1. Executive summary and main conclusions

What are the economic impacts of new regulatory requirements for the disposal and recycling of sewage sludge?

Evaluating and comparing different disposal and recycling options for sewage sludge

*Landspreading routes rank best overall, landfilling and incineration routes worst*

Landspreading of solid and landspreading of semi-solid sludge entail on average the lowest cost (110-160 €/ton of dry matter) from an overall economic point of view, i.e. accounting for both internal and external costs and benefits.

Landfilling, mono-incineration and co-incineration of sludge with other wastes entail the highest costs (260-350 €/ton of dry matter) from an overall economic point of view.

Landspreading of composted sludge, use of sludge in land reclamation, and use of sludge in silviculture record intermediate total costs (210-250 €/ton of dry matter).

*Total costs are mainly composed of investments and operating costs of sludge treatment. However, the quantifiable environmental impacts (external costs) can make a difference as regards routes whose internal costs are similar.*

Whatever the sludge route investigated, total costs are mainly composed of investment and operating costs (internal costs and benefits) of infrastructure and of operations required for sludge treatment. The internal costs of landspreading of composted sludge, use of sludge in land reclamation and use of sludge for silviculture are among the highest.

Quantifiable environmental impacts, however, can be a factor in differentiating routes with similar internal costs. For example, the environmental benefits associated with landspreading of composted sludge make this route more attractive than the co-incineration of sludge with other waste, whereas their net internal costs are similar.

Quantifiable environmental impacts (external costs and benefits) represent less than 15% of total costs. However, many environmental impacts such as impacts on soil biology, ecosystems and some long-term effects on human health could not be quantified. Thus, the importance of environmental costs and benefits is in fact larger than estimated in this study.

*The agronomic or farm value of sludge, assessed in terms of savings resulting from reduction in fertiliser use, can represent between 10% and 30% of the cost of landspreading.*

Farmers' interest in sludge can be increased due to treatments which enhance the fertiliser and enriching agent content of the treated sludge, e.g. tertiary treatment of nitrogen or phosphorus, liming, or mixing with a carbonated substance. However, such treatments lead to additional costs for sludge producers, which therefore means they may be of less general economic interest.
Evaluating and comparing scenarios

Costs of compliance with new requirements in terms of:
- More stringent limit values on heavy metals in sludge
- New limit values on heavy metals in soils
- New limit values on organic compounds in sludge
- More stringent obligation of treatment
- New requirements on sludge quality assurance system

range from 0.8 billion €/year in the short term to 1.0 billion €/year in the long term for the 15 Member States of the European Union.

The best estimates of costs necessary to meet new regulatory requirements of more stringent limit values on heavy metals in sludge, new limit values on heavy metals in soils and new limit values on organic compounds in sludge, more stringent obligation of treatment and new requirements on sludge quality assurance systems amount to 0.8 billion €/year in the short term, 0.9 billion €/year in the medium term (after 2015) and 1.0 billion €/year in the long term (after 2025) for the 15 Member States of the European Union.

The analysis shows that the “worst-case scenario”, where no sludge is able to meet new regulatory requirements without an efficient pollution prevention policy, leads to costs as high as 1.2 billion €/year for the 15 Member States of the European Union.

The share of the costs between Member States is approximately proportional to the relative quantities of sludge produced in each Member State.

Estimated percentages of sludge failing to comply with new requirements on heavy metals and organic compounds are high if no pollution prevention policy is implemented.

According to our estimates, 67% of sludge in the short term, and 83% in the long term, fails to comply with limit values on heavy metals or organic compounds in sludge or in soil, if no pollution prevention policy is implemented.

If an efficient pollution prevention policy is implemented, then this percentage could drop down to 25% (minimum due to proposed limit values on heavy metals in soil).

The integration of a Pollution Prevention Policy into the policy package leads to similar overall costs.

- The integration of the necessary pollution prevention measures to minimise the diverting of sludge from recycling, the so-called called the Pollution Prevention Policy scenario, leads to a very limited increase (less than 15%) in the overall costs of the policy.

- However, the evaluation of the costs of the measures required for the Pollution Prevention Policy scenario is difficult. As the costs used in the present study have been obtained from a single study (carried out in a United Kingdom context), cost estimates of such measures remain to be confirmed and further analysed.

However, the Pollution Prevention Policy changes the allocation of the costs among stakeholders: the Pollution Prevention Policy scenario shifts majority of the cost-burden from the local authorities, farmers and citizens to the industry.

While the cost of an efficient pollution prevention policy is mostly borne by industries (around 60% for the medium term estimates), the local authorities (20%) and water companies (8%), the cost without such a policy is borne mainly by local authorities (up to 60%, for the cost of switching from landspreading to incineration), farmers (up to 20%, for the loss of compounds of agricultural value) and citizens (up to 16%, for environmental and health impacts).
This change in the cost-burden, however, should not mask the fact that costs allocated to local authorities and water operators (costs of switching from landspreading to incineration and up to 70% of the costs of a quality insurance scheme) are ultimately borne by water consumers.

