Environmental Technology ”Towards Sustainable prroduction and consumption. PEER Seminar Main outcomes of the PEER Seminar

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PEER

Partnership for European Environmental Research
A new dimension in environmental research

Environmental Technology

TOWARDS SUSTAINABLE PRODUCTION AND CONSUMPTION

Research needs and scientific challenges

PEER Seminar

Oct. 11-12, 2006, Montpellier, France

Main outcomes

V2

Document filename: ET_Peer_outputs_v2.pdf
Dated 20 December 2006
Report process coordinated by Claire Leamy and Philippe Roux, Cemagref (FR)

Foreword

This document evaluates the research needs and scientific challenges in the development of Environmental Technology, as an important contributor to Sustainable Production and Consumption. It is based on the outcomes from the seminar[1] organised by the PEER partnership in October 2006 in Montpellier (website: http://peer2006.teledetection.fr/).

The preparation of this document was lead by the seminar chairpersons, the scientific committee (see Annexe page 20) and a board of PEER staff and scientists. Claire Leamy and Philippe Roux both from Cemagref were the secretaries and coordinators of this report process.

These seminar outcomes tries to present the main cross cutting issues which are of general interest and does not attempt to be a definitive list of research needs for all specific topics in relation with Environmental technology.

Main abbreviations:

- ET Environmental Technology
- LCA Life Cycle Assessment
- SPC Sustainable Production and Consumption

[1] *PEER Environmental Technology Seminar – Oct. 11-12, 2006, Montpellier, France - A seminar organised by the PEER partnership (http://peer-initiative.org) with participation of the European Commission*

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1 INTRODUCTION

"… Needs for broader and deeper research …"

PEER aims to lead the development of a European Research Area in the environmental sciences by integrating a broad range of disciplines to provide science-based support for the development of a sustainable European environment. **Environmental Technology**, as a major contributor to **Sustainable Production and Consumption**, is therefore of the higher importance for the PEER partnership.

As an introduction and to put the following scientific challenges in perspective we will start by the eloquent concluding remarks delivered by Per Mickwitz[1] as the Chair of the final seminar plenary round table[2]:

*"My take home message from the seminar is that **we have to be** both **broad** and **deep** in our research … there is a general consensus for **combining social sciences** including economics, with environmental and engineering sciences, especially Life Cycle Thinking in a better integrated manner … and that has to be done in the context of governance, at all levels from the global to the local scale… One of the main reason why we should be broad is that Environmental technology R&D is still much more promoted based on a push approach, than a pull one from the consumers. This is changing, but slowly and how push and pull processes interact should be understood much better than we do now … But **while we strive to be broad we also must be bold enough to be deep** … being broad and integrated doesn't means that all projects have to be broad … we also need to do **hard engineering research**, somebody has to do **focused research on** narrow topics …. And this comes from a social scientist … so you will not hear it often …."*

[1] *Per Mickwitz, SYKE - Finnish Environment Institute (Finland)*

[2] *PEER Environmental Technology Seminar – Oct., 2006, France – website: http://peer2006.teledetection.fr/*

2 POLICIES AND METHODOLOGIES STATEMENTS

What are important scientific challenges in Environmental Technology? That is the question to be addressed. This first chapter will present general cross-cutting issues of importance for all types of Technologies.

2.1 Sustainability Assessment

Twenty years pass since the Brundtland Commission[1] defined Sustainable development as ''development that meets the needs of the present without compromising the ability of future generations to meet their own needs''. Sustainability Assessment by integration of environmental, economic and social aspects for decision support in industry and policy is a key issue of environmental technology development.

The research needs related to that question face several challenges … Assessment of what? (Focusing & prioritising), Assessing How? By Who? When and for what? (links between assessment & decisions).

