary	10	1000/1(3)	1000	10	200	750	2500
Ireland	20		1000	16	300	750	2500
Italy	20		1000	10	300	750	2500
Lithuania	-	-	-	-	-	-	-
Luxembourg	20-40	1000-1750	1000-1750	16-25	300-400	750-1200	2500-4000
Portugal	20	1000	1000	16	300	750	2500
Spain	20-40	1000-1750	1000-1750	16-25	300-400	750-1200	2500-4000
Czech Republic	5	200	500	4	100	200	2500

In practice however, information on the quality of sludge seems to indicate that the quality of sludge may be better that the national limits given in Table 49. There is limited information however on the percentile distribution of metal in sludge by MS. Thus, the information presented in Table 50 is based on country averages and has been used for estimating the impacts (this information was provided to the consultants by the Commission services). Although the quality of the sludge seems to be better than those given under the proposed new limits, it can not be stated that all sludge arisings within these are compliant with the new limits. Indeed the first consultation revealed that the content can vary significantly, so these figures need to be read with caution. (In addition, the data do not cover all Member States).

Table 51: Quality of sewage sludge (on dry solids) recycled to agriculture (2006) against new Option 2 limits

Parameter	**Cadmium**	**Chromium**	**Copper**	**Mercury**	**Nickel**	**Lead**	**Zinc**
New limits Option 2	**10**	**1000**	**1000**	**10**	**300**	**750**	**2500**
BE –Flanders	1	20	72	0.2	11	93	337
BE-Walloon	1.5	54	167	1	25	79	688
Bulgaria	1.6	20	136	1.2	13	55	465

Parameter	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc
New limits Option 2	**10**	**1000**	**1000**	**10**	**300**	**750**	**2500**
Germany	1	37	300	0.4	25	37	713
Spain	2.1	72	252	0.8	30	68	744
Finland	0.6	18	244	0.4	30	8.9	332
France	1.3	43	272	1.1	21	50	598
Italy	1.3	86	283	1.4	66	101	879
Portugal	<0.4	20	12	<1	15	27	341
Sweden	0.9	26	349	0.6	15	24	481
UK	1.3	61	295	1.2	30	112	574
Cyprus	6.9	37	180	3.1	21	23	1188
Czech Republic	1.5	53	173	1.7	29	40	809
Estonia	2.8	14	127	0.6	19	41	783
Hungary	1.4	57	185	1.7	26	36	824
Lithuania	1.3	34	204	0.5	25	21	534
Latvia	3.6	105	356	4.2	47	114	1232
Portugal	4	127	153	4.6	32	51	996
Slovenia	0.7	37	190	0.8	29	29	410
Slovakia	2.5	73	221	2.7	26	57	1235

The CBA conducted in 2002 highlighted that the percentage of sludge failing to comply with the new limits on heavy metals could be 12% of the total sludge being produced, in the short term, without pollution prevention[34]. Based on more recent data from our consultation on sludge quality, however, we believe that this may be an overestimate. Indeed the consultation undertaken for this impact assessment has provided us with some estimates about the percentage of sludge affected in some MS. The following Table summarises the percentages assumes for this assessment but includes also our estimates on the percentage failure[35].

Table 52: % recycled sludge failing new limits on heavy metals under Option 2

Parameter	% affected	Source of data
Austria	0%	E
Belgium	0%	C
Brussels region	0%	C
Flemish region	0%	C
Walloon Region	0%	C
Denmark	0%	C
Finland	0%	C
France	1%	C
Germany	0%	C

[34] These percentages vary however according to country and range from 0% to 20% depending on whether pollution prevention measures are in place.

[35] The estimate has been in cases calculated based on standard deviation from the UK response, as there is available information to the consultants on the percentile distribution for this particular MS, and assuming that the distribution among EU countries remains the same. In other cases, when this estimate was considered too high, the frequency of failure has been revised downwards.

Parameter	% affected	Source of data
Greece	12%	E
Ireland	12%	E
Italy	5%	C
Luxembourg	10%	E
Netherlands	0%	Due to ban on application
Portugal	>5% , <15%	C
Spain	5%	E
Sweden	0%	E
United Kingdom	5%	C
Bulgaria	0.1%	E
Cyprus	12%	E
Czech Republic	0%	C
Estonia	6.5%	E
Hungary	8%	E
Latvia	20%	E
Lithuania	0.6%	E
Malta	-	nd
Poland	12%	E
Romania	0%	C
Slovakia	20%	E
Slovenia	0.2%	E
Key to source: C – provided by consultee; E- estimate by consultant based on information gathered for Report 2		

5.2.2 Step 2: Impacts on Sludge Management

For the sludge that is failing, there will be two scenarios:

- specific treatment measures are taken to reduce the heavy metals loads in sludge by waste management operators ; or
- alternative disposal options (i.e. to landfill or incineration).

Both of the scenarios will have costs implications for water and sludge management operators. The treatment available for reducing heavy metals by sludge operators is, according to the state of the art, rather limited. Most of the consultees to the impact assessment concluded that the most likely outcome was incineration. In absence of any information on the different disposal routes, the following estimates have been used to estimate the costs of Option 2, based on information available in the literature (trend in mono-incineration and co-incineration) and consultation responses.

Table 53: Impacts from Option 2- disposal options for sludge failing standards

Parameter	% going to co-incineration	% going to mono-incineration	% going to landfill
France	40%	50%	10%
Greece	25%	50%	25%
Ireland	80%	-	20%
Italy	80%	-	20%
Luxembourg	50%	50%	10%

Parameter	% going to co-incineration	% going to mono-incineration	% going to landfill
Portugal	30%	50%	20%
Spain	40%	40%	20%
United Kingdom	0%	100%	0%
Bulgaria	50%	-	50%
Cyprus	50%	-	50%
Estonia	50%	-	50%
Hungary	50%	-	50%
Latvia	50%		50%
Lithuania	50%	-	50%
Poland	50%	-	50%
Slovakia	50%	-	50%
Slovenia	100%	-	0%

5.2.3 Step 3: Impacts from the component – Costs and Benefits

The following costs are calculated on the basis of the costs of the alternative disposal options. The unit cost presented in Section 3 are used for the analysis. It is important to note that owing to the nature of the unit costs, such costs include both environmental and human health costs in addition to financial costs. The environmental costs, on the basis of the degree of quantification possible to date however, represent around 10% of the total costs (although in the case of incineration, the externality are closer to the 10% value of the total quantifiable costs). Estimates on the GHG for this component are presented at the end of the Section separately.

Table 54 Costs from New Limits of PTE in sludge: Option 2 (EAC, €2009)

MS	Costs from switch to mono-incineration	Costs from switch to co-incineration	Costs from switch to landfill	TOTALS
France	980,000	513,000	110,000	1,602,000
Greece	158,000	53,000	43,000	254,000
Ireland	1,381,000	446,000	391,000	2,217,000
Italy	1,770,000	1,166,000	492,000	3,428,000
Luxembourg	111,000	91,000	16,000	217,000
Portugal	1,789,000	723,000	391,000	2,903,000
Spain	3,185,000	2,120,000	878,000	6,182,000
United Kingdom	10,527,000	-	-	10,527,000
EU15	19,900,000	5,111,000	2,320,000	27,331,000
Bulgaria	-	2,000	2,000	4,000
Cyprus	-	47,000	39,000	86,000
Estonia	-	17,000	13,000	30,000
Hungary	-	494,000	379,000	872,000
Latvia	-	114,000	89,000	203,000
Lithuania	-	10,000	7,000	17,000
Poland	-	1,364,000	1,042,000	2,406,000
Romania	-	-	-	-
Slovakia	-	456,000	350,000	805,000
Slovenia	-	1,000	-	1,000
EU-new	**-**	**2,504,000**	**1,920,000**	**4,424,000**
EU-TOTAL	**19,900,000**	**7,614,000**	**4,241,000**	**31,755,000**

5.3 Limits on organics

5.3.1 Step 1: Identification of MS affected by changes to the Directive

The previous report highlighted that, currently, some MS have limits on organics although this is not the general norm. Some countries such as UK, USA and Canada have not set any limit on organic contaminants (OCs) in sludge suggesting that concentrations present are not hazardous to human health, the environment or soil quality. However, other countries have set limits for some OC groups. For example, Germany has set limits for PCBs and dioxins but not PAHs. France has limits for PAHs and PCBs but not dioxins. Denmark has set limits for a range of OCs including linear alkyl sulphonates, nonylphenol and nonylphenol ethoxylates and the phthalate, di(ethylhexyl)phthalate (DEHP). The following Table shows the different limits on organics based on previous consultation.

Table 55: Existing legislative limits on organics

	Polycyclic aromatic hydrocarbon (PAH) mg/kg DS	Polychlorinated biphenyls (PCB) mg/kg DS
Option 2	6	0.8
Austria		
Lower Austria	-	0.2 c)
Upper Austria		0.2 c)
Vorarlberg		0.2 c)
Carinthia	6	1
Denmark (2002)	3a)	
France	Fluoranthene: 4 Benzo(b)fluoranthene: 2.5 Benzo(a)pyrene: 1.5	0.8c)
Germany (BMU 2002)		0.2 d)
Germany (BMU 2007) e)	Benzo(a)pyrene: 1	0.1 d)
Sweden	3a)	0.4b)
Hungary	10	1
Czech Republic	-	0.6

Notes:
a)sum of 9 congeners
b)sum of 7 congeners: PCB 28, 52, 101, 118, 138, 153, 180
c)sum of 6 congeners:PCB28,52,101,138,153,180
d)Per congener
e)Proposed new limits in Germany (BMU 2007)

Out of the 40 consultees' responses to the first consultation, eight would like OC limits, or stricter limits than currently in place in some location (with another respondent stating that any recycling is unacceptable), five argued that there is no evidence of sufficient risk to require limits on OCs, and another four would prefer it if limits were based on a common risk assessment and applied generally. There were no common views amongst those responding in favour of introducing EU limits on OCs in sewage sludges on which substances should be regulated. Under Option 2, we agreed with the Commission that limits are set on PCBs and PAHs as follows:

Table 56: Limit values for organics in sludge

PAH	6mg/kg dry matter
PCB	0.8 mg/kgdry matter

Under this option, most MS will be affected, excluding:

- Austria (three of Austria's nine states already have a sufficient limit on PCBs in place and another state [Carinthia] has a limit on PAH and a limit on PCBs that is slightly higher than the proposed 0.8 mg/kg);
- Denmark (currently only has a limit on PAH);
- Germany;
- Sweden; and
- Czech Republic (will comply with PCB limit but not limit on PAH).

The IA in 2003 estimated that 50% of sludge meeting the new heavy metal limits would fail to meet the new organics limits (although this included more standards than those proposed under this Option). Some consultees have stated that the maximum amount of sludge failing would be less than 50%. However, there is limited evidence on this. Although there appear to be a reduction of organic content, there are no detailed data on the amount of OC in sludges at different concentrations. The following table summarises the assumptions and information provided by the stakeholders on the amount of sludge affected.

Table 57: % recycled sludge failing the new limits on OCs under Option 2

MS	% affected	Source of data
Austria	0%	E
Belgium	20%	E
Denmark	0%	C
Finland	20%	C
France	1%	C
Germany	0%	C
Greece	50%	E
Ireland	50%	E
Italy	50%	E
Luxembourg	50%	E
Netherlands	0%	Due to ban on application
Portugal	>30 and <50%	C
Spain	50%	E
Sweden	50%	E
United Kingdom	10% - 50%	C
Bulgaria	50%	E
Cyprus	50%	E
Czech Republic	40%	C
Estonia	50%	E
Hungary	50%	E
Latvia	50%	E
Lithuania	50%	E
Malta	nd	nd
Poland	50%	E
Romania	50%	E
Slovakia	50%	E
Slovenia	50%	E
Key to source: C – provided by consultee; E- estimate by consultant		

5.3.2 Step 2: Impacts on Sludge Management

A UK DETR study considered that composting would reduce the concentration of most organic compounds below the limit. The ICON study confirmed that aerobic sludge treatment (such as composting) would destroy most of the LAS, NPE or DEHP. However, persistent organic compounds such as PAHs, PCBs, PCDD/Fs would probably not be sufficiently destroyed by composting. This will entail that the options for that sludge failing will be again incineration and landfill.

The same percentages going to incineration and landfill as for PTE have been applied here. However, new estimates need to be developed for those countries which did not fail the limits on heavy metals but will fail the limits on organic contaminants. The estimates on the different disposal routes used in the calculations are provided in the next Table.

Table 58: Disposal for sludge failing OC (% of failing sludge)

Alternative disposal	Co-incineration	Mono-incineration	Landfill
Belgium	40	50	10
Denmark	-	-	-
Finland	50	50	0
France	40	50	10
Greece	25	50	25
Ireland	25	50	25
Italy	40	40	20
Luxembourg	50	40	10
Portugal	30	50	20
Spain	40	40	20
Sweden	40	50	10
United Kingdom	-	100	-
Bulgaria	50	-	50
Cyprus	50	-	50
Czech Republic	40	50	10
Estonia	50	-	50
Hungary	50	-	50
Latvia	50	-	50
Lithuania	50	-	50
Poland	50	-	50
Romania	50	-	50
Slovakia	50	-	50
Slovenia	100	-	-

5.3.3 Step 3: Impacts from the component – Costs and Benefits

The following table summarises the annual costs from this component and option (including the costs of externalities due to alternative disposal options, i.e. landfilling and incineration).

Table 59 Costs from New Limits of OC: Option 2 (EAC, €2009)

MS	Costs from mono-incineration	Costs from co-incineration	Costs of landfill	TOTALS
Belgium	347,000	182,000	39,000	567,000
Finland	179,000	116,000	-	295,000
France	980,000	513,000	110,000	1,602,000
Greece	658,000	220,000	181,000	1,059,000
Ireland	5,753,000	1,857,000	1,628,000	9,239,000
Italy	17,699,000	11,659,000	4,924,000	34,282,000
Luxembourg	556,000	453,000	78,000	1,086,000
Portugal	7,158,000	2,892,000	1,562,000	11,612,000
Spain	31,847,000	21,195,000	8,781,000	61,823,000
Sweden	2,003,000	1,046,000	225,000	3,274,000
United Kingdom	63,162,000	-	-	63,162,000
EU15	130,341,000	40,133,000	17,528,000	188,001,000
Bulgaria	-	1,138,000	796,000	1,934,000
Cyprus	-	197,000	161,000	357,000
Czech Republic	4,888,000	2,699,000	522,000	8,109,000
Estonia	-	131,000	103,000	233,000
Hungary	-	3,085,000	2,367,000	5,452,000
Latvia	-	284,000	222,000	506,000
Lithuania	-	801,000	607,000	1,408,000
Malta	-	-	-	-
Poland	-	5,682,000	4,342,000	10,024,000
Romania	-	857,000	636,000	1,493,000
Slovakia	-	1,139,000	874,000	2,013,000
Slovenia	-	197,000	-	197,000
EU-new	**4,888,000**	**16,210,000**	**10,630,000**	**31,728,000**
EU-TOTAL	**135,229,000**	**56,343,000**	**28,157,000**	**219,730,000**

5.4 Standards for pathogens

5.4.1 Step 1: Identification of MS affected by changes to the Directive

Seventeen respondents to the first consultation specifically mentioned or discussed pathogens in sludge. Most of these either inferred or specifically described the evidence that there have been no adverse health effects on humans, animals or plants whilst using sludge for agriculture treated and recycled in accordance with the Sludge Directive requirements. Five of the respondents specifically described a desire for pathogen controls to be based on different standards for different purposes, and possibly even with requirements adjusted by location as well, whilst three respondents would prefer consistent or harmonised controls.

None of the respondents made any specific recommendations other than by referring to existing quality limits or more stringent recycling controls used in some Member States either as regulatory controls or as codes of practice.

Option 2 will involve introducing standards for pathogens in line with the conventional treatment as given in the Commission Communication in 2003. Conventional treatment means any sludge treatment capable of achieving a reduction in *Escherichia coli* to less than $5x10^5$ colony forming units per gram (wet weight) of treated sludge.

Currently, only a few MS are known to have limits on pathogens, shown in Table 18. The 2002 CBA concluded that pollution prevention for pathogens by reducing at source was not feasible. However, local controls which specify indicator pathogen limits in the sludge have been implemented in several of the EU15 countries, driven by stakeholder demands. Sludge producers have installed new treatment processes that achieve more reliable and greater levels of pathogen destruction during treatment. Countries without equivalent systems to conventional standard however are using anaerobic digestion or aerobic digestion but this may not reliably achieve the standards.

Table 60: Standards for maximum concentrations of pathogens in sewage sludge (Sede and Andersen, 2002; Alabaster and LeBlanc, 2008)

	Salmonella	Other pathogens
Denmark a)	No occurrence	Faecal streptococci:< 100/g
France a)	8 MPN/10 g DS	Enterovirus: 3 MPCN/10 g of DS Helminths eggs: 3/10 g of DS
Finland (539/2006)	Not detected in 25 g	Escherichia coli <1000 cfu
Italy	1000 MPN/g DS	
Luxembourg	-	Enterobacteria: 100/g no eggs of worm likely to be contagious
Hungary	-	Faecal coli and faecal streptococci decrease below 10% of original number
Poland	Sludge cannot be used in agriculture if it contains salmonella	

No attempt has been made at this time to closely model the forms of sludge treatment used in each country as the combinations of sewage and sludge treatment processes lead to a very wide variety of possible scenarios. Consultation for the interim report revealed that the % of sludge being treated with anaerobic digestion can range from 20% (Norway) to 49% (Belgium). Consultation for the impact assessment provided some estimates about the % of sludge affected but in cases the range varies significantly (in such cases the median has been taken).

Table 61: % recycled sludge affected

Parameter	% affected	Source of data
Austria	0%	E
Belgium	40%	E
Denmark	20%	E
Finland	0%	C
France	5%-20%	C
Germany	0-40%	C
Greece	50%	E
Ireland	50%	E
Italy	50%	E
Luxembourg	50%	E
Netherlands	0%	Due to ban on application
Portugal	C. 90%	C
Spain	50%	E
Sweden	50%	E
United Kingdom	20%	C
Bulgaria	40%	E
Cyprus	40%	E
Czech Republic	40%	E
Estonia	40%	E
Hungary	40%	E
Latvia	40%	E
Lithuania	40%	E
Malta	nd	nd
Poland	40%	E
Romania	30%	C
Slovakia	40%	E
Slovenia	40%	E
Key to source: C – provided by consultee; E- estimate by consultant		

5.4.2 Step 2: Impacts on Sludge Management

This sludge will have to be treated further in order to meet the new limits on pathogens. Treatment processes to deal with pathogens include biological (digestion), chemical (lime treatment), and physical (high temperature drying). All these have different pathogen removal or inactivation characteristics (which vary from the relatively modest capability of mesophilic anaerobic digestion to reduce measurable *E.coli* concentrations by one hundred-fold with significant variation in effectiveness, to the substantially complete inactivation of vegetative cells achieved by thermal drying).

On this basis, we have assumed that all failing sludge will receive further treatment and use the costs given in Section 3, **Table 28: Costs €/tDS for enhanced treatment**. However, this may be an underestimate and/or an overestimate of the costs if companies decide to dispose of failing sludge by landfill and incineration in the former cases or use a more expensive way of treatment in the latter case.

5.4.3 Step 3: Impacts from the component – Costs and Benefits

The following table summarises the annual costs from this component and option.

Table 62: Costs from New Limits of Pathogens: Option 2 (EAC, €2009)

MS	Lower bound	Upper bound	Average
Belgium	238,000	423,000	331,000
Denmark	319,000	567,000	443,000
France	1,314,000	2,336,000	1,825,000
Germany	1,917,000	3,408,000	2,663,000
Greece	275,000	489,000	382,000
Ireland	2,517,000	4,475,000	3,496,000
Italy	9,418,000	16,743,000	13,080,000
Luxembourg	300,000	533,000	417,000
Portugal	11,954,000	21,252,000	16,603,000
Spain	16,702,000	29,692,000	23,197,000
Sweden	863,000	1,535,000	1,199,000
United Kingdom	3,551,000	6,314,000	4,932,000
EU15	**49,369,000**	**87,768,000**	**68,568,000**
Bulgaria	367,000	652,000	509,000
Cyprus	78,000	139,000	108,000
Czech Republic	1,554,000	2,762,000	2,158,000
Estonia	49,000	88,000	68,000
Hungary	1,125,000	2,001,000	1,563,000
Latvia	106,000	189,000	148,000
Lithuania	288,000	511,000	400,000
Poland	2,062,000	3,666,000	2,864,000
Romania	168,000	299,000	234,000
Slovakia	416,000	739,000	577,000
Slovenia	38,000	68,000	53,000
EU-new	**6,251,000**	**11,113,000**	**8,682,000**
EU-TOTAL	**55,620,000**	**98,880,000**	**77,250,000**

5.5 Provision of Information on Nutrients

As for the component providing information on nutrients, this is unlikely to affect MS significantly. This is because there is currently a requirement to measure N&P in accordance with the existing directive although the frequency is relatively low (6 months or when significant changes in quality). Although there will be costs these are not expected to be significant against the other components.

5.6 Other changes concerning quality and aimed at prevention

Option 2 will require that sludge shall be stabilised (or pseudo-stabilised) to reduce degradability during field side storage or after landspreading, to reduce methane emissions during storage and after landspreading, and to reduce odours. There are a number of means of demonstrating stability from which the most appropriate measurement may be agreed; for example, achieving 38% volatile solids reduction, or demonstrating that the specific oxygen uptake rate of the sludge is less than 1.5mgO_2/hour/g total solids.

Based on our estimates on sludge arising[36] from 2010-2020 the costs of quality assurance could be significant; however, as some plants are expected to be applying them already and due to economies of scale the following assumptions could apply:

- 50% of total sludge affected for newer MS and 20% for "older" MS (EU-15);
- lower range of cost: €3/tDS and
- upper range of costs: €18/tDS.

On this basis the following costs can be calculated.

Table 63: Costs from Quality Assurance: Option 2 (EAC, €2009)

MS	Lower bound	Upper bound	Average
Austria	3,000	19,000	11,000
Belgium	2,000	12,000	7,000
Denmark	11,000	64,000	37,000
Finland	1,000	6,000	4,000
France	112,000	673,000	392,000
Germany	64,000	383,000	224,000
Greece	1,000	9,000	5,000
Ireland	13,000	81,000	47,000
Italy	50,000	301,000	176,000
Luxembourg	2,000	10,000	6,000
Portugal	20,000	118,000	69,000
Spain	89,000	534,000	312,000
Sweden	5,000	28,000	16,000
United Kingdom	118,000	710,000	414,000
EU15	491,000	2,948,000	1,720,000
Bulgaria	19,000	115,000	67,000
Cyprus	4,000	24,000	14,000
Czech Republic	81,000	486,000	283,000
Estonia	3,000	15,000	9,000
Hungary	59,000	352,000	205,000
Latvia	6,000	33,000	19,000
Lithuania	15,000	90,000	52,000
Poland	107,000	644,000	376,000
Romania	16,000	93,000	55,000
Slovakia	22,000	130,000	76,000
Slovenia	2,000	12,000	7,000
EU-new	**332,000**	**1,994,000**	**1,163,000**
EU-TOTAL	**824,000**	**4,943,000**	**2,883,000**

[36] Total sludge recycled from 2010 to 2020 is estimated at around 56,817,200 tDS. Extrapolated quantities of sludge from 2010-2020

5.7 Change in limits on heavy metals based on soil conditions

5.7.1 Step 1: Identification of MS affected by changes to the Directive

Option 2 will involve changes to Annex IA, with more stringent limits of heavy metals in soil as proposed below.

Table 64: Proposed limit values of heavy metals in soil

PTE	86/278/EEC (6<pH<7)	5≤pH<6	6<pH<7	pH≥7
Cd	1-3	0.5	1	1.5
Cr	-	50	75	100
Cu	50-140	30	50	100
Hg	1-1.5	0.1	0.5	1
Ni	30-75	30	50	70
Pb	50-300	70	70	100
Zn	150-300	100	150	200

Table 21 sets out the maximum permissible concentrations in soil across different MS. Grey highlight denotes that the national limit is higher than proposed under Option 2. When there is no distinction based on pH, the highest bound has been applied.

Table 65: Maximum permissible concentrations of potentially toxic elements in sludge-treated soils (mg kg^{-1} dry soil) in EC Member States, (SEDE and Andersen, 2002)

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Option 2 5£pH<6	**0.5**	**50**	**30**	**0.1**	**30**	**70**	**100**
Option 2 6<pH<7	**1**	**75**	**50**	**0.5**	**50**	**70**	**150**
Option2 pH³7	**1.5**	**100**	**100**	**1**	**70**	**100**	**200**
Austria							
Lower Austria	1.5/1h)	100	60	1	50	100	200
Upper Austria	1	100	100	1	60	100	300/150(9)
Burgenland	2	100	100	1.5	60	100	300
Vorarlberg	2	100	100	1	60	100	300
Steiermark	2	100	100	1	60	100	300
Carinthia if 5<pH<5.5	0.5	50	40	0.2	30	50	100
if 5.5<pH<6.5	1	75	50	0.5	50	70	150
if pH>6.5	1.5	100	100	1	70	100	200
Belgium-Brussels	2		50	1	30	50	150
Belgium, Flanders	0.9	46	49	1.3	18	56	170
Belgium, Wallonia	2	100	50	1	50	100	200
Bulgaria							
pH=6-7.4	2	200	100	1	60	80	250
pH>7.4	3	200	140	1	75	100	300
Cyprus	1-3		50-140	1-1.5	30-75	50-300	150-300
Denmark	0.5	30	40	0.5	15	40	100
Finland	0.5	200	100	0.2	60	60	150
France	2	150	100	1	50	100	300
Germany (6)	1.5	100	60	1	50	100	200
Germany (7)							
Clay	1.5	100	60	1	70	100	200
Loam/silt	1	60	40	0.5	50	70	150

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Option 2 5£pH<6	**0.5**	**50**	**30**	**0.1**	**30**	**70**	**100**
Option 2 6<pH<7	**1**	**75**	**50**	**0.5**	**50**	**70**	**150**
Option2 pH³7	**1.5**	**100**	**100**	**1**	**70**	**100**	**200**
Sand	0.4	30	20	0.1	15	40	60
Greece	3	-	140	1.5	75	300	300
Ireland	1	-	50	1	30	50	150
Italy	1.5	-	100	1	75	100	300
Luxembourg	1-3	100-200	50-140	1-1.5	30-75	50-300	150-300
Estonia (10)	3	100	50	1.5	50	100	300
Hungary	1	75/1 (8)	75	0.5	40	100	200
Latvia	0.5-0.9	40-90	15-70	0.1-0.5	15-70	20-40	50-100
Lithuania	1.5	80	80	1	60	80	260
Malta							
pH 5<6	0.5	30	20	0.1	15	70	60
pH 6-7	1	60	50	0.5	50	70	150
pH >7	1.5	100	100	1	70	100	200
Netherland	0.8	10	36	0.3	30	35	140
Portugal							
Soil ph<5.5	1	50	50	1	30	50	150
5.5<soil<7	3	200	100	1.5	75	300	300
Soil ph>7	4	300	200	2	110	450	450
Poland							
Light soil	1	50	25	0.8	20	40	80
Medium soil	2	75	50	1.2	35	60	120
Heavy soil	3	100	75	1.5	50	80	180
Romania	3	100	100	1	50	50	300
Slovakia	1	60	50	0.5	50	70	150
Slovenia	1	100	60	0.8	50	85	200
Spain							
Soil ph<7	1	100	50	1	30	50	150
Soil ph>7	3	150	210	1.5	112	300	450
Sweden	0.4	60	40	0.3	30	40	100
UK(1)	3	400 (5)	135	1	75	300 (3)	20

Notes:

(1) For soil of pH ≥5.0, except Cu and Ni are for pH range 6.0 – 7.0; above pH 7.0 Zn = 300 mg kg-1 ds (DoE, 1996);
(2) Approximate values calculated from the cumulative pollutant loading rates from Final Part 503 Rule (US, EPA 1993);
(3) Reduction to 200 mg kg-1 proposed as a precautionary measure;
(4) EC (1990) – proposed but not adopted;
(5) Provisional value (DoE, 1989).
(6) Regulatory limits as presented in the German 1992 Sewage Sludge Ordinance (BMU, 2002)
(7) Proposed new German limits (BMU, 2007)
(8) Chromium VI
(9) For ph<6
(10) In soils where 5<ph<6 it is permitted to use lime-sterilised sludge

Source: Andersen and Sede (2002a): Disposal and Recycling Routes for Sewage Sludge Regulatory sub-component report – Part 1, 29 January 2002 as reproduced in DSR1 p.19

Note: Unless specified otherwise, we assume that limits listed in Andersen & Sede (2002) refer to ph between 6 and 7. Where Member State legislation includes ranges, the higher limit is taken as indicative of compliance with proposed Option 2

The above table depicts a number of MS with less stringent limits. However, this may not relate to the actual concentrations in soil. There is limited information on the percent of soil at different concentrations of pH.

The previous IA estimated that the percent of soil failing the new standards would range from 10% to 100% in some MS (the latter is relevant to the UK). However, the 100% figure is based on compounding data on the proportion of land failing to comply with limits on individual heavy metals and as such represents a worst-case scenario and we believe that it may be an overestimate. Indeed WRc estimated that 40% of the total agricultural land in the UK will not be available for sludge recycling should these limits be implemented[37]. Thus, this component is expected to have impacts on the land available for spreading. The following Table presents our estimates on the % of land failing for estimating the costs in terms of fertiliser replacement.

Table 66: % of failing land considered under Option 2 affected by limits in soil

Parameter	% affected	Source of data
Austria	10%	E
Belgium	0%	C
Denmark	0%	E
Finland	0%	C
France	2%-3%	C
Germany	25-35%	C
Greece	40%	E
Ireland	10%	E
Italy	30%	E
Luxembourg	30%	E
Netherlands	0%	Due to ban on application
Portugal	30%	C
Spain	20%	E
Sweden	50%	E
United Kingdom	15-65%	C
Bulgaria	30%	E
Cyprus	30%	E
Czech Republic	0%	C
Estonia	30%	E
Hungary	30%	E
Latvia	30%	E
Lithuania	30%	E
Malta	nd	nd
Poland	30%	E
Romania	0%	C
Slovakia	0%	E
Slovenia	30%	E
Key to source: C – provided by consultee; E- estimate by consultant		

5.7.2 Step 2: Impacts on Sludge Management

The main assumption affecting our calculation is that the land affected is equated to the % of recycled sludge affected. There is no method available to reduce heavy metals in soil. Thus, the failing sludge will have to be disposed of by incineration and/or landfilling (further treatment is not consider feasible in this case as the standards concern background concentrations). The following estimates are given in order to calculate the costs.

[37] based on the following concentrations in soil:Cd – 0.6, Cr – 84, Cu – 26, Hg – 0.1, Ni – 34, Pb – 29, Zn – 60

Table 67: Alternative disposal (% of failing sludge going to different disposal)

	Co-incineration	Mono-incineration	Landfill
Austria	50	40	10
Finland	50	50	-
France	40	50	10
Germany	50	50	-
Greece	25	50	25
Ireland	25	50	25
Italy	40	40	20
Luxembourg	50	40	10
Portugal	30	50	20
Spain	40	40	20
Sweden	40	40	20
United Kingdom	-	100	-
Bulgaria	50	-	50
Cyprus	50	-	50
Czech Republic	-	-	-
Estonia	50	-	50
Hungary	50	-	50
Latvia	50	-	50
Lithuania	50	-	50
Poland	50	-	50
Slovakia	50	-	50
Slovenia	100	-	-

5.7.3 Step 3: Impacts from the component – Costs and Benefits

The following costs are calculated on the basis of the costs of the alternative disposal options. The unit cost presented in Section 3are used for the analysis. It is important to note that owing to the nature of the unit costs, such costs include both environmental and human health costs in addition to financial costs. The environmental costs on the basis of the degree of quantification possible to date however represent around 10% of the total costs (although in the case of incineration the externality are closer to the 10% value of the total quantifiable costs). Estimates on the GHG for this component are presented at the end of the Section for the sake of brevity.

Table 68: Costs and Benefits from Limits of PTE in soil (EAC, €2009)

MS	Costs from mono-incineration	Costs from co-incineration	Costs of landfill	TOTALS
Austria	227,000	187,000	32,000	445,000
France	2,449,000	1,283,000	274,000	4,006,000
Germany	16,915,000	11,154,000	-	28,069,000
Greece	527,000	176,000	145,000	847,000
Ireland	1,151,000	371,000	326,000	1,848,000
Italy	10,619,000	6,995,000	2,954,000	20,569,000
Luxembourg	333,000	272,000	47,000	652,000
Portugal	5,368,000	2,169,000	1,172,000	8,709,000
Spain	12,739,000	8,478,000	3,512,000	24,729,000
Sweden	1,603,000	1,046,000	449,000	3,098,000

MS	Costs from mono-incineration	Costs from co-incineration	Costs of landfill	TOTALS
United Kingdom	84,216,000	-	-	84,216,000
EU15	**136,145,000**	**32,131,000**	**8,911,000**	**177,187,000**
Bulgaria	-	683,000	478,000	1,160,000
Cyprus	-	118,000	96,000	214,000
Estonia	-	78,000	62,000	140,000
Hungary	-	1,851,000	1,420,000	3,271,000
Latvia	-	171,000	133,000	304,000
Lithuania	-	481,000	364,000	845,000
Malta	-	-	-	-
Poland	-	3,409,000	2,605,000	6,015,000
Slovenia	-	118,000	-	118,000
EU-new	**-**	**6,909,000**	**5,159,000**	**12,067,000**
EU-TOTAL	**136,145,000**	**39,040,000**	**14,069,000**	**189,255,000**

5.8 Setting conditions on application

Article 7 of the Directive 86/278/EEC sets restrictions on the spreading of sludge on grassland and forage crops, and on land on which vegetables and fruits are grown. For grassland and forage crops, it requires a minimum period of 3 weeks between sludge application and grazing or harvest. For fruit and vegetable crops in direct contact with soil and normally eaten raw, a period of 10 months is required.

