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ABOUT THE IPTS REPORT

The IPTS Report was launched in December 1995, on the request and under the auspices of Commissioner Cresson. What seemed like a daunting challenge in late 1995, now appears in retrospect as a crucial galvaniser of the IPTS' energies and skills.

The Report has published articles in numerous areas, maintaining a rough balance between them, and exploiting interdisciplinarity as far as possible Articles are deemed prospectively relevant if they attempt to explore issues not yet on the policymaker agenda (but projected to be there sooner or later), or underappreciated aspects of issues already on the policymaker's agenda. The long drafting and redrafting process, based on a series of interactive consultations with outside experts guarantees, quality control.

The first, and possibly most significant indicator, of success is that the Report is being read. The issue 00 (December 1995) had a print run of 2000 copies, in what seemed an optimistic projection at the time. Since then, its circulation has been boosted to 7000 copies. Requests for subscriptions have come not only from various parts of Europe but also from the US, Japan, Australia, Latin America, N. Africa, etc.

The laurels the publication is reaping are rendering it attractive for authors from outside the Commission. We have already published contributions by authors from such renowned institutions as the Dutch TNO, the German VDI, the Italian ENEAand the US Council of Strategic and International Studies.

Moreover, the IPTS formally collaborates on the production of the IPTS Report with a group of prestigious European institutions, with whom the IPTS has formed the European Science and Technology Observatory (ESTO), an important part of the remit of the IPTS. The IPTS Report is the most visible manifestation of this collaboration.

The Report is produced simultaneously in four languages (English, French, German and Spanish) by the IPTS; to these one could add the Italian translation volunteered by ENEA: yet another sign of the Report's increasing visibility. The fact that it is not only available in several languages, but also largely prepared and produced on the Internet World Wide Web, makes it quite an uncommon undertaking.

We shall continue to endeavour to find the best way of fulfilling the expectations of our quite diverse readership, avoiding oversimplification, as well as encyclopaedic reviews and the inaccessibility of academic journals. The key is to remind ourselves, as well as the readers, that we cannot be all things to all people, that it is important to carve our niche and continue optimally exploring and exploiting it, hoping to illuminate topics under a new, revealing light for the benefit of the readers, in order to prepare them for managing the challenges ahead

Preface

Innovation is a determining factor in industrial competitiveness. In order to allow European research to have maximum impact on economic growth and to facilitate its translation into products and services -and thus jobs- mechanisms for promoting innovation, exploitation of the results of scientific work and the creation of innovative businesses must be developed.

SMEs are important innovation vectors and actors, and represent two thirds of employment in the European Union, and should benefit from ready access to the advanced technologies which they need, and the possibilities created by the EU's research programmes.

The plans for the Fifth Framework Programme for Research and Development, of which supporting innovation is one of the principal orientations, create a commitment to a horizontal programme for the involvement of SMEs in research activities.

European Community action is intended in particular to promote the participation of SMEs in research programmes through an effort to achieve administrative simplification.

This includes the creation within the European Commission's services of a 'one-stop shop' for all research programmes together and the support given to 'cooperative research' activities.

The idea is to launch a dynamic for the creation of activities involved in the dissemination of scientific and technical advances and the improvement of conditions for the creation and development of innovative businesses. This, by ensuring the European Union's future in markets through the exploitation of its scientific excellence, the EU can get back on the path to creating jobs and meeting the most important expectations of its citizens.

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ERRATUM

In the article "Towards Meeting CO2 Emmissions Targets: The role of the Carbon Dioxide Removal" (issue 16, july 1997) an error has been made. In figure 2 on Indicated Costs of Carbon Dioxide Mitigation, the unit on the y-axis has been expressed as - GtC-. This should have been expressed as - Costs (ECU/tC avoid).

EDITORIAL

The first article in this issue deals with wastewater reuse, and the divergence of opinions/regulations surrounding it. Broadly speaking and with several intermediate shades of grey in between, there are two camps. On the one hand, there are the proponents of the World Health Organization (WHO) guidelines, who stress the adequacy of the regulations proposed 1989, and the feasibility of following such guidelines in less developed countries where wastewater reuse is often common. On the other hand we have the supporters of the much more stringent (and more costly to adopt) 'California' guidelines, whose proponents champion their safety, doubt the adequacy of WHO guidelines, and downplay the risk of the costlier California guidelines being used in protectionist, trade-discrimination practices. Since wastewater reuse is practised in Europe (mostly, but not exclusively, in Southern European countries), and since Europeans (largely, but not exclusively Northern Europeans) import and consume produce from non-EU countries, possibly irrigated with wastewater, an integrated European pro-active approach would be desirable.