Important general issues behind the research needs

It seems to be essential to draw some important issues before any evaluation of the research needs regarding sustainability assessment:

- Multi-levels of scale
  - From EU to local
  - But also developing countries and global
- Different actors
  - Public – private
  - Decision makers – stakeholder (incl. consumers)
- Many potential focuses
  - Technology, technological systems, regulation or policies, needs, or needs within sustainability limits…

[1] *The Brundtland Commission - formally the World Commission on Environment and Development (WCED), known by the name of its Chair Gro Harlem Brundtland, was convened by the United Nations in response to the 1983 General Assembly Resolution A/38/161*

Sustainability Assessment "generic" research needs

Before dealing with specific needs in sustainability assessment, here find some of "generics" research isuues:

- How to make Sustainability Assessment useful for questions of different actors?
  - Radical macro level change, e.g. Factor 4
  - Local level decisions for instance on airport or waste treatment
- Developing target based Sustainability Assessment
  - At different level, but also examining the consistency of the targets
- How to incorporate the constraints imposed by nature in Sustainability Assessment
  - Macro "limits to growth"
  - Micro, e.g. Soil quality protection constraints
- The potential role of stakeholder involvement for Sustainability Assessment
  - Which stages, how, which stakeholders
  - How to link it with uncertainty and long time effects
- The role of quantification
  - What should be quantified that be can not quantify today; How?
  - How could quantified and qualitative (e.g. categorised) information better be used jointly?

2.2 Sustainable Consumption

Within the context of the Environmental Technologies Action Plan (ETAP[1]), societal acceptance for the implementation of environmental technologies is crucial. Consumer awareness-raising measures can stimulate demand for environmental technologies but are not sufficient to fill the gap between consumer-knowledge and consumer-action. New products and services must fit into consumer routines or provide worthwhile benefit to change these. Therefore, goods and services should correspond to the dynamics of attitudes and values of the consumers for instance to avoid rebound effects. So, for the acceptance and implementation of environmental technologies it is absolutely necessary to involve the consumers or consumer institutions in a very early stage of product and technology development.

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[1] *Stimulating Technologies for Sustainable Development: An Environmental Technologies Action Plan for the European Union (ETAP) - Brussels, 28 January, COM(2004) 38 final*

Main foci of research demands related to sustainable consumption, social perception, awareness and behaviour related to environmental technology are:

- the consumer and her/his behaviour
- the necessity of a trans-disciplinary approach

Consumer behaviour

Social Science Research needs to focus on determinants of consumer behaviour: it is needed to learn why people consume what they consume, what is driving the consumer and influencing consumption (culture, life-style, values, morals, peer-groups).

Research is also needed on the feasibility of changing consumer behaviour. Therefore you also need research on ways to influence consumers through different paths like: media, school, labels at the point of sale, internet. One specific focus on environmental technology may be to understand the context in which environmental technologies are adopted and used.

Attention needs to be focused to help inspire cooperation between technology R&D and consumers: media, advertising, marketing people, and idols like TV-stars.

Focus-group research should also work on market impacts of ecolabels and environmental product declarations.

The necessity of a trans-disciplinary approach

The ETAP action plan and the Environmental research in the 7th FP need to include socio-economic/ consumption research in calls and budgets.

A bridge/link between designers, LCA users and sociologist must also be built in particular for defining the functional/service unit. That means directly involving the social science at the LCA starting point – which is the reflection of the functional/service unit. That should need research on the deep meaning of word such as functionality in its context and the definition of shared vocabulary and tools.

Focus research must also be conducted on the use of LCA and the intersection of consumer/client needs.

Some other needs

Research within 'implementing agencies' for effective policies, strategies and intervention, points for sustainable consumption (beyond education, information and regulation) is needed.

2.3 Environmental Impact Assessment and LCA

Evaluating research challenges linked to LCA development is a huge task. Specialized LCA scientific communities are the most important contributors on LCA research questions. Nevertheless, PEER members, with diverse specialties (including environmental researchers, LCA users and 'designers', etc…) proposed the following contributions, grouped under the three following themes:

(i) the extension of LCA to social and economic aspects,

(ii) the adaptation of LCA methods to the 'objectives there are used for' and especially to the decision-maker,

(iii) Scientific challenge of overcoming some of the perceived limitations of LCA (in particular time and spatial limitations).

Extension of LCA to other aspects than environment

Despite that everyone accord on the fact that the inclusion of monetary evaluation of impacts is a big issue, some found it very controversial whereas some others found it useful for decision-makers. The endpoint indicators methodology was suggested to be useful in that context (considering impacts in an integrated framework across categories such as climate change, acidification, etc.).