These dispositions have been transposed by Member States with some variations. Ireland, Portugal and the United Kingdom have transposed the exact requirements of the directive. Other countries have introduced longer delays before spreading (Austria, Belgium, Estonia, Italy, and Luxembourg). Some countries have introduced additional restrictions for specific crops such as a ban for grassland in Austria, Latvia, Poland and Sweden, or on agricultural practices, such as direct ploughing (e.g. in Finland) or the use of pasteurised / enhanced treated / hygienised sludge (e.g. in France, where delay before spreading is greater when not using pasteurised / hygienised sludge).

Most countries have also introduced additional requirements for landspreading such as restricting the use of sludge in agriculture near surface water, in forests, on frozen or snow-covered ground, and on sloping land in order to reduce the impact of erosion and run-off. Requirements may also be added in order to protect groundwater. Additional recommendations have also been introduced in codes of practice or voluntary agreements (i.e. the UK Safe Sludge Matrix).

Although there appears to have been no evidence of risks due to landspreading when carried out according to the existing rules, Option 2 will entail moderate changes to Article 7 as highlighted above and repeated here for the sake of analysis:

- Setting periods for harvesting for grassland and/or forage crops;
- Make compulsory 10 month period for fruit and vegetable crops;
- Ban the application of untreated sludge - changes to Article 6 which currently allows MS to authorise under certain conditions the use of untreated sludge if injected or worked into the soil. Outright ban on the use of untreated sludge injected or worked into the soil – changes to Article 6; and
- Liquid sludge may only be used if injected or immediately worked into soil.

The main costs implications could be expected to arise from the ban on untreated sludge on those MS currently using it untreated, and the requirement that liquid sludge may only be injected or immediately worked into the soil. The other conditions are not expected to impact significantly. Untreated sludge is not currently widely applied. In the Czech Republic, Denmark, Spain, Finland, Germany, Hungary, Italy, Luxembourg, the Netherlands, Slovakia, Slovenia, and in the UK it is prohibited to spread any untreated sludge on land (EC 2006). The consultation has expressed that the impacts from such ban however are not expected to be significant. A French consultee stated that the land will be less than 5%; similarly a Finish and German stakeholders stated that the impact was nil. Thus the impacts from this component are expected to be negligible.

5.9 Changes to sampling and monitoring requirements

Option 2 will involve changes to sampling and monitoring requirements in line with Annex VI of CEC (2003) and concerning the frequency of sampling and monitoring with at least the frequency shown in the following table:

Table 69: Proposed analysis

Quantity of sludge produced per year and per plant (tonnes of dry matter)	Minimum number of analyses per year				
	Agronomic parameters	Heavy metals	Organic compounds (except dioxins)	Dioxins	Micro-organisms
< 50	1	1	-	-	1
50 – 250	2	2	-	-	2
250 – 1 000	4	4	1	-	4
1 000 – 2 500	4	4	2	1	4
2 500 – 5 000	8	8	4	1	8
> 5 000	12	12	6	2	12
The frequency of analysis of any of the parameters (heavy metals, organic compounds, micro-organisms) may be reduced if it has been shown that in a two-year period each measured value of the parameter is consistently below 75% of the limit. The analysis of organic compounds may be omitted if it has been shown that in a two-year period each measured value of the parameter is consistently below 25% of the limit. The frequency of analysis of any of the agronomic parameters may be reduced if in a two-year period it has been shown that each measured value of the parameter deviates by less than 20% from the average. There are some allowances for the number of samples that can fail within certain deviation, a maximum of 2 for any substance and limit, within a maximum of 20% deviation.					

Although costs have been provided for individual sampling and analysis (e.g. €500 per analysis of dioxins), baseline data does not allow us to estimate the number of plants affected and the number of total additional analysis. Consultees have stated that the costs implication could range from modest in comparison with other standards to significant as the number of analysis will be much higher than those currently undertaken. Thus, we have assumed that the costs from this component will be similar to those of quality assurance for illustrative purposes (**Table 63: Costs from Quality Assurance: Option 2 (EAC, €2009)**).

5.10 Impacts from Option 2

The following Table summarises the net costs of the different components from this Option. These include:

- Costs of alternative disposal;
- Obligation of treatment;
- Loss of use of sludge as a fertiliser and fertiliser replacement costs;
- Benefits/costs from alternative routes of disposal including climate change; and
- Human health from alternative routes of disposal

Table 70: PV costs from Different Option Components under Option 2

Component	PTE in sludge	OC	Pathogens		QA= Increased analysis		
MS			**Lower bound**	**Upper bound**	**Lower bound**	**Upper bound**	**PTE in soil**
Austria	-	-	-	-	31,000	188,000	4,341,000
Belgium	-	5,535,000	2,324,000	4,132,000	19,000	116,000	-
Denmark	-	-	3,113,000	5,534,000	104,000	623,000	-
Finland	-	2,881,000	-	-	10,000	61,000	-
France	15,638,000	15,638,000	12,827,000	22,803,000	1,095,000	6,567,000	39,096,000
Germany	-	-	18,713,000	33,267,000	624,000	3,743,000	273,967,000
Greece	2,481,000	10,338,000	2,687,000	4,776,000	14,000	86,000	8,271,000
Ireland	21,642,000	90,173,000	24,567,000	43,675,000	131,000	786,000	18,035,000
Italy	33,461,000	334,608,000	91,921,000	163,415,000	490,000	2,941,000	200,765,000
Luxembourg	2,120,000	10,601,000	2,929,000	5,207,000	16,000	94,000	6,361,000
Portugal	28,335,000	113,339,000	116,679,000	207,430,000	192,000	1,152,000	85,004,000
Spain	60,342,000	603,424,000	163,018,000	289,810,000	869,000	5,217,000	241,370,000
Sweden	-	31,956,000	8,426,000	14,980,000	45,000	270,000	30,238,000
United Kingdom	102,748,000	616,490,000	34,663,000	61,624,000	1,155,000	6,933,000	821,986,000
EU15	**266,768,000**	**1,834,983,000**	**481,867,000**	**856,653,000**	**4,796,000**	**28,777,000**	**1,729,433,000**
Bulgaria	38,000	18,872,000	3,579,000	6,362,000	186,000	1,118,000	11,323,000
Cyprus	837,000	3,489,000	760,000	1,352,000	40,000	238,000	2,093,000
Czech Republic	-	79,149,000	15,165,000	26,961,000	790,000	4,739,000	-
Estonia	296,000	2,279,000	481,000	855,000	25,000	150,000	1,367,000
Hungary	8,514,000	53,211,000	10,984,000	19,527,000	572,000	3,433,000	31,927,000
Latvia	1,977,000	4,942,000	1,037,000	1,843,000	54,000	324,000	2,965,000
Lithuania	165,000	13,746,000	2,808,000	4,991,000	146,000	877,000	8,248,000
Poland	23,482,000	97,842,000	20,127,000	35,782,000	1,048,000	6,290,000	58,705,000
Romania	-	14,577,000	1,642,000	2,919,000	152,000	912,000	-
Slovakia	7,860,000	19,651,000	4,056,000	7,211,000	211,000	1,268,000	-
Slovenia	8,000	1,924,000	371,000	660,000	19,000	116,000	1,154,000
EU-new	**43,177,000**	**309,682,000**	**61,011,000**	**108,464,000**	**3,244,000**	**19,465,000**	**117,783,000**
EU-TOTAL	**309,945,000**	**2,144,665,000**	**542,878,000**	**965,117,000**	**8,040,000**	**48,242,000**	**1,847,216,000**

Table 71: EAC costs from Different Option Components under Option 2

Component			Pathogens		QA= Increased analysis		-
MS	PTE in sludge	OC	Lower bound	Upper bound	Lower bound	Upper bound	PTE in soil
Austria	-	-	-	-	3,000	19,000	445,000
Belgium	-	567,000	238,000	423,000	2,000	12,000	-
Denmark	-	-	319,000	567,000	11,000	64,000	-
Finland	-	295,000	-	-	1,000	6,000	-
France	1,602,000	1,602,000	1,314,000	2,336,000	112,000	673,000	4,006,000
Germany	-	-	1,917,000	3,408,000	64,000	383,000	28,069,000
Greece	254,000	1,059,000	275,000	489,000	1,000	9,000	847,000
Ireland	2,217,000	9,239,000	2,517,000	4,475,000	13,000	81,000	1,848,000
Italy	3,428,000	34,282,000	9,418,000	16,743,000	50,000	301,000	20,569,000
Luxembourg	217,000	1,086,000	300,000	533,000	2,000	10,000	652,000
Portugal	2,903,000	11,612,000	11,954,000	21,252,000	20,000	118,000	8,709,000
Spain	6,182,000	61,823,000	16,702,000	29,692,000	89,000	534,000	24,729,000
Sweden	-	3,274,000	863,000	1,535,000	5,000	28,000	3,098,000
United Kingdom	10,527,000	63,162,000	3,551,000	6,314,000	118,000	710,000	84,216,000
EU15	**27,331,000**	**188,001,000**	**49,369,000**	**87,768,000**	**491,000**	**2,948,000**	**177,187,000**
Bulgaria	4,000	1,934,000	367,000	652,000	19,000	115,000	1,160,000
Cyprus	86,000	357,000	78,000	139,000	4,000	24,000	214,000
Czech Republic	-	8,109,000	1,554,000	2,762,000	81,000	486,000	-
Estonia	30,000	233,000	49,000	88,000	3,000	15,000	140,000
Hungary	872,000	5,452,000	1,125,000	2,001,000	59,000	352,000	3,271,000
Latvia	203,000	506,000	106,000	189,000	6,000	33,000	304,000
Lithuania	17,000	1,408,000	288,000	511,000	15,000	90,000	845,000
Poland	2,406,000	10,024,000	2,062,000	3,666,000	107,000	644,000	6,015,000
Romania	-	1,493,000	168,000	299,000	16,000	93,000	-
Slovakia	805,000	2,013,000	416,000	739,000	22,000	130,000	-
Slovenia	1,000	197,000	38,000	68,000	2,000	12,000	118,000
EU-new	**4,424,000**	**31,728,000**	**6,251,000**	**11,113,000**	**332,000**	**1,994,000**	**12,067,000**
EU-TOTAL	**31,755,000**	**219,730,000**	**55,620,000**	**98,880,000**	**824,000**	**4,943,000**	**189,255,000**

As it can be seen from the Tables, the component causing the greatest costs is the new limits of OC followed by PTE limits in soil. The reasons for the highest costs for OC relate to the fact that no technology is known to date that may help to address such limits, as a result failing sludge will have to be disposed of by landfill and incineration. As for the limits in soil, this was indeed one of the main concerns of the consultation as most MS considered that the existing backgrounds would limit the amount of sludge that could be recycled.

It is important to note that some costs are not included above, such as those related to changes the legislation and monitoring and control. These are not estimated to be significant however in comparison.

5.10.1 Environmental and Human Health Impacts from Climate Change

Although there will be benefits (environmental and human health) from more stricter standards these cannot be easily quantified. This is due to the lack of evidence on dose-response but it is uncertain whether this is due to the Directive and/or existing national legislation and practices.

The external costs from alternative disposal options subject to quantification are expected to be around 10% of the total costs of the values above. Table 46 presents the valuation of GHG emissions based on the rated of alternative disposal applied (environmental and human health impacts due to GHG emissions). The valuation of GHG seems to indicate that the component bearing the greatest costs is that concerning the organic contaminants in sludge (from increased amount of sludge failing the standards).

Table 72: EAC due to GHG from alternative disposal by Component

MS	PTE in sludge	OC in sludge	PTE in soil
Austria	-	-	60,000
Belgium	-	71,000	-
Denmark	-	-	-
Finland	-	35,000	-
France	200,000	200,000	499,000
Germany	-	-	3,899,000
Greece	33,000	138,000	110,000
Ireland	224,000	934,000	187,000
Italy	439,000	4,386,000	2,631,000
Luxembourg	27,000	136,000	82,000
Portugal	415,000	1,662,000	1,246,000
Spain	850,000	8,507,000	3,402,000
Sweden	-	399,000	370,000
United Kingdom	1,275,000	7,647,000	10,197,000
EU15	**3,463,000**	**24,114,000**	**22,684,000**
Bulgaria	1,000	403,000	242,000
Cyprus	12,000	48,000	29,000
Czech Republic	-	1,411,000	-
Estonia	5,000	36,000	21,000
Hungary	143,000	892,000	535,000
Latvia	31,000	79,000	47,000
Lithuania	3,000	239,000	143,000
Poland	397,000	1,654,000	992,000
Romania	-	273,000	-
Slovakia	132,000	330,000	-
Slovenia	-	40,000	24,000

EU-new	**763,000**	**5,620,000**	**2,142,000**
EU-TOTAL	**4,226,000**	**29,734,000**	**24,825,000**

5.10.2 Other Impacts

One other impact that was considered in the initial assessment was the effects on agricultural production. Consultation has revealed however that such impacts are expected to be negligible.

The costs above reflect the total costs to the economy but exclude the costs to the regulatory authorities concerning changes to legislation and monitoring. These have not been valued but are expected to be negligible in comparison. One other benefit from this Option to regulators is that it will help meeting some other legislation objectives, such as WFD objectives. The contribution towards these objectives may be limited to agricultural inputs to watercourses. As the percentage of sludge applied to agriculture is considerably low, the benefits in this regard are not expected to be significant.

There may be some benefits in terms of amenity and public perception. These are highly uncertain however and have not been valued.

5.10.3 Distributional Analysis

5.10.3.1 Distributional impacts among MS

The impacts from the different option components will vary according to the MS. The following Table sets out the percentages of costs falling on the different MS according to their contribution to the total costs. As it can be seen, the main costs will fall onto the old MS. This is mainly due to the fact that the projections from the sludge arising are more significant, and not so much to the percentage of sludge failing. Among those EU-15 that are likely to be the most affected are the UK, Spain and Italy for the components concerting PTE and OC, with Spain and Italy also affected by the limits on pathogens together with Portugal. As for the limits concerning soil, Germany will be affected significantly (based on the consultation responses). France will be most affected by quality assurance requirements together with the UK and followed by Spain.

5.10.3.2 Distributional impacts among Stakeholders

As for distributional impacts among stakeholders, the main stakeholders affected by Option 2 are:

- sludge producers: operators of sewage treatment works would have to upgrade and replace current treatment plant equipment in order to meet the new standards of treatment set out in the regulations and dispose of the sludge that will not be recycled;
- local authorities/municipalities: running the incinerators and/or landfills (and/or companies on their behalf or sub-contractors) that may need upgrading capabilities and/or setting new incinerator facilities and
- farmers: who are the sludge users, would have to comply with revised restrictions. Farmers would face costs for replacement of fertilisers (or treated sludge). However the consultation has revealed that they will use other organic fertilisers and not just mineral fertilisers which may be more expensive. The costs in terms of impacts on agricultural production are according to the stakeholders likely to be negligible. Hence unemployment impacts are expected to be negligible in this sector alone.

The exact distribution in costs is uncertain but sludge producers and waste disposal facilities will bear the greatest costs. Stakeholders have expressed concerns about the possibility that water companies may pass on the costs of existing legislation. This is possible; however, in some MS such price increases are regulated, e.g. the UK, and as a result such increases are not expected to be significant.

On the other hand, stakeholder have highlighted that strict limits on sludge may cause unemployment impacts on related sectors such as recycling machinery manufacturers. These impacts need highlighting although their quantification is surrounded by uncertainty.

Environmental and social costs will accrue from increased incineration and landfill, as these will be the alternative routes for disposal to untreated sludge. These will accrue to all stakeholders through airborne pollutants.

Table 73: Distributional Analysis

	PTE in sludge	OC	Pathogens		QA= Increased analysis		PTE in soil
MS			**Lower bound**	**Upper bound**	**Lower bound**	**Upper bound**	
Austria	0%	0%	0%	0%	0%	0%	0%
Belgium	0%	0%	0%	0%	0%	0%	0%
Denmark	0%	0%	1%	1%	1%	1%	0%
Finland	0%	0%	0%	0%	0%	0%	0%
France	5%	1%	2%	2%	14%	14%	2%
Germany	0%	0%	3%	3%	8%	8%	15%
Greece	1%	0%	0%	0%	0%	0%	0%
Ireland	7%	4%	5%	5%	2%	2%	1%
Italy	11%	16%	17%	17%	6%	6%	11%
Luxembourg	1%	0%	1%	1%	0%	0%	0%
Portugal	9%	5%	21%	21%	2%	2%	5%
Spain	19%	28%	30%	30%	11%	11%	13%
Sweden	0%	1%	2%	2%	1%	1%	2%
United Kingdom	33%	29%	6%	6%	14%	14%	44%
EU15	**86%**	**86%**	**89%**	**89%**	**60%**	**60%**	**94%**
Bulgaria	0%	1%	1%	1%	2%	2%	1%
Cyprus	0%	0%	0%	0%	0%	0%	0%
Czech Republic	0%	4%	3%	3%	10%	10%	0%
Estonia	0%	0%	0%	0%	0%	0%	0%
Hungary	3%	2%	2%	2%	7%	7%	2%
Latvia	1%	0%	0%	0%	1%	1%	0%
Lithuania	0%	1%	1%	1%	2%	2%	0%
Poland	8%	5%	4%	4%	13%	13%	3%
Romania	0%	1%	0%	0%	2%	2%	0%
Slovakia	3%	1%	1%	1%	3%	3%	0%
Slovenia	0%	0%	0%	0%	0%	0%	0%
EU-new	**14%**	**14%**	**11%**	**11%**	**40%**	**40%**	**6%**
EU-TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

6. Option 3: More stringent limits (Significant change)

6.1 Overview

Table 6 showed the different components for Option 3. Option 3 will set more stringent standards than Option 2. The Option will consist of the following:

- Changes to the limits on heavy metals concerning the quality of the sludge (as given in the CEC (2003)) and in soil;
- Setting limits for all organic contaminants for sludge quality;
- Introduce standards for treatment compatible with CEC (2003) advanced treatment;
- Provision of information on nutrients;
- Ban of application of sludge for fruit, vegetable crops and grassland; and
- Changes to sampling and monitoring requirements.

The main issues with this Option are similar to those for Option 2, i.e. setting limitations on sludge use from higher standards in areas where there is no added value in terms of human health and the environment. However, as the limits are more stringent, the main risks relate to those environmental and human health risks stemming from the increased alternative disposal options to the sludge that will not be suitable for use (landfilling and incineration routes). Other issues relate to the ability to replace all sludge with fertiliser, although this is not expected to be significant as reflected by the consultation responses and impacts on productivity.

6.2 Heavy metal content in sludge

6.2.1 Step 1: Identification of MS affected by changes to the Directive

The limits proposed under Option 3 are given in the following Table.

Table 74: Proposed limit values on the content of heavy metals in sewage sludge – Option 3

PTE	mg/kg
Cd	5
Cr	150
Cu	400
Hg	5
Ni	50
Pb	250
Zn	600

Under these new limits more MS national legislation will be affected than under Option 2. Table 74 depicts, in grey colour, the countries that will be affected based on the regulatory limits. All MS, with the exception of Denmark (which would only have to amend the limit for zinc) would have to amend their legislative limits in respect to all heavy metals.

Table 75: Countries potentially affected by Option 3 i. setting limits on Maximum level of heavy metals (mg per kg of dry substance) in sewage sludge used for agricultural purposes - in grey

PTE	Cd	Cr	Cu	Hg	Ni	Pb	Zn
New limits	**5**	**150**	**400**	**5**	**50**	**250**	**600**
Bulgaria	30	500	1600	16	350	800	3000
Cyprus	20-40	-	1000-1750	16-25	300-400	750-1200	2500-4000

Denmark	0.8	100	1000	0.8	30	120	4000
Estonia	15	1200	800	16	400	900	2900
France (4)	10	1000	1000	10	200	800	3000
Germany (1)	10	900	800	8	200	900	2500
Greece	20-40	500	1000-1750	16-25	300-400	750-1200	2500-4000
Hungary	10	1000/1(3)	1000	10	200	750	2500
Ireland	20		1000	16	300	750	2500
Italy	20		1000	10	300	750	2500
Lithuania	-	-	-	-	-	-	-
Luxembourg	20-40	1000-1750	1000-1750	16-25	300-400	750-1200	2500-4000
Portugal	20	1000	1000	16	300	750	2500
Spain	20-40	1000-1750	1000-1750	16-25	300-400	750-1200	2500-4000

As noted earlier however, the fact that national limits are higher than the proposed standards does not entail that the sewage sludge being produced is of the same quality. Table 76 depicts the MS affected, in grey, against current information on average sludge quality. As noted under Option 2 however, these are national (weighted) averages so they do not show the effect of different distributions. Indeed, we believe that Option 3 limits may rule out 50% of UK medium size works on Cu and Zn. The Andersen & Sede (2002) report estimated that the percentages of sludge affected by the new limits on heavy metals would range from 50% to 80% of total sludge production[38].

Table 76: Quality of sewage sludge (on dry solids) recycled to agriculture (2006) compared with new Option 3 limits

Parameter	**Cadmium**	**Chromium**	**Copper**	**Mercury**	**Nickel**	**Lead**	**Zinc**
New limits Option 3	**5**	**150**	**400**	**5**	**50**	**250**	**600**
BE –Flanders	1	20	72	0.2	11	93	337
BE-Walloon	1.5	54	167	1	25	79	688
Bulgaria	1.6	20	136	1.2	13	55	465
Cyprus	6.9	37	180	3.1	21	23	1188
Czech republic	1.5	53	173	1.7	29	40	809
Germany	1	37	300	0.4	25	37	713
Spain	2.1	72	252	0.8	30	68	744
Finland	0.6	18	244	0.4	30	8.9	332
France	1.3	43	272	1.1	21	50	598
Italy	1.3	86	283	1.4	66	101	879
Portugal	<0.4	20	12	<1	15	27	341

[38] This was estimated for the long term scenario, whose limits are more similar to, but less stringent than, those proposed under this Option.

Parameter	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc
Sweden	0.9	26	349	0.6	15	24	481
UK	1.3	61	295	1.2	30	112	574
Estonia	2.8	14	127	0.6	19	41	783
Hungary	1.4	57	185	1.7	26	36	824
Lithuania	1.3	34	204	0.5	25	21	534
Latvia	3.6	105	356	4.2	47	114	1232
Portugal	4	127	153	4.6	32	51	996
Slovenia	0.7	37	190	0.8	29	29	410
Slovakia	2.5	73	221	2.7	26	57	1235

The following Table sets out our assumptions in terms of sludge failing new limits on heavy metals under Option 3 based on the consultation responses and standard deviation from percentile distributions for the MS where such information is available.

Table 77: % recycled sludge failing new limits on heavy metals in sludge under Option 3

MS	% failure	Source
Austria	20%	E
Belgium	20%	E
Denmark	20%	E
Finland	10%	C
France	50%	E
Germany	80%	C
Greece	50%	E
Ireland	50%	E
Italy	50%	E
Luxembourg	10%	E
Netherlands	0%	E
Portugal	60%	C
Spain	50%	E
Sweden	20%	E
United Kingdom	55%	C
EU15		E
Bulgaria	60%	E
Cyprus	60%	E
Czech Republic	60%	E
Estonia	60%	E
Hungary	60%	E
Latvia	60%	E
Lithuania	60%	E
Poland	60%	E
Romania	60%	E
Slovakia	60%	E
Slovenia	60%	E

6.2.2 Step 2: Impacts on Sludge Management

For the sludge failing, there will be two scenarios:

- landfill;
- incineration.

Both of the scenarios will have costs implications for water and sludge management operators. Depending on the specific scenarios, the environmental and social impacts from alternative disposal routes will vary in magnitude. In absence of any information on the different disposal routes, the following estimates will be used based on information available in the literature and consultation (these are based on the same trends as for Option 2).

Table 78: Impacts from Option 3 – disposal options and treatment

MS	Co-incineration	Mono-incineration	Landfill
Austria	50	40	10
Belgium	50	40	10
Denmark	40	50	10
Finland	50	50	-
France	40	50	10
Germany	50	50	-
Greece	25	50	25
Ireland	25	50	25
Italy	40	40	20
Luxembourg	50	40	10
Netherlands	-	-	-
Portugal	30	50	20
Spain	40	40	20
Sweden	40	40	20
United Kingdom	-	100	-
Bulgaria	50	-	50
Cyprus	50	-	50
Czech Republic	40	50	10
Estonia	50	-	50
Hungary	50	-	50
Latvia	50	-	50
Lithuania	50	-	50
Poland	50	-	50
Romania	50	-	50
Slovakia	50	-	50
Slovenia	100	-	-

6.2.3 Step 3: Impacts from the component – Costs and Benefits

The following costs are calculated on the basis of the costs of the alternative disposal options. The unit cost presented in Section 3 are used for the analysis. It is important to note that owing to the nature of the unit costs, such costs include both environmental and human health costs in addition to financial costs. The environmental costs, on the basis of the degree of quantification possible to date however, represent around 10% of the total costs (although in the case of incineration, the externality are closer to the 10% value of the total quantifiable costs). Estimates on the GHG for this component are presented at the end of the Section separately.

Table 79: Costs and Benefits from Limits of PTE (EAC, €2009)

MS	Costs from mono-incineration	Costs from co-incineration	Costs of landfill	TOTALS
Austria	453,000	373,000	63,000	890,000
Belgium	277,000	227,000	39,000	543,000
Denmark	1,798,000	920,000	205,000	2,923,000
Finland	90,000	58,000	-	148,000
France	48,978,000	25,654,000	5,479,000	80,111,000
Germany	45,106,000	29,745,000	-	74,851,000
Greece	658,000	220,000	181,000	1,059,000
Ireland	5,753,000	1,857,000	1,628,000	9,239,000
Italy	17,699,000	11,659,000	4,924,000	34,282,000
Luxembourg	111,000	91,000	16,000	217,000
Portugal	10,736,000	4,338,000	2,343,000	17,418,000
Spain	31,847,000	21,195,000	8,781,000	61,823,000
Sweden	641,000	418,000	180,000	1,239,000
United Kingdom	115,797,000	-	-	115,797,000
EU15	**279,945,000**	**96,755,000**	**23,839,000**	**400,539,000**
Bulgaria	-	1,365,000	955,000	2,320,000
Cyprus	-	236,000	193,000	429,000
Czech Republic	7,333,000	4,049,000	782,000	12,164,000
Estonia	-	157,000	123,000	280,000
Hungary	-	3,702,000	2,840,000	6,542,000
Latvia	-	341,000	266,000	608,000
Lithuania	-	961,000	729,000	1,690,000
Poland	-	6,818,000	5,211,000	12,029,000
Romania	-	1,029,000	763,000	1,792,000
Slovakia	-	1,367,000	1,049,000	2,416,000
Slovenia	-	237,000	-	237,000
EU-new	**7,333,000**	**20,262,000**	**12,912,000**	**40,506,000**
EU-TOTAL	**287,278,000**	**117,017,000**	**36,751,000**	**441,046,000**

6.3 Set limits on organics

6.3.1 Step 1: Identification of MS affected by changes to the Directive

Under Option 3, new standards will be introduced for all organics. The proposed standards for PCBs and PAHs will be the same as those suggested under Option 2. However, additional limits will be introduced for PCDD/F, LAS and NPE. These are set out in Table 79.

Table 80: New limits on organics proposed under Option 3

OC	Limit value
PAH[39]	6 mg/kg dry matter
PCB[40]	0.8 mg/kg dry matter
PCDD/F[41]	100 ng ITEQ/kg dry matter
LAS[42]	5 g/kg dry matter
NPE[43]	450 mg/kg dry matter

As concerning the regulatory limits, this will impact all MS with the exception of Denmark. From surveys carried out in different countries/regions[44] (Norway, North Rhine Westphalia, UK) the range of concentrations of different contaminants is wide. Individual components are not necessarily linked with others. The median concentrations in these surveys are within the limit values for Option 3 (apart from UK LAS median concentration of 5.5g/kg DS), with values from 10% to 80% of the limit values, but the maximum values are all greater than the limit values shown. Hence it is expected that the new limits will affect a significant percentage of the total sludge recycled. It is not clear if the amount of sludge affected would be as high as the 50% estimated in the Andersen & Sede (2002) report. Estimates of sludge failing to meet these new OC limits are shown in Table 34; we have undertaken a conservative scenario for those MS from which information was not provided on the basis of other consultees responses.

Table 81: % recycled sludge which may fail the new limits on OCs under Option 3

MS	% affected	Source of data
Austria	50%	E
Belgium	30%	E
Denmark	0%	C
Finland	50%	C
France	30%	E
Germany	50%	C
Greece	50%	E
Ireland	50%	E

39 Sum of the following polycyclic aromatic hydrocarbons: acenapthene, phenanthrene, fluorene, flouranthene, pyrene, benzo(b+j+k)fluoranthene, benzo(a)pyrene, benzo(ghi)perylene, indeno(1, 2, 3-c, d)pyrene.

40 Sum of the polychlorinated byphenls components number 28, 52, 101, 118, 138, 153, 180.

41 Polychlorinated dibenzodioxins/ dibenzofuranes.

42 Linear alkylbenzene sulphonates.

43 It comprises the substances nonylphenol and nonylphenolethoxylates with 1 or 2 ethoxy groups.

44 Norwegian Scientific Committee for Food Safety (VKM) 2009; Risk assessment of contaminants in sewage sludge applied on Norwegian soils. www.vkm.no.; Ministry of the Environment, Conservation,Agriculture and Consumer Protection of theState of North Rhine-Westfalia (2005) Characterization and assessment of organic pollutants in Sewage Sludge; Smith S & Riddell-Black (2007) Sources and Impacts of past Current and Future contamination of soil: Appendix 2. Organic contaminants. Final report to Defra.

MS	% affected	Source of data
Italy	50%	E
Luxembourg	50%	E
Netherlands	0%	E
Portugal	60%	C
Spain	50%	E
Sweden	50%	E
United Kingdom	95%	C
Bulgaria	50%	E
Cyprus	50%	E
Czech Republic	50%	E
Estonia	50%	E
Hungary	50%	E
Latvia	50%	E
Lithuania	50%	E
Poland	50%	E
Romania	50%	E
Slovakia	50%	E
Slovenia	50%	E

6.3.2 Step 2: Impacts on Sludge Management

It is not clear what conventional treatment methods could be reasonably used to deal with a failed sludge. It might be possible to dilute the sludge by mixing it with another sludge. High temperature treatments may be capable of improving degradation. The same trends as for heavy metals will be applied for considering the impacts on alternative disposal options.

Table 82: Alternative Disposal for sludge failing OC

MS	Co-incineration	Mono-incineration	Landfill
Austria	50	40	10
Belgium	50	40	10
Denmark	40	50	10
Finland	50	50	-
France	40	50	10
Germany	50	50	-
Greece	25	50	25
Ireland	25	50	25
Italy	40	40	20
Luxembourg	50	40	10
Netherlands	-	-	-
Portugal	30	50	20
Spain	40	40	20
Sweden	40	40	20
United Kingdom	-	100	-

MS	Co-incineration	Mono-incineration	Landfill
Bulgaria	50	-	50
Cyprus	50	-	50
Czech Republic	40	50	10
Estonia	50	-	50
Hungary	50	-	50
Latvia	50	-	50
Lithuania	50	-	50
Malta	-	-	-
Poland	50	-	50
Romania	50	-	50
Slovakia	50	-	50
Slovenia	100	-	-

6.3.3 Step 3: Impacts from the component – Costs and Benefits

The following table summarises the annual costs from this component and option. These include the internal and external costs from the alternative disposal options.

Table 83: Costs from New Limits of OC: Option 3 (EAC, €2009)

MS	Mono-incineration	Co-incineration	Costs of landfill	TOTALS
Austria	1,133,000	933,000	158,000	2,224,000
Belgium	416,000	341,000	58,000	815,000
Finland	448,000	290,000	-	738,000
France	29,387,000	15,392,000	3,287,000	48,067,000
Germany	28,191,000	18,591,000	-	46,782,000
Greece	658,000	220,000	181,000	1,059,000
Ireland	5,753,000	1,857,000	1,628,000	9,239,000
Italy	17,699,000	11,659,000	4,924,000	34,282,000
Luxembourg	556,000	453,000	78,000	1,086,000
Portugal	10,736,000	4,338,000	2,343,000	17,418,000
Spain	31,847,000	21,195,000	8,781,000	61,823,000
Sweden	1,603,000	1,046,000	449,000	3,098,000
UK	200,013,000	-	-	200,013,000
EU15	328,440,000	76,315,000	21,888,000	426,642,000
Bulgaria	-	1,138,000	796,000	1,934,000
Cyprus	-	197,000	161,000	357,000
Czech R	6,110,000	3,374,000	652,000	10,136,000
Estonia	-	131,000	103,000	233,000
Hungary	-	3,085,000	2,367,000	5,452,000
Latvia	-	284,000	222,000	506,000
Lithuania	-	801,000	607,000	1,408,000
Poland	-	5,682,000	4,342,000	10,024,000
Romania	-	857,000	636,000	1,493,000
Slovakia	-	1,139,000	874,000	2,013,000
Slovenia	-	197,000	-	197,000
EU-new	**6,110,000**	**16,885,000**	**10,760,000**	**33,755,000**

6.4 Set standards for pathogens

6.4.1 Step 1: Identification of MS affected by changes to the Directive

Option 3 will entail advanced treatment as envisaged in the 2003 communication to deal with pathogens. In other words, 'advanced treatment' means any sludge treatment listed in Section 3 or any other process that sanitises sludge and achieves:

- a 99.99% reduction (in the indicator micro-organism mentioned in Annex I) of *Escherichia coli* to less than $1 \cdot 10^3$ colony forming unit per gram (dry weight) of treated sludge;
- no Ascaris ova;
- a sample of 1 gram (dry weight) of the treated sludge does not contain more than $3 \cdot 10^3$ spores of *Clostridium perfringens*;
- and a sample of 50 grams (wet weight) of the treated sludge does not contain *Salmonella spp*; and
- a 99.99% reduction in *Salmonella senftenberg* W775 for sludge spiked with this micro-organism. This is a process validation and not used on a regular basis; it is used to demonstrate a treatment process is capable of removing Salmonella.