The second article deals with the impact of recent advances in combinatorial chemistry, which is destined to become a core technology for chemical as well as pharmaceutical companies. The article, besides explaining the mechanics of combinatorial chemistry techniques, underlines the domination of this field by US firms, and explains it by showing how the origin of these techniques may be traced to dedicated biotechnology firms, of which many arose and thrived in the US in the last twenty years. In Europe due to different market structures (capital markets and otherwise) as well as due to certain initial reluctance vis-à-vis certain aspects of biotechnological research raising ethical questions, the biotechnology market did not follow similar paths to its US counterpart. The lesson from the emergence of combinatorial chemistry, may be that failing to follow quickly certain technological trajectories, may result in lagging behind in other, highly desirable, technologies which arise in the future about which no qualms have been expressed.

The third article examines one of the ways that have been proposed for achieving greenhouse gas reductions, called Joint Implementation. This involves a deal in which countries with high costs of pollution abatement invest in abatement in countries with lower costs, and receive credit themselves for the resulting reduction in greenhouse gas emissions. The method has clear efficiency advantages (by getting the same reduction in a less-costly way), and may help the usually poorer host country achieve locally better performance than it could afford on its own, as well as promoting technology transfer. However certain ethical considerations need to be borne in mind, and it should be ensured that incentives for future developments towards cleaner technologies are not compromised by the availability of the Joint Implementation mechanism. Moreover, as in most other pollution reduction mechanisms, accounting and baseline definition problems are very thorny issues and need to be addressed carefully.

The fourth article highlights the need for collaboration and coordination in research and development in food safety issues in the EU - a need underlined by the recent bovine spongiform encephalopathy (BSE) (so-called "mad cow" disease) case. The EU and its research centres can set international collaboration in motion which will take advantage of the large scope for obtaining international economies of scale in food safety R&D, particularly with regard to the costly development process for the reliable and rapid tests needed to ensure public confidence in food products, as wells as enabling cross-fertilization of ideas and overcoming the limitations arising from the fact that relevant expertise does not usually reside in a single laboratory.

Finally the last article suggests that so-called smart materials and smart structures have many applications in transport, medicine, civil engineering, etc. Europe's slow adoption and awareness patterns regarding this technology are due to factors including the fact that policy frameworks not always conducive to innovation and commercial uptake, a failure to understand and identify key challenges, and the areas where policy intervention could have an impact. Contrary to what one may expect, the bottleneck is not basic research but rather in the translation of results from the laboratory to the marketplace. The multidisciplinary character of work on smart materials may also be responsible for their not receiving as much attention as perhaps they deserve.

6 Environment

Municipal Wastewater: Public Health and The Environment

Laurent Bontoux

Issue: The reuse of wastewater is increasing rapidly in Europe, mostly, but not exclusively, in southern European countries. The most important applications are the irrigation of crops, golf courses and sports fields, which are moreover cases where pathogens from the wastewater may come into contact with the public. At the same time Europe, and in particular the Northern European countries, import produce and flowers irrigated with reclaimed wastewater from countries on the southern littoral of the Mediterranean. As with many activities, these trends are occurring in Europe against the backdrop of heterogeneous regulation.

Relevance: The resolution of this issue requires a transparent European approach to protecting European consumers and tourists while preserving the single market and avoiding a new health scare as damaging as the recent 'mad cow' affair. Embarking on this work on time would also ensure that full advantage is taken of the reclamation and re-use of wastewater as a water resource and environmental protection option. Additionally, the development of clear European guidelines for the re-use of reclaimed wastewater would provide a quality benchmark for non-European countries, which is desirable in the perspective of the forthcoming Euro-Mediterranean Free Trade Area and in the context of a general improvement of quality of life in Southern Mediterranean countries.

Analysis: The need for European wastewater re-use guidelines

The 1989 WHO 'Health guidelines for the use of wastewater in agriculture and aquaculture' are the only existing guidelines for wastewater reuse at international level

Microbiological quality is the most contentious issue linked to wastewater re-use in irrigation. At the international level, the 1989 WHO 'Health guidelines for the use of wastewater in agriculture and aquaculture' (WHO, 1989) are the only existing guidelines for wastewater reuse. While reviewing the health risks and the (insufficient) epidemiological evidence available at the time, the only specific criteria the WHO proposes are microbiological. Table 1 presents these criteria. Work has now started on chemical guidelines (Chang et al., 1995).

The main justification for the 1000 faecal coliforms per 100 ml guideline is the comparison with the 2000 faecal coliforms per 100 ml used as the European standard for bathing waters. Protozoa are not included in the WHO guidelines because the technologies effective in achieving the nematode standard arguably also provide a certain removal of protozoa. Viruses are not considered and their presence is difficult to monitor on a routine basis.