- The connection between LCA and social aspects is still a great research challenge, in particular with two different approach angles.
  - Firstly, in the perspective of using LCA to diminish environmental impacts, research should be conducted on individual behaviours
  - As well as on the type of information that can be understood by individuals or decision-makers and that will make them act differently (i.e. education and communication).
  - Secondly, it must be notice that brilliant sustainable reports published by companies, could hide very different social behaviours, and that social reporting could also be ruled by specific standards.

Finally, there is a consensus on the need for social sciences collaborations, but also on the difficulties of communication between specialised scientists and on the necessity to harmonise languages between disciplines.

Adaptation of LCA methods to the 'objectives there are used for' and especially to the decision-maker

- The adaptation of LCA methods to the decisions to take was discussed several times along the session. Although complicating the task of the decision-maker and existing in most assessments, uncertainties were pointed as a concern.
- The use of single score indicator was found controversial (as stated before about monetarisation).
- Linked also to the issue of uncertainty, it is suggested that a non specialist decision-maker is expected to require a level of evidence of environmental impacts: are they possible, expected or certain impacts?
- Reflection about the relevancy of product LCA for policy decisions is needed; i.e. which tool to use when?
  - It is suggested that product LCA (so-called bottom-up) may be more adapted to company levels and for detailed studies of products (goods, services, technology options), whereas input/output LCA (top-down), although less detailed and giving only sector insights, covers the entire regional economy and flows. The input/output LCA thus allows giving a macro level picture based on sectorial economic flows. LCA is stated to be only one of the existing tools for environmental assessments and life cycle thinking and the better connection/interaction with the other tools should be studied.

Scientific challenge of overcoming some of the limitations of LCA

- Time and spatial limitations of LCA can be considered both as potential limitations of the method:
  - For spatial limitations, it can be suggested to use emissions profiles correction factors, when materials are issued from different countries where emissions and/or impact severities can be very different than in European countries.
  - For time, it was e.g. suggested to consider future technological developments when assessing alternatives for goods, services, and technologies.
- The need of getting individuals and companies to think outside of their own action sphere has also to be pointed out.

2.4 Developing Environmental Technologies

The development of environmental technologies is 'regulated' by the market and driven by a combination of incentives push approaches (legislation, standards, etc.) and 'voluntary' pull ones from consumers. It combines several aspects from Eco-design, R&D, verification-testing and labelling, green purchasing, innovation, the market and therefore the consumers themselves, etc.

In that context, a very efficient approach consists in assessing brakes (bottlenecks …) and opportunities of environmental innovation in a **win-win** scheme. At this point, the question is how can research supports and contributes to this process?

How to enhance the development and use of environmental technologies

It seems impossible to evaluate research needs without some preliminary context words.

Fact: European companies are not always ready to take the advantages of environmental legislation:

- Development of technical innovation is quite long:
  - Need of long term European environmental strategy
  - Encourage the company to collaborate with researchers at the early stage of the development
- **Validation process of technologies** is very heavy:
  - Can we standardize in a voluntary way the validation process (ecolabels?)
  - Development of simple methods as a pre-screening
- More European funding for **high-risk projects** (radical, disruptive technologies).
- Funding of **high-risk projects** and in particular for the 'radical disruptive technologies' ones should be enhanced in particular at the European level (FP7)
- More funding also needed for demonstration projects.
- Lack of information on Environmental Innovations (EI) for end users
  - Communication on EI has to be enhanced by EC

So, a need for regulatory Push/Pull Options seems to be needed:

- Option of voluntary Environmental Technology Verification (ETV) system
- Goal: Reference for new technology
- Experience: US is in advance of market introduction of ET, although Europe is technology leader, because they have such a system
- Reason may be that they have a verification system
- Difference of validation systems: differences in involving stakeholders etc.
- Keyword is "confidence" of consumers, users

Research needs

- Information exchange between EU projects, from the perspective of the end user
- Development of simple, rapid screening tests for environmental technologies (ETV light)
- Research should design dedicated much more simples tools/methods than full LCA for assessing technologies (in particular in direction of SME's)
- Long term research should be independent of short term competitiveness criterion
- Research for high-risk projects including radical, disruptive technologies.