Table 83 shows the percentage of sludge which is expected to require advanced treatment so that it meets the proposed standards for pathogens. These percentages will be used in the cost-benefit analysis unless other estimates are suggested.

Table 84: % sludge affected under new treatment

MS	%	Source
Austria	50%	E
Belgium	50%	E
Denmark	20%	E
Finland	50%	E
France	80%	C
Germany	70%	C
Greece	50%	E
Ireland	50%	E
Italy	50%	E
Luxembourg	50%	E
Netherlands	0%	E
Portugal	90%	E
Spain	50%	E
Sweden	50%	E
United Kingdom	70%	C
Bulgaria	50%	E
Cyprus	50%	E
Czech Republic	50%	E
Estonia	50%	E
Hungary	50%	E
Latvia	50%	E
Lithuania	50%	E
Poland	50%	E

MS	%	Source
Romania	50%	E
Slovakia	50%	E
Slovenia	50%	E

6.4.2 Step 2: Impacts on Sludge Management

The consultation responses highlighted enhanced digestion, i.e. thermal treatment as the main process to deal with sludge. Owing to the stricter limits for pathogens under this Option than those under Option 2, the upper bound of unitary costs has been used for our estimates. This may, on the other hand, offset the conservative assumptions concerning the percentage of sludge failure, so a more realistic estimate can be produced.

6.4.3 Step 3: Impacts from the component – Costs and Benefits

The following table summarises the annual costs from this component and option.

Table 85: Costs from New Limits of Pathogens: Option 3 (EAC, €2009)

MS	Costs
Austria	1,072,000
Belgium	662,000
Denmark	567,000
Finland	348,000
France	95,693,000
Germany	41,752,000
Greece	489,000
Ireland	4,475,000
Italy	16,743,000
Luxembourg	533,000
Portugal	21,252,000
Spain	29,692,000
Sweden	1,535,000
United Kingdom	77,341,000
EU15	**292,154,000**
Bulgaria	1,018,000
Cyprus	216,000
Czech Republic	4,316,000
Estonia	137,000
Hungary	3,126,000
Latvia	295,000
Lithuania	799,000
Poland	5,728,000
Romania	831,000
Slovakia	1,154,000
Slovenia	106,000
EU-new	**17,727,000**
EU-TOTAL	**309,880,000**

6.4.4 Provision of Information on Nutrients

As for the component providing information on nutrients, this is unlikely to affect MS significantly. As noted under Option 2, there is currently a requirement to measure N&P in accordance with the existing Directive. This component may increase the costs but such increase is not expected to be significant.

6.4.5 Other changes concerning quality and aimed at prevention

Option 3 will require Hazard Analysis and Critical Control Point (HACCP), as for Option 2. Under this component, we have assumed that the percentages of sludge affected will be the same; only in this case, the upper bound costs will apply (as companies will have to observe more substances). The costs estimates from this are summarised below.

Table 86: Costs from Quality Assurance: Option 3(EAC, €2009)

MS	**Costs**
Austria	19,000
Belgium	12,000
Denmark	64,000
Finland	6,000
France	673,000
Germany	383,000
Greece	9,000
Ireland	81,000
Italy	301,000
Luxembourg	10,000
Portugal	118,000
Spain	534,000
Sweden	28,000
United Kingdom	710,000
EU15	2,948,000
Bulgaria	115,000
Cyprus	24,000
Czech Republic	486,000
Estonia	15,000
Hungary	352,000
Latvia	33,000
Lithuania	90,000
Poland	644,000
Romania	93,000
Slovakia	130,000
Slovenia	12,000
EU-new	**1,994,000**
EU-TOTAL	**4,943,000**

6.5 Change in limits based on soil conditions

6.5.1 Step 1: Identification of MS affected by changes to the Directive

Under Option 3, the limit for zinc in soil with be decreased to 20mg/kg DS for all soils with a pH below 7, where as the proposed limits for Cd, Cr, Cu, Hg, NI and Pb are the same as those specified under Option 2. The proposed values are replicated in the following Table.

Table 87: Limits for PTE in soil – Option 3

PTE	5≤pH<6	6<pH<7	pH≥7
Cd	0.5	1	1.5
Cr	50	75	100
Cu	30	50	100
Hg	0.1	0.5	1
Ni	30	50	70
Pb	70	70	100
Zn	20	20	200

Based on current permissible concentrations of PTEs in sludge treated soils, all member states will be affected to some extent by these revised new limits, in particular those relating to Zn. For example, we estimate that 40% of the total agricultural land in the UK will not be available for sludge recycling should these limits be implemented. This component is expected to have significant impacts on the land which is available for sewage spreading. Table 87 presents our estimates of the percentages of land failing.

Table 88: % of failing land (due to heavy metals) considered under Option 3

MS	%	Source
Austria	20%	E
Belgium	40%	E
Denmark	0%	E
Finland	20%	E
France	50%	C
Germany	40%	C
Greece	40%	E
Ireland	20%	E
Italy	40%	E
Luxembourg	40%	E
Netherlands	0%	E
Portugal	40%	C
Spain	40%	E
Sweden	40%	E
United Kingdom	80%	C
EU15		
Bulgaria	40%	E
Cyprus	40%	E
Czech Republic	40%	E
Estonia	40%	E
Hungary	40%	E

MS	%	Source
Latvia	40%	E
Lithuania	40%	E
Malta	0%	E
Poland	40%	E
Romania	40%	E
Slovakia	40%	E
Slovenia	40%	E

6.5.2 Step 2: Impacts on Sludge Management

The main assumption affecting our calculation is that the land affected is equated to the % of recycled sludge affected. Thus, the failing sludge will have to be disposed of by incineration and/or landfilling (further treatment is not consider feasible in this case as the standards concern background concentrations). The following estimates are given in order to calculate the costs.

Table 89: Alternative disposal (% of failing sludge going to different disposal)

MS	Co-incineration	Mono-incineration	Landfill
Austria	50	40	10
Belgium	50	40	10
Finland	50	50	-
France	40	50	10
Germany	50	50	-
Greece	25	50	25
Ireland	25	50	25
Italy	40	40	20
Luxembourg	50	40	10
Portugal	30	50	20
Spain	40	40	20
Sweden	40	40	20
United Kingdom	-	100	-
Bulgaria	50	-	50
Cyprus	50	-	50
Czech Republic	40	50	10
Estonia	50	-	50
Hungary	50	-	50
Latvia	50	-	50
Lithuania	50	-	50
Poland	50	-	50
Romania	50	-	50
Slovakia	50	-	50
Slovenia	100	-	-

6.5.3 Step 3: Impacts from the component – Costs and Benefits

The following costs are calculated on the basis of the costs of the alternative disposal options. The unit cost presented in Section 2 are used for the analysis. It is important to note that owing to the nature of the unit costs, such costs include both environmental and human health costs in addition to financial costs. The environmental costs on the basis of the degree of quantification possible to date however represent around

10% of the total costs (although in the case of incineration the externality are closer to the 10% value of the total quantifiable costs). Estimates on the GHG for this component are presented at the end of the Section for the sake of brevity.

Table 90: Costs and Benefits from Limits of PTE in soil (EAC, €2009)

MS	Costs from mono-incineration	Costs from co-incineration	Costs of landfill	TOTALS
Austria	453,000	373,000	63,000	890,000
Belgium	555,000	454,000	78,000	1,086,000
Finland	179,000	116,000	-	295,000
France	48,978,000	25,654,000	5,479,000	80,111,000
Germany	22,553,000	14,872,000	-	37,425,000
Greece	527,000	176,000	145,000	847,000
Ireland	2,301,000	743,000	651,000	3,695,000
Italy	14,159,000	9,327,000	3,939,000	27,426,000
Luxembourg	444,000	362,000	62,000	869,000
Portugal	7,158,000	2,892,000	1,562,000	11,612,000
Spain	25,477,000	16,956,000	7,025,000	49,459,000
Sweden	1,282,000	837,000	359,000	2,478,000
United Kingdom	168,432,000	-	-	168,432,000
EU15	**292,498,000**	**72,763,000**	**19,364,000**	**384,625,000**
Bulgaria	-	910,000	637,000	1,547,000
Cyprus	-	157,000	129,000	286,000
Czech Republic	4,888,000	2,699,000	522,000	8,109,000
Estonia	-	105,000	82,000	187,000
Hungary	-	2,468,000	1,893,000	4,361,000
Latvia	-	227,000	178,000	405,000
Lithuania	-	641,000	486,000	1,127,000
Poland	-	4,546,000	3,474,000	8,019,000
Romania	-	686,000	509,000	1,195,000
Slovakia	-	911,000	699,000	1,611,000
Slovenia	-	158,000	-	158,000
EU-new	**4,888,000**	**13,508,000**	**8,608,000**	**27,004,000**
EU-TOTAL	**297,387,000**	**86,271,000**	**27,972,000**	**411,629,000**

6.5.4 Setting conditions on application

Option 3 proposes a ban on application of sludge for fruit and vegetable crops and a ban for grassland. This component will thus have the following costs implications:

- Costs to sludge producers: quantities of sludge currently used on fruit and vegetable will have to be disposed differently, though incineration and/or landfill; and
- Costs to farmers: fertiliser replacement and, potentially, loss of agricultural production.

Some countries already have considerable restrictions relating to the types of land or timing of application of sewage sludge. The implications of banning the use of sludge on fruit and vegetable crops and grassland are therefore expected to vary significantly by country. Currently, we have limited information on the amount of sludge applied on fruit, vegetable crops and grassland.

Some consultess have stated that this component will have limited impacts (based on national legislation and practices). Others however such as Portugal and the Uk have highlighted that there will be costs implications. As information on the application of sludge on these particular crops alone is not available, it is not feasible at the time of writing to put a monetary value on such impacts. If these crops represented a significant amount of sludge, the costs for this countries will be similar to those calculated under Option 4.

6.5.5 Changes to sampling and monitoring requirements

Under Option 3, sampling and monitoring requirements will be as for Option 2 but Option 3 could have more substances to be tested, including organics.

Table 39: Proposed Analyses

Quantity of sludge produced per year and per plant (tonnes of dry matter)	Minimum number of analyses per year				
	Agronomic parameters	Heavy metals	Organic compounds (except dioxins)	Dioxins	Micro-organisms
< 50	1	1	-	-	1
50 – 250	2	2	-	-	2
250 – 1 000	4	4	1	-	4
1 000 – 2 500	4	4	2	1	4
2 500 – 5 000	8	8	4	1	8
> 5 000	12	12	6	2	12
Note that the number of analyses per substance is likely to be the same as under Option 2. However, for Option 3, organics such as PAH, PCB, PCDD/F, LAS and NPE will require testing.					

Similarly as for Option 2, the costs of Option 3 in this regard are similar to those calculated under quality assurance.

6.6 Impacts from Option 3

The impacts from Option 3 are expected to be more significant than for Option 2, due to the more stringent limits and the conditions on application. The following Table summarises the net costs of the different components from this Option. These include:

- Costs of alternative disposal;
- Obligation of treatment;
- Loss of use of sludge as a fertiliser and fertiliser replacement costs;
- Benefits/costs from alternative routes of disposal including climate change; and
- Human health from alternative routes of disposal.

Table 91: PV costs from Different Option Components under Option 3

MS	PTE in sludge	OC	Pathogens	QA= Increased analysis	PTE in soil
Austria	8,682,000	21,706,000	10,463,000	188,000	8,682,000
Belgium	5,302,000	7,952,000	6,457,000	116,000	10,603,000
Denmark	28,533,000	-	5,534,000	623,000	-
Finland	1,440,000	7,202,000	3,395,000	61,000	2,881,000
France	781,921,000	469,153,000	934,005,000	6,567,000	781,921,000

MS	PTE in sludge	OC	Pathogens	QA= Increased analysis	PTE in soil
Germany	730,578,000	456,611,000	407,524,000	3,743,000	365,289,000
Greece	10,338,000	10,338,000	4,776,000	86,000	8,271,000
Ireland	90,173,000	90,173,000	43,675,000	786,000	36,069,000
Italy	334,608,000	334,608,000	163,415,000	2,941,000	267,686,000
Luxembourg	2,120,000	10,601,000	5,207,000	94,000	8,481,000
Portugal	170,008,000	170,008,000	207,430,000	1,152,000	113,339,000
Spain	603,424,000	603,424,000	289,810,000	5,217,000	482,739,000
Sweden	12,095,000	30,238,000	14,980,000	270,000	24,190,000
United Kingdom	1,130,231,000	1,952,218,000	754,888,000	6,933,000	1,643,973,000
EU15	**3,909,455,000**	**4,164,233,000**	**2,851,559,000**	**28,777,000**	**3,754,125,000**
Bulgaria	22,647,000	18,872,000	9,941,000	1,118,000	15,098,000
Cyprus	4,187,000	3,489,000	2,112,000	238,000	2,791,000
Czech Republic	118,723,000	98,936,000	42,126,000	4,739,000	79,149,000
Estonia	2,735,000	2,279,000	1,336,000	150,000	1,823,000
Hungary	63,853,000	53,211,000	30,511,000	3,433,000	42,569,000
Latvia	5,931,000	4,942,000	2,880,000	324,000	3,954,000
Lithuania	16,495,000	13,746,000	7,799,000	877,000	10,997,000
Poland	117,410,000	97,842,000	55,910,000	6,290,000	78,273,000
Romania	17,492,000	14,577,000	8,109,000	912,000	11,661,000
Slovakia	23,581,000	19,651,000	11,268,000	1,268,000	15,721,000
Slovenia	2,308,000	1,924,000	1,032,000	116,000	1,539,000
EU-new	**395,363,000**	**329,469,000**	**173,024,000**	**19,465,000**	**263,575,000**
EU-TOTAL	**4,304,818,000**	**4,493,702,000**	**3,024,583,000**	**48,242,000**	**4,017,700,000**

Table 92: EAC costs from Different Option Components under Option 3

MS	PTE in sludge	OC	Pathogens	QA= Increased analysis	PTE in soil
Austria	890,000	2,224,000	1,072,000	19,000	890,000
Belgium	543,000	815,000	662,000	12,000	1,086,000
Denmark	2,923,000	-	567,000	64,000	-
Finland	148,000	738,000	348,000	6,000	295,000
France	80,111,000	48,067,000	95,693,000	673,000	80,111,000
Germany	74,851,000	46,782,000	41,752,000	383,000	37,425,000
Greece	1,059,000	1,059,000	489,000	9,000	847,000
Ireland	9,239,000	9,239,000	4,475,000	81,000	3,695,000
Italy	34,282,000	34,282,000	16,743,000	301,000	27,426,000
Luxembourg	217,000	1,086,000	533,000	10,000	869,000
Portugal	17,418,000	17,418,000	21,252,000	118,000	11,612,000
Spain	61,823,000	61,823,000	29,692,000	535,000	49,459,000
Sweden	1,239,000	3,098,000	1,535,000	28,000	2,478,000
United Kingdom	115,797,000	200,013,000	77,341,000	710,000	168,432,000
EU15	**400,539,000**	**426,642,000**	**292,154,000**	**2,948,000**	**384,625,000**
Bulgaria	2,320,000	1,934,000	1,018,000	115,000	1,547,000
Cyprus	429,000	357,000	216,000	24,000	286,000
Czech Republic	12,164,000	10,136,000	4,316,000	486,000	8,109,000

MS	PTE in sludge	OC	Pathogens	QA= Increased analysis	PTE in soil
Estonia	280,000	233,000	137,000	15,000	187,000
Hungary	6,542,000	5,452,000	3,126,000	352,000	4,361,000
Latvia	608,000	506,000	295,000	33,000	405,000
Lithuania	1,690,000	1,408,000	799,000	90,000	1,127,000
Poland	12,029,000	10,024,000	5,728,000	644,000	8,019,000
Romania	1,792,000	1,493,000	831,000	93,000	1,195,000
Slovakia	2,416,000	2,013,000	1,154,000	130,000	1,611,000
Slovenia	237,000	197,000	106,000	12,000	158,000
EU-new	**40,506,000**	**33,755,000**	**17,727,000**	**1,994,000**	**27,004,000**
EU-TOTAL	**441,046,000**	**460,398,000**	**309,881,000**	**4,943,000**	**411,629,000**

As it can be seen from the Table, the component causing the greatest costs is the new limits of OC followed by PTE limits in sludge.

6.6.1 Environmental and Human Health Impacts

Although there will be benefits (environmental and human health) from more stricter standards these cannot be easily quantified. This is due to the lack of evidence on dose-response but it is uncertain whether this is due to the Directive and/or existing national legislation and practices.

The external costs from alternative disposal options subject to quantification are expected to be around 10% of the total costs of the values above. Table 92 presents the valuation of GHG emissions based on the emissions from alternative disposal applied (environmental and human health impacts due to GHG emissions).

Table 93: EAC due to GHG from alternative disposal by Component

MS	PTE in sludge	OC in sludge	PTE in soil
Austria	121,000	302,000	121,000
Belgium	71,000	106,000	141,000
Denmark	298,000	-	-
Finland	18,000	88,000	35,000
France	9,981,000	5,989,000	9,981,000
Germany	10,396,000	6,498,000	5,198,000
Greece	138,000	138,000	110,000
Ireland	934,000	934,000	374,000
Italy	4,386,000	4,386,000	3,508,000
Luxembourg	27,000	136,000	109,000
Portugal	2,493,000	2,493,000	1,662,000
Spain	8,507,000	8,507,000	6,805,000
Sweden	148,000	370,000	296,000
United Kingdom	14,020,000	24,217,000	20,393,000
EU15	**51,537,000**	**54,164,000**	**48,734,000**
Bulgaria	484,000	403,000	322,000
Cyprus	58,000	48,000	39,000
Czech Republic	2,116,000	1,763,000	1,411,000
Estonia	42,000	36,000	28,000
Hungary	1,070,000	892,000	713,000
Latvia	94,000	79,000	63,000

MS	PTE in sludge	OC in sludge	PTE in soil
Lithuania	286,000	239,000	191,000
Malta	-	-	-
Poland	1,985,000	1,654,000	1,323,000
Romania	327,000	273,000	218,000
Slovakia	397,000	330,000	264,000
Slovenia	48,000	40,000	32,000
EU-new	**7,169,000**	**5,975,000**	**4,781,000**
EU-TOTAL	**58,706,000**	**60,139,000**	**53,514,000**

6.6.2 Other Impacts

One other impact that was considered in the initial assessment was the effects on agricultural production. Consultation has revealed however that such impacts are expected to be negligible.

There may be some benefits in terms of amenity and public perception. These are highly uncertain however and have not been valued. One other benefit from this Option is that it will help meeting some other legislation objectives, such as WFD objectives. On the other hand, too stringent limits may compromise meeting some other legislation such as the Waste Directive. These impacts have been highlighted by the consultees but are difficult to put a monetary value on.

6.6.3 Distributional Analysis

6.6.3.1 Distributional impacts among MS

The impacts from the different option components will vary according to the MS. The following Table sets out the percentages of costs falling on the different MS according to their contribution to the total costs. As it can be seen, the main costs will fall onto the old MS. This is, as for Option 2, due to the fact that the projections from the sludge arising are more significant. Among those EU-15 that are likely to be the most affected are the UK, France, Germany and Spain; although the percentages vary according to the component considered. It is important to note here, however, that the zeros may be due to rounding and do not necessarily entail zero costs (but the costs would be small against the totals).

Table 94: Distributional Analysis

MS	PTE in sludge	OC	Pathogens	QA= Increased analysis	PTE in soil
Austria	0%	0%	0%	0%	0%
Belgium	0%	0%	0%	0%	0%
Denmark	1%	0%	0%	1%	0%
Finland	0%	0%	0%	0%	0%
France	18%	10%	31%	14%	19%
Germany	17%	10%	13%	8%	9%
Greece	0%	0%	0%	0%	0%
Ireland	2%	2%	1%	2%	1%
Italy	8%	7%	5%	6%	7%
Luxembourg	0%	0%	0%	0%	0%
Netherlands	0%	0%	0%	0%	0%
Portugal	4%	4%	7%	2%	3%
Spain	14%	13%	10%	11%	12%
Sweden	0%	1%	0%	1%	1%

MS	PTE in sludge	OC	Pathogens	QA= Increased analysis	PTE in soil
United Kingdom	26%	43%	25%	14%	41%
EU15	**91%**	**93%**	**94%**	**60%**	**93%**
Bulgaria	1%	0%	0%	2%	0%
Cyprus	0%	0%	0%	0%	0%
Czech Republic	3%	2%	1%	10%	2%
Estonia	0%	0%	0%	0%	0%
Hungary	1%	1%	1%	7%	1%
Latvia	0%	0%	0%	1%	0%
Lithuania	0%	0%	0%	2%	0%
Malta	0%	0%	0%	0%	0%
Poland	3%	2%	2%	13%	2%
Romania	0%	0%	0%	2%	0%
Slovakia	1%	0%	0%	3%	0%
Slovenia	0%	0%	0%	0%	0%
EU-new	**9%**	**7%**	**6%**	**40%**	**7%**
EU-TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**

6.6.3.2 Distributional impacts among Stakeholders

As for distributional impacts among stakeholders, the main stakeholders affected are:

- sludge producers: operators of sewage treatment works would have to upgrade and replace current treatment plant equipment in order to meet the new standards of treatment set out in the regulations and dispose of the sludge that will not be recycled; and
- local authorities/municipalities: running the incinerators and/or landfills (and/or companies on their behalf or sub-contractors) that may need upgrading capabilities and/or setting new incinerator facilities and
- farmers: who are the sludge users, would have to comply with revised restrictions. Farmers would face costs for replacement of fertilisers (or treated sludge). However the consultation has revealed that they will use other organic fertilisers and not just mineral fertilisers which may be more expensive. The costs in terms of impacts on agricultural production are according to the stakeholders likely to be negligible. Hence unemployment impacts are expected to be negligible in this sector alone.

The exact distribution in costs is uncertain but sludge producers and waste disposal facilities will bear the greatest costs. Stakeholders have expressed concerns about the possibility that water companies may pass on the costs from complying with new standards. This is possible; in some MS, however, such price increases are regulated, e.g. the UK, and as a result such increases are not expected to be significant.

On the other hand, stakeholder have highlighted that strict limits on sludge may cause unemployment impacts on related sectors such as manufacturers of recycling machinery. These impacts need highlighting although their quantification is surrounded by uncertainty.

Environmental and social costs will accrue from increased incineration and landfill, as these will be the alternative routes for disposal to untreated sludge. These will accrue to all stakeholders through airborne pollutants.

7. Option 4: total ban on the use of sludge on land

7.1 Overview of Option 4

Option 4 will consist of a total ban on the use of sludge on land.

The main risks from this Option relate to the impacts from the alternative means of disposal for sludge, amenity impacts from landfill and public health risk from incineration (i.e. air emissions). Such impacts are quantified below. The main benefits relate to reduced risk to the environment and human health from application of sludge, but these will have to offset the costs of the alternative routes of disposal, which seems unlikely. There will be benefit from compliance with other legislation, such as the WFD. But these are very difficult to quantify due to uncertainty about the degree of implementation of relevant legislation at national level.

7.2 Impacts from Option 4

7.2.1 Step 1: Identification of MS affected by changes to the Directive

This Option will have significant implications in all MS, excluding parts of Austria (specifically two of its nine federal states) and the Netherlands (since there effectively is already a ban).

The countries most affected by the ban will be those where recycling is the greatest, i.e Luxembourg, Ireland, France, UK, Hungary, Spain.

7.2.2 Step 2: Impacts on Sludge Management

The only alternatives for the sludge failing will be incineration and/or landfill. The following Table summarises the assumptions in terms of disposal for sludge failing the standards.

Table 95: Disposal for sludge under Option 4

MS	Co-incineration	Mono-incineration	Landfill
Austria	50	40	10
Belgium	50	40	10
Denmark	40	50	10
Finland	50	50	-
France	40	50	10
Germany	50	50	-
Greece	25	50	25
Ireland	25	50	25
Italy	40	40	20
Luxembourg	50	40	10
Netherlands	-	-	-
Portugal	30	50	20
Spain	40	40	20
Sweden	40	40	20
United Kingdom	-	100	-
EU15	-	-	-
Bulgaria	50	-	50
Cyprus	50	-	50
Czech Republic	40	50	10
Estonia	50	-	50
Hungary	50	-	50
Latvia	50	-	50

MS	Co-incineration	Mono-incineration	Landfill
Lithuania	50	-	50
Poland	50	-	50
Romania	50	-	50
Slovakia	50	-	50
Slovenia	100	-	-

7.2.3 Step 3: Impacts from the component – Costs and Benefits

The following costs are calculated on the basis of the costs of the alternative disposal options. The unit cost presented in Section 3 are used for the analysis. It is important to note that owing to the nature of the unit costs, such costs include both environmental and human health costs in addition to financial costs. The environmental costs on the basis of the degree of quantification possible to date however represent around 10% of the total costs (although in the case of incineration the externality are closer to the 10% value of the total quantifiable costs). Estimates on the GHG for this component are presented at the end of the Section.

Table 96: Costs from Option 4 (EAC, €2009)

MS	Costs from mono-incineration	Costs from co-incineration	Costs of landfill	TOTALS
Austria	2,266,000	1,866,000	315,000	4,448,000
Belgium	1,387,000	1,135,000	194,000	2,716,000
Denmark	8,992,000	4,598,000	1,026,000	14,617,000
Finland	896,000	580,000	-	1,476,000
France	97,956,000	51,308,000	10,958,000	160,222,000
Germany	56,382,000	37,181,000	-	93,563,000
Greece	1,317,000	439,000	362,000	2,118,000
Ireland	11,507,000	3,715,000	3,256,000	18,477,000
Italy	35,398,000	23,318,000	9,848,000	68,564,000
Luxembourg	1,111,000	905,000	156,000	2,172,000
Portugal	17,894,000	7,231,000	3,906,000	29,030,000
Spain	63,694,000	42,390,000	17,562,000	123,646,000
Sweden	3,205,000	2,092,000	899,000	6,196,000
United Kingdom	210,540,000	-	-	210,540,000
EU15	**512,544,000**	**176,758,000**	**48,483,000**	**737,785,000**
Bulgaria	-	2,000	2,000	4,000
Cyprus	-	394,000	321,000	715,000
Czech Republic	12,221,000	6,748,000	1,304,000	20,273,000
Estonia	-	261,000	206,000	467,000
Hungary	-	6,170,000	4,734,000	10,903,000
Latvia	-	569,000	444,000	1,013,000
Lithuania	-	1,602,000	1,215,000	2,817,000
Poland	-	11,364,000	8,685,000	20,049,000
Romania	-	1,715,000	1,272,000	2,987,000
Slovakia	-	2,279,000	1,748,000	4,027,000
Slovenia	-	394,000	-	394,000
EU-new	**12,221,000**	**31,497,000**	**19,930,000**	**63,648,000**

EU-TOTAL	**524,765,000**	**208,255,000**	**68,412,000**	**801,433,000**

The impacts from Option 4 are expected to be more significant than for any of the other options. The above figures include the costs, internal and external, for alternative disposal options for sludge that will not be recycled due to the ban.

The benefits from the ban itself in terms of reduced risk to the environment and human health are not included above. This is because, as highlighted earlier such benefits are not subject to valuation (due to the lack of data on dose-response).

7.2.4 GHG from alternative disposal

The costs from GHG emissions are set out in the next table.

Table 97: Costs from Option 4 (EAC, €2009)

MS	Landfill Costs	Mono-incineration	Co-incineration	TOTAL
Austria	22,000	261,000	321,000	604,000
Belgium	13,000	152,000	188,000	353,000
Denmark	53,000	804,000	633,000	1,490,000
Finland	-	89,000	87,000	176,000
France	716,000	10,769,000	8,477,000	19,962,000
Germany	-	6,550,000	6,446,000	12,995,000
Greece	28,000	166,000	82,000	276,000
Ireland	187,000	1,126,000	554,000	1,868,000
Italy	678,000	4,079,000	4,014,000	8,771,000
Luxembourg	10,000	118,000	145,000	272,000
Portugal	320,000	2,411,000	1,423,000	4,155,000
Spain	1,315,000	7,912,000	7,786,000	17,013,000
Sweden	57,000	344,000	339,000	740,000
United Kingdom	-	25,492,000	-	25,492,000
EU15	3,398,000	60,274,000	30,496,000	94,167,000
Bulgaria	-	-	628,000	628,000
Cyprus	-	-	76,000	76,000
Czech Republic	-	1,917,000	1,509,000	3,426,000
Estonia	-	-	56,000	56,000
Hungary	-	-	1,405,000	1,405,000
Latvia	-	-	124,000	124,000
Lithuania	-	-	375,000	375,000
Poland	-	-	2,612,000	2,612,000
Romania	-	-	422,000	422,000
Slovakia	-	-	519,000	519,000
Slovenia	-	-	80,000	80,000
EU-new	2,227,000	1,917,000	7,807,000	11,950,000
EU-TOTAL	**5,625,000**	**62,190,000**	**38,302,000**	**106,117,000**

7.2.5 Distributional Analysis

7.2.5.1 Distributional impacts among MS

The table below provides the share of the total costs by MS. As it was noted earlier the countries most affected are the UK and France due to the greatest amount of sludge being recycled. The EU-15 will bear the greatest costs of the ban as opposed to newer MS (this also is due to the volume of sludge generated).

Table 98: Distributional Analysis

MS	**Share of total costs**
Austria	1%
Belgium	0%
Denmark	2%
Finland	0%
France	20%
Germany	12%
Greece	0%
Ireland	2%
Italy	9%
Luxembourg	0%
Netherlands	0%
Portugal	4%
Spain	15%
Sweden	1%
United Kingdom	26%
EU15	**92%**
Bulgaria	0%
Cyprus	0%
Czech Republic	3%
Estonia	0%
Hungary	1%
Latvia	0%
Lithuania	0%
Malta	0%
Poland	3%
Romania	0%
Slovakia	1%
Slovenia	0%
EU-new	**8%**
EU-TOTAL	**100%**

7.2.5.2 Distributional impacts among stakeholders

As before, the main cost will fall onto sludge and waste disposal operators and farmers currently using the sludge. The impacts on the sludge operators however are significantly greater than on the farmers.

There may be a possibility that the costs will be passed on to consumers. Price-elasticities for water services are fairly inelastic; on the other hand, regulation in some MS could stop water companies to pass all the costs in full. Information on price elasticities by MS is not available; hence these impacts cannot be evaluated in detail. However, owing to the greater costs, the possibility that these costs may be passed on is greater than for the other Options.

As before, there will be social impacts associated with the human health impacts stemming from the alternative disposal routes will fall on all stakeholders. These have been included in the above values however.

7.3 Summary of Costs and Benefits and Distributional Impacts from Option 4

This Option is likely to have significant impacts on the different MS. The main costs associated with this option will be related to:

- financial costs from increased incineration and recycling;
- environmental costs from increased incineration and recycling (i.e. from transport and emissions); and
- human health impacts derived from the above (increased incineration and landfill).

The total costs estimated in Andersen & Sede (2002), for the scenario where no sludge is able to meet the new regulatory requirements, could be seen as a check for this Option. This scenario led to costs of 1.2bn/year for the 15 MS of the European Union.

Another study calculated the value of sewage sludge in the EU to range from 0.5% to 1% of the total agricultural budget in the EU[45] (used to substitute mineral fertiliser). The agricultural budget for the EU in 2009 is €116bn. This would imply that the value of sludge is of around €0.58bn to €1.16bn per year.

Our estimates, annualised costs, are estimated to be of around €0.8bn. This is not very far off the estimate produced above.

[45] Kroiss H and Zessner M (2007): Ecological and Economical Relevance of Sludge Treatment and Disposal Options, Institute for Water Quality and Waste Management at Vienna University of Technology, Austria.

8. Option 5: Repeal of the Directive

8.1 Overview of Option

Option 5 will involve repealing the Directive.

8.2 Impacts from this Option

The impacts of this option will depend on two main issues: first, how Member States react and in particular whether they might change national legislation governing sewage sludge; and second, the extent to which other EC legislation might govern the sludge disposal and in particular the spreading of sludge on land. The future actions of the Member States in this situation in particular are difficult to predict.

8.2.1 Actions of Member States

As noted above, it is quite difficult to predict the actions of Member States were the Sewage Sludge Directive to be repealed. On the one hand, Member States with national legislation that is currently more stringent than the directive might keep this in place. However, Member States would also be free to remove all restrictions on sludge disposal (within the restrictions of other EC legislation).

Under this Option, however, we could assume that the national legislation will remain in place especially in the short term but changes may be introduced in the future. The greatest issue however is that in the case that some Member States lift all restrictions on sludge disposal. In this case, people could just apply sludge how and when they wanted (in line with national requirements). This may not guarantee a standard level of protection across all MS.

8.2.2 Influence of other EC legislation

Without the Sewage Sludge Directive in place, other EC legislation might influence the spreading of sludge on land. The following table presents an overview of other environmental protection legislation that might influence the spreading of sludge. (Note that such drivers also apply to the baseline scenario).