These guidelines were intended to guide wastewater treatment design engineers in the choice of treatment and management technologies that will reliably achieve these standards. Since

these guidelines have a world-wide scope, they were also designed to stand realistic chances of being applied in developing countries, where an unnecessarily stringent stance would most probably result in them being ignored (Mara and Cairncross, 1989). Today, the WHO guidelines represent the minimum below which everybody agrees that public health protection is not assured. The other end of the spectrum in the above mentioned debate is held by the very stringent 1978 California 'Title 22' guidelines, resulting from a high-tech, 'better safe than sorry' approach.

The California criteria stipulate conventional biological wastewater treatment followed by tertiary treatment, filtration and chlorine disinfection to produce effluent that is suitable for irrigation use. In support of this approach, Asano and Levine (1996) have reported two major epidemiological studies that were conducted in California during the 1970's and 80's. These studies scientifically demonstrate that food crops that were irrigated with municipal wastewater reclaimed according to the California approach could be consumed uncooked without adverse health

The stringent 1978 California 'Title 22' guidelines have been shown to ensure public health protection

Table 1. Recommended microbiological quality guidelines for wastewater use in agriculture[a] (WHO, 1989)

Category	Reuse conditions	Exposed group	Intestinal nematodes[b]	Faecal coliforms	Wastewater treatment
A	Irrigation of crops likely to be eaten uncooked, sports fields, public parks	Workers, consumers, public	≤1	≤1000[c]	A series of stabilization ponds designed to achieve the microbiological quality indicated, or equivalent
B	Irrigation of cereal crops, industrial crops, fodder crops, pasture and trees[d]	Workers	≤1	No standard recommended	Retention in stabilization ponds for 8-10 days or equivalent helminth and faecal removal
C	Localized irrigation of crops in category B if exposure of workers and the public does not occur	None	Not applicable	Not applicable	Pre-treatment as required by the irrigation technology, but not less than primary sedimentation

[a] In specific cases, local epidemiological, socio-cultural and environmental factors should be taken into account and the guidelines modified accordingly.

[b] Ascaris, Trichuris and hookworms.

[c] During the irrigation period.

[d] When edible crops are always consumed well cooked, this recommendation may be less stringent.

[e] In the case of fruit trees, irrigation should cease two weeks before the fruit is picked, and no fruit should be picked off the ground. Sprinkler irrigation should not be used.

Table 2. Microbiological quality guidelines and criteria for irrigation of the State of California (1978)

Reuse application	Irrigation technique	Faecal or total coliforms[b]	Wastewater treatment requirements
Edible crops	Spray	< 2.2/100 mL[a]	Secondary treatment, coagulation, clarification, filtration and disinfection
Edible crops	Surface	< 2.2/100 mL[a]	Secondary treatment and disinfection
Fruit trees and vine	Surface	No limit	Primary treatment
Fodder crops, production of fibres and seeds	Surface or spray	No limit	Primary treatment
Pasture for milking animals	Surface or spray	< 2.2/100 mL[a]	Secondary treatment and disinfection
Golf courses, cemeteries, motorway landscapes and other landscapes with similar public access	Surface or spray	< 23/100 mL[a,c]	Secondary treatment and disinfection
Parks, public gardens, playgrounds, school yards and other areas with similar public exposure	Surface or spray	< 2.2/100 mL[a]	Secondary treatment, coagulation, clarification, filtration and disinfection

[a] The California Wastewater Reclamation Criteria are expressed as the median number of total coliforms per 100 cm^3, as determined from the bacteriological results of the last 7 days for which analyses have been completed.

[b] The coliform concentration must not exceed 23 per 100 cm^3 in more than one sample per period of 30 days

[c] The coliform concentration must not exceed 240 per 100 cm^3 in more than one sample per period of 30 days

Are the WHO guidelines sufficient for public health protection? This question is at the centre of a heated international debate

effects. However, the nutrients removed by the tertiary treatment are not available for fertilizing.

The California guidelines also mention the possibility of derogations to Table 2 if the California Health Department judges that the 'commercial, physical or chemical' treatment of food guarantees the destruction of pathogens before human consumption.

Beyond the microbiological limit values, a few differences can be noted between the WHO and California guidelines. In contrast to the California approach, the WHO guidelines say that the most stringent microbiological water quality requirements can be met by a series of stabilization ponds. Microbiological monitoring requirements also vary: the WHO guidelines require monitoring of intestinal nematodes whereas the California criteria rely on the required treatment systems and the sole monitoring of the total coliform count to assess microbiological quality (Asano and Levine, 1996).

Are the WHO guidelines sufficient for public health protection? This question is at the centre of a heated international debate (Marecos do Monte et al., 1996). International organizations such as the World Bank and WHO call for epidemiological studies to defend the WHO quality guidelines. A large part of the answer probably lies in the treatment requirements associated to the limit values. In any case, and in spite of their safety, the stringency of the California standards are a barrier to their widespread adoption world-wide.