3 ENVIRONMENTAL TECHNOLOGIES RELATED TO SPECIFIC TOPICS

The PEER network has particular competencies in the areas where technologies, human needs, and the environment intersect. The scientific challenge of developing cleaner technologies in some of these areas will be addressed in the following chapter.

3.1 Solid Waste management

The research challenges and perspectives regarding waste management are addressed hereunder as methods for assessing different options and systems (including waste prevention, recovery, recycling, etc.). Therefore, the research needs on waste management technologies themselves are not tackled within the present contribution.

Research challenge for DATA in Assessment tools/software

- Availability of site specific data and modelling emissions
- Waste composition:
  - Difficulty to get representative data
  - Take into account the future variation in waste composition (fractions & chemicals)

Needs for an holistic approach

Research on waste management should change its perspective to look for longer term and more global objectives:

- Material recycling society
  - Ecodesign : Communication between designers & waste managers / recyclers
  - Industrial ecology
  - Market issues to be addressed
- Waste prevention
  - Awareness of ALL actors (including consumers, retailers, industry, …)
  - Communication

Social Sciences in a waste management perspective

- Education (school level) on LCT
- Knowledge gaps between the different actors
- Take into account the behavioural changes in society (dynamics)

3.2 Integrated Water Resource Management

Within a general framework of integrated water resources management, implementation of water related technologies is to be considered in a systemic approach, on a site specific basis, considering possible future scenarios (global and local change). Among the water related technologies contributing to such system solutions, we have distinguished as a transversal topic monitoring and information technologies, which are a key to numerous innovations.

Research directions and topics identified are grouped under three topic headings: monitoring, water technologies, and system implementation.

Monitoring:

- performance and capabilities of monitoring and of related information communication technologies: combining robustness, low maintenance, low energy needs, low cost, high reliability
- need for both online and integrating/sampling and monitoring devices
- sensors for :
  - Living organisms in water (prions, bacteria, viruses, insects…)
  - "emerging pollutants", insecticides, pesticides
  - groundwater condition and flows

Treatment technologies:

- integrate decision makers and stakeholders at very early stages
- assessment needs:
  - cost-effectiveness and social effectiveness
  - real efficiency of existing systems in particular considering emerging pollutants

- innovation means addressing existing technologies / systems and developing new technologies
  - rehabilitation of existing technologies and new technologies
  - Flexible use of centralized / decentralized technologies (with consideration of decision makers, economic conditions…)
  - adaptive technologies
- new needs
  - treating living organisms in water (prions, bacteria, viruses…)
  - use of non conventional resources (reuse of wastewaters, flood water, brackish water …)
  - define water quality according to different uses, treat water correspondingly

System implementation:

- integrated decision making, with very early participation of stakeholders, multi-criteria approaches … (decision systems, information systems …); solve conflicting needs and uses
- assessment of socio-economic performance of systems
- new ways for financing and governance
- suited regulation frameworks
- combine centralized and decentralized systems; considering existing infrastructures
- adaptive systems in design and management

3.3 Environmental Restoration / Remediation

The progress of sustainable remediation technologies faces many challenges. The following challenges were discussed and decided on as the main bottlenecks to developing better remediation technologies:

- The main barrier is economic, dumping prices are variable. Low dumping prices are hindering the development of new technologies
- Soil Directive calls for remediation but does not emphasize sustainable remediation methods
- Driving forces of new technologies are the costs (multi-criteria-analysis taking into account economics and sustainability criteria could help: in situ could be win-win).

The research needs for the progress of sustainable remediation technologies should at least include decision making, technological development, tools for site description and monitoring.

Decision making:

- LCA-needs to be promoted in remediation as well: adverse effects can be worse than the cure
- Better access to info: joint European data base on experiences on remediation technologies
- Definition of criteria for sustainable environmental restoration. Consequences for the different stakeholders including social and economical aspects should be known
- The choice between different restoration alternatives should be based on economy, sustainability and the future land-use. Decision support tools should be developed.