Table 99: Current EC environmental legislation that might influence the spreading of sludge on land if Directive 86/278/EEC were to be repealed

Directive	Potential influence
Directive 2008/98/EC	• sets the basic concepts and definitions related to waste managament and lays down waste management principles such as the "polluter pays principle" or the "waste hierarchy" thus recycling is a better options than disposal; • could lead to further recycling provided that standards are being met (will favour incineration versus landfilling)
Directive 91/676/EEC – Nitrates Directive	• Fertilizer application limited in nitrate vulnerable zones; also affects sludge application • No influence on other pollutants
Council Regulation (EC) No 889/2008 on organic production and labelling of organic products	• Ban on organic labelling of sewage sludge (Annex I to Regulation contains positive lists of fertilisers and soil improvers allowed in organic farming. Sludge is not included) • As organic production is a small share of all agriculture, any effects from this Regulation or Member State requirements likely to be negligible overall; perhaps some influence in restricted local areas
EC Decisions 2006/799 and 2007/64 on criteria for the award of a Community eco-label to growing media	• Growing media containing sludge shall not be awarded an eco-label • Same as above: likely to have negligible or mainly local effects
Environmental Liability Directive	• Environmental liability requirements may encourage private operators to

Directive	Potential influence
2004/35/EC	use good practice for sludge disposal – not all operators, however, may do so
Directive 2003/87/EC on greenhouse gas emissions	• Possible impact on ammonia production
Directive 2006/118/EC – groundwater protection against pollution and groundwater quality standards	• May influence spreading of sludge in local areas where groundwater exceeds quality standards
Directive 2008/105/EC – EQS for pollutants to achieve good surface water quality	• May influence spreading of sludge in local areas where surface waters exceed quality standards

The initial analysis suggests that these pieces of legislation may have some influence on the spreading of sewage sludge. However, they will influence only specific pollutants (the case for the Nitrates Directive) or local areas, for example where groundwater or surface water quality does not meet standards. While the Liability Directive might have a more broad-based influence, it may not affect all operators.

The European Commission's proposal for a Framework Soils Directive (COM(2006) 232) may have a more far-reaching effect. This proposal remains under discussion, however, and in the face of this uncertainty it has not been assessed.

A further question is whether EC food safety legislation would protect human health from indirect exposure, e.g. from fruits and vegetables grown using sewage sludge. Here, a broad and integrated framework of legislation has been put in place to ensure food safety (the framework is provided by Regulation (EC)178/2002 laying down the General Principles and requirements of Food Law). It is not clear, however, if this legislation and its implementation currently addresses potential risks from the spreading of sewage to land, as these are covered by the Sewage Sludge Directive. The repeal of this directive might require an adjustment of food safety legislation and its implementation in order to ensure adequate protection of human health.

8.3 Assessment of Option

8.3.1 Assessment of economic impacts

The marginal costs of this Option against the baseline are negligible.

The benefits will be in terms of costs savings from current monitoring, sampling and analysis accruing to the regulatory authorities. However, it is not certain that MS will change their regulation and practices. Indeed, it is unlikely that repeal of the Directive will lead to the adoption of less stringent quality standards for sludge in national legislation, especially in the short term. This is based on the results of the first consultation. So savings may not be large.

It is important to identify that such option may affect trade among MS depending on consumers' perception of risk from different products. Competitiveness and competition may be affected at EU level too; operators of wastewater treatment plants across the EU might find much greater divergences among Member State requirements than at present. While in some Member States they might realise savings, in others they would not. This could indicate significant distributional impacts.

8.3.2 Assessment of environmental and social impacts

In a worst-case scenario, a country could remove all restrictions on the spreading of sludge. This might create actual health impacts from contamination of food, and while sludge is not traded among Member

States, food is, making this a risk for the EU as a whole. The question is: does EU food safety legislation provide adequate safeguards against such an event?

In addition, as highlighted above, consumer perception and confidence are likely to play a key role on the social impacts (and likely macro-economic impacts) from this Option. It is important to identify that such option may affect consumer confidence as well as trade among MS depending on consumers' perception of risk from different products. The repeal of the directive could significantly reduce consumer confidence in the safety of food products, either from specific Member States or in general. In the consultations for this study, one stakeholder warned that the end result could be an end to all spreading of sewage sludge on land.

8.4 Summary of Costs and Benefits from Option 5

This preliminary review thus suggests that other EC environmental legislation would not provide sufficient protection of the environment in the event that Directive 86/278/EEC were to be repealed; nor would other legislation provide sufficient protection of human health from direct impacts of sewage sludge spread on land.

The responses from the consultation on this Option include the following:

> *Option 5 is not acceptable as it cannot guarantee protection of the environment. It will have an impact on stakeholders' confidence. This could lead to a sudden loss of the sludge to land outlet and Option 5 will have similar impacts to Option 4.*
>
> *86/278/EEC was the first soil protection directive and to a very large extent it still is. It would be very regrettable if it was repealed.*
>
> *Option 5 is unacceptable because there must be a legal instrument that provides protection of public health and the Environment*
>
> *In relation to option 5, any perceived savings are likely to be offset by the damage which might result to consumer confidence and the land bank for spreading.*

This tentative conclusion would appear to make this option unacceptable.

9. Sensitivity Analysis

9.1 Main sources of uncertainty

The main sources of uncertainty of this impact assessment relate to the following:

a. assumptions concerning the amount of sludge being affected and the different management routes for the sludge failing to meet the new standards;
b. unitary costs and benefits related to the different management options.

Sensitivity analysis is undertaken on the three aspects below.

9.2 Sensitivity on Amount of Sludge affected and disposal

The assumptions concerning the sludge affected were revisited on the basis of the responses provided by the consultees. Overall, it is expected that the consultees have taken into account responses on existing pollution prevention measures in their countries when answering the relevant questions. However, sensitivity analysis is still undertaken to account for the fact that more stringent analysis may lead MS to undertake further pollution prevention at source thus reducing the amount of sludge affected going to incineration and/or landfill as disposal.

Pollution prevention may be implemented through a variety of measures and can include individual regulatory, economic and voluntary and educational instruments. These instruments are consistent with an overall strategy of waste minimisation, polluter pays, and reduction at source. Examples of such instruments in the past are included in the following box. The effectiveness of such instruments however has been variable, with the waste water tax in Germany being limited but other such as the Danish eco-labelling of washing powders containing LAS being highly effective. In cases, however, the same instrument can have a varied impact depending on local conditions, e.g. a public campaign effectiveness may depend on the degree of public awareness at the time the campaign is out.

Box 1: Examples of Pollution prevention programmes

- Targeted waste collection in France;
- Charges on Cadmium fertilisers in Sweden;
- Provision of consumer information in France;
- Wastewater Tax in Germany;
- UK code of practice for the Dentist sector to reduce discharges of mercury to the sewerage system;
- Eco-labelling and LAS in Scandinavia;

Source: ICON (2001): Pollutants in urban waste water and sewage sludge,a report for the European Commission DG Environment.

Information on the costs and effectiveness of pollution prevention measures at source is limited by MS and moreover can be expected to vary significantly. The selection of measure or technology to pollution prevention and control will depend on the availability of resources but other aspects concerning perception. Examples of costs from pollution reduction measures are provided below.

Box 2: Targeted Waste Collection in France

This measure constitutes a specific drive and effort by authorities to collect dangerous and harmful waste from homes. While effective in its own terms it is not a long-term solution to the problem of discharges to UWW. It may be effective to deal with continuing risks of contamination from smaller and diffuse sources, and be used in connection with the adoption of a longer-term waste minimisation and collection strategy and public education campaign. One of the first targeted waste collection initiatives carried out in France was in 1989, where 11,500 kg of waste products were collected over 16 days, including solvents, paints, medicines among other waste categories. The costs of one such campaign in Boisset-Gaujac (Gard), conducted in 1994, was estimated at about 12,000 French francs . This consisted of two days of product collection.

Box 3: Costs of reducing mercury content in amalgams

Elements involving extra costs would be installation, maintenance of amalgam separators and training of personnel. On the other hand, there are reduced costs for; (i) special deposition of sludge because of high Hg contents, (ii) treatment and disposal capacity for Hg containing dental waste and (iii) environmental and health impacts of Hg released via sewage and waste.

Lassen et al (2008) concludes that it is clearly indicated that applying high efficiency filters and maintenance requirements is a very cost-effective measure. The costs to reduce one kg Hg is stated as being within the range of 1,400 to 1,800€. The benefits of reduced environmental and health impacts of Hg released from the entire life cycle of amalgam fillings were not assessed in this study. However, they are regarded as being significant.

Lassen, C., Holt Andersen, B., Maag, J., Maxson, P., 2008: Options for reducing mercury use in products and applications, and the fate of mercury already circulating in society, Final Report, September 2008

The following box provides an example of how pollution reduction measures can be effective in reducing discharges.

Box 4: **Awards for Company Innovation in Waste Management and Minimisation**

In 1996, the trophy ADEME "Economic and clean technologies" went to the STEN society, which is a metal finishing company which managed zero cadmium discharges by concentrating the cadmium-containing effluents through evaporation and recovered the metal through electrolysis.

Source: ICON (2001): Pollutants in urban waste water and sewage sludge,a report for the European Commission DG Environment.

Sede and Andersen estimated that if an efficient pollution prevention policy was implemented, the percentage of sludge failing could drop significantly (from 83% down to 25%). However in terms of costs, the difference between a scenario with pollution prevention measures and a scenario without pollution prevention measures was significantly less, and could range from 12% to 14%. This is because the costs of pollution prevention were also considered to be considerably large in comparison with other management options[46] thus offsetting the difference on amounts of sludge affected.

The following Table shows the result of a sensitivity analysis should other pollution measures be implemented, with these affecting the amount of sludge affected (based on the available information on costs from Sede and Andersen and our estimates on the amounts of sludge failing). This sensitivity analysis is given for illustrative purposes only and should take as an indication of the type of benefits that may accrue should the stakeholders decide to implement pollution prevention measures at source. As it can be seen from the Table, the savings will depend on the specific component under consideration but are not expected to exceed 7% of the total costs. However, other measures may be more effective in reducing the sludge failure level (although the costs of such measures will have to be considered against the benefits).

Table 100: Sensitivity to Pollution Prevention Programmes (PPP)

Scenario	Costs per tonne	Notes/Assumptions
PPP	229	Costs of PPP may vary significantly. Costs from Sede and Andersen reflect pre-treatment at industrial site. Only for heavy metals and organic contaminants.
No PPP		
Landspreading	126	Lowest costs taken as PPP will improve quality to minimise treatment costs and application
Incineration	371	Average mono-incineration and co-incineration
Net saving	245	As a result of the PPP now sludge will be applicable to land. Includes internal and external costs
Saving per tonne after PPP	**16**	

[46] The costs of pollution prevention were based on a single study and on average costs; but the same costs applied across a number of different pollutants, i.e. heavy metals and pathogens. Such costs were estimated at around €200/tonne and were based on ion exchange technology.

	Limits on Heavy metals	Limits on OC	% change in volume failing from 25% to 83% but assumes average of 54% fro calculation Assumes that all sludge will be applicable to land which may overestimate the savings.
Sludge to incineration without PPP (tonnes) – Option 2	2,391,858	16,722,805	
Volume of sludge not failing after PPP - Option 2	1,291,603	9,030,315	
Savings from PPP as sludge can be applied to land	21,147,000	147,854,000	
Main assessment costs	309,945,000	2,144,665,000	
As a percentage of totals main assessment	**7%**	**7%**	

9.3 Sensitivity on Unitary costs and benefits

The assumptions on the disposal routes were presented to the consultees and re-visited on the basis of their responses and more information available on the amount of mono-incinerators and co-incinerators. Similarly the disposal options have been chosen on the basis of technology known to data (as further development is uncertain).

Innovation and research is likely to develop overtime that could reduce the costs of treatment to deal with specific pollutants as well as disposal methods increasing the capacity for energy recovery. Such impacts are difficult to model but would suggest that the above estimates could be over-estimates of the total costs. This was highlighted by the consultees.

Sede and Andersen (2002) concluded that the costs of recycling routes and other disposal options were highly sensitive to the type and duration of storage and design capacities respectively. The impacts on internal costs of the routes could vary between ±30% and ±50%[47]. For sensitivity purposes we have assumed a 40% variation on the internal costs of incineration and sludge disposal. The results of our sensitivity analysis are shown in the next Table. This will imply a ±18-19% variation in costs. In relative terms therefore, even significant variation in internal costs may not affect the estimates of the cost from the Options to the same degree but the percentage change is still significant. However, this is not expected to affect the rank of the Options.

Table 101: Sensitivity to changes in unitary internal costs (€2009)

Main assessment			
PV	Option 2	Option 3	Option 4
EU-TOTAL	2,144,665,000	4,493,702,000	7,822,364,000
Annualised Costs	Option 2	Option 3	Option 4
EU-TOTAL	219,730,000	460,398,000	801,433,000
Sensitivity results			
PV	Option 2	Option 3	Option 4
EU-TOTAL (reduction)	1,764,439,000 (-18%)	3,651,475,000 (-19%)	6,406,784,000 (-18%)
Annualised Costs	Option 2	Option 3	Option 4
EU-TOTAL (reduction)	180,774,000 (-18%)	374,108,000 (-19%)	656,401,000 (-18%)

[47] On the other hand, transportation distance were not found to be significant as most of the costs seem to be related to loading and downloading of sludge.

10. Comparison of Options

10.1 Summary of Options

This Section presents a summary of the assessment, based on the assumptions presented above. The aim of the consultation was to refine our assumptions and the input of the stakeholders has been extremely valuable in order to do so.

A problem in order to comparing the options, however, is that the analysis of costs by component does not allow us to aggregate all the individual components to produce a total estimate for the Option. This is because should all the components be implemented together, double-counting will occur. In other words, the treatment plants may opt for incineration and/or landfill only once should the limits be too stringent.

The advantage of a component by component analysis, however, is that it allows the Commission services to account for the difference in costs among the different components and, as a result, make a decision on the individual aspects that may need changing in the Directive. This allows account to be taken of the consultees' varied responses with regard to the difference in impacts from the different aspects under analysis.

A comparison of Options however can be undertaken on the basis of different scenarios concerning specific changes to the Directive:

3. Scenario 1: the highest costs among the different options' components is taken as an indicator of the total costs for the Option. For both Option 2 and Option 3, the most expensive component concerns the new limits on organics, which is the component leading to the greatest costs (although the other component leading to similar magnitude of costs is the limits of PTEs in soil);
4. Scenario 2: the lowest costs among the different options' component is taken as an indicator of the total cost for the Option. This reflects a situation when only quality assurance and monitoring requirements are changed.

The following Table presents a summary of the Options for the above scenarios. As it can be seen, Option 2 and Option 3 are significantly cheaper than Option 4 for both scenarios.

Table 102: Scenario 1 – Summary of Net costs of Options (against Option 1)

PV	**Option 2**	**Option 3**	**Option 4**
EU-TOTAL	2,174,438,000	4,540,742,000	7,964,555,000
Annualised Costs	**Option 2**	**Option 3**	**Option 4**
EU-TOTAL	222,780,000	465,217,000	816,001,000
PV discounted at 4% covering period from 2010 to 2020			

Table 103: Scenario 2– Summary of Net Costs of Options (against Option 1)

PV	**Option 2**	**Option 3**	**Option 4**
EU-TOTAL	8,040,000	48,242,000	7,964,555,000
Annualised Costs	**Option 2**	**Option 3**	**Option 4**
EU-TOTAL	824,000	4,943,000	816,001,000

The following Table sets out the estimates from externalities related to GHG emissions from the different disposal route by Option and Option component (note that such values are included in the figures above). Again, and although the totals cannot be added, the Table shows how the greatest emissions (and hence externalities) are linked to Option 4.

Table 104: GHG Emissions Valuation – Annualised Costs (€2009)

Option Component	PTE in sludge	OC in sludge	PTE in soil	Option 4
Option 2	4,226,000	29,734,000	24,825,000	-
Option 3	58,706,000	60,139,000	53,514,000	-
Option 4	-	-	-	106,117,000

10.2 Interpreting the values and examining trade-offs

The above estimates do not include all impacts however. Importantly, the benefits to the environment and human health from changing the standards and reducing application of sludge to land have not been quantified. This is because the impacts from this are highly uncertain. The environmental and human health impacts have been quantified with regard to the emissions from the alternative routes of disposal and transport impacts. The following Table summarises the impacts valued in this impact assessment for the purpose of interpreting the results of the valuation.

Table 105: Impacts considered and approach

Economic impacts	**Stakeholder**	**Description**	**Quantified?**	**Qualitative assessment when no quantification/other comments**
Costs of alternative disposal	Water and sludge management operators	As sludge recycled will be ended, there will be internal costs from its disposal	Yes	-
Policy implementation and control	Regulators	There will be costs from changing legislation and consultation (not monetised)	No	These are expected to be moderate in comparison with total costs
Benefits/costs if meeting related legislation requirements (e.g. WFD)	Regulators	The total ban is likely to influence positively meeting the objectives of other legislation but may act against other	No	Depends on the level of changes. A ban may compromise objectives of Waste Directive
Loss of use of sludge as a fertiliser and fertiliser replacement costs	Farmers	As sludge is no longer available, they will have to be replaced by fertiliser (this could be organic and/or mineral)	Yes (included under net costs)	On the other hand, recycling is still a viable option to recover phosphorus which is a decreasing resource of the environment.
Loss of agricultural output/crops	Farmers	There could be impacts on crops in the short term and depending on availability of fertiliser as a replacement.	No	Impacts expected to be negligible as based on consultation responses
Environmental impacts				
Environmental benefits from end to application	General public	Impacts on biodiversity, ecosystems, quality of water and groundwater from an end to application.	No	Benefits are highly uncertain – lack of evidence on impacts from recycling
Benefits/costs from alternative routes of disposal including climate change	General public	Impacts from increase in use of landfill and incineration for sludge.	Partly	Values include externalities from air emissions (including energy recovery) but excludes impacts to the environment and human health through emissions to soil and water

Economic impacts	Stakeholder	Description	Quantified?	Qualitative assessment when no quantification/other comments
Social Impacts				
Human health benefits from end to application	General public	Owing to national practices and standards, benefits uncertain due to lack of evidence.	No	As above - Benefits are highly uncertain – lack of evidence on impacts from recycling
Human health from alternative routes of disposal	General public	Values include human health externalities from emissions (including energy recovery)	Yes	-

The main benefits could relate to reduced risk to the environment and human health from application of sludge from Option 2, 3 and 4. In order to make Option 4 cost-beneficial though, the benefits will have to offset the costs of the alternative routes of disposal. Based on the costs calculated, the implicit benefits should be equivalent to around 680 Value of Statistical Life (VOSL) saved[48] over the next 10 years. This is however highly unlikely on the basis of the current evidence.

There may be additional benefits in terms of amenity and public perception from more stringent standards and/or a ban. These are also uncertain however and could not be quantified in this assessment.

Other benefits from the Options include compliance with other legislation, such as the WFD. On the other hand, as highlighted by the consultees, putting restrictions on application that may deter from safe recycling (particularly with regard to Option 4) could work against the principles of the waste hierarchy within the Waste Framework Directive. Such balances need to be considered in order to make an informed decision.

10.3 Concluding Notes

The estimates produced here are subject to many uncertainties and as a result should be only interpreted as an approximation of the costs each option. This is due to uncertainties regarding the amount of sludge affected, disposal options and also the scope of the costs and the uncertainties concerning the unitary values as well as, more importantly, uncertainties concerning the baseline (i.e. percentile distribution of sludge pollutants by MS, level of treatment and background concentrations of heavy metals in soil by MS). The results nonetheless provide an idea about the order of magnitude of these costs. Moreover, they incorporate the information provided through the second consultation and as a result represent the best estimate possible based on the information available. It is important to remember that the following aspects were out of the scope of this study:

- scope of changes to the Directive: current changes include agricultural land use only. Consultees highlighted the fact the Directive should be extended to cover non-agricultural uses such as forestry but also included other industrial sources;
- changes should be consistent with a more general EU policy on soil fertilizers including the new directive on biowaste.

Based on the findings, the Commission may wish to include or exclude specific components from the Options or, alternatively, implement only the least costly components. Based on our analysis and the responses from the consultees, the most costly components appear to be the limits on organic compounds (in particular the limits on PAHs) and those on heavy metals in soil. The component with the smallest cost implications is that for quality assurance and/or increased monitoring (although the costs appear to vary significantly in range). The limits proposed under Option 2 concerning heavy metals in sludge seem to be achievable and most Member State and stakeholder responsdents called for this type of change on the basis

[48] Based on the NewExt values of Value of Statistical life of €1,213,000 (€2009).

that most national standards are already more stringent than the current Directive. As a result the costs of only introducing more stringent limits on PTEs in sludge (at levels such as those in Option 2) appear to be limited.

The above figures do not reflect all costs and benefits. In addition to the unquantifiable reduction in human health and environmental risks from reduced recycling, there may be additional benefits in terms of amenity and public perception from Option 2, 3 and 4. These are highly uncertain, however. One other benefit from Options 2, 3 and 4 is that in some geographical areas they could help meet other EU environmental objectives, such as those for the Water Framework Directive. A total ban, on the other hand, may act against the waste hierarchy set forth in the Waste Directive: this gives priority to the recovery and recycling of waste.

Such trade-offs will have to be borne into consideration in a decision on the revision of the Directive.

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Annex 1: Results of the Consultation

1. Introduction

This report is one of the outputs elaborated for the project "Study on the environmental, economic, and social impacts of the use of sewage sludge on land" (Contract Number: 070307/2008/517358/ETU/G4). It summarises the responses received to the Commission's consultation launched on 17th November 2009 for an eight week period regarding possible revision of the Sewage Sludge Directive 86/278/EEC and impacts from the different options for potential policy change. Responses received up to 26th January have been considered.

This document presents a summary of the responses, including a breakdown by type of stakeholder.

The report does not aim to provide a statistical survey of opinions. The consultants have responded to some comments with a short discussion but this is not intended to present a final view. The consultants do not necessarily agree with all the views expressed.

2. Scope and objectives of consultation

It is important to note that the lack of data led the consultant to make assumptions across the EU that may not always have been appropriate but were based on existing literature and on the 1st consultation on the evidence base. The aims of the consultation were to invite stakeholders to comment on the options and the assumptions undertaken by the consultants in relation to the impact assessment The Commission sought contributions from stakeholders which were structured around some general questions and nearly 20 specific questions.

Respondents were invited to comment if they disagreed with the findings and/or to submit alternative data to support the estimation of benefits and costs of the various policy options.

This report includes a list of respondents and a summary of their responses. These have been used to inform the revision of the Impact Assessment (see the main report), which is also based on discussions at a stakeholder workshop which took place in January 2010 and on other comments. See (see http://circa.europa.eu/Public/irc/env/rev_sewage/home for more information.

3. Facts and figures

A total of 39 responses were received in time to include in this report (more detailed information on respondents is provided in Tables 1 – 3[49]). Some were joint responses from several stakeholders and some originated from different organisations but reiterated the same comments. 14 were received from governmental bodies, 23 from the private sector or from associations with commercial interests, and two were received from non-profit making organisations.

Responses were not received from all the Member States (16 MS out of 27) but European representatives of commercial organisations from the agricultural, water and waste sectors as well as some of their national members were well represented. The highest number of responses originates from Germany, with respondents from the UK and France also providing three or more responses each. Due to the lack of response from certain organisations, the views of respondents described in this report do not necessarily represent the full range of opinions held by stakeholders within certain industrial sectors (i.e. food manufacturers) or societal groups (public citizens, environmental NGOs, etc).

[49] A last minute entry from Austria was received but this was not included here. On the other hand, a look at the response does not seem to entail significant changes to the report.

Some respondents provided general comments whilst others provided detailed responses to the questions and some additional material.

Table 106 Respondents to Public Consultation by Member State

Member State	Responses received	Public authorities	Organisations	General comments	Specific response to 28 questions
EU-15					
Austria					
Belgium	**2**	☺		☺	☺
Denmark	**2**	☺	☺	☺	
Finland	**1**		☺	☺	☺
France	**3**	☺	☺	☺	☺
Germany	**7**	☺	☺	☺	☺
Greece	**1**	☺		☺	
Ireland					
Italy			☺		
Luxembourg					
Netherlands					
Portugal	**2**	☺	☺	☺	☺
Spain	**1**		☺		
Sweden	**1**			☺	
United Kingdom	**6**	☺	☺	☺	☺
EU-12					
Bulgaria					
Cyprus		☺		☺	
Czech Republic	**2**	☺		☺	
Estonia					
Hungary	**1**	☺		☺	☺
Latvia		☺		☺	
Lithuania		☺		☺	
Malta					
Poland	**1**	☺		☺	
Romania	**1**	☺		☺	
Slovakia					
Slovenia	**1**	☺		☺	☺
EU			☺	☺	☺
Norway			☺	☺	☺

Table 107 Categories of Respondents

Respondent category	Total number	Sub-category	Number
Public authorities	**13**	National authority (MS)	8
		Regional authority (MS-R)	4
		Statutory advisor, agency, public institution (MS-A)	3
Organisations	**24**	International Professional association/federation (EF)	6
		National Professional association/federation (NF)	7
		Company/industry (IS)	8
		Consultancy	1
		Research/academic institute	0
		NGO	1
		Other	1

Table 108 List of respondents

Name	Type	Country
Official organisations		
Ministry of the Environment of the Czech Republic	MS	Czech Republic
Ministry of the environment and spatial planning	MS	Slovenia
Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Ministry Environment)	MS	Germany
Ministry of the Environment	MS	Hungary
Hungarian Ministry of Environment	MS	Romania
Danish Ministry of the Environment	MS	Denmark
French Representation of the authorities in Brussels	MS	France
Department of Environment, Food and Rural Affairs (Defra)	MS	UK
Agencia Portugesa do Ambiente (Portugese Environmental Agency)	MS	Portugal
Municipal Enterprise for water and sewage of Patras	MS-R	Greece
Walloon Region Ministry of Agriculture, natural resources and Environment –Soil and waste department – soil protection direction (DGANRE-DSD-DPS)	MS-R	Belgium
Ministry of The Environment, Wasaw	MS-R	Poland
Bavarian Ministry for Environment and Health	MS-R	Germany
Centre for Waste Management	MS-A	Czech republic
OVAM - Flemish Waste Agency	MS-R	Belgium
Commercial organisations		
EUREAU (European Federation of National Associations of Water Suppliers and Waste Water Services)	EF	EU
EULA -European Lime Association	EF	EU
EFAR - European Federation Agricultural Recycling	EF	EU
EWA – European Water Association	EF	EU
CIAA - Confederation of the Food and Drink Industries of the EU	EF	EU
Ecosol (European producers of Linear Alkylbenzene)	EF	EU
FIWA (Finnish Water and Waste Water Works Association)	NF	Finland
Water UK	NF	UK
National Farmers' Union (Part of COPA-COGECA response)	NF	UK
COPA Cogeca - response from National Farmer's Union	NF	UK
DAKOFA (Danish Waste Management)	NF	Denmark

Name	Type	Country
Bundesverband der Deutschen Entsorgungswirtschaft BDE Federation of the German Waste, Water and Raw Material Management Industry	NF	Germany
The German Association of Energy and Water Industries (NDEW)	NF	Germany
3R Consulting	IS	Spain
Kemira	IS	Germany
United Utilities	IS	UK
SUEZ Environment	IS	France
REETRRA Service GmbH	IS	Germany
VEOLIA Environnement Europe Services	IS	France
Thames Water	IS	UK
Reciclamas Multigestão Ambiental S.A., from Águas de Portugal (AdP)	IS	Portugal
Others		
CIWEM (Chartered Institution of Water and Environmental Management)	Other	UK
Ren Aker Ren Mat	NGO	Sweden
Tim Evans Environment	Consultancy	UK

4. Summary of comments

Overall, the report was welcome although some of the respondents did not seem to agree with the options in its current form and have asked for more reasoning behind the selection of the options. Most of the respondents seem to agree that a revision of the Sludge Directive is needed:

> *We believe that the Sludge Directive 86/278/EEC needs an appropriate update for greater public and stakeholder confidence based on proven technological progress. Considering the environmental, social and economical advantages of recycling sewage sludge on land when appropriately treated, the Sludge Directive should be revised so to set standards and requirements that will ensure the public and environment safety without leading to its unnecessary banning (either direct or indirect).*

> *[…]the directive dating from 1986 does not reflect the present state of knowledge and technology.*

> *[…]the Directive is now 23 years old [..] it is thus necessary[…] to revise limit values in order to bring them to the average level of limit values set out in national legislations*

> *Option 1 is not satisfactory […] the current Directive does not properly take into account the distinction between sewage sludge of different quality (for municipal waste, industrial, small stations, etc)*

> *We appreciate a revision of the sludge directive (86/278/EEC) that would reaffirm the relevance of sludge land application and also guarantee a European-wide uniform approach to protect human health and the environment*

Only a few of them advocated for leaving the Directive as it is.

> *Option 1 is by far our preferred approach[...]Option 1 will allow Member States sufficient flexibility in their approach to regulating this activity*

The application of sewage sludge in agriculture based on the implemented system works satisfactorily [..] the most acceptable scenario is Option 1

However a few respondents noted that the revision should be undertaken in the context of other legislation, e.g:

For the moment, we miss a consistent EU policy about soil fertilizers. When we only deal with sewage sludge, the biggest part of fertilisers isn't included by law (like manure). Therefore we really hope this directive could be examend alongside other environmental proposals, for example on soils or on biowaste.

[..] the Sludge Directive, its baseline data and gap analysis needs to be extended to cover all biowaste under a biowaste directive, in order to establish a common set of standards for any biowaste applied to land and thus, to provide an even regulatory playing field and economic fairness.

It needs to be noted, however, that stakeholders' views are reflected clearly in their responses and the opinions vary from no change to a few stating their preference for a ban (e.g. Bavaria's ban on application of sludge on land and one NGO). Some others stated that they disagreed with the Options as they are currently proposed:

The proposals for revising 86/278/EEC are based on old thinking and do not take account of today's environmental priorities.

Most of the respondents seem to agree that Option 2 is the more realistic one. Overall, there is support for Option 2 but some issues have been highlighted (these are discussed below). Only a few respondents were in favour of Option 3 mainly on the basis that the national standards are more stringent than those in Option 2 but with also some shortcomings (e.g. no limits on organics or pathogens in Slovenia). Some respondents noted that Option 5 is unacceptable. Very few are in favour of Option 4.

Some respondents agreed with the data and assumptions used for assessing the impacts from the various policy options which were detailed in the consultation document forwared to them. Others disagreed and provided alternative figures instead. These are summarised by question below and they have been considered in drawing up the final report for this study.

Generally, incineration is not favoured by the consultees and amenity aspects have been highlighted but there are exceptions (e.g. NGO and some UK companies). Some respondents have also highlighted the lack of space for landfilling (e.g. UK); thus some of the estimates may need revising as for the destination of sludge failing. However, respondents seems to agree with sludge recycling hence the objective should be to utilise as much sludge as possible. This explains partially the main support for Option 1 and 2.

Generally, the respondents called for more information on the % applied, calculations and impacts included. Some data in the final report, some percentages have been revisited based on information provided. More specific comments are given below.

5. Summary of responses by component

Scope of the Directive	A call for extending the scope of this new/revised directive to all sludge that could be used on land (i.e. not only from the treatment of urban wastewater but also from pulp/leather/food industries wastewaters).
	Also the application on forestry should be considered.
	Nowadays,sewage sludge has a waste status on European level. If the directive would be changed significant with stringent requirements, which statute will sewage sludge get that meets the limits? Will it become a product? But then the Reachlegislation is applicable!

	The various quality and origin of the sludge should lead to a differential management system based on the classification of sewage sludge (e.g. four classes in the Walloon region), on requirements in term s of soil quality, and on differential traceability system given the origin of the organic material.
Heavy metals in sludge	Some respondents agree with limits proposed in Option 2; other have proposed the ones they have nationally. Other bodies acting across the whole of the EU have proposed the ones presented in the INERIS risk assessment study which are as follow (in mg/kg DS): Cd:10 Cr : 1000 Cu: 1000 Hg: 10 Ni: 300 Pb : 500 Zn : 2500 One other respondent noted that a revision should include more metals, e.g. Sb, Co, Mo and Se; also Arsenic.
Organic contaminants in sludge	There are different opinions with regard to the choice of OC in the Options. Some resposdents have argued that PCBs have legislative source control and PAHs are in decline due to cleaner engines. Oner respondent notes, with regard to LAS and Option 3: *In 2005, the Organization for Economic Cooperation and Development (OECD), approved the SIDS Initial Assessment Report (SIAR) for linear alkylbenzene sulfonate (LAS), concluding that LAS "is low priority for further work", and thus of low regulatory concern. The OECD acceptance of the LAS SIAR represents the culmination of nine years of collaborative efforts in researching, compiling and assessing the scientific information on the health and environmental properties of LAS, carried out by a consortium of 16 detergent and supplier companies, with the US Environmental Protection Agency as the sponsor country for the assessment*
Pathogens	The national regulations are very different when controlling pathogens and the percentages may need revisiting significantly. Some respondents have argued that E. coli is not an accurate indicator and recontaminations during storage may happen, and it will be very difficult to monitor proper sanitisation with this indicator. Others have argued that setting reduction limits is not feasible (as it implies that we can determine an entry value at the upstream treatment sludge process, which is inapplicable in certain sectors (eg lagoon ...). Others however have mentioned that a list of methods should be made available.
Provision of information on nutrients	Respondents did not provide a lot of information on this. However, one respondent noted that these were not stringent enough and proposed that in order provide guarantees to different stakeholders it is necessary to supply the information outlined below: ¾ Sludge analysis: - Agronomical value not less than 4 analysis per annum and at least one per 150t DS. - Heavy metal not less than 2 analyses per annum and at least one per 300t DS. - Organic compounds not less than 2 per annum and at least one per 500t DS. ¾ Soils analysis on agronomical parameter (every five years) and heavy metal (every ten years) per 20 hectares area. ¾ Establishment of a spreading forecast submitted to local authorities validation including: - Sludge and soil analysis. - Identification of the landbank which is going to be spread. - Information about the nutrient quantities spread on each plot of land and integration of other types of fertilisers (i.e. animal manure). ¾ Establishment of a yearly balance report integrating the record of all the data regarding the spreading campaign.