**Sludge management costs remain low compared to the overall water management costs but must be kept to a minimum**

Sludge management costs remain relatively marginal when compared to the overall costs of managing water and urban wastewater: internal costs of managing sewage sludge represent, on average for the 15 Member States, less than 6% of the total costs of water service (production, delivering and treatment).

However, consumer sensitivity to increases in water prices resulting from the significant increase in prices during the past decade may impose constraints on ensuring sludge treatment costs are kept to a minimum.

**Compliance costs for industrial sludge should be lower than those for urban sludge**

Whatever the scenario, costs of compliance with regulatory requirements that would also apply to industrial sludge should be lower than those for urban sludge. This is mainly due to the lower estimated production and better sludge quality.

Costs are estimated to range from 0.1 billion €/year in the short term to 0.2 billion €/year in the long term.

**Compliance costs in Accession Countries should be much lower than those borne by Member States.**

Costs of compliance with new regulatory requirements in ten European Union Accession Countries, i.e. Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia, should be significantly lower than those borne by the Member States. This is mainly due to the lower quantities of sewage sludge currently produced and recycled in these countries, forecast to be much lower than the quantities recycled in the Member States.
Sensitivity, uncertainties and limitations of the study results

The estimation of costs associated with the various scenarios are very sensitive to forecasts of quantities of sludge recycled, quantities of sludge not meeting new regulatory requirements and pollution prevention costs

The most sensitive factors for the analysis of scenarios are the forecasts of the quantities of sludge recycled, the quantities of sludge not meeting new regulatory requirements and, for the Pollution Prevention Policy scenario, the costs of pollution prevention measures. Any variation in one of these factors leads to an almost proportional variation in the total costs of any scenario.

Sensitivity is relatively lower for other factors such as unit costs of switching from landspreading to incineration, quality assurance costs, sludge treatment obligations, nutrient concentration in sludge, and external cost coefficients.

Impacts of uncertainties on cost estimates for the scenarios are very high

Uncertainties regarding basic factors are very high overall. Thus, overall uncertainties for estimates of costs associated with scenarios are high. Clearly, the results obtained in the present study are to be used very cautiously and remain indicative only.

Uncertainties that have the strongest impacts on the study results are the quantities of sludge not meeting new regulatory requirements and pollution prevention management and costs. Other uncertainties that were identified should have a more limited impact on the total costs estimated for the different scenarios.

Evaluation of environmental and social costs is limited to airborne emissions and may underestimate the external costs and benefits

Quantifiable environmental and social costs were limited to airborne emissions. Thus, the impacts on other natural environments (water and soil) have not been quantified.

As described in the scientific and technical report and in the social acceptance report, other environmental effects or social issues may have significant impacts on the comparison of routes and scenarios. In particular, the lack of knowledge on how to economically quantify the impacts on soil biology or the ecosystems, exposure to pollutants and their long-term effects on public health leads to a limitation of the evaluation of external costs.

Moreover, the social costs and benefits such as unpleasant odours, the fears associated with the perception of environmental or health risks, the acceptance of sludge by the farming world or by the food industry etc. are key factors to be considered in assessing the overall impact and costs of disposal and recycling options and scenario. These factors have however, not been quantified.
Improving the economic analysis of sludge disposal and recycling: ideas for the way forward

Improving the information base is necessary to increase the certainty of cost estimates

To reduce uncertainties and improve the reliability of results, information is required on:

* **Sludge composition**

A more precise evaluation of the percentage breakdown of sludge not meeting requirements would require a precise and updated percentage breakdown of pollutants (heavy metals and organic compounds) in the quantities of sludge produced for all 15 Member States.

* **From general categories of sludge disposal and recycling routes to detailed databases with sludge quality, routes and treatments**

More reliable results can be obtained if the database containing the details of sludge quality (percentage breakdown) were to include the type of treatment (conventional, advanced etc) and a detailed allocation of sludge to different disposal and recycling routes. The description of detailed categories of disposal and recycling routes should be standardised among Member States.

* **Defining Pollution Prevention Policy measures and cost**

To obtain more reliable results on the impact of Pollution Prevention Policy measures on the costs for scenarios, more analysis is required to better define the types of measures required for such Policy Prevention Policy in the various Member States. Also, better estimates of the costs associated with these measures are required.

* **Quantifying unknown external costs: human health, ecosystem degradation etc.**

To make a better evaluation of external costs, it would be necessary to improve knowledge on the economical quantification of impacts on soil biology, ecosystems, the exposure to pollutants and long-term effects on health (see chapter on "gaps in knowledge" in the scientific and technical report).

* **Information databases should also be developed for industrial sludge and for Accession Countries to the European Union**

At the present time, even less information is available on industrial sludge and the situation in Accession Countries than on urban sludge in Member States: for instance, basic information such as sludge quantities and routes are not known. Therefore, more precise and reliable information should be gathered on industrial sludge in Accession Countries in order to allow a comprehensive cost and benefits analysis.