Technical/scientific technology development:

- The new information on microbial diversity and genomics could be better exploited in remediation technologies and monitoring of clean up progress. The focus should be on the understanding of the real in situ conditions and the adjustment of the technology to these.
- New developments can be applied in remediation technologies (chemical oxidation/reduction, biological aerobic/anaerobic, sorption materials, electrokinetics, UV, sanitation, geophysics etc., drilling technology, sensor technology and nanotechnology. Probable risks (e.g. for nanotechnology) and applicability to the real environment should be taken into account
- We need much more demonstration of existing scientific ideas: we need the owners and the authorities to go along and LIFE-projects
- Technologies for physical remediation of soils e.g. erosion: 'remediation' of spoiled areas such as for instance skiing tracks.

Site description

- We need better tools for describing the site variability: geology and contamination. It gives idea of which remediation alternatives should be applied, as well as of uncertainties of remediation duration and costs

Monitoring

- Monitored natural attenuation of contaminated soil and groundwater as a sustainable remediation technology could become better accepted if monitoring devices/methods would be harmonized or standardized. Methods to determine efficiency of the process and the sustainability on the long term are also needed. The responsibility after ending the operations should be discussed
- Bio-indicators could help to prove positive effects of remediation. E.g. the biodiversity of soil micro- and macro fauna in remediated soils and how to use biodiversity as bio-indicators in monitoring programmes. Biological criteria for remediated soil are also needed.

3.4 Biomass, Bioenergy

The progress of sustainable Energy Generation faces many research challenges and a great one is the mobilisation and conversion of biomass in the context of land use competition. A consensus basis for short and mid-term may be to split them into four main categories:

- Biomass potentials and biomass conversion methods (1)
- Changing paradigms in the field of biomass use (2)
- Concerns related to bioenergy development and its sustainability (3)
- Identification of actions and public support mechanisms aiming at the optimal development of bioenergy (4)

Biomass for bioenergy: What are we dealing with?

There is a need for research on:

- The assessment of biomass potentials at various levels (global, national, regional…) taking into account land use (present land use, future land use under various assumptions) but also logistics (production, harvesting, transport, biomass conditioning …) and corresponding costs[1]. Biomass assessment for bioenergy is a complex issue in the sense that the potential is not only related to natural conditions (soil, climate, topography) but also to the costs (how much are we ready to pay for…?). The degree of complexity is also greatly increased by the high number of raw materials that can be used (agriculture, forestry, Short Rotation Forestry and waste being the main categories).

[1] *Wide meaning of costs including both monetary and non monetary ones*

- The performances of conversion processes, including optimisation of processes, waste minimisation and the identification/analysis/development of new processes (wood to biofuels, for example).

Biomass: Changes of paradigm

If in the 20th Century, biomass has mainly been used for food … changes of paradigm generate necessarily **new research needs on:**

- The **value/usefulness of wastes and residues** (from agriculture, forestry or municipal waste …) that have to be reconsidered in many cases as co-products. An example is given by the use of straw from cereals for electricity production in the United Kingdom and Spain and the need to better understand for example the impact of variety selection or of straw harvesting on soil properties. Bioenergy offers an opportunity to reconsider available resources and production chains.
- The **development of bio-refineries** dealing in an **integrated way** with various feedstock and various productions (energy, products, chemistry …). This development should be assessed in an integrated 'life cycle thinking' approach combining environmental (LCA), social and economic impact of entire bioenergy chains and that should take into account scale or regional effects.
- The **specificity of biomass** supply in the context of competitive uses for food, heating/energy, paper pulp, chemistry, etc. For instance, the integration of this specificity in LCA approach and tools (taking into account the importance of soil and climate conditions) is a research challenge on its ones.

Concerns related to bioenergy development

Further research is needed about the sustainability issues of bioenergy:

- The ecological/environmental impact of various bioenergy options and scenarios, especially for soil, water and air,
- The impact of land use changes and intensification of biomass production on biodiversity, especially in tropical regions (Latin America, Asia…);
- The economic and social implications of bioenergy development both in Europe and in non-European countries that might increase their exports of biomass/biofuels? The articulation of local and international markets for energy and for food requires better understanding.