Heavy metals in soil	This is the component that lead to most comments. Many European areas have comparatively high natural concentrations of metals in much of its surface soil with background concentrations of metals already exceeding some of the proposed limits for sludge-treated soil, potentially restricting the land bank available for recycling biosolids in these areas. More data are needed to properly assess the impact of those limit values. A few respondents suggested alternative means like a total load application per annum (Limit values for PTE on the total load brought to the soil by the total quality of sludge spread, in order to limit the quantity of heavy metals spread on land from anthropogenic source) but most of the respondents suggested that flexibility was needed and that this component should be left out on the basis of subsidiarity.
Conditions on application and banning injection of untreated sludge	Here responses also varied significantly; some of the respondents noted that application of untreated sludge in not allowed hence they will not be affected. Others however noted that they could be significantly affected.
Quality and prevention	There was a general support for risk assessment aspects before application (in cases this may be preferred to the limits themselves) but HACCP is not yet widespread across Europe and other quality assurance systems have been highlighted (e.g. Industry in Germany has also sent a Manual on quality requirement and certification processes).

6. Other recommendations

Other recommendations for changes to the Directive and the quality of the IA include:

- reference to Health Risk Assessment by EFAR/INERIS (2007); the European Commission should launch a comprehensive Health Risk Assessment to be carried out by a panel of international experts, with the aim of setting up all limit values (PTE, OC without microbiological parameters);

- the development and implementation of sludge application rules should also be taken into account (e.g. a buffer zone between amended soils and rivers should also be proposed in order to prevent any impact of sludge spreading on the quality of surface waters). Such a double barrier approach will provide very good result as it has been observed in many countries without excessive costs;

- a study should be commissioned to assess markets and consumer confidence;

- authors should consider COST 68/681 programme on the Treatment and use of Sewage Sludge and Liquid Agricultural Wastes ran from 1972-1990. This programme brought together experts across Europe with the aim of developing the science and engineering base for recycling biosolids in agriculture. This work produced almost 1,000 papers and a number of other publications covering all aspects of the recycling options and a re-issuing of this work would certainly be valuable to everybody working in this field and help to provide information relevant to the areas of uncertainty outlined in summary report 1;

- Need to include a description of the benefits from the Options: some of the respondents noted that quantification was needed; however, there is a lack of quantification of benefits owing to the fact that there is not evidence base on any impacts from sludge application;

- a review of the estimated costs for the alternative treatment and disposal options, including additional options to the ones proposed such as thermal treatment;

- a review of alternative outlets and the availability of these for example non-agricultural land, reclamation etc;

- Consider the use of bio-fertilisers and other organic resources rather than conventional fertilisers as a replacement. Consider the Biowaste Directive; and

- highlight the positive aspects of sewage sludge recycling. In that respect nutrients have to be considered (e.g. copper and zinc that are important for plant growth and the soil), but also resources aspects (e.g. phosphorous - the availability of the primary resource is limited to approximately 120 years!) and the humus content of sludge used as organic fertiliser or soil improver. One of our suggestions includes developing a nutrient/pollutant-ratio in order to better recognise the positive impacts of organic fertilisers.

7. Responses to specific questions

The full copy of the responses is available on the CIRCA website http://circa.europa.eu/Public/irc/env/rev_sewage/home.. The responses to the specific questions in the report are summarised below.

Question 1: Do you have any comments on the Options as proposed?

The commercial stakeholders' responses are presented below.

Denmark **Option 2 or 3 seems the most realistic** and benefiting options for sewage sludge on land. More stringent standards will raise the public confidence and acceptance and also meet the standards many member states already adopted. Although stricted standards may be more costly Danish experience shows that it is only a matter of time before the sludge meets the standards and it is at the same levels. **Option 4 will not be in line with the Waste Directive** an also the general costs are too high. *Fertiliser replacement costs between 2010-2020 for Denmark is estimated to be 66m in this 10 years period and not 26m as stated in Table 46).* This is based on calculations of the amount actually used in agriculture, the amount of phosphorus in it and the actual plant uptake and utilisation.
Option 5 is not acceptable as the protection of the environment cannot be guaranteed.

Finland Al anternative treatement is incineration but they are objected on the basis of amenity. Strict limits on heavy metals and organics call for upstream approach. It is not only up to the waste water operators to limit the amount of pollutants entering the system (i.e. industrial sources and household chemicals). Waster water utilities have no opportunity to limit use of chemicals in the households. In case of strict quality criteria more pre-treatment will be demanded. In many cases technology is avilaible but it is expensive. Effect to industry may be considerable.

France The implementation of Option 1 and Option 5 would not lead to significant modifications of the current state of play of sludge management.
Option 4, which would consist in a total ban of sludge return to the soil, would lead to a huge modification and perturbation of sludge disposal in France and Spain where almost 70% of the total sludge national production is currently land spread. The implementation of this option in the 2 countries, and more generally in the EU at large, **does not seem realistic**. Member States indeed do not have sufficient capacities in alternative treatment solutions (incineration or landfill) for such important volumes, which are generally produced on a large number of small wastewater treatment works.
The adoption of options 1 or 5 do not present a sustainable way forward and should not be considered;
• As stated above, a total ban of sludge use on land (option 4) is unacceptable for environmental, technical and economic reasons;
• option 3 is unrealistic since it proposes more stringent values without justification on either environmental or health gains;
• option 2 should be favoured as long as the limit values for all parameters are determined on a scientific and sound basis.
Adoption of option 2 with revisited limit values for all parameters, on the basis of scientific evidences (global risk assessment) and pragmatic compromises.

Germany An option related to the relation of nutrients to heavy metals (phosphorus/Cd-relationship corresponding to mineral phosphorus fertilizers) is also recommended.
The restrictions made for cupper and zinc in Option 3 are from our point of view not comprehensible

and not acceptable.
The impacts on markets of mineral and other natural fertilisers could vary regionally, and could be more important than stated in Table 7.

One comment to the economic impacts in table 6: For **option 3 (significant changes) the impacts for Germany will be more like the impacts of option 4** (total ban). If we will get the stringent limits for copper (400) and zinc (600) in sludge and the strong pathogen standards we believe that most of German waste water treatment plant operators will give up agricultural use and turn to a safe incineration.
Altogether DWA votes for further developing the revision of the sludge directive on the basis of Option 2. It’s not clear whether the scope of the options 2 & 3 is extended to non agricultural land. We call for a clarification on the basis of an enlargement of the current scope in order to take into account all the outlets using sludge as a fertiliser on all soils (agriculture, land reclamation, forestry, green areas, and landscapes).

Today in Germany voluntary QA-Systems are applied for about roughly 30% of the sludge recycled to land and we expect this rate to rise strongly during the next years, at least if legislation gives corresponding incentives. In Germany QA-Systems proved that they can provide a major contribution to improve sludge quality and that they are recognised positively by farmers and the food industry who are seeking for more confidence to trust the current practices. **Against the background of these experiences we strongly recommend that a revised sludge directive should take QA-Systems into account.**

Portugal

In Table 6 row Option 2 –“soil decontamination” (+) should be included under Economic Impacts
“Environmental benefits from reduced application” (+) should be included under environmental impacts;
Human health from alternative routes of disposal (+)
In Table 7: “amenity” –column quantified should say yes but highlighy variable but possible to be estimated. For energy recovery – should be yes, could be estimated depending on technology.
Environmental impacts – changes in risk from changes of recycled sludge – quantified yes, there are impacts from soil application
Social - human heal impact – yes – the use of contaminated sludge have an impact in human health.

UK

Some of the options proposed in the report would lead to a huge increase in ‘non-compliant’ sludge which is at odds with the majority of related Directives[..]Similarly some of the options do not reflect the best use of the beneficial properties within sewage sludge and the part that it can play in sustainable agriculture.
Option 2: We support this option in principle. We do however call for a review of the limit values proposed, specifically the PTE’s for soils and organic contaminants
We think the EC could be in breach of the Waste Hierarchy provisions of Article 4 (1) of the Waste Framework Directive[..].Using the current Sludge Directive as a basis, the UK water industry has developed further plans to increase renewable energy generated from sewage sludge as a primary contribution to the climate change mitigation and the Renewable Energy Directive. We are keen to see that any revision to the Sludge Directive continues to support this policy and enables the residual sludge to be used are fertiliser and soil improver
The increasing level of investigation and application of risk assessment techniques has consistently shows that OCs in sludge amended soil have negligible impact on human health or the environment.
Option 2 (Moderate Changes) and Option 3 (Significant Changes) identify that most of the costs (E.g. Enhanced treatment costs, pollution prevention costs) will fall upon the water and sludge management operators. However the water companies and operators are likely to try to pass these costs to farmer users by increases in the prices of the sludge material. Many of the water companies here in the UK are charging farmers for biosolids and some farmers are happy to pay as they value the resource. But if the costs are increased too much then farmers may instead look to other material – as discussed above, in the future there will many other organic resources competing against sludge. Similarly, if there are more additional costs of policy implementation and control for the regulators, they too might try to recover these costs from farmers – e.g. charging farmers to have an environmental permit or licence to spread sludge material. So these costs that might be passed down to farmers also need to be considered and factored into the IA. Although the outcome will still remain the same = less farmers using sludge. “
Options 1 and 2 are the only supportable options. Option 1 is by far the favoured approach. Option 2 has the potential to increase stakeholder confidence in the sludge recycling route. However, the new organics and heavy metals in soil limits presented in this consultation document would need much

further consideration and scientific justification. **Option 3, 4 and 5 are unworkable and inappropriate and should not be considered.**
None of the options mentions odour which is known to be the root-cause of more than 95% of complaints.
The concept of "options" is flawed because it bundles changes together that are not necessarily associated

EU wide federation

Option 4 (ban on sludge recycling on land) would be the worst case: contradiction with the landfill directive, [..] **A total ban within the EU is not a viable possibility**.
Option 5 (repeal), without an other legal framework (Soil Directive e.g.), would be a bad scenario, with possible environmental impacts in countries with no national regulation ; this could lead to a possible loss of confidence on the use of sludge on land, prohibiting the possibility to develop in the future the possibility for recycling sludge
Option 1 ("business as usual") would be a missed meeting: since 1986, new scientific evidences have shown the need for a more accurate framework for sludge use in agriculture (pathogens, etc.), and farmers as the food industry are seeking for more confidence to trust the current practices. An accurate and sound regulation is the basis for developing sludge use on land in climate of confidence among stakeholders.
Option 3 is too expensive, and would be counter-productive with a low share of compliant sludges for a small increase in environmental/human health/soil protection level. We advocate for the abandonment of this option.
Option 2 is more realistic, providing a high protection for environment, human health, crops and soils, while needing reasonable costs. Nevertheless, we call for some modifications in the level of some specific requirements for this option 2.

In table 5, additional costs for increased scope of analyses in monitoring (more parameters as PCDD/PCDF e.g.) have been forgotten in economic impacts for water and sludge management operators.

We don't think that there could be "increased sales from reduced sludge linked to consumer demand" for food/retailers. Consumers are not aware of this issue and look for various labels (organic food, etc.), but the share of these label will concern a minority of cultivated areas, and will not hamper the sludge use in agriculture (e.g. 3-4% of arable land in France).

The more stringent will the requirements for sludges be, the more it will be necessary to get alternative outlets for non-compliant sludges (landfill, incineration plants). This could be in contradiction with the objectives of the landfill directive, and it will require additional treatment capacities (or new plants); this last point has been forgotten in table 5 for social impacts, because it's clear that extension of treatment capacities or new plants will lead to resistance of residents (NIMBY). This is not only a matter of "increased bill" for consumers.

It should be noticed that strict limits for heavy metals and organics call for upstream approach. It is not only up to the waste water operators to limit the amount of pollutants entering the sewer system. Many organics are entering waste water either through industrial sources or household chemicals. Waste water utilities do not have much opportunity to limit use of chemicals in the households.

In case of strict quality criteria for sludge industry will be affected since waste water treatment utilities will demand more pre-treatment for industrial effluents which are allowed to enter sewer system. According to the polluter pays principle, all the costs should be addressed to the original source of pollutant. Effects to industry can be considerable.
Option 2 appears to be the soundest option. However, as studies have shown that the contribution of sludge spreading to land to public health risk is low with regards to its heavy metal content and organic contaminants, we believe the main focus of the new standards should be on pathogen reduction. We therefore would like to suggest the introduction of:

- Classes of treatment for pathogen inactivation with: conventional treatments that have a residual disease risk and which requires a second barrier in the form of cropping and harvesting restrictions and advanced treatments that reduce disease risk to be similar to the soil to which the sludge is applied.
- A requirement not to cause odour nuisance, which is the root cause of most of the complaints about sludge.
- A mandatory quality management and good practice to comply with Hazard Analysis Critical Control Points (HACCP) of the different treatments methods to ensure for the public, safety and

reliability on a long term basis.

Also, any revised values should be set according to a risk based approach.

As already exposed several times before, EFAR is in favour of a potential revision of the directive on sludge land application in order to reaffirm the relevance of this disposal route while increasing the guarantees given to the different stakeholders.

Therefore **options 4 and 5 are not acceptable.** Regarding the options 2 to 4 EFAR maintains that any change in the limit values has to be based on a risk assessment. EFAR regrets that once again this is not the case and that there is no scientific justification to the different set of values mentioned in the scenarios 2 and 3.

Regarding Option 4, the reasons which could lead to a total ban of sludge land application need to be developed. It requires that the alternatives solutions have sufficient capacity to accept the whole sludge production which obviously is not currently possible.

EFAR also wishes that industrial sludges are being incorporated into the impact assessment which is not the case and which could have a significant impact on the final conclusion of the study.

Generally speaking EFAR believes that the different assumptions taken into account into the report are not sufficiently supported and documented particularly regarding the sludge failing rate to the proposed threshold limit values (before and after receiving further treatment).

CIAA thus recommends option 1 as first choice. Option 2 would require comprehensive further analysis of related benefits and costs. CIAA **does not support options 3, 4 and 5**.

[..]**favours Option 2** along the lines suggested in the Report. It is pleased to offer its services and far reaching knowledge base to the Commission in developing more elaborate criteria for the management of sewage sludge on land.

EWA is fully supportive of the practice of recycling sewage sludge to land as a safe and effective fertiliser and soil conditioner. We consider that where practice in accordance with appropriate standards (such as those which have been in place for many years in the UK and other countries), the practice is safe and also represents by far the most sustainable option, particularly in the light of future challenges including climate change and declining phosphate (P) resources.

The EWA agrees with the DWA that not all the disposal routes have been considered and the authors of the report should take account of the use of sludge in landscaping. This is important in a number of EU member countries as is the use of sludge for other land applications such as forestry.

The EWA would like to see more discussion of climate change not just in relation to Green House Gas emissions and energy re-use but also mention of the fact that sludge is an excellent soil conditioner and is absorbent so it could therefore act to reduce moisture loss during drought periods [..] there are issues in relation to heavy metals, organic pollutants and pathogens but contamination with organic pollutants and heavy metals contents have clearly declined substantially in the past two decades. The scientific evidence has not identified the need for statutory controls on organic contaminants at the European level to protect human health and the environment. Source control measures (e.g. REACH and WFD) will continue to have a positive effect on the chemical composition of sludge further reducing the risk of contamination with undesirable substances.
[…] the directive should be include all land-use applications for sludgeincluding for example forestry and land restoration. In reference to incineration the

EWA believes that it is important to distinguish between mono-incineration" and co-

Incineration", mainly because only mono-incineration makes it possible to recover phosphorous, from the ashes. Such recovery is increasingly important and the use of novel processes which also allow for phosphorous recovery such as super wet critical oxidation should be considered.

The EWA also considers that the reports authors should review the use of the term sewage sludge and bio-waste. Although the distinction is made between the two the EWA believes that is it better to use the terms 'bio-solids' and 'wastewater bio-solids' as these better reflect the matter that arises from commercial organic wastes and that from sewage treatment.

EWA considers that where sewage sludge has undergone suitable treatment, there should be no barrier to it being awarded an eco-label. Page 17 of summary document 1 refers to decisions by the Commission that products containing sewage sludge shall not be awarded an eco-label. The EWA considers that the presence of such a barrier discourages the recycling of suitably treated sludge to agriculture. This should be reviewed.

The answers of the official organisations are given below.

Belgium-Wallonia

Option 1 is not satisfactory[..]

Option 2 is not satisfactory but can become suitable provided that is modified [..]

Option 3 is not supported [..]

Option 4 is not supported [..]

Option 5 is satisfactory [..]

Belgium Flanders -

Option 1 and 2 positively evaluated. Option 3, 4 and 5 negatively evaluated. In Flanders, we have an additional limit value for As. Limit values for Sb, Co, Mo and Se are proposed for the near future. Arsenic for example is poisonous, Zinc is 'only' dangerous. Why don't you take into account the addition of some new?

The sludge production in 2008 was 105 kt (Table 8)

In our comments, we haven't made enough nuance between sewage sludge from plants treating domestic or urban waste waters and sewage sludge from the food industry. Sludge from domestic/urban waste waters aren't used anymore in agriculture in the Flemish region since 2006 because they are too heavilly polluted to use on the soil. On the other hand is sludge from the food industry a good fertilizer that can still be used. (nuance to our remarks on option 4)

As a general comment we stated that we miss a consistent EU policy about soil fertilizers. Therefore we advised to examen this revision alongside other environmental proposals. We would like to stress here that we really do not want to propose to 'integrate' several legislations into each other, like melting together the sewage sludge directive with a possible new directive on biowaste.

Denmark

Denmark has set up stringent standards for heavy metals, xenobiotics and the sanitary and treatment requirements. The limit values are based on the precautionary principle, focusing on long term protection of the agricultural soil. Due to the strict limits it is ensured that there will be no accumulation of metals and contaminants in soil due to application of sewage sludge. Like-wise, it is prohibited to use raw sewage sludge for agricultural purposes, and application of sewage sludge is restricted to the degree of treatment.

Option 2 and 3 are the most realistic. Option 4 seem to be in conflict with the waste hierarchy. Option 5 seem to be not a realistic option.

France

It is necessary to recall that the studies carried out in France during many years did not reveal any contamination due to the use of sludge when conducted in accordance with regulation. Although sludge contains many traces of unwanted compounds, exposure risks are in most cases known and considered as very low or negligible. A revision of Directive 86/278/EEC should it take place should therefore be based on scientific risk analysis.
Regarding the various "options" included in the report, France questions the criteria that led to retain PCDD / F (dioxins and furans), LAS (Linear Alkyl Sulfonates) and NPE (Nonyl-Phenols ethoxylates) as relevant substances as well as the assessments and assumptions used to define the proposed quality standards. The same questions concern the assumptions and

criteria leading to the development of quality standards relating to the suitability for land application.
c) Options 3 (major changes to the Directive) and 4 (ban on use) lead either explicitly or implicitly to the inability to develop the agricultural usage of sludge. This hypothesis is currently not possible for France. It results in a reduction of the possibilities to dispose of sewage sludge and actually leads to promote incineration as a method of treating these materials as the introduction of the landfill directive restricts admission to discharge of biodegradable waste. This is not an option for France on the commitments made at the Grenelle de l'Environnement.
d) Option 2 (limited changes to the Directive) would lead to adopt quality limits for sludge similar to those of the current regulations in France. The impact of changes in concentrations of metallic elements determining soil suitability for land application could not be determined because of the time needed to carry out the study. At first glance, some proposed values are however in the lower range of those known to the French soil and would lead to strongly penalise the agricultural sector.

Czech Republic

Prefers Option 2. In the case of approval of Option 2 there would be no the impacts on sludge recycled to land in the Czech Republic, the limits given by Czech legislation are more stringent than these proposed in Option 2. The increase of operational costs would not be significant; it would apply only to the costs of PAH determination.

The new suggested limits from Option 2 are from our point of view very moderate and for the Czech Republic does not means change. Different situation is with the limits on organic compounds. The Czech Republic has only one legislative limit for PCB (0,6 mg/kg) concerning to organics polutants. This issue should be solved widely because it is not obvious which organics and their limits should be observed in the future.
Chapter 4 – Option 3 (significant change) suggests much more stringent standarts than Option 2, but this standarts are closer to the legislative limits valid in the Czech Republic. We compared all new limits in report with our alredy valid limits. New limits according to the report are a little bit stricter at Cr, Cu, Ni and Zn. Stricter limits (especially for Zinc) raise the question, if it would be possible and economic to use the recycling of sewage sludge to agriculture.
We find Option 1,4,5 (of the Consultation report more or less counterproductive. Option 4 is also acommpanied with the highest cost. Therefore we suggest to use for finall review of the sewage sludge Directive the **Option 3, but with corrections** which will allows and retains recycling of sewage sludge on land (better to say on soil) at the present rate.
We would highlight potential extra cost in case of Option 5. For Option 5 the impacts are uncertain. We would hightlight potential extra costs araising from possible contamination of soil by the wrong usage of sewage sludge and from the consecutive remediation of demaged soil.
We highlight extra potential benefits in case if it would be used according to Option 4, but only in the case that European Commission find a some way of subvention for using compost. The ban of using sewage sludge on agricultural and other soil could be a chance for increased usage of the compost that can serve alternative quality fertilizer.

Greece

sludge should be used in forestry

Hungary

The application of sewage sludge in agriculture based on the implemented system works satisfactorily [..] the most acceptable scenario is Option 1.
Comparing all the costs and benefits Hungary is not in favour of modifying the existing legislation

Romania

In the revision process of Directive 86/278/EEC it is necessary to correlate its provisions with the provisions of other EU Directives: Water Framework Directive, Nitrates Directive, Directive 80/68/CEE on ground waters protection against certain hazardous substances and Directive 2006/118/CE on groundwaters protection against pollution and deterioration.

The EU Directives implementation has particular features for each Member State. In Romania, 55% of whole territory is declared as vulnerable zone at pollution with nitrates from agriculture activities. Thus, the use of sewage sludge with high nutrients content is restricted to the land of farms.

For the recycling of sewage sludge in agriculture, it is necessary a more complex knowledge of its composition, taking into account more advanced sampling and monitoring of sewage sludge for waste water operators. Those aspects can encourage the farmers in spreading sludge on land. In the process of waste water infrastructure development from Romania, there were noticed difficulties in farmer's perception regarding the use of sewage sludge.

Regarding the "Application conditions" Romania considers relevant the restriction of sewage sludge application in certain crops (fruits, vegetables) in order to prevent possible diseases among population.

Option 2 application will contribute to correlation with the provisions of other EU Directives (Water Framework Directive, Nitrates Directive, Directive 80/68/CEE on groundwaters protection against certain hazardous substances and Directive 2006/118/CE on groundwaters protection against pollution and deterioration). In this respect, the elaboration of a guide with good practice in sewage sludge recycling is necessary. The implementation of option 2 will have a moderate impact in Romania.

Option 3 involves high costs and big efforts for Romania, especially in endowment with high performance sludge treatment technologies, laboratory equipment and personal training.

Slovenia

In generally Slovenia has already set the most stringent restrictions on concentrations of heavy metals in sewage sludge for the use on agriculture land as proposed in Option 2 and even more stringent than in Option 3 (except for Zn in Option 3), wherein the estimated concentration of heavy metals are standardized on 30% organic matter. Slovenia has also set limits for heavy metals contents based on soil conditions as shown in the following table- table 1 (representative soil sample with pH between 6 and 7)

Table 1: Limit concentrations for heavy metals in soil

PTE	Soil (mg/kg DM)
Cd	1
Cr	100
Cu	60
Hg	0,8
Ni	50
Pb	85
Zn	200

The limit concentrations for heavy metals based on soil conditions are almost as stringent as proposed in Option 3. The analysis of recycled sludge must be carried out every six months or in distinct cases even more frequently. The analysis of soil on which the sludge should be implicated should be carried out, as well.

On the other hand Slovenia has not set any limits for organics either pathogens.

In Slovenia, 2007 approximately 25% of sewage sludge was exported for incineration due to the fact that Slovenia does not have any thermal treatment plant. Almost a half of produced sewage sludge was disposed to landfills. After July 15th 2009 there is a ban to dispose untreated waste and sewage sludge. Due to the stricter waste acceptance criteria for landfilling such as the total organic carbon content of less than 18% DM and the calorific value less than 6 MJ/kg the landfilling of sewage sludge will decrease.

The agricultural use is almost inexistent due to the low quality of sewage sludge due to high content of PTEs in sludge, especially zinc, copper, chromium and lead. The available arable land in Slovenia is limited to 36% as 60% of the country is covered with forests and woods. Application of sewage sludge in forestry is prohibited. Composting of dehydrated sewage sludge in Slovenia is most often performed in combination with biodegradable municipal waste and other structural materials. Composted sewage sludge is used in non-agricultural applications: for recultivation of closed landfill sites and land reclamation of degraded areas, public parks maintenance and other similar locations.

Germany	Option 1: do-nothing: keeping the Directive as it is; A revision of the sewage sludge directive with more stringent requirements would greatly contribute to establishing the stakeholder's confidence in agri-cultural sludge use. Option 2: introduce certain more stringent standards, especially for heavy metals, standards for some organics and pathogens, and more stringent requirements on the application, sampling and monitoring of sludge; In Germany the levels of pollutants in sewage sludge are far lower than existing legislation demands [..]This has been achieved by a number of measures such as minimising pollutants at the source. The proposed limits in option 2 would result in acceptable costs and also provide a high level of protection of the environment, human health and water and soil. **A revised directive based on option 2 seems the best option in every respect.** Option 3: In Germany the more stringent standards as described in option 3 would result in an extremely low amount of compliant sewage sludge in the range of about 10-20% at the most. As the necessary treatment if it is even possible would be extremely expensive and a probable result would be a de facto ban on sludge application resulting in incineration for all sludge. German legislation is quite prohibitive compared to a number of other EU member states so I would expect the impact to be similar in quite a few of these. The gain compared to option 2 seems small. The possibly slightly higher level of protection of the environment, human health and soil protection cannot compensate the EU-wide doubling of the costs. Option 4: total ban on the use of sludge on land; A total ban on the use of sludge on land would have a number of negative consequences without discernable advantages. As the report shows there would be a formidable economic impact. Further negative consequences are a reduction of recycling (organic matter, plant nutrients) and as a result long term sustainability, considerably higher GHG emissions and probable negative impact on the implementation of the landfill directive. The high costs of a total ban coupled with negative environmental impacts without discernable advantages rule out this option. Option 5: repeal of the Directive. **The repeal of the directive cannot be an option** as the possible risks if a member state has no legislation at all in place can not be quantified, i.e. use of untreated sludge from industry could have grave environmental consequences. A further assessment of this option does not seem necessary.
Germany - Bavaria	**The study does not consider sufficiently the drawbacks and risk of the use of agricultural use of sewage sludge**. When looking at incineration of sewage sludge though, mainly the negative and hardly the positive aspects are considered. A considerable deficit of this study lies in the fact that the environmental and human health benefits of a reduced use or rather ban of the use of sewage sludge are not quantified. In accordance with the Bavarian goal for a phase out of the use of sewage sludge on agricultural land, the precautionary principle should be accommodated with respect to the protection of water bodies, soil and consumers.
Poland	Existing legislation in Poland is stricter than Option 1; so this Option will ensure stability. Option 2 will increase expenses on sludge management. The objectives of the Polish plan is to extend sludge thermally treated. However, this is expensive. Option 3 will have adverse effect. Option 4 is not acceptable and Option 5 should be completely rejected. The benefits should include the impact of quality of water resources.
UK	- **Option 1 remains viable** in that it provides minimum standards and that member states are at liberty to adopt higher standards. However, as noted above, revisions to domestic standards relating to heavy metals and pathogens are under consideration at Defra and it may well be appropriate to consider updating certain standards. It should be recognised that doing nothing may generate impacts, for example in terms of the confidence of food purchasers. **- Option 2 provides an opportunity to consider updating standards but this should be on the basis of standards justified by sound evidence and experience and proposed only where necessary to protect human health and the environment.** It is not immediately clear that wholesale redrafting of the Directive would be appropriate in order to reinforce confidence in the use of sludge on agricultural land. - Option 3 envisages 'more stringent standards' across all substances and a 'ban on application of sludge to some crops'. **It is not clear why option 3 is necessary.** The notion of 'more' or 'less' stringent is irrelevant if any fresh standards are to be justified by the

evidence – they are either necessary or they are not. The same applies to the proposition of a ban on application to some crops although we are aware of no evidence which would justify such an approach.

- **Option 4, total ban, is wholly unsustainable from a UK point of view.** Such an approach would be the cause of major and disproportionate costs, and disruptive to the water industry and its customers. There is no justification for such a course of action.

- Option 5, repeal of the directive. Although it is possible for member states to make their own arrangements, **repeal would probably counterproductive in that the confidence of food purchasers could be damaged such that the route for recycling could be undermined.**

The answer of the NGOs are summarised in the next Table.

Sweden

EFSA has in a report from 2009 concluded that the cadmium load on the kidneys of people has to be *decreased*. The supply of cadmium has to be kept on the lowest possible level. As all sewage sludge is relatively highly contaminated by cadmium it should not be spread on agricultural land. That goes for every other fertilizer, that is highly contaminated by cadmium, as well.

Some examples of cadmium content in fertilizers

Humane urine	0,7 mg Cd/ kg Ph
Urine+faeces	10
NPK	3
Swedish sewage sludge 2006 (average)	37

An alternative way to handle the sludge is incineration, which is a growing trend in EU. By incineration you get energy and the possibility to extract a clean fraction of phosphorus.

Our organisation ”Ren Åker – Ren Mat” (“Clean Land – Clean food”) will strongly emphasize that the disposal of sewage sludge on land should be prohibited

Questions 2 – 10: Impacts from Option 2

Question 2- Would your MS be affected by any of the components considered under Option 2?

The commercial stakeholders’ responses are presented below.

Germany

The threshold values are high enough for giving an sufficient opportunity for implementing quality assurance system with quality standards for different sewage sludge types. It is also possible to set individual standards on member states level with take into account improving of sewage sludge by waste water control systems, better processing and quality control of the sludge. Moreover individual standards can be set and gives an approbate option for improving sewage sludge step by step for an good agricultural use

For Germany we think that we will have no bigger impacts by setting the new limits for heavy metals in the sludge. As in many ways Cadmium is surly most relevant for both, environmental protection and human health, DWA would advocate for further reduction to 5 mg/kg. This reduction could be implemented within 5 years after the revised directive comes into force. The same procedure could be intended for mercury (Hg) and lead (Pb) as these substances have a relatively high hazardous potential, too. On the contrary the limit values for copper (Cu) and zinc (Zn) should not be reduced much further as these substances count as micronutients for plants.

It is proposed, that all sludge must be treated by any process that ensures a reduction in Escherichia coli to less than $5*10^5$. According to our data, sludge which is treated by anerobic digestion will meet this standard. Regrettably we have no reliable data for E.Coli **in aerobically digested sludge**. But as E.Coli prefers aerobic conditions we doubt, whether aerobically digested sludge will comply with this requirement. Hence, we suggest that further information should be gathered on this issue or appropriate analysis should be made. If the use of sludge on land should not be hampered seriously, there must be the possibility to recycle **an**aerobically **and** **aerobically** digested and stabilised sludge without further hygienic treatment. Where appropriate, recycling of this kind of "conventionally treated sludge" can be carried out in combination with certain conditions on application or in combination with QA-Systems.

In this context we'd like to point out, that in Germany about 10.000 wastewater treatment plants are in operation and approximately about 8.000 plants have arobic digestion to stabilise the sludge. Of course these are the "small plants" and the corresponding bulk of sludge is about 20% of the total sludge-mass produced in Germany, which is about 2,2 Mio t DM.

It is proposed, that stabilisation (or pseudostabilisation) should be monitored by using the following methods:

- volatile solid reduction of 38% or
- specific oxygen uptake rate of less than 1,5 mg/h/g total solids.

We clearly support that all sludge recycled to land should be stabilised. To assess the degree of stabilisation there are a number of additional possible indicators. In our opinion it is important that analysis is safe and easy. Therefore we would prefer as indicators the ratio BSB_5/CSB or the ratio dry substance / ignition loss.

Germany As far as Germany is concerned, we believe that we will have no major impacts by setting the new limits for heavy metals in sludge. So we see Germany in line one of table 13, which means that 0 % of sludge recycled to land today will fail the new limits.

Regarding cost calculations **BDE** mainly discovered a problem for hygienisation (standards for pathogens). The report assumes that in Germany 0% of the sludge would need advanced treatment (Table 19). Consequently, the economic impact calculated no costs for hygienisation in Germany.

It is true that German standards on good practice ensure a sufficient pathogen control, however, if - besides all - hygienisation would be required, basically all sludge applied to land would need a separate or advanced treatment. A recent study[50] published by our Federal Environment Agency (UBA - Umweltbundesamt) in 2009 indicates the following costs for hygienisation, depending on plant size:

- o 207-1.100 € per ton of dry matter (lime hydrate treatment of wet sludge)
- o 84-167 € per ton of dry matter (unhydrated lime treatment of dewatered sludge)

As a result, costs for hygienisation - especially with regard to wet sludge - are much higher than those calculated in the report (74-134 €/t DM, page 48). Another source (Schmelz, DWA-Conference 2007) indicates additional expenses of around 40% for obligatory sludge hygienisation. The calculations are based on the assumption that the sludge would then be treated thermally (no direct use on land anymore).