Actions towards bioenergy implementation

The uncertainties and possible irreversibility surrounding bioenergy development is worldwide acknowledged, enhancing the importance of public policies. Several research needs may be linked to that:

- Scenario modelling and risk analysis, learning from considerable experience on bioenergy and assessing the consistency of the different newly formulated objectives;
- The identification of complementarities and incompatibilities of various technology developments so as to best combine innovations and their associated incentives. It was also considered that bioenergy is not a solution in itself, but has to be combined with other renewable energy or energy efficiency/saving programmes in an innovation portfolio.;

The transfer of experience or technology from more advanced countries to less experienced ones was retained as important. It was considered that public authorities play an essential role to allow the development of bioenergy at an early stage, especially through mechanisms such as green procurement and use of feed-in tariffs, for which comparative analysis is still needed.

3.5 Technology for landscape management and sustainable agriculture

Drastic changes may be needed to significantly reduce the impacts linked to landscape management and agriculture. But those needed advanced smarter technologies (combined with precision farming and ICT[1] in a wider information system) have to face the glass roof of existing systems (regulation, norms and standards for instance).

Some general issues before identifying research needs

First, it is stated that drastic changes based on smarter technology combined with advanced information systems should require a kind of sustainability assessment. The social impact of radical innovation is a crucial point, going from the acceptances of robots and automation, of sharing more or less confidential data for a better overall transparency, to the questions of training and employment, of awareness and education. The competitiveness of these innovative technologies is a second key point calling for targeted economic incentive instruments from funding systems to taxes, in place of and not additional to existing ones. It must reduce the risk for innovative enterprises by giving them an easier access to the market recognizing their key role of first movers.

[1] *ICT: Information and Communication Technologies*

Considering the environmental issues, agriculture and more specifically all types of land use technology should shift from minimizing their environmental impacts to a clear and strong commitment in tackling environmental problems, in particular when related to potential public health issues.

Research needs summary

Research needs were deduced from these preliminary considerations:

- The impacts of robotics and ITC based innovative technology on employment and on agriculture competitiveness requires methodology and tools, considering that existing activities and associated business models will be replaced by new ones. It could refer to retrospective analysis of the last agriculture revolution use and to the future of the agriculture common market. Some specific research fields should address these impacts on the agriculture in new and candidates members' states and of the agriculture in countries in the global South.
- Another methodology problem is to develop tools (new or derived from existing ones as LCA) for the environmental assessment of a spatial area combining different land uses which necessitate a coordinated approach. Scale problems and relations between agriculture production and viability should be addressed.
- The development of highly innovative automated equipments requires works in the fields of
    - Real time modelling
    - Wireless networks
    - advanced sensors including bio-monitoring
    - Test kits to control and to optimize practices
- New organisation schemes are needed for
    - an optimal economic use of innovative equipments
    - connecting data collection to artificial intelligence systems for assisted diagnosis and recommendations (based on agronomic models)
    - logistics options applied to short loops for products and services, including tracking and quality assessment

In conclusion, the group recommended going further in the opening of a dedicated research initiative. The building of a Technology Platform on agricultural ET (or equivalent) could be a first step.

4 ANNEXES

PEER at a glance

PEER will lead the development of a European Research Area in the environmental sciences, by integrating a broad range of environmental disciplines to provide science-based support for the development of a sustainable European environment.

PEER Members:

- ALTERRA The Netherlands
- CEH United Kingdom
- CEMAGREF France
- JRC-IES European Commission
- NERI Denmark
- SYKE Finland
- UFZ Germany

Website for more information: http://peer-initiative.org/html/

PEER Environmental Technology seminar[1] - Scientific Committee

- Chuzel, Gérard, CEMAGREF, Head of Env. Technology for Agro-systems Dpt. (FR)
- Müller, Dr. Roland, UFZ, Centre for Environmental Biotechnology (D)
- Trine Jensen, NERI, Policy Analysis Department (DK)
- Okx, Joop, ALTERRA, Soil Remediation (NL)
- Pennington, David, JRC-IES, Life Cycle Assessment and Waste Management (I-EU)
- Seppälä, Jyri, SYKE, Programme for Environmental Technology (FIN)
- Thompson, Ian, CEH, Environmmental Biotechnologies (UK)

[1] *See seminar website for further information: http://peer2006.teledetection.fr/*

PEER Environmental Technology seminar - Sessions chair and reporter

- 1b - Sustainability Assessment (Integration of environmental, economic and social