However, assuming costs of in average 200 €/t DM for 592.000 tons of dry matter (Table 8), Germany will face additional expenses of 118 million Euro per year, or even 148 million under the assumption of 250 Euro per ton dry matter. These costs might be slightly reduced considering other impacts estimated in Tables 31 and 32. **BDE** therefore recommends revising the chapter on economic impacts.

France The thresholds of Option 2 concerning heavy metals contenin sludge are very similar to the current French thresholds, and are slightl lower only for Lead and Zinc.

UK Yes, the Uk will be affected by the introduction of organics limits for sludge quality (PAHs) and by the changes to the heavy metal limits in soil.

UK company estimated that 5% of the sludge will not comply. The impacts on the disposal option are not realistic as they assume sufficient landfill (20% failing going to landfill). The only viable option will be incineration, pyrolisis, gasification. *They are very costly and incomplete solutions.*

The authors appear to misunderstand that a greater margin of safety does not represent a reduction in risk. If a limit value gives an acceptable level of risk then increasing the margin of safety by changing the limit value does not make it more 'safe'.

- The limit values for heavy metals in sludge should not be difficult to achieve provided that there is the legal framework and organisation to enforce control of discharges from industrial premises.

[50] Texte 05/09: "Anforderungen an die Novellierung der Klärschlammverordnung unter besonderer Berücksichtigung von Hygieneparametern", March 2009, in German

- There is no scientific justification for changing the limit values for metals in soils. Results from pot trials have little relevance in testing soil limit values. The long-term field trials in the UK demonstrate that the current limit values protect crops and soil microbial function.
- There is no scientific justification for setting limits for PCBs and PAHs in sludges; to analyse for them routinely would be a waste of money, furthermore project HORIZONTAL has demonstrated that the reproducibility between laboratories is very poor so even when there are limits, the data from laboratories are questionable.
- In principle it would be an improvement to have standards for treatment provided they are sensible.
- Farmers need information on fertiliser replacement value so that they can use sludge to best advantage – this is essential.
- The conditions on application do not need to change, cross-compliance requirements under CAP should be sufficient.
- Monitoring for organic compounds (including dioxins) would be a waste of money. We still need standardised methods that have good reproducibility – HORIZONTAL has failed to produce these. Detailed probabilistic risk assessment has demonstrated that at the concentrations found in sludges there is no need for routine monitoring.

Portugal Yes, of course. The quality of sludge can vary significantly depending of the waste water source and waste water treatment plant (WWTP) lay out. A more restricted limit for heavy metals, organics and pathogen land application will have a big impact on SS management practices and costs, because at present agricultural valorisation and landfill are the only available final destination solutions for sludge, in Portugal. The data of Table 13 are not actual.

EU wide Detailed justifications of the sludge threshold values are required. Half lives of NPE and LAS in soils are of less than 6 months. Inclusion of these compounds into the list of PTE cannot be accepted without explanation. Regarding heavy metals the most important decreases between the scenario 2 and 3 are for chromium, nickel and zinc. As lead is the element which contributes the most to the risk increase EFAR would like to know how the decreasing rates for the different PTE have been determined between the two scenarios.

Regarding pathogens EFAR wants to stress the fact that there has never been a major sanitary crisis linked to sludge landspreading. In some countries like France where there is a specific survey cell very few incident have been reported and the conclusion is that the risk is very low. This has been confirmed by a recent epidemiological study carried ouby the SYPREA (French representative of EFAR) on workers directly in charge of spreading operation. Therefore applying very stringent constraints as the one proposed in option 3 is non sense. The use of E coli and C perfringens as treatment indicators needs to be justified (if C perfringens could be used as composting indicator this is surely not thecase for the other types of sludge treatments). Finally EFAR also believes that pathogens standards have to be defined in term of limit values per quantity of sludge (gram) rather than in percentage of reduction. This is particularly true for industrial sludge like paper or food industries sludges which have to be included in the scope of the directive revision asstated previously.

On the pathogen sensitive issue (more in term of public perception than in term of effective risks) another possibility is to ban at an EU level the landspreading of primary sludge and to leave to member states the choice to set up their own policies. Most of them have already specific disposition in their sludge regulations but unfortunately they are not convergent. Regarding the soil threshold limits EFAR said repeatedly that setting limits on three different classes of ph is totally inapplicable on the ground level. Indeed it is common that soil pH varies from more than one point in the course of an agricultural year. Moreover the set of data proposed are too stringent (even in option 2) and will immediately limit significantly or even practically stop for certain area the use of sludge on land. It is also well known that the major part of the heavy metals soils content is due to natural background level with very low availability rates. EFAR would also like to be informed of the justification of the particular limitation proposed for zinc between option 2 and option 3. Such restrictive value makes finally the option 3 equivalent to option 4!

The risk assessment study carried out by INERIS has demonstrated on the basis of the average levels of heavy metals in soils subject to sludge landspreading (database of 80,000 data provided by EFAR's members) that this activity does not lead to unacceptable risk to human health even using systematically the highest transfer coefficients. For the record the JRC study published in 2004 and which conclusion are obviously used to propose limit values per ph classes was registering only circa 6,000 data.

EFAR therefore proposes to set only two soil ph classes (less than 6 and over 6). For these two classes the soil threshold limit can be adjusted to the 90th percentile of the soil database for ph<6 which will automatically lower the average content of soil in heavy metal and therefore reduce the corresponding risk. On this basis the proposed values are as follow (in mg/kg using Aqua Regia extraction):

	Ph<6	Ph>6
Cd	1	1.5
Cr	100	140
Cu	50	100
Hg	0.5	1
Ni	50	70
Pb	70	100
Zn	150	200

Nutrients in soils: EFAR does not understand the difference between option 2 information only and option 3 nitrate vulnerable zones.

The answers of the official organisations are given below.

Belgium - Wallonia This option is not satisfactory but can become suitable provided that is modified. The main modifications relate to:

- OC: the PAH parameter is different from those we analyse in the Walloon region. The limits do not correspond either. MS should be able to determine the best parameter to analyse given their context. Guidance can be provided by EU but not obligation should be put forward.
- Treatment for pathogens: the conventional treatment proposed is not specified. In practice it will be easier to determine a list of treatments allowed to be used without considering supplementary analysis. The strategy here is to restrict the use and sanitary delay imposition and, if appropriate, a case by case approach.
- The limits proposed in soil for heavy metals should not be linked to pH and this should be taken by each MS given the quality of sludge to be recovered (pH is highly variable throughout the year and space). The limits proposed are similar to those in the region except for Cd which is lower; this would exclude a significant part of our soils due to the industrial history of our region. The limit should be raised to 2mg/kg.
- While setting periods for harvesting a 10 month compulsory will have no impact, the ban would highly impact the current sludge management. Currently liquid sludge can be spread on agricultural soild with restrictions: a storage of 6wk is required prior to spreading, a maximum volume per track,. This ban will affect sludge from small stations and from food processing industries. A ban is not acceptable neither to propose more restrictions on the use of liquid sludge.

Belgium - Flanders We wouldn't be affected at all by option 2. In the report, you mention that we would be affected for organiclimits, pathogens, etc. Please see chapter 'additional data' for a correction on these points

France over 70% of sewage sludge produced in France are valued on agricultural soils, 3 to 5% of the French agricultural area being affected by these practices.

Czech Republic Czech Republic would not be affected by any of the above components of Option 2

Germany Table 3: Some organic pollutants are regulated in German legislation. The wide range of chemicals used in industry and in households nowadays complicates the decision for which contaminants legislation is needed, especially as the only feasible approach is the control of pollutants at the source. A number of aspects must be considered for each substance i.e. toxicity, amounts discharged, persistence in the environment, possible health hazards before deciding whether binding upper limits are necessary. It would also be important to have comparable data for all member states as planned in the FATE-SEES project. In Germany PFT/PFC (perfluorated tensides) and benzo(a)pyren as an indicator substance for PAH will probably be included in the revised German sewage sludge legislation.

In Germany no cases of disease transmission from sewage sludge have been reported. Possible health risks are minimised as the use of sewage sludge in sensitive areas such as fruit or vegetables is prohibited in current legislation. As a result pathogen reduction has not been a major concern in the last two decades. In the revised sludge directive pathogen reduction will play a role. When defining standards for pathogen reduction it must be taken into account that the member states have different approaches and a binding pathogen reduction may result in costs, especially for smaller treatment plants, that render agricultural use of sludge as too costly compared to other options. A study conducted to analyse the imple-mentation of pathogen reduction treatments in Germany and estimate the costs, shows that small treatment plants (approx. 1.000 inhabitants) may have costs up to
59 € per inhabitant and year.

A flexible system combining standards for pathogen reduction with differing possibilities for application would be more appropriate.

Quality assurance systems specifically for sewage sludge have been widely established on a voluntary basis in Germany. As quality assurance leads to higher costs, at least during implementation, incentives for participation are important. In upcoming German sludge legislation quality assurance will be encouraged by easing a number of requirements such as sampling and reporting as proposed in the report. The report does not describe the scope and contents of quality assurance systems in detail but experiences show that again a flexible system is necessary to function well at different sewage treatment plants

Table 5/6:
- Water and sludge management operators will also have higher costs for the higher number of analyses per year and additional organic pollutants.
- Increased sales for food/retailers from reduced sludge use do not seem realistic. Costumer awareness is focused on other aspects, i.e. GMO or regional products.
- At least in Germany further social impacts in form of amenity impacts for incineration and depending on the necessity, the building of new incineration plants are to be expected.

Denmark The introduction of PCB as a new parameter will affect Denmark in terms of analytical costs. Previous investigations have shown that PCB found in sludge was at a level below the porposed limit.The proposed limit value for zinc is not considered to have any impact because the Danish average level is significantly below the proposed limit.

In table 13 the percentage of recycled sludge failing new limits on heavy metals is 0 % for Denmark, but in table 14 you operate with 40% of sludge failing receiving further treatment and 60% of sludge of failing going to in-cineration with energy recovery. If zero percent of the sludge is failing (table 13), how is it then possible to operate with 40% and 60% in table 14?

Concerning table 25 it is difficult to see how the different costs have been calculated on the basis of the information in tables 13, 17 and 22. In Denmark's case the recycled sludge failing new limits on heavy metals is zero percent (table 13); the percentage failing new limits on OC is 10% (table 17) and the percentage of failing land will be 0% (table 22 and Q7). On this basis the costs mentioned in table 25 seem excessive. The parameters and the limit values mentioned in this option are very similar to the current Dan-ish legislation.

Romania The implementation of option 2 will affect Romania in terms of institutional building capacity of environmental institutions and of improvement of sludge management in waste water treatment services.

UK At table 3 [this table detailed the proposed standards under various options] the standards used are neither consulted nor discussed and cannot be taken as necessarily appropriate to the calculation of impacts. [Under] Option 2, any proposed changes to the limits on heavy metals should be justified by scientific evidence and should focus on soil quality.

Question 3: Do you agree with our estimate of recycled sludge failing the limits on heavy metals and the impacts on disposal and treatment?

The commercial stakeholders' responses are presented below.

UK

UK company estimated that 5% of the sludge will not comply. The impacts on the disposal option are not realistic as they assume sufficient landfill (20% failing going to landfill). The only viable option will be incineration, pyrolisis, gasification. *They are very costly and incomplete solutions.*

As with report 1 and 2, comparing average metal values (Table 11 Page 17) is inappropriate because aggregations of internal company site-specific data are misleading and this is even more misleading at national level.

Your estimates are almost certainly wrong because it is so long since we had a proper survey and reporting of sludge analysis. Even today, some MS (according to your report AT, SE, EE, MT) have not complied with the reporting requirements of 86/278/EEC. The MS that have reported will not have provided sufficient detail to estimate the amounts of sludge that would fail the limits.

The limit values for heavy metals in sludge should not be difficult to achieve provided that there is the legal framework and organisation to enforce control of discharges from industrial premises but some MS do not have these necessities.

Finland

Proposed limits less stringent that in Finland so this Option will not affect the sludge use.at the moment only very small fraction is incinerated. In the future, this situation may change.

France

According to our sludge analysis data bank, out of 1129 heavy metals analyses that comply with the French regulation, only 3 analyses for lead and 1 analysis for zinc would not comply with the thresholds considered in Option 2. If we refer to our internal data bank, the proportion of sludge that would be affected by this parameter threshold would be way under 5% and would not affect more than 1% of french recycled sludge.

Portugal

For Portugal it will be more than 5% and less than 15%

Germany

We agree with the estimates made in the report. Germany will not be concerned by setting the limits for the mentioned organic contaminants.

EU wide

No comment on new thresholds for PTE in sludge since most of the sludge will be compliant with those proposed thresholds. Impacts may vary among MS, but this will concern a low share of sludge quantity. Only few MS, if none, get accurate data to confirm or change the proposed ratio of non compliant sludges proposed in table 13. But it seems to be more or less to reflect reality.

What are the "further treatment(s)" in the first column of table 14? Is it economically (and technically) feasible to take into account such alternative treatments? We think that the main routes for non complaints sludges will be incineration and/or landfilling with the proposed share; so the first column would have to be deleted.

The estimation of €200/tDM for reduction of PTEs in sludge (p. 19) is probably not an annual cost but an investment cost for the 1st or 2 first years when setting up campaign for industrial PTE discharges in the sewage network. The following years, this cost is falling down.
The EWA would argue that there is a case to simplify the controls on PTEs in sludge and sludge-amended soil as concentrations of many of the elements that were important contaminants in sludge in the 1980s have declined below critical risk thresholds. The statutory regime could include Zn and Cu and possibly Cd, but, whilst it would be desirable to monitor other elements (eg Ni, Pb, Cr, Hg) for quality assurance purposes, in Member States where the concentrations in sludge are below risk thresholds, there specific regulation is no longer necessary. The EWA believes therefore believes that the maximum permissible values applied to today in relation to organics and heavy metals are extremely safe and demonstrate that every precaution is being taken.

The answers of the official organisations are given below.

Czech Republic	Czech Republic would not be affected hence 0%
Germany	The proposed heavy metal limits for option 2 will not have a significant impact in Germany, only a small percentage of the sludge will not comply with the limits. The impacts on disposal and treatment (table 19) are unclear and possibly not correct. A sewage sludge failing to comply with legal limits will be incinerated. I do not understand which treatment could lower the heavy metal content apart from mixing it with better sludge, something I would not call a treatment.
Portugal	Decree law 276/2009 of 2nd October establishes limit values for concentration of heavy metals in sludge identical to the limit values indicated in option 2, except for Cd and Hg.
Romania	The Romanian legislation (Ministerial Order no 344/2004 transposes the Directive 86/278/EEC) establishes limits of heavy metals and organic substances in sewage sludge more restrictive that provided by the Directive, so no different impact on disposal and treatment will be expected.
UK	It is not clear why the UK would fail as postulated in table 14 [disposal routes for sludge failing limits on heavy metals as proposed under Option 2].

Question 4: Do you agree with our estimate of recycled sludge failing the limits on OCs and the impacts on disposal and treatment?

The responses of commercial stakeholders are given below.

UK	Same UK company said that 10% of the sludge production will not comply with the OC limits. Disposal other than landfill is the only option. We believe the case for setting OCs has not been made and justified on the basis of sound science. It is likely that the % recycled sludge failing new limits on OC's for the UK of 40% is an underestimate, data from 2007 (Smith and Riddell-Black) suggests the majority of sludge has PAH's greater than the 6 mg/kg limit. We believe that 40% figure for sludge in the UK failing the new organic limits under Option 2 could be an under estimate. We are disappointed that no justification has been provided as to the limits for PAHs and PCBS given in Table 16. Research for Defra indicate that present levels are not of concern. Labs could not measure 6 mgPAH/kgDS or 0.8 mg PCB/kgDS reproducibly in the HORIZONTAL interlaboratory trial. The results from 16 laboratories that analysed a sludge sample ranged from 7.49 to 20.86 mgΣPAH/kgDS, mean 12.3, standard deviation 3.5 mgPAH/kgDS. When experienced laboratories report results like this for an ideal sample it is very unlikely that your estimates are correct because the base data are not comparable.The fact that some MS have chosen to set limits for OCs is no reason to impose them on all MS. For example the basis of the LAS limit in DK has been demonstrated to be wrong and that there was no need for a limit. The other limits are not justified by risk assessment, which as a matter of policy should be the basis for EU legislation [CEC (2000) Communication from The Commission On The Precautionary Principle COM(2000) 1 final Brussels, 2.2.2000].
Finland	At the moment there are no limits in organics. Not possible to make reliable estimates of how limits would affect Finland. New limits will increase amount of analysis and costs. Laboratories do not make these analysis at the moment. PAH is not a suitable parameter to regulate since PAH is mainly formed by incomplete burning and deposition is difficult to control by waste water utilities.
France	For organic pollutants, out of 700 analyses, 2 PAH analyses and 1 PCB analysis would not comply with the Option 2 thresholds. For PAH, we do not have any internal data bank available regarding the 6 new compounds that should be taken into consideration. However, if we refer to the 2002 ASTEE study led on 60 different French waste water treatment plants for 11 different PAH compounds content in sludge, the average value was only of 2,3 +/- 2 ppm on dry matter, to be compared to the proposed threshold of 6. If we refer to our internal data bank and to the ASTEE 2002 study, the proportion of recycled sludge that would be affected is not theoretically null, but remains very low (about 1% ?). A little incertitude remains on PAH due to the global 9 compounds approach of the Option 2. Following the INERIS risk assessment released in 2007 for EFAR, we propose to implement

limit values only for PAHs and PCBs due to insignificant contribution to global health risk for other OCs (as DEHP, LAS or NPE). For PAHs and PCBs, the following limit values should be:
- 2 ppm DM for benzo(a)pyrene (that should be considered separately from other PAHs),
- 4 ppm DM for other PAHs,
- 0.8 ppm DM for PCBs

Germany In the current German sludge ordinance, there is no regulation for PAH. Thus we do not have sufficient data for this parameter. But we are quite confident that due to the improvements in sludge quality, which has been achived during the past, most sludges will comply with the proposed limit value.

For PCB in Germany there is already a limit value in force which is 0,2 mg/kg for each of six congeners. As most German sludges clearly go below this limit, we expect the new limit $PCB_{(Sum\ of\ 7)}$ will be no major problem.

Altogether Germany should not to be too much concerned by setting the proposed limits for the mentioned organic contaminants ($PAH_{(Sum\ of\ 9)}$: 6 mg/kg DM and $PCB_{(Sum\ of\ 7)}$: 0,8 mg/kg).

Portugal For Portugal it will be more than 30% and less than 50%

EU wide EFAR suggests setting up limits only for PAH with a maximum of 4 mg/kg DS for the sum of Fluoranthene + Benzo (b) fluoranthene and of 2 mg/kg for benzo (a) pyrene which is the most poisonous.

The limits mentioned in the table 15 for France are the specific case of sludge spreading on grassland. For the general case other values are to apply.

EFAR is really doubtful with the content of the last § page 20 which could be summarized by " As there were no common view on the OC issue the author has arbitrarily set the limit values mentioned in table 16" !!!

Once again EFAR wonders how the different country classes have been set. For example how is Portugal in the same group as Italy and Ireland and not with Greece, Spain, Luxembourg and UK?

How the 12% failing rate for the EU 12 has been determined?

It's not clear what the 6 mg/kg DM for PAH is covering: is it a limit value for each congener (and which ones?) or is it a limit value for a sum (and the sum of which congeners?). According the answer, the failure ratio will change, and the list of MS not affected might change.

The answers of the official organisations are given below.

Belgium Flanders We have no legislative limits in organics – please correct!

Czech Republic Small water treatement plants and small localitites in the Czech republic could comply with the limits proposed in Option 2.

In the Decree of the Ministry of Environment of the Czech Republic No. 294/2005 Coll., on the conditions of landfilling of waste and use of waste on surface and below the surface and amendment of Decree No. 383/2001 Coll., on details of waste management are in Table No. 4.1. maximum allowable concentrations of PAHs and PCBs given for wastes (therefore also for sludge), which may not be accepted in a landfill group S-inert waste. The maximum allowable concentrations for PAH is 80 mg/kg and for PCB 1 mg/kg. Further the maximum allowable concentrations for PAH in dry matter of waste, used on surface is 6 mg/kg of dry matter.

In the Decree No. 382/2001 Coll., of the Ministry of Environment of the Czech Republic of 17th October 2001, on the conditions for using treated sludge on agricultural land, the value for PCB is determined only, and that is 0.6 mg/kg of dry matter of sludge. The values for PAH are not given.

Decree 341/2008 Coll. (Decree on Details of Management of Biologically Degradable Waste) gives concentrations of PCB and PAH for outputs from facilities for recovery of biologically degradable waste. For PCB is limit 0.02 – 0.2 mg/kg of dry matter and for PAH 3 – 6 mg/kg of dry matter.

Germany As stated in the report we do not believe that the suggested limits for PAH or PCB will have any impact in Germany.

Poland Table 18 contains incomplete criteria. It should also include other parameters such as Ascaris eggs, Trivhuris SP and Toxocara sp.

Portugal As far as organic compounds are concerned, Decree law 276/2009 of 2nd October establishes limit values for concentration identical to limit values illustrated in the option 3.

UK Para 3.2.2 assumes the at OC controls are desirable but it is not clear what the evidence for such an assumption would be.

Question 5: What percentage will be affected by the new limits on pathogens and will receive further treatment? Would this treatment consist of adding lime?

The response of the commercial stakeholders is given below.

UK The estimate of 40% of sludge failing the conventional standard for pathogens is in our opinion an over estimate. There has been significant work in the UK by Water companies to meet the requirements of the Safe Sludge Matrix (SSM). The standards set in the SSM however remain non-statutory guidance parameters.

The addition of lime to non-compliant sludge represents an option for re-treatment, there are however other options, for example, further digestion, use on alternative outlets or disposal. The addition of lime to 40% of UK sludges would have a significant impact on the carbon footprint of the water industry. Any alternative treatment option would need to be verified to the same levels as the primary treatment source.

The estimate of 40% of sludge affected is likely to be a little high as significant investment in advanced digestion is occurring across the UK.

The reliance upon lime addition as a main treatment process or a 'back-up' process for achieving pathogen compliance is predicted to significantly reduce over the coming 5 years as companies responsible for sludge treatment are aiming to maximise the energy value associated with sludge and moving towards anaerobic digestions as the predominant treatment process.

We think the costs of liming seem rather low. For example we estimate that 22Euro per tds would only cover the material costs, and would not cover impact of labour, power and maintenance. Our estimate (based on Ofwat July Return data) would be closer to £150/tds for lime treatment OPEX.

Option 2 is likely that the suggested limit for PAH at 6 mg/kg dry matter will preclude a significant amount of biosolids from application to soils.

The utilisation of landfill will diminish in the future as either the costs significantly increase (gate fees and escalating landfill tax) or availability becomes an issue, as an example it is suggested that the Southeast of England has only 3 years of landfill life left. It is likely that current incineration capacity will need to be increased to accommodate such volumes of sludge.

The UK water industry treats the large majority of sludge to a conventional standard and the estimated % should be lower, closer to 20%. The reliance on lime stabilisation is one that adds to the carbon foorprint and increasing the mass for transport. As such it is an unsustainable process and one tha the UK water industry is moving away from.

As with organic contaminants, the percentages of sludge that will require additional treatment are almost certainly unreliable. For one thing the point of sampling needs to be defined closely because numbers of organisms enumerated can increase or decrease depending on conditions.

Lime is easy to deploy and is very effective for reducing the numbers of pathogens and has been used for this purpose for centuries but it has two drawbacks a) the treated sludge can be very malodorous and b) lime has a large carbon footprint (it is produced by burning limestone at 825ºC).

The reality of public acceptance is that odour by far the most important consideration, much more than pathogens – not causing odour nuisance should be one of the requirements if the directive is going to be revised.

Finland In Finland advance treatment is required. Thus, it will not affect the use of sludge in agriculture. The percentage of sludge affected will be 0%. Lime treatment is not usual in Finland, majority of sludge is composted. Pathogen reduction is also done by thermal treatment before digestion. In Oulu sludge is treated by Kemicond reduction.

Germany But the new requirements for sanitation /reduction of Escheria coli to less than 5x105 have to be proved also for anaerobic-mesophilic processes, so that we cannot make any statements on these issue. In a worst-case-examination we don´t believe in a 0% sludge rate for Germany affected under these new treatment duty

(question 5), but approximately about 40 %? (Question 5,6)

Today we have no requirements for pathogens in sewage sludge going to agriculture in Germany. Most of the sludge bulk in Germany is treated by mesophilic anerobic digestion. We are relatively sure that digested sludge will meet the suggested standard (less than $5 * 10^5$ colony forming units of E. coli).

On the other hand –as already mentioned above- we are not sure, whether aerobically stabilised sludge can observe the standard. **This is significant for a huge number of smaller wastewater treatment plants in rural areas (in Germany about 8.000 plants!) where usually the sludge is used in agriculture,** mostly as liquid sludge.

France For Escherichia Coli, as this parameter is not analyzed in France, we do not have any reference data on raw product that could help us appreciate the impact of this new parameter and threshold. It can be only mentioned that this threshold would probably mainly affect liquid sludge or pasty sludge for direct land spreading without further treatment (AD, liming or composting). These sludge recycling solutions are less and less frequent in France as they bring about logistic and environmental difficulties (important restrictions on parcels slope and on calendar of use for liquid sludge; odour problems for pasty sludge storage and land spreading).

It is impossible to say that 0% of French recycled sludge would be affected since the E.Coli numeration threshold is not applied in France, and since the "boues hygiénisées" status mentioned in the French regulation is not mandatory.

We can only assume that the implementation of this threshold could affect (in DM proportion) between 5% and 20% of French recycled sludge without having any guaranty on the sanitary risk due to pathogens

Portugal The new Portuguese legislation already establishes new limits for the following organism: E. coli: <1,000/g. Salmonella spp: not detected in 50g.

Almost all WWT in Portugal are not prepared to promote higienisation. Therefore the % of sludge that needs advanced treatment will be much higher than 40%, probably around 90%. Adding lime is one of the simplest ways to obtain the expected results, although plants are not prepared to do so.

EU wide EFAR regrets that his previous comments regarding maximum concentration for pathogens have not been taken into account. Once again for France the limits mentioned are only applicable for hygienezed sludge and for specific uses.

Pathogen controls in the revised Directive could be developed to include different levels of microbiological quality according to treatment status and end use.

Agricultural use of untreated sludge should not be permitted and is no longer regarded as acceptable practice. Waiting periods for sludge treated to eliminate pathogens are unnecessary and would increase the flexibility in end-uses of sludge processed to this standard. Agricultural use of sludge treated to significantly reduce pathogens (but necessarily to eliminate them) coupled with suitable land use restrictions, following the well established multi-barrier approach, is an acceptable and safe practice and should be maintained by the revised Directive.

The answers of the official organisations are given below.

Belgium Flanders	We do have standards on pathogensAdding lime is common used treatment to reduce the risk of pathogens in Flanders
Czech Republic	Waste water treatment plants, which have set up new technologies including hygienization of sludge outputs, produce sewage sludge complying with the limits given in the Czech legal regulation. Waste water treatment plants greater than 100 000 EI are concerned. Treatment consisting of adding lime has been introduced in some Waste water treatment plants after the Decree No. 382/2001 Coll., on the conditions for using treated sludge on agricultural land entered into effect. At present adding lime is decreasing due to the problems with NH3 and problems with homogenization. In final phase the treatment consisting of adding lime did not prove to be suitable treatment of sludge.
Germany	As explained in Q1 Germany has minimised health risks by prohibiting sludge use if risks can be expected, i.e. sludge use in vegetables is not allowed. Normally specific treatments to reduce pathogens are not applied. Anaerobic digestion is the usual procedure, but according to the study this may not reliably achieve standard. Some sewage treatment plants have processes integrated for other reasons that would reduce the amount of pathogens as a side effect, i.e. in some areas the farmers prefer sewage sludge treated with lime.
UK	At 3.2.3 we would draw attention to the use of the SSM in the UK in respect of pathogen standards.
Romania	According with Romanian propose regarding 2020 scenario for the sewage sludge disposal, 30% of sludge will be affected by the new limits on pathogens and will receive further treatment. In principle, this treatment will consist of adding lime.

Question 6: Do you have and can you provide costs data on HACCP? Please provide estimates of the number of staff or time required per installation if feasible.

The responses of the commercial stakeholders are below.

UK	We do not have any specific cost data at this time, however, in order to ensure that we meet the requirements of HACCP we have:- • trained site staff at all of our wastewater treatment facilities • created a compliance manager and compliance reporting role within operations to manage this specific requirement • developed in-house procedures, data collection processes and sampling regimes to ensure we are compliant • invested in complex digestion and liming processes to ensure compliance • invested in contingency process to manage non-compliant products • invested in R&D to understand issues including re-growth/re-activation. Clearly these actions have significant costs associated with them. It is estimated that HACCP monitoring is in the region of £5000 - £8,000 per treatment site/year. Having done a lot of HACCP training and HACCP analysis and plans, I would say that it is impossible to answer this question because it is inadequately defined. However HACCP is the best way to design a process, if it is done honestly and properly. Undertaking HACCP need not take a lot of time. It is the best way to assure and to demonstrate that standards are achieved. If a lot of work is required to bring a works into HACCP it is because it was not doing the job it was supposed to be doing in the first place. For a works that is achieving good treatment without short circuiting, etc. should comply with HACCP easily. Neither of the suggested measures of stabilisation have proved effective in practice.
Finland	We do not have information about HACCP costs. We are of the opinion that methods and liits of stability measurement should be decided locally since different methods are in place already.
Germany	No experiences and cost data exists to the HACCP processing currently, because it is not carried out yet. A comparable tool might be the voluntary Quality Assurance System (e. g. QLA) that controls the raw materials, the treatment process and the application in agriculture. We welcome the opportunity for implementing quality assurance systems in order to get more transparency in the process and in the quality of the end-product. We calculate just now only for the new quality assurance system of sewage sludge 2- 3EURO/t DM and huge costs for

the demanded additional analyses. Just now we calculate of about 600 €/ analysis (inclusive sampling).
The increased quantity of analysis will bring more than doubling of analysis costs and additional costs for quality assurance – beginning with waste water register testing, process and product control, as well as checking the good agricultural fertilization (question 9).
HACCP is unusual in Germany, hence we can not provide cost data.
As far as we know, HACCP originates from the food industry. For the following aspects, we would like to put for discussion, whether it is wise to try to carry forward the principles of HAACP to sludge recycling:
HACCP is based on **accurate definition of the control points** (measured variables) which correspond with **definite actions** that have to be taken, whenever any discrepancy occurs. In our opinion the whole process of wastewater- and sludge-treatment, as well as sludge recycling does not fit very well into this system, because control points and corresponding actions can not be defined that stringent. To ensure "state-of-the-art" recycling of sludge, we would prefer a Quality Assurance System which is particularly designed according to the complex and often "fuzzy" context of wastewater treatment and sludge recycling. To give an example for such a system, we enclose the "Qualitäts- und Prüfbestimmungen Klärschlamm" of the German QA-System "Qualitätssicherung Landbauliche Abfallverwertung (QLA)" in Annex 1.

France Even if the categories of waste water treatment plant sizes differ in the French regulation and in the Option 2, we can consider that the frequency of analyses required in Option 2 (and option 3) is twice lower than in the current French regulation. In that case, the implementation of Option 2 would not impact the current quality control of land spread sludge in France. By limiting the test duration to 4 days, the approximate cost of practicing this test with the SUEZ ENVIRONNEMENT BIODEC apparatus (equipped with 4 cells of ten liters each) would be about 200 € by sample with a minimal number of 4 samples to be analysed simultaneously. A new apparatus comprising 8 to 10 cells and automatically monitored could allow for a decrease in costs.

EU wide Stability of sludge is difficult to define and different practices and methods are used for this purpose. Nationally, there might be different requirements for stability as well. Thus methods and limits for stability measurements should be decided locally.
There are numerous different quality control methods used in different countries. HACCP is one of them. EUREAU is of the opinion that there should not be any rigid requirement for HACCP in all plants but it should be based on decision in each country how to implement quality control.
As Stated in our general comments, we advocate for flexibility. Flexibility has been a relevant tool in the 1986 directive, and this should be kept as a warranty for success
The EWA would like to ask the authors of the report to review the Quality Assurance Systems (QAS) in Germany and Sweden. In Germany expert organisations from agriculture (VDLUFA) and waste water treatment (DWA) have developed a QAS that now applies to approximately 10% of the sewage sludge used in agriculture. In Sweden a quality assurance system (ReVAQ) has been designed by all stakeholders and it incorporated aspects of the DIN ISO certification standard. This scheme is being rolled out across the country. Quality assurance schemes are also used by some water utilities for example Anglian Water from the UK adopts aspects of the ISO standard and uses them in combination with concepts from the food industry such as Hazard Analysis & Critical Control Points (HACCCP). The EWA has taken the initiative in establishing a task group to determine if it is possible to create a common European QA framework and once complete the organisation is happy to share the findings with the commission.

Portugal Portugal does not have experience in this area

The answers of the official organisations are given below.

Czech Republic No data

Germany As stated in Q1 pathogen reduction has not been a major concern in Germany, as a result HACCP is not applied and no data is available.

Romania Presently, Romania cannot provide costs data on HACCP.

Question 7: What do you expect the % of total agricultural land to be failing to comply on the new limits of heavy metals in soil? Would production be maintained through the application of fertiliser?

The responses of the commercial stakeholders are below.

UK

We estimate a 15% - 65% loss of available land (best case to worst case from 3 years of data). N.B. This does not account for all agricultural land in our region.

In regard to potential loss of production, UK wide the water industry accounts for approximately 5% of all organic manures applied to land, as such, loss of sludge as an alternative is unlikely to impact significantly on food production as farmers would turn to readily available alternatives. The question should perhaps be directed at the lost opportunity to utilise a low carbon, sustainable supply of valuable plant nutrients.

We believe that the data provided by WRc for the UK to be a reasonable estimate of the land not available for biosolids recycling. It is probable that production would be maintained through the application of commercial fertilisers.

The maximum presimissible limts under Option 2 are lower than the current UK ones. However research for Defra shows that immediate changes to permissible soild limits calues for Zinc, Copper and Cadmium are unwarranted at this stage.

While it is likely that production will be maintained through the use of commercial fertilisers, sludge is more sustainable. These are often imported from Europe or beoun and are less sustainable.

There are probably few, if any, MS that can answer this question with any degree of accuracy because few, if any, MS have sufficiently detailed national soil inventories [for all of the elements] with data held in a relational database where it is possible to make multiple compound queries.

High geogenic concentrations of metals in soils seldom coincide, thus, for example, some soils might exceed the new Ni but others exceed the Pb. If a field exceeds a single pH/metal limit it will be excluded from sludge application. For the UK (which has no map for soil-Hg) the percentage of the total agricultural land that would fail almost certainly exceeds 40%.

The long-term, multi-site field trial in England, Scotland and Wales has found that the ceiling soil limits in the UK are adequately protective of crops and soil microorganisms and their functions.

The EU is supposed to be committed to science-based policy; there is no evidence from field trials that the soil limits values need to be changed; pot trials cannot replicate field conditions.

Agricultural production would of course be maintained through the application of fertiliser but the opportunity to conserve and recycle phosphate would be lost, which would be a scandalous dereliction of responsibility. The world's phosphate is being exhausted; EU policy should aim to conserve phosphate. Furthermore, soils would not benefit from the organic matter, nitrogen and trace elements.

Finland

New limits will not affect sludge use in agriculture.

Germany

In Option 2 also the new regulation of soil heavy metal concentrations could have an greater impact of the fertilization of sewage sludge especially on sandy soils as the estimated 10% "failing land rate" for Germany. In east Germany a lot of sandy soils are under cultivation and could be affected by the new soil heavy metal limits. We think that the percentage land considered under Option 2 could be regional much more than the estimated 10%.

We don't have enough data to give an exact answer. As the proposed limits fall clearly below the existing German limits for soils with 5<pH>6 and 6<pH<7, our estimation is that considerably more than 10% of the total agricultural land will not comply with the new limits. We expect this share to be in the range of 25% to 35%.

We do not have a sufficient amount of data available to give an exact answer to this question. But we agree with the estimation made in table 22, which means that about 10 % (or less) of the total agricultural land will not comply with the new limits.

France

Only 2 to 3% of the soils will be affected.

Portugal

The new Portuguese legislation states the same limits mentioned in Table 21. 30% will be correct for Portugal.

EU wide

The proposed limit values on PTE for soil will cause significant impacts on sludge recycling and do not appear to take into consideration:

▫ The EU's complex soil variety.
▫ Natural background values in soil
▫ The difference of behaviour for PTE in soils ; scientific evidence show that PTE from anthropogenic sources (contamination) are more bio-available) than background concentration (geogenic origin) for plant uptake
▫ Thresholds based on risk assessment
▫ The evolution of soil pH with the agricultural practices (liming, fertilising, etc.), the natural microbiological soil activity and the growth of the crop

Due to a possible huge impact of this PTE limit values in soils, we think that it should be the matter for a separate and specific study, aiming at collecting more data on soils per country, and doing a proper assessment of the expected impacts. Most of the stakeholders responding to the consultation are not experts on this issue.

Furthermore, doing comparisons require that methods for analysis should the same or should be similar; but it seems not to be the case, comparing PTE extraction with aquae regia or HF acid.

Such an important issue should not be solved without an accurate assessment (more data, health risk assessment, peer review for soil analysis methods). We consider that the current impact assessment for this issue is not accurate.

Production will be maintained through the application of fertilisers since the farmer will get the same crop yields and incomes, but with a less favourable economic balance (price of fertilisers), and a worse environmental balance (GHG, consumption of natural resources).

The answers of the official organisations are given below.

Belgium Flanders	0%
France	The issue of limits in concentration for metals determining soil suitability for land application will take the following developments. The geochemical background varies greatly from one region to another. It is thus important to be able to waive these limits where appropriate. The French approach of granting an exemption provided that the exceedance is of natural origin and that the metal concerned is neither moving nor bioavailable could be accepted.
Czech Republic	The limits for sludge are stated in the Decree No. 382/2001 so that not to affect the quality of soil. The Decree (see section 1) gives in addition to concentrations of metals also technical conditions for using treated sludge on agricultural land as for example doses, which can be used similarly as fertilizers.
Germany	The limits on heavy metals in soil seem acceptable. As the classification of soil by the pH-value is not normally used in Germany appropriate data to estimate effects is not readily available. Production would be maintained by the application of other fertilisers.
Portugal	In relation to the options 2 and 3, Decree law 276/2009 of 2^{nd} October establishes less restrictive limit values for concentration of heavy metals in soil. It is thus considered that the adoption of limit values for heavy metals established in the option 2 implies significant impacts, namely reduction in terms of percentage of the soil available for sludge application. So being, it is considered that this point requires a more in-depth approach, and that specific soil characteristics of the different Member States are taken into account when establishing limit values.
UK	Evidence is required for the PTE standards set out at table 21.
Romania	The heavy metals concentration in soil from Romania complies with national limits. In Romania, the production will be maintained through the application of fertilizer.

Question 8: What % of total agricultural land do you expect will be affected by Option 2 conditions on application?

UK	This would be limited as the UK already works to the application requirements detailed in the SSM, including the banning of untreated sludge application, harvesting and grazing intervals. The banning of liquid sludge injection would have minor impacts as this practice has already been significantly curtailed by the implementation of the Nitrates Directive and Nitrate Vulnerable zones. This impose extended closed periods for readily available N organic manures It is expected that such a ban will have a negligible effect on the % of total agricultural land in

the UK.
There is really no objective reason to ban injecting untreated sludge and/or liquid sludge into the soil; it is effective, avoids the problem of odour, prevents run-off and is used extensively for manure. If MS chose to do it, that should be a matter for subsidiarity, it does not need to be harmonised across the whole EU.

Finland All sludge must be treated. This ban is not expected to affect the agricultural use of sludge.

France Much lower than 30%, elss htan 5% of French soils that receive or could receive sludge.

Germany It is not clear to us what is meant by "*untreated sludge and/or liquid sludge*". If "untreated" means "not stabilized" this part must be divided from liquid sludge. In Germany it is forbidden to use unstabilised sludge in agriculture. All liquid sludge used in agriculture is stabilized and mostly spread on land and rarely injected into soil.

Portugal Since most of the WWT have only conventional treatment of sludge, operators will need to invest in higienisation systems to remove pathogens. The costs will be probably much higher. (Table 24) Environmental impacts from reduced application should be changed to comply with the precautionary principle. There are impacts os using sludge in agriculture that must be quantified. The impacts of sludge application should be included with the impacts from incineration and landfill.

EU wide This percentage is quite variable among EU countries, since untreated sludge will concern the small size and a lot of medium WWTP (< 10,000 p.e.), and thus the rural areas. But for some countries, it could concern a large share of WWTP that won't have the financial capacity to set up more advanced treatment to produce dehydrated sludge.

We would like to highlight that requiring the immediate injection in soil for liquid sludge would de facto ban all recycling in mountainous areas (where arable crops are very rare) and large areas where cattle farming and grassland are predominant, since the injection in soil destroys the pasture. Because spreading dehydrated sludge is difficult on grassland, this would get to a huge decline of recycling ratio while requiring dehydrated treatment for incineration as alternative outlet (not to say about the cost of building up new incinerators).

As a result, it would be better to set allowable periods for grazing, rather than prohibiting the use of liquid sludge.
Figures are at least wrong for France where lot of liquid sludge coming from long term aeration processes is spread on land. Why as for the heavy metal issue is there no column for sludge receiving further treatment?
The definition of untreated sludge needs to be given. Does this term refer to primary sludge or also to biological sludge with only aerobic treatment?
Considering that untreated sludge is primary sludge and due to the lack of sanitary crisis linked to sludge landspreading EFAR believes that the restrictions proposed page 27 are appropriated.
However it is necessary to pay specific attention to sludge landspreading on grassland and forage crops. For these types of crops a compulsory six weeks period between spreading and grazing or harvesting is suitable. This could be limited to three weeks for advanced treated sludge and for sludge direct injection.

The answers of the official organisations are given below.

Belgium Flanders 0% of untreated sludge because this is forbidden by law.
We have a lot of liquid sludge from the food and paper industry. This will have an extra costs implication (if it cannot be applied without being injected or immediately worked into the soil)

France using liquid, untreated sludge has the advantage, for small wastewater treatment plants (it is recalled that France has about 5200 stations handling capacity less than 1000 population equivalent of a total of about 11,800 stations with over 200 population equivalent), to reduce the investment required for sludge treatment while using the nutrient content available in it. The issue of odour is an important component in public acceptance of such usage. Strict usage rules, such as the requirement of rapid burial and the respect of minimum distances between areas of application and houses, implemented in France are an appropriate response to this issue.

Czech Republic Czech Act No. 185/2001 Coll. on waste states in Section 33 (1) that:
A legal entity and a natural person using soil shall be obliged to use **only treated sludge**

taking into account the nutritional requirements of plants, under the conditions stipulated in this Act and an implementing regulation and in accordance with the sludge use program stipulated by the producer of sludge so that the quality of soil and the quality of surface waters and groundwater is not impaired.

Germany The use of untreated sludge is prohibited in Germany. Liquid sludge used in agriculture is stabilized and spread on land. It is very rarely injected into soil. The no relevant amount of land used for agriculture would be affected.

Portugal Decree law 276/2009 of 2nd October already contemplates the conditions indicated in option 2.

Romania In Romania, according to the water management national legislation, the direct discharge of waste water in groundwater is forbidden. Due to this provision, the practice of injecting of untreated sludge and/or liquid sludge into soil is not in operation.

UK At paragraph 3.2.7, it is unclear what evidence there is for the amendment on current restriction on spreading. The UK is considering further controls over the spreading of untreated sludge to land.

Question 9: What are the costs implications of these new monitoring requirements? Please explain (e.g. number of additional FTE, administrative costs, etc.)

UK Option 2: Increased sampling requirements will lead to additional staffing levels (a small number per company, for example 3 staff). Overall this cost is considered modest in comparison to the capital costs identified in the report.

Some additional costs may be more significant, particularly the organic contaminants and pathogens analysis in sludge as these would require new methods and additional sampling requirements e.g. refrigerated vans for pathogens.

It is likely that the sampling requirements will increased staffing levels, with sampling and administration adding a probable 2 FTE posts (per Company) resulting in up to 30 additional posts in the UK. The analysis is likely to be contracted out to a service provider and as such will not impact on FTE's to the Water Companies but increase current opex costs by a suggested 10 fold.

As discussed above, there is no objective reason for monitoring organic compounds and dioxins routinely; it would be a waste of money and have no benefit. If MS chose to do it, that should be a matter for subsidiarity, it does not need to be harmonised across the whole EU.

Regrettably it is delusional to think that the analytical methods produced by CEN/TC 308 [or HORIZONTAL] give results that are reproducible between laboratories as the international interlaboratory evaluation exercises have demonstrated.

Finland The proposal will increase the amount of analysis. OC and dioxins are not analysed at the moment and these analysis would increase the costs. Amount of heavy metals will increase. Micro-organism are followed according to the monitoring plan of the sludge management operator. Amount of analysis will probably increase.

Germany The suggested number of analyses per year is much higher than it is required in Germany today (Heavy metals, AOX and agronomic parameters 2 times per year; Dioxins and PCB every two years). The frequency proposed in is higher and in addition there will be new parameters (PAH, microorganisms). This will considerably increase the costs for sampling and analysis. For example the analysis of Dioxins costs about 500 € per analysis. Usually sludge quality from a certain plant moves within a certain band width that can be recognized by relatively few analyses. Therefore increasing the number of analyses does not automatically lead to a much better knowledge of the sludge quality. Hence, we think the number of analyses should be reduced substantially, particularly with regard to the sludge directive giving a standard for whole Europe. Memberstates still can set up stricter requirements if this seems adequate due to special conditions in the state.

The suggested number of analyses per year is much higher than usual today in Germany. The frequency is higher and we will get some new parameters (pathogens). This will increase the costs for these monitoring requirements.

For example, costs for the analysis of dioxins amount to about 500 € per analysis. According to the valid German sludge ordinance, dioxins in the sludge for use in agriculture must be analyzed every two years, independently of the size of the WWTP.

EU wide It will depend on the current monitoring situation of each country: see appendix on national data.

The answers of the official organisations are given below.

Czech Republic We have no available data.

Germany Compared to current legislation (agronomic parameters and heavy metals twice a year) the necessary number of analysis is far higher. The draft of the revised Ger-man sewage sludge directive requires more analysis, comparable to the proposal, but it is planned to reward participants of quality assurance systems by requiring less analyses per year. The frequency for the organic compounds seems extremely high, in Germany Dioxins and PCB are analysed once every two years and this seems to be sufficient, particularly as the costs are high.

Romania The Romanian legislation (Ministerial Order no 344/2004 transposes the Directive 86/278/EEC) establishes a minimum number of analyses per year higher than monitoring requirements proposed by Option 2, so no cost impact will be expected.

Question 10: Do you agree with our assessment of Option 2? If not, please expand. Feel free to add comments on the benefits and costs from Option 2 as well as any data that could influence the assessment.

UK We suggest that further work is undertaken on the estimated failure rates in order to refine the overall impact assessment. We also suggest alternative treatment/disposal options are considered rather than simply rely on landfill to solve a significant proportion of non-compliant sludge problem as this is not considered realistic or sustainable.

The estimates for non-compliant sludge with more than one parameter exceedance will need to be explored to fully understand the impacts, for example some sludge may fail individual metals and a different sludge may fail the organics limits. The total non-compliant sludge volume could therefore be significantly higher if no overlap assumed (worst case v best case).

We propose the following revisions to refine the risk assessment:

- a separate study on the PTE limit value options and the development of the most appropriate methodology to administer the approach ensuring protection of human health and the environment;
- a review to look at the distribution of low pH soils across Europe as this will be the most significant factor in terms of future landbank availability for option 2 or 3;
- a study to quantify the potential benefits for example a CBA of the different options; and
- an assessment of market and consumer confidence impact

In general the assessment is reasonable. However we consider the benefit of this option to implementation of the Water Framework Directive (WFD) is overstated and unlikely. For example use of biosolids on land is not even considered a risk to meeting the WFD objectives in the recently published River Basin Management Plans in the UK. There are definitely no measures identified in the RBMPs relating to the Sludge Directive.

The total cost of all of Option 2 is estimated in Table 25 at €4.5bn but no evidence has been given for the benefit that would be achieved for this huge investment nor evidence of risk that needs to be reduced.

The "environmental costs (to incineration)" in Table 26 almost certainly do not take account of the fact that sludge is burnt in coal fired power stations in Germany (and possibly other MS) without the power stations complying with the Waste incineration Directive.

Squandering phosphate by burning or landfilling sludge brings forward the day when agricultural production will be phosphate limited and the geopolitical issue of relying on Morocco for supply [e.g. Dery & Anderson (2007) Peak Phosphorus. Energy Bulletin http://energybulletin.net/node/33164 and Vaccari, D. A. Phosphorus Famine: The Threat to Our Food Supply. Scientific American Magazine - June 3, 2009].

The proposed revised soil limit values are the particular issue because, whilst controlling contaminants at source is practicable, there is no means of getting around the distribution of geogenic metals. Unless there is evidence of adverse effects it would be irresponsible and reckless to change the soil metal limits.

Germany In table 27, we are surprised by the huge impact for 2 countries, UK (1.1 – 1.3 billions €) and Spain (0.7 - 0.8 billion €), with some disproportion compared to other countries: e.g. for UK

	and Spain 10 times more than Germany on a €/Mg sludge used in agriculture basis. Those data should be checked.
Finland	Influence in FInalnd is estimated based on the assumption that only 3% of sludge is used in agriculture. This was the case in year 2007 but the use has increased. We suggest that at least 15-20% of sludge generated in Finland in 2020 is assumed to be used in agriculture in the impact assessment.
France	Should the thresholds concerning pathogens (E coli) proposed in Option 2 not become mandatory, the overall impact of Option 2 on the current French legal framework on the use of sludge in agriculture would be very low. It would thus be acceptable for the major stakeholders who want to maintain a high rate of return to soil for sludge of good quality in the future.
Portugal	In our opinion, there weren't considered all the impacts associated with the use of sludge in agricultural valorisation.
EU wide	In table 27, we are surprised by the huge impact for 2 countries, UK (1.1 – 1.3 billions €) and Spain (0.7 - 0.8 billion €), with some disproportion compared to other countries: e.g. for UK 40 times more than Finland on a €/inhabitant basis (20 times vs Belgium, 10 times vs France). Those data should be checked.
EU wide	EFAR would like to understand how the different failing rates have been determined. Is it statistical analysis or expert point of view (if it is who are they?)? It is obviously a mistake to consider that all the sludge disposed by incineration will be treated in facilities with energy recovery equipments. Methodology which has to be applied to answer the question 3 has to be presented other wise how could it be possible to validate the data received in return? The amount of 200 €/t DM is extremely high. Indeed to meet the new quality criteria you will have initially to carry out a network policy to identify the industrial discharges to the sewer. This will generate the main part of the costs. Further actions will then be limited to the control of the pre-treatment effectiveness by a yearly analysis campaign. EFAR would appreciate if EUREAU could comment this figure. It is absolutely necessary to generate here a recapitulative table mentioning clearly what are the impacts of the different restrictions proposed on the tonnages which are currently spread on land. It is also essential to take into account the cumulative impacts (i.e. sludge compliant with heavy metals limit values but failing for pathogens or OC). EFAR wants also to stress that in comparison with the 33 potential impacts listed in table 4 only four are totally integrated and three partially. Taking into account the uncertainties related to the different assumptions it is evident that the conclusions of the impact assessment should be considered with great caution. How can one imagine that it is possible to validate the figures presented in table 25 without a calculation example provided to the reader! It also seems that where there is no data available the costs are supposed to be nil which is surely not the case. Having a look in annex 2 table 55 it appears that the same disposal costs are applied for all of the member states and that the figures are in fact a simple update of the 2002 ones! This approach is not acceptable. EFAR does not understand from where the 320 to 380 million € per year comes from. Indeed economic impacts already represent 450 million € per annum. Moreover is there a link between table 27 and table 25 and 26?

The answers of the official organisations are given below.

Czech Republic	Data provided with different recovery rates – the national decree sets stringent standards so no impacts from Option 2 expected.
Germany	It is noticeable that Spain and the UK bear nearly 70% of the costs for all of the EU-27. This seems quite high and is surprising, especially in comparison to the costs Germany for example will have. It is not possible to understand the basis of calculation with the given information.
Romania	Romania agrees with your assessment.

Questions 11 – 19: Impacts from Option 3

Question 11: Would your MS be affected by any of the above components?

The commercial stakeholders' comments are presented below.

UK

Option 3: The proposed tightening of existing standards and limit values and the introduction of 'new' standards in this option would be 'equivalent to a ban', given the large volumes of sludge impacted (for the small perceived environmental protection benefit). **We advocate the removal of this option**

Option 3 will preclude a significant amount of biosolids from application to soils due to the proposed standards for copper, nickel, PAH, PCDD/F5, LAS6 and NPE7.

Yes, the UK will be affected by the changes to the heavy metal limits and new limits in pathogens. In additiona, it will be affected by the changes to heavy metals in soil and the introduction of organics limits for sludge quality.

All MS would be affected, except possibly NL, which set limits such the sludge use in agriculture is hardly possible in order that farmland would be available for manure.

When sludge is treated to "advanced treatment" status it is essentially free of pathogens and therefore there is no objective reason for restricting the crops on which it can be used.

Finland

See below

Germany

The thresholds for heavy metals content in sewage sludge set in Option 3 are very restricted, and will lead not only to an significant reduction in sewage sludge material use, but to its total ban from use in agriculture.

Due to the fact that zinc and copper are micronutrients it is not comprehensible, why the limits of theses parameters in the sludge are so low. In spite of that, the content for the real pollutants Pb 250 ppm, Cd 5 ppm, Hg 5 ppm) are very high. From our point of view we see a urgent need for clarification!

As described above, we are of the opinion that **Option 3** would be **counter-productive** with a low share of compliant sludges for a small increase in environmental protection level.

We advocate for the abandonment of this option.

All factors considered **BDE** believes that Option 3 will lead to a complete stop of sewage sludge used on land. We found especially the following reasons:

Table 28 includes very strict requirements for heavy metals and **BDE** wonders on which scientific research work these assumptions are based on. Assumptions should be reasonable to represent an option for European sewage sludge management. For instance, we believe lead (Pb), cadmium (Cd) and mercury (Hg) to be relatively high compared to extreme low limiting values for micro-nutrients such as copper (Cu) and zinc (Zn). How does that correspond to each other? Applied to Germany these assumptions would definitely have a higher impact than to half of the sludge, which is given in Table 31, as the German average-value for zinc is already above the limiting value of 600 ppm (713 ppm; Table 12).

The report further estimates that 20% of the land will fail to comply with the new limits for heavy metals in soil (Table 38). **BDE** is familiar with the discussion in Germany as well as a similar approach is used in the revision of the Sewage Sludge Regulation (working document 2007): clay, loam/mud/silt, sand. However, again values given for the micro-nutrient zinc deviate a lot from the German approach. Measurements in the Federal State North Rhine-Westphalia show an average of 67 mg Zn per kg soil and a 90%-percentile of 119 ppm. Population areas with higher density even result to 219 ppm (90%-percentile). In these areas no sewage sludge could be used on land and as a result we believe that above mentioned 20% are underestimated.

Finally, **BDE** doubts that the requirement for hygienisation affects 0% of the German sewage sludge (Table 36). As earlier stated we believe there is no danger by sewage sludge after appropriate treatment and handling according to good practice rules. However, measurements that include

- a 99.99% reduction of *Escherichia coli* to less than $1x19^3$ colony forming units per gram (dry weight) of treated sludge

- no Ascaris ova
- not more that $3x10^3$ spores of *Clostridium perfringens* in a sample of 1 gram
- no *Salmonella spp* in a sample of 50 grams and
- a 99.99% reduction in *Salmonella senftenberg*

will definitely lead to mayor impacts. Furthermore, the HACCP has to be considered. As a result also cost calculations (see calculations given under Q1) should be adjusted.

France Option 3 tresholds concerning heavy metals content in sludge are significantly lower (between 2 times for Cadmium and Mercury and 5/6 times for Zinc and Chromium) than current French thresholds. The overall impact of Option 3 on sludge quality is very high and that it compromises the future of sludge recycling in France and more generally in the European Union.

Portugal Yes. A more restricted limit for heavy metals and rest will compromise the application of sludge. SS will be landfilled.

EU wide EUREAU is of the opinion that Option 3 is too much expensive, and wouldbe counter-productive with a low share of compliant sludges for a small increase in environmental/human health/soil protection level. We advocate for the abandonment of this option.

EFAR refuses to comment this option because the need of such stringent limits is not clearly supported. For simple comment the proposed limit values for zinc (20 mg/kg for ph<7) in soil will immediately declassified more than 90% of the existing land banks! The percentages mentioned in table 38 are totally wrong for information the10th percentile for Zn in our soil database is over 40 mg/kg. The same considerations apply for the PTE limits proposed in sludge for copper and zinc.Table 36 as also to be reviewed because at least for France and Germany there is a significant part of the sludge production which is not achieving the proposed standards for pathogens.

Thus ***ERASM*** doesn't support the proposed limit values for LAS in sludge, as mentioned in option 3 of the report "Environmental, economic and social impacts of the use of sewage sludge on land", developed by prepared by RPA, Milieu Ltd and WRc for the European Commission, DG Environment.

The answers of the official organisations are given below.

Belgium - Wallonia This option is not supported as the conditions are more stringent than for Option 2 and would therefore be far away from an integrated strategy that can be implemented for the management of organic material.

Czech Republic we would be affected by all components mentioned on page 37 of the Consultation report.

Denmark In this option Denmark may be affected by the new limits for copper and zinc in sewage sludge. Danish research has shown that the Danish average level for copper is lower than the proposed limit and for zinc it is about the proposed limit.

The introduction of PCDD/F, an additional limit and the introduction of fur-ther standards for pathogens and advanced treatments may have an impact for Denmark.

The estimated percentage at 50% sludge affected under new treatment seems to be very high. In Denmark there already exist strict requirements about the treatment of sewage sludge and its application on agricultural land.

Romania Option 3 involves high costs and big efforts for Romania, especially in endowment with high performance sludge treatment technologies, laboratory equipment and personal training. In this respect, Romania will not support this option.

UK At table 3 [this table detailed the proposed standards under various options] the standards used are neither consulted nor discussed and cannot be taken as necessarily appropriate to the calculation of impacts.

Question 12: Do you agree with our estimates of sludge failing the limits on heavy metals and the likely percentages receiving further treatment or going for incineration/landfill?

The commercial stakeholders' comments are presented below.

UK	We estimate a minimum of approximately 60% non-compliant sludge (limiting metal typically Zinc) The utilisation of landfill will diminish in the future as either the costs significantly increase (gate fees and escalating landfill tax) or availability becomes an issue, as an example it is suggested that the Southeast of England has only 3 years of landfill life left. It is extremely likely that current incineration capacity will need to be increased to accommodate such volumes of sludge. No. The percentage is likely to be higher for sludge to incineration. Imposing these limits could prevent approximately 42% of the sludge to being recycled to land. There is no incineration capacity for 50% of the UK's sludge. There is neither capacity for landfill. As noted on page 38 the data "are national (weighted) averages so they do not show the effect of different distributions" – the detailed information is simply not available because the EC has not been insisting on reporting and not at this level of detail.
Finland	Chromium, copper and zinc limits are lower that current limits in Finland. Proposed limits on Zn and Cu may be demanding. Heavy metal information is not generally available and thus it is not possible to estimate consequences accurately. Our estimate is that even though most of the sludge will fulfil criteria it is likely that some will fail.
Germany	In spite of the assessment of the report, which estimate for Germany an 50% recycling sludge failing the new limits, we think the quota much higher and near by 100%. We also don´t believe, that 40% of sludge failing limits would receive further treatment. We assume that in these cases the waste water treatment plants decide to incinerate all their sludge directly, if the limit values are fulfilled near by 90% of one parameter already by a few analysis. We guest that also great investment costs for sewage sludg treatment plants would not carried out (Question 12). An evaluation of data from more than 1.800 German waste water treatment plants shows that more than 80% of the plants would fail to comply with the suggested limits. In addition, one has to keep in mind that this share is a computed value. That is to say that for example a sludge with Zn 599 mg/kg passes for the computed share, whereas in practice the operators will need a safety margin of about 20% to cover variability in sludge quality. Therefore we expect that practically no German wastewater treatment plant would continue sludge recycling to land if these limit values come to force. We don't see possibilities to make a further sludge treatment to reduce the amount of heavy metals in the sludge. The only possible way would be to mix different loaded sludges to come to a dilution but from our point of view this is no solution and has to be declined. We are relatively sure that about 100% of German sludge failing the suggested limits on heavy metals will go to incineration. We do not see any possibilities of further sludge treatment to reduce the amount of heavy metals in the sludge. The only possible way is to mix different loaded sludges to come to a dilution; but from our point of view this is no solution and has to be declined.
France	20% of analyses would not comply with the Copper threshold proposed in Option 3, and 40% would not comply with the Zinc threshold. the proportion of sludge that would be affected by this parameter threshold would be of about 50 %, as mentioned in the report. For France, about 30% of samples do not comply with the limit values (estimation). But such percentage is largely due to high "geogenic" concentrations that will be met on large areas (e.g. Trias on the east borderline of the Bassin Parisien). So it means that it will concern more than 30% of national amount because the distances for transportation (in order to find PTE concentrations "complying" with the limit values) will be too expensive, and sludges will be incinerated. Thus an estimation of 50% of sludges that couldn't be used on land is more probable. We propose to use risk assessment methodologies for setting the PTE limit values. In 2008, the INERIS risk assessment released for EFAR concluded that the proposed limit values in CEC 2003 were relevant except for lead, where the limit value should be 500 ppm DM. So there is no need to go further with more stringent limit values, as it would be counter productive for achieving a high level ratio of sludge recycling on land.
Portugal	By year 2012, the % of sludge failing receiving further treatment and % of sludge failing going

	to incineration with energy recovery will be 40% and 60% (instead of 30% and 50%).
EU wide	There's no use to set more stringent PTE limit values in sludges if there are no gain for environmental and/or health reasons proved by a proper risk assessment.

The answers of the official organisations are given below.

Czech Republic	we suppose in case of stricter limit that %of sludge going to incineration with energy recovery will increase and in future will be higher.
Germany	In the study the estimate was that about 50% of the sludge from Germany would fail. It is to be expected, that a higher amount may be affected as about 60 % (Cu) respectively only 20 % (Zn) of the sludge will be able to comply with the proposed values. It is also extremely important not to forget that there will not only be sewage treatment plants with only high values so the 60% and the 20% mentioned above may add up to 70%. All sludge failing would go to incineration, a possible further treatment suitable to extract Cu and Zn from sewage sludge without huge costs does not seem feasible.

Question 13: Do you agree with our estimates of recycled sludge failing the limits on organic contaminants and the impacts on disposal and treatment?

The responses of the commercial stakeholders are below.

UK	The UKWIR organics in sludge report (Sutherland, Comber 2009) estimated that up to 95% of sludge in the UK would be non-compliant (limiting factor typically NP/NPE) It is likely that the % recycled sludge failing new limits on OC's for the UK of 50% is an underestimate, data from 2007 (Smith and Riddell-Black) suggests the majority of sludge has PAH's greater than the 6 mg/kg limit. See detailed comments in Section 2 above. No, we do not agree. Increasing investigation in recent years has not identified ecotoxicological significant of organic contaminants on the soil-plant-water system and in the food chain. The question is fatuous because we have even less information about the concentrations of organic contaminants than we do for metals. There is no evidence to support a requirement for these limits. The cost of monitoring and analysis would be a waste of money because there would be no benefit from the limits. Even asking the question gives strength to the companies selling incinerators and other options that will squander phosphate.
Finland	At the moment there are not limits in Fi. We assume that 50% is a safe approximation. It is possible that the limits will have a dramatic effect to the sludge use in agriculture in Finland.
France	For organic pollutants, PAH and PCB thresholds of Option 3 are the same as those of Option 2 and would not have any significant impact on the rate of compliant sludge. The concentration of organic micro pollutants measured in sludge is low and generally below the proposed thresholds. the proportion of recycled sludge that would be affected by the new parameters and thresholds is low (about 5 % ?), and in any case much lower than the 50% mentioned in the report. We can say that more or less 80 % of French recycled sludge would be affected because the thresholds asked for E.Coli, Salmonella, Ascaris eggs, and Clostridium Perfringens correspond to composted or thermally dried sludge that could eventually qualify for a product status. In this view, we can say that Option 3 is not dealing with a waste status of sludge any more, but rather with a product status, which can currently only be reached by a minority of sludge feedstocks. In that case, since the "boues hygiènisées" status is not mandatory in the current French regulation and is generally not applied, the rate of non-compliant French sludge would not be 0 as it is mentioned in the report, but rather about 80% !
Germany	We are not really sure because there is a lack of data. But we think the estimation given in table 34 might be a realistic scenario.
Portugal	It is possible that % of recycled sludge which may fail the new OC limit will be bigger than 50%
EU wide	Organic harmful compounds have been studied widely. We support that all the possible

limitations to the quality of sludge are based on sound science and risk analyses. So we regret the absence of justification for the specific organics chosen in option 3.

Moreover, we call for strong upstream control with these substances. Both PAH and NPE are substances which are also listed in the Environmental Quality Directive 2008/105. We think that long lasting solution is to limit use of these substances in the first place and thus prevent them entering both into sludge or water courses.

Strict levels for sludge are not a comprehensive solution.

The answers of the official organisations are given below.

Belgium Flanders No, we do not agree. The estimate of the Flemish region is less than 50%

Czech Republic We agree with your estimates.

Germany A number of organic pollutants are listed which are not regularly analysed in Germany, i.e. LAS. In connection with the voluntary quality assurance system benzo(a)pyrene is analysed instead of the PAH. As a result the impact of the new limits cannot be estimated precisely. It could be helpful to await the result of the FATE-SEES project to see the EU wide results and perhaps discuss the chosen pollutants regarding their relevance. In Germany i.e. PFC (perfluorated tensides) are widely discussed and limits for this extremely persistent pollutant seem more important than LAS, especially as a report from the commission to the European parliament (KOM (2009) 230 final) came to the conclusion that at the present there is no evidence that would justify legislative measures at EU level, such as regulatory limit values for LAS in sludge.
The most important aspect is limiting use of extremely toxic and/ or persistent substances and prevent them entering wastewater, water and sewage sludge.

Portugal As far as organic compounds are concerned, Decree law 276/2009 of 2nd October establishes limit values for concentration identical to limit values illustrated in the option 3.

Question 14: What percentage of sludge will be affected by the new limits on pathogens and will receive further treatment? What is the preferred treatment? Please specify the costs of this treatment if possible.

The responses of the commercial stakeholders are presented below.

UK Option 3: We do not have any data on the specific pathogens other than E.coli and Salmonella. The option would require all sludge to be treated to an advanced standard or with full pasteurisation (even the latter may be insufficient for *clostridium perfringens*). We currently treat approximately 13% of our sludge production to an advanced standard. To increase the level of treatment at our remaining sites would require significant investment **>£100M**
The introduction of Option 3 will lead to a figure as high as 70% of sludge that would not be compliant with the proposed standard and therefore require additional treatment. The additional treatment is likely to be advanced digestion, probably thermophilic anaerobic stabilisation and possibly some thermal drying.
The UK water industry currently produces only 24% of its sludge make to an advanced treatement standard (based on the UK Water Industry Sludge Summary) so the estimate that 70% of sludge would be affected is correct. Our company has the capability to produce advance treated sludge at three of our 37 STC wich will increase to eight sites in the period 2010-2015. The preferred treatment to meet new limits on pathogens would be a form of enhanced digestion, e.g. Thermal Hydrolisis Process (THP). We would however question that Table 36 which implies that all sludge in Austria, France, Germany and Holland and Sweden meets the advanced treatment standards set out in 4.2.3 Our understanding is that not all of these countries treat 100% of their sludge to an advanced standard.
There is sense in establishing two classes of treatment on the basis of the level of pathogen inactivation that they achieve: Conventional treatment that is partnered by restrictions on cropping and harvest intervals and Advanced that essentially has no pathogen risk and for which no cropping or harvest interval restrictions need be required. There is no objective

reason to require all sludge to be Advanced treated any more than there is objective reason to require treatment for all manure. The production of manure is at least two orders of magnitude greater than sludge and manure carries a greater pathogen load. Cropping restrictions and intervals to harvest provide an effective barrier to disease transmission.

Finland Only salmonella and E colli are used as parameters. It is important that operators are allowed to decide which technology is used for the treatment as long as results are acceptable.

France For new pathogens parameters integrated in Option 3, as Escherichia Coli,Clostridium Perfringens, Salmonella and Ascaris eggs numeration, we lack internal data enabling us to appreciate the impact of the proposed thresholds as these parameters are not analyzed in France -except for the product status that can be reached by some sludge composts that comply with the French quality standard U44095. We can however underline that these thresholds can be only reached after thermal treatment, as sludge in vessel composting or sludge thermal drying would greatly lower the rate of non-compliance of urban sludge (thermal treatments are currently applied to only 15- 20% of the total French production of sludge).

Germany The preferred treatment in Germany is the mesophilic anaerobic digestion (about 80 % of sludge mass; which is treated by roughly about 20% of the wastewater treatment plants) and simultaneous aerobic digestion (roughly 80% of the wastewater treatment plants; 20% of sludge mass). Normally we have no further treatment to reduce pathogens because there are no requirements in the valid German sludge ordinary. With the usual sludge treatment on WWTP's it will be impossible to meet the suggested limits. Only a few sludges with thermal drying or lime-conditioning may observe the limits. We think that more than 80 % of the German sludges can not meet the limits without additional treatment, hence in Table 36 Germany has to be moved from the first line to the third line (70 % affected).

Costs :

- Thermal treatment of liquid sludge (70 °C, >30 min): Costs: ca. 120 €/Mg DS
- Adding quicklime Costs: ca. 200 €/Mg DS

Portugal The WWTP in Portugal aren't prepared to make advanced treatments to eliminate pathogens. The % of sludge needing additional treatment will be probably be higher than 90% of the global production of Portugal.

EU wide The % reduction is not a relevant method for pathogens since it depends on original concentration in sewage (raw material); furthermore, some methods (e.g. spiked sludges with microorganisms) are complex and expensive (andnot developed in a routine way). A simpler approach to assess advanced treatment should be found.

There are very many criteria for advanced treatment. For practical follow up only very few indicative parameters should be used. Theses parameters should be easy to monitor all over Europe. For example Clostridium Perfringens does not exist in all sludges. Thus it is not suitable as a limit parameter.

The answers of the official organisations are given below.

Czech Republic we expect a little bit less percentage of sludge which will be affected the new limits on pathogens (50%). The preferred treatment of sewage sludge in Czech Republic is anaerobic digestion and sewage sludge composting.

Germany As described in Q5 there are no legal requirements concerning pathogen reduction to date. About 80% of the sewage treatment plants use a mesophilic anaerobic digestion which will not be sufficient to meet the suggested limits. In Table 36 Germany would belong to the member states where 70% (or even more) of the sludge is affected.

Portugal In terms of *Escherichia coli* and *Salmonella* spp, Decree law 276/2009 of 2nd October establishes limit values identical to the limit values indicated in the option 3.

Question 15: What are the costs of HAAP?

The responses of the commercial stakeholders are below.

UK	We do not have any specific cost data at this time It is estimated that HACCP monitoring is in the region of £5,000-8000 per treatment site/year The costs of HACCP depend on how well processes are designed, instrumented and managed. For example, if there is by-pass or short-circuiting, HACCP should identify this and there will be investment to correct the deficiency, but actually the process was not compliant anyway, so is that a cost of HACCP of merely correcting a deficient process? As another example, if the temperature probes in a digester are not working or if they are not being recorded, HACCP would reveal the deficiency and it would have to be corrected, but in the prior condition there was no traceability or record that treatment had been accomplished. If processes are deficient then HACCP should reveal the deficiency, which will have to be corrected, but that is merely correcting a delusion about the treatment. Where processes are designed, instrumented and managed properly HACCP will cost very little.
Finland	Information not available.
Portugal	Nol costs data
EU wide	This information is not available.

Question 16: What do you expect the % of total agricultural land to be failing to comply on the new limits of heavy metals in soil set by Option 3? Would production be maintained through the application of fertiliser?

The responses of the commercial stakeholders are below.

UK	We estimate that >82% of the monitored agricultural land may exceed the proposed metal limits (with Zn being responsible for the majority of this figure). We believe that the WRc estimate of land not available for biosolids applications due to PTE's in the soil, in particular chromium, mercury and zinc levels would be the critical elements. . It is probable that production would be maintained through the application of commercial fertilisers. The soils of England and Wales were sampled on a 5 km square grid, only 7% of samples had <20mgZn_{tot}/kgDS and only 28% of soils had pH>7.0(McGrath, S.P. and Loveland, P.J. (1992) The soil geochemical atlas of England and Wales. Chapman & Hall, London). Clearly, around 70% of soils would fail the pH tiered limit for zinc. The estimates of the land failing are wrong for England and Wales and almost certainly wrong for other MS as well. It is not uncommon to find herbage that is deficient in zinc as regards animal nutrition. Zinc is a very important micronutrient, which plays an important part in soil fertility. One role is in the creation of over 100 enzymes in plants and over 300 in livestock animals and humans. The proposed limits are misguided. As discussed earlier, changes such as those proposed should be considered only where 86/278/EEC has been demonstrated not "to prevent harmful effects on soil, vegetation, animals and man" sufficiently.
Finland	However, consultation report does not indicate what is the standard method for analysing heavy metals.Correlation between used methods in literature and standard methods for proposed limits should be clarified before results can be interpreted correctly.
France	*As this threshold is very low, it leads to the non-compliance of 500 analyses in our internal data bank, and to the elimination of 50% of French soils currently receiving sludge. According to our internal data bank on soils, the proportion of French soils that would be affected by Option 3 thresholds is of about 50%, similar to the rate of non-compliance indicated in the report (40%).*
Germany	As the limit for Zinc is extremely low (20mg/kg DS, maybe a literal mistake?) we guess that the percentage of failing land will be considerably higher than 20%. We are sure that the agricultural production will be maintained trough the application of mainly mineral fertilisers. Because of a lack of data, we cannot give an exact answer to this question. So we agree to the estimation made in table 38 (20 % failing). We are sure that the production will be maintained through the application of mainly mineral fertilisers.

Portugal 40% to Portugal is probably correct. The production will be maintained through the application of fertiliser.

EU wide This is too stringent. See answer to Q7.

The responses from official organisation are presented below.

Germany The limits on heavy metals in soil seem acceptable. As the classification of soil by the pH-value is not normally used in Germany appropriate data to estimate effects is not readily available. Production would be maintained by the application of other fertilisers.

Portugal In relation to the options 2 and 3, Decree law 276/2009 of 2nd October establishes less restrictive limit values for concentration of heavy metals in soil. It is thus considered that the adoption of limit values for heavy metals established in the option 2 implies significant impacts, namely reduction in terms of percentage of the soil available for sludge application. So being, it is considered that this point requires a more in-depth approach, and that specific soil characteristics of the different Member States are taken into account when establishing limit values.

Question 17: What % of total agricultural land do you expect will be affected by application conditions considered under Option 3? What are the costs and implications?

The responses of the commercial stakeholders are presented below.

UK Option 3: Banning sludge application to grassland would be catastrophic for United Utilities as this accounts for the majority of agricultural landbank in the Northwest of England

If biosolids are applied to fruit or vegetable crops it is only a minimal amount and therefore the ban is unlikely to have any significant financial impact.

In respect of Section 4.2.7, we are very concerned about proposed ban on use of grassland and salad crops. In some areas in the UK around 20% of biosolids application is through these routes. Some 78% available landbank in these some areas is grassland (unlike other largely arable areas in the UK). A ban would have a severe affect in this area.

Restrictions on cropping and harvest intervals are only needed when a second barrier to transmission is required to prevent transmission of harm. In the case of Advanced treated sludge, the pathogen risk has been reduced to ambient, i.e. the risk from the sludge is no greater than the risk from the soil in which the crops are grown, consequently the first barrier (treatment) is all that is required. 86/278/EEC did not include the concept of Advanced treatment but if a revised directive were to include it, there would be no reason to have cropping and harvest interval restrictions when Advanced treated sludge is used.

Finland According to the Finnish legisltation sludge cannot be used for fruit and vegetables or grassland. Thus this ban will not affect sludge use in Finland.

Germany This ban will have no consequences for Germany because the application of sludge for fruit and vegetable crops and grassland is already forbidden in Germany.

Portugal In Portugal, the main crops that use SS are: fruit, vegetable crops and grassland. At least for these crops the fertilising process costs will raise by the ban.

Official organisations' responses are presented below.

Germany In Germany the application of sewage sludge on fruit, vegetables and grassland is prohibited as procedures for the reduction of pathogens are not compulsory. There would be no additional cost. In the revised sewage sludge directive this may be different; at the moment it is not possible to quantify effects.

Question 18: What are the costs implications of these new monitoring requirements? Please explain (e.g. number of additional FTE, administrative costs, etc.)

The responses of the commercial stakeholders are presented below.

UK	Option 3: Increased sampling requirements will lead to additional staffing levels (a small number per company, for example 3 staff). Overall this cost is considered modest in comparison to the capital costs identified in the report. Some additional costs may be more significant, particularly the organic contaminants and pathogens analysis in sludge as these would require new methods and additional sampling requirements e.g. refrigerated vans for pathogens. Increased sampling requirements will lead to additional staffing levels (a small number per company for example 3 staff). Overall this cost is minimal in comparison to the capital costs identified in the report. The additional analysis costs could be more significant particularly the organic contaminants and pathogens in sludge as these would require new methods and additional sampling requirements (refrigerated vans for pathogens as an example). It is likely that the sampling requirements will increased staffing levels, with sampling and administration adding a probable 2 FTE posts (per Company resulting in up to 30 additional posts in the UK). The analysis is likely to be contracted out to a service provider and as such will not impact on FTE's to the Water Companies but increase current opex costs by up to 10 times. Routine monitoring of organic compounds and dioxins would be a waste of money because at the concentrations present in modern sludges the risk is within acceptable limits. Furthermore the methods of analysis do not give reproducible results. Occasional surveys to check the situation are useful but routine monitoring would be a waste of money, which could be spent better on other things.
Finland	The proposal will increase amount of analysis. Organic analysis is not currently undertaken and they are expensive.
Germany	The proposal would increase the amount of analyses and costs. See answer to Q 9.
Portugal	Advance treatment – to achieve hygienisation by adding lime we need a dosage of 300kg lime/ton DM. Since lime value for money is about €100/t, we have a value of €30/ton DM. This value does not include investment costs. Monitoring costs – each OC set of analysis cots over €1,000/analysis. Other costs like investment costs on additional treatment, microorganism' analysis, sludge transportation and so on must be calculated on a case by case basis. The costs will raise significantly
EU wide	Proposal would increase amount of analyses and costs.

Question 19: Do you agree with our assessment? If not, please expand. Feel free to add comments on the benefits and costs from Option 3

The responses of the commercial stakeholders are below.

UK	We feel that the assessment is reasonable. 4.3 states "Similarly, benefits are expected to be greater." but nowhere have benefits been discussed or monetised. Having less of a hazard is not necessarily a benefit if the concentration (limit value) was already such that the risk was within tolerable limits. The disbenefit to the planet and to future generations of squandering phosphate because of unnecessary restrictions that prevent the recycling of P have not been considered. This is not just a matter of today's fertiliser prices but the fact that the global resource is being exhausted unacceptably rapidly. The objective of the Directive is to control risk; if you are serious about controlling risk you must have quality assurance (QA) so implementing QA is not a cost, it should be there already, where there is no QA (informal or formal) the idea that risks are being controlled effectively is probably a delusion.

The total of Table 40 for EU27 is a cost of €10.56bn, which as discussed above is almost certainly an underestimate, for no apparent benefit (at least no benefit has been monetised) and this to modify a directive that is thought to be a success already.

DEHP is readily biodegradable in a standard OECD test for assessing biodegradation potential. If DEHP is present in soil in a bioavailable state, it will degrade rapidly, it will not accumulate. DEHP has an extremely low water solubility (order of 1 ug/l) and a very high octanol water partition coefficient therefore DEHP will bind very strongly to the organic matter in soil and hence leaching to water or significant uptake by plants or other soil organisms is not expected. Experimental evidence confirms this, it shows that DEHP has a low potential for transfer from soil to both plants and to earthworms. DEHP is virtually non-toxic to mammals. The negative evidence about mammalian toxicity was obtained using very high doses rodents. These effects occur through a mechanism which appears to be rodent specific and not relevant to other mammals: humans are not rodents. A limit value for sludge use in agriculture is not justified.

Some very important uncertainties in the data are listed at the end of 4.3.2. 86/278/EEC is declared to have been successful. Before contemplating investing €10.56bn plus €7bn operating costs these uncertainties should be clarified with objective data at the very least.

Germany

We are not able to assess the assumption for the different costs which a made in the report. It is a very complex issue, that depends very much on the regional situation, the quality of the sludge, the acceptance of the product and the guidelines of the authorities on the basis of the waste water and fertilizer law.
With the requirements and limits made in Option 3 we think that in the same extent costs as in Option 4 (total ban) could be calculated.

France

Implementation of Option 3 would thus not impact the current framework of quality control in France, but it would increase the cost of quality control due the greater number of additional parameters to be analyzed.
SUEZ ENVIRONNEMENT regrets that the strengthening of limit values and the introduction of new parameters should not be based on sound scientific justification. The benefits of such modifications on health and the environment are therefore questionable, while additional costs are very high.
Should the Option 3 thresholds on sludge and soils quality become mandatory:
- more than 50% of sludge (and up to 80 % if we consider new pathogens thresholds) would not comply with these thresholds
- about 50 % of soils would not comply with the Zinc specific threshold (which is extremely low, probably under the original Zn content of numerous "natural" soils without anthropogenic inflows of Zinc)

In these conditions, sludge agricultural recycling (and many agricultural effluents like treated pig slurry) would become impossible to manage. This would lead to a very important loss of organic matter and of sustainable nutrients that are increasingly demanded by European farmers.
Making three classes for the pH of soil is not workable due to the changing nature of pH values in soil during any one year (pH can also vary by more than one unit in a short period of time). We believe that PTE limit values in soils are the most sensitive issue, since it could de facto limit sludge use (including those that provide a very high agronomical value as well as harmless sludges) on very large areas all over Europe. This key issue should be described through a more accurate and detailed study for each Member State, with soil databases. Such a study ought to be launched by the European Commission.

Portugal

The report does not consider the advantages in the E associated with sludge incineration with energy recovery and the economic, social and environmental impacts associated to the use of sludge in agricultural valorisation. Both options have positive and negative impacts that should be considered at the same detail.

EU wide

Safe use of sludge should be achieved with reasonable costs. The costs for this option are more or less 10 times higher than costs for option 2 without real (and proved) gain for health and/or environment. This option is non cost effective and has to be abandoned. Advanced treatment methods typically increase energy use at the sludge treatment plant. Hygienisation requires high temperatures and especially in cold climate this is causing both high investment costs but also increased use of energy for the whole running period of the treatment plant.

The answers of the official organisations are given below.

Czech Republic	In general we agree with changes provided in the assessment.
Germany	As the absolute amounts cannot be judged without more information on the basis of calculation it is neither possible to agree nor disagree. As remarked in Q19 the absolute amounts cannot be judged at this stage. It is to be expected, that an option 3 will be much more expensive than option 2. See also the remarks concerning table 5/6 at the end of Q1.
UK	At section 4, what is the justification for 'more stringent standards' over and above what can be justified on the basis of sound science and the evidence of practical experience and impacts? Para. 4.3.2, the statement that 'there could be benefits in terms of reduced environment (and human health) risks', and later references, is vague in the extreme and does not justify the inclusion of such standards. What are the risks referred to here and how do they play in an evaluation of costs and benefits?

Impacts from Option 4

The responses of the commercial stakeholders are below.

UK	The estimate on percentages going to landfill and incineration are incorrect. A total ban is likely to lead to nearly 100% of the sludge going to incineration in the UK as the landfill route is unsustainable in the longer term. The increased storage of sluge at Sewage Treatment works would also present a public health issue and may give rise to nuisances such as odour and flies.There will be increase transport costs and hence carbon dioxide, road traffic, nosie and other disruptions to local communities and potential environmental damage.The additional costs will be passed on to the consumers. This will have consequences too for metting national targets for recycling and sustainability. The statements "The main benefits relate to reduced risk to the environment and human health from application of sludge" and "There will be benefit from compliance with other legislation, such as the WFD" are fallacious because (a) there is no benefit from reducing risk below that which considered "safe" already and (b) the requirements of the WFD will have to be satisfied irrespective of sludge use in agriculture or any other activities. Combustion facilities that comply with the Waste Incineration Directive (2000/76/EC) do not increase the risk however this is not true for co-combustion in facilities that are not regulated under the WID, such as the coal fired power stations in Germany that burn sludge. The disbenefit of squandering phosphate has not been considered. The climate change impact of landfilling sludge has not been considered or monetised.
Finland	Banning of sludge in agriculture would cause much pressure to find alternative uses. Another uses will demand different treatment facilities and equipment which would increase the costs for waste water utilities and their customers. Incinerators are objected on the basis of amenity. In Finland many incineration plants do not even plan to incinerate sludge due to amenity. Most of the sludge is composted at the moment. In the future use of sludge as a landfill cover will come to an end. It is up to the farmers to decide if they use sludge or not. This Option would reduce their possibilities to choose.
EU wide	No comment on this option without a clear demonstration of its relevance.

Official stakeholders' responses are presented below.

Belgium - Wallonia	This Option is not supported
Belgium Flanders	When no sludge can be used on the land anymore, you do not have to send it to 100% to

	incineration or disposal. You have other treatment like composting and digesting of sludge from food industry! Why did you not take these treatments into account?
UK	Option 4 does not respect the flexibility which we understand it is the intention to preserve and is not regarded as feasible. No further comment is made at this stage. However it should be noted that the costs (table 43) will always affect the general public at every level since they pay water charges and costs will feed through as a consequence of this (and all) options. Overall a more 'joined-up' approach in relation to other EU legislation is to be commended. In relation to the comment at 5.2.3 that consumer confidence is difficult to value, this is nevertheless one of the most important beneficial impacts to be gained.

Impacts from Option 5

The responses of the commercial stakeholders are presented below.

UK	Option 5 is not acceptable as it cannot guarantee protection of the environment. It will have an impact on stakeholders' confidence. This could lead to a sudden loss of the sludge to land outlet and Option 5 will have similar impacts to Option 4. Table 49 does not mention the cross compliance obligations for the Single [farm] Payment Scheme (SPS) under the Common Agricultural Policy which require good agricultural practice, preventing soil erosion, etc. which apply to all the options. Neither does it mention the Water Framework Directive. 86/278/EEC was the first soil protection directive and to a very large extent it still is. It would be very regrettable if it was repealed. The vacuum that would be created if it were repealed would probably be filled by the immensely powerful food industry that buys the produce from farms and which for its own sake would impose conditions. Most likely they would refuse to buy produce from land that had been treated with sewage sludge unless it was regulated by government legislation and the companies had confidence in the policing, which is currently part of the SPS.
Portugal	Option 5 is unacceptable because there must be a legal instrument that provides protection of public health and the E, from SS land application in the MS.
EU wide	No comment on this option for which EFAR is not in favour of (please refer to our general comments).

Official stakeholders below.

Belgium - Wallonia	This Option is satisfactory. If Option 2 modified as suggested is not implemented, this Option will allow the region to implement its integrated management of various organic materials including sewage sludge.
UK	In relation to option 5, any perceived savings (6.3) are likely to be offset by the damage which might result to consumer confidence and the land bank for spreading.

Questions 20 – 21: Comparison of Options

Question 20: Do you have any comments on the Options as proposed, especially in terms of the ir impacts?

The responses of the commercial stakeholders are below.

UK	Option 1 remains viable given that biosolids recycling to agriculture under the current regulatory framework has a proven record as a low risk environmental activity that does pose a risk to public health. The introduction of HACCP regulations would be a logical step however and this should perhaps be evaluated before the existing Regulations are amended or the

tighter options introduced. An alternative would be to introduce HACCP Regulations separately.

Options 2 updating of the current Regulations would be useful if it led to an increase in consumer/retail confidence.

Option 3 will significantly increase costs to the MS without any proven material benefit.

Option 4 should not be considered as a viable proposition based on risk analyses and given the overall benefits of sludge recycling.

Option 5 should not be considered as a viable proposition as Regulations prevent poor practice and assists in engendering confidence.

Option 1 is the most viable and allows MS sufficiently flexibility in their approach to regulating sludge to land activities. Sludge use has been safe in agriculture for 40 years. Sound science should be used and not individual MS areas of concern. Option 2 might lead to an increased stakeholder confidence in the sludge recycling to land route. However, the new organics and heavy metals in soil limits presented in this consultation would need further consideration. Option 3 is completely unworkable. Both Option 2 an dOption 3 would require further work and may well require a detailed study for each of the countries involved. Options 4 and 5 should not be considered as viable options.

The report admits several times that the data on which assumptions have been based are very uncertain. It also says “The Sewage Sludge Directive (86/278/EEC) could be said to have stood the test of time in that sludge recycling has expanded since its adoption without environmental problems”. The phosphate crisis has not been acknowledged in any of the impact assessments. EU policy is supposed to be based on science and risk assessment. No evidence has been presented that changes to the metal limits in 86/278/EEC are required or for introducing limits for organic compounds.

Introducing two classes of sludge treatment (Conventional and Advanced) with appropriate cropping and intervals-to-harvest based on risk of pathogen transmission, compared with the ambient risk, would be an advance and would be welcomed by the food industry.

Introducing an obligation not to cause odour nuisance would also be an advance because it would control the factor that is the root of 95% or more of complaints from the public.

Reinstatement of interest by the Commission in the reporting requirements of 86/278/EEC would reduce the uncertainty in the data. It is scandalous that some of the EU15 are still not reporting; it reflects the Commission’s lapse of interest in the past few years, which is also manifest in the way that project HORIZONTAL was allowed to slip.

Finland Advanced treatment method typically increase energy use. Hygienisation requires high temperatures and especially in the cold climate this is causing both high investment costs but also increased energy use. In Finland, costs of treatment have increased fast. Traditionally windrow compositng has been used but in cold climate it is challenging to maintain high temperatures all year round.

Germany The data given in the assessment shows a clear result. Even if the expected changes and the estimated costs may be corrected for some MS, the finding will be the same. Option 3 and option 4 will become very expensive. Option 2 is the most realistic scenario that ensures a high level of environmental protection with tolerable costs.

Official stakeholders’ responses are presented below.

Belgium - Wallonia We cannot comment for Belgium as a whole so data should be dissagregated by region.

Portugal Compared to Decree law 276/09 of 2nd October with the numerous options identified in the report, we verify that the diploma already contemplates most of the components of option 2, and some of the components of option 3.

It is thus considered that at a national level the adoption of the option 2 does not imply significant impacts seeing that Decree law 276/2009 of 2nd October mainly contemplates the stipulated conditions in the option 2. The adoption of limit values of heavy metals in soil established in the option 2 is the only situation that could have an impact at a national level.

Nutrients in sludge:
Decree law 276/2009 of 2nd October establishes that in quantity definition of nitrogen (N), phosphorus (P) and potassium (K) to be applied by sludge on a cultivated soil, the quantities of these nutrients supplied by other fertilizing materials, namely livestock effluents and fertilizers, are taken into account, as not for the necessary quantities for crops to be exceeded. So being, a fertilization plan is drawn up in which it is shown that only the N, P and K quantities needed for the crops are applied. The options 2 and 3 establishes that information should be facilitated related to the quantities of N, P and C supplied by sludge. It is concluded that this component is already contemplated in Decree law 276/2009 of 2nd October.

Nutrients in soil:
Decree law 276/2009 of 2nd October establishes that analyses should be done to the soil agronomic parameters (N and P). The sludge application in nitrate vulnerable zones, is restricted to what the different action programs stipulate. Thus, the conditions of options 2 and 3, are already covered by the Decree law 276/2009 of 2nd October.

UK

The comparison of options (at 7) suffers, as already pointed out, from the major disadvantage that it relies on unconsulted standards for which evidence of justification has not been put forward.

UK policy takes the view that the use of sludge in agriculture represents the current best practicable environmental option in many circumstances whilst soils can benefit from the addition of good quality biowastes. We could not, therefore, support options which prevented their use or unnecessarily restricted such use.

At the same time it is recognised that the unsustainable spreading of sludge can be harmful and revised standards, provided that they can be justified, can be considered. More stringent standards than in the Directive are already employed, including the ‘safe sludge matrix.’ Defra is currently considering revision of the current Use of Sludge in Agriculture Regulations, subject to government clearance of policy, and UK experience would provide a valuable contribution to a proper discussion if more stringent standards are to be considered.

We would therefore wish to raise awareness of UK evidence of costs, benefits and risks of sludge use on land and its sustainable management. We would wish to draw your attention to UK experience if it your intention to work up a proposal.

Question 21: Do you agree with our costs data and assumptions presented in this report and the overall estimates presented in Table 51? Please expand, provide us with your data and estimates if possible.

The responses of the commercial stakeholders are below.

UK

The costs against the total ban are an underestimate. For example based upon the most recent data within the industry, a capital cost of £2500/tds is estimated for the construction of incineration plant.

Applying this data to the construction of incineration plant with a capacity of 1,050,000 tds (currently applied to the landbank) gives an immediate total capital costs of the order of £2.6bn.

The estimates in Table 51 are flawed because they are based on flawed data, as the authors admit in the report. Member States simply do not have the detailed knowledge of their soils or their sludges to estimate effects. The “benefits” in Table 51 are spurious; if 86/278/EEC has prevented environmental problems, how can its revision generate improvements in environmental or human health? Even these spurious amounts are greatly outweighed by the costs. Nobody would make a business investment based on such a poor return. The report has failed to consider the phosphate crisis.

Finland

Costs of Finland should be corrected to correspond to the more realistic amount of sludge used in agriculture.

Official stakeholders’s responses are presented below.

UK At various points in the report (and at 3.3.2) there is reference to the potential use of landfill in place of spreading. Such an approach would be at variance with EU policy to restrict the use of landfill and is therefore not, in practice, a viable option. Similar comments could be made in respect of the alternative of incineration because of the implications for increased carbon emissions, including increased transport movements. The recycling of sewage sludge is in fact one of the lower carbon emission options. The impact assessment appears to overlook this critical dimension to assessment.

At table 7, too much remains unquantified to make meaningful assessments.

The paper is predicated on the basis of a large number of new standards for which no scientific or practical evidence is presented. Furthermore the standards presented have not been consulted or discussed amongst experts and to all intents and purposes appear arbitrary. Proposal for new standards must recognise the variety of conditions under which sludge is applied in various member states in order to preserve the flexibility which currently exists. This step is crucial to the formulation and negotiation of any new directive. The use of these standards for anything other than for purely illustrative purposes would be unacceptable, particularly if conclusions as to costs and benefits, and cost-effectiveness, are to be drawn in support of a new proposal.

It follows from this that the standards and practices incorporated in this paper remain to be properly discussed and justified by scientific evidence prior to any formal discussions in relation to a new directive. To this extent any conclusions drawn in the Impact Assessment are spurious in the absence of fully-justified, discussed and agreed standards which are essential components of any Impact Assessment.

We note that the study confines its interest to entirely traditional considerations pertaining to the use of sludge in agriculture. There is scope for development of treatment processes to extend to anaerobic digestion and the treatment of other wastes. Whilst there is no need for an EU directive on the subject, some might see this study as unduly restrictive in its scope.

Annexes

Annex 2 1 Assessment of economic impacts
Table 55 What is the justification of the higher cost of landspreading of solid in comparison with landspreading of semi solid? Does solid mean dried? Please clarify.

As mentioned previously it is not acceptable to use the same costs within the whole EU. Landspreading of liquid sludge has also to be taken into account with the necessity of a initial dewatering operation to have access to disposal outlets like incineration or landfilling.

Table 59 Please provide the detail of the capital costs. EFAR would like to understand how the liming operating costs can vary from simple to double and finally being comparable with the incineration operating costs mentioned in table 56.

2 Assessment of environmental impacts
Table 62 As energy recovery seems to have a significant impact on the final balance EFAR would like to get the calculation details as sludge even at 25% DS is just self combustible.

Annex 3 Need to include CHP generation
Concerned about the data given in highly uncertain. Section 1.1. omits to mention that in addition to GHG there will be emissions from the lorry movements. This will depend on geographical location. Equally this assessment does not reflect the GHG emissions associated with replacement of sludge by man-made fertilisers,w hich we believe gives a very limited and unrealistic impression of the actual carbon impact.
Once again it is a copy and paste of values coming from other reports dating from 2002! It is important to consider that the methodology for establishing carbon footprint balances has evolved considerably since then.
The origin of the data and methodology used are insufficiently documented.

EFAR is therefore unable to comment the values provided, but informed the Commission that it has launched a study of the comparison of the carbon footprint of the different sludge disposal routes which conclusion will be available by the end of the first quarter of 2010.
The authors admit they have limited information about the percentage of sludge treated by anaerobic digestion; this is another example of lack of base data, which should be collected in order that a proper assessment of this important treatment can be made. Information should also be collected about biogas use; about plans to upgrade digestion to increase biogas yield (which is a very current topic in the industry) and about co-digestion if it were enabled by legislation.

Gasification, even when it is developed to be operationally viable, is unlikely to yield very much net energy because of the high water content of sludge. For a similar reason the net energy from incineration is low. These thermal processes squander phosphate.

Energy recovery is already a key aspect of sludge management but at present the only sensible contribution is from anaerobic digestion; especially advanced AD, i.e. phased digestion and thermal hydrolysis. The digestate could be disposed by incineration but there will be little additional net energy produced.

Smith et al. included carbon sequested when compost was used on land; this was accepted by the EC and published; it could be extrapolated to sludge. [Smith, A., K. Brown, S. Ogilvie, K. Rushton, and J. Bates. 2001. "Waste management options and climate change: Report to the European Commission." http://ec.europa.eu/environment/waste/studies/pdf/climate_change.pdf]

CO_2 from sludge or from burning biogas is “biogenic” [short-cycle] and therefore has no climate change impact. I think there must be a mistake in Table 3 CH_4 high estimate. All the table that include CO_2 and therefore wrong and also the climate change cost tables derived from them.

When accounting N_2O, allowance should be made for the N_2O that would have been released from the mineral fertiliser that the sludge replaces.

Annex 4

Table 1 suggests that landfills have the ability to leach to soil and/or water, as ‘modern’ landfills are lined and controlled. –
Table 2, we are surprised to see the ‘value’ of CH4 the same as CO2 as it is 20x more harmful.
Table 3, should the table match Table 2 and include Emissions from transport? Also similar comments to operation of a ‘modern’ landfill
Table 5, should the table match Table 2 and include Emissions from transport?
Table 6 , we are surprised to see no ‘value’ against CH4 as the industry (through the workbook) suggests significant levels of CH4 associated with biosolids application to land.
Annex 4 is hugely uncertain because it is based on uncertain data. It does not consider the consequence of not recycling P on the depletion of the world’s phosphate resource.

Other comments

Company operating in France but with offices elsewhere stated that:

In Spain, where SUEZ ENVIRONNEMENT is present through Agbar, the current legal framework on the land spreading of sewage sludge is very similar to the provisions of the Directive. The impacts of Option 2 and 3 would thus be greater than the ones we expect in France.

In Germany, where SUEZ ENVIRONNEMENT is active in sludge land spreading through Eurawasser, the legal framework at the federal level is slightly more restrictive than in France. However, some Länders have decided a ban on sludge land spreading. The impacts of the two Options considered in this document would thus be a little less significant.

In the Walloon region of Belgium, where SITA practices sewage sludge land spreading, *the current legal framwork is slightly more restrictive than in France as to the maximum heavy metal contents. There is however no threshold for organic mico-pollutants. We can thus infer that the potential impacts of Options 2 and 3 would be equivalent to the ones expected in France.*

Some other respondents also were uncertain about the distributional impacts as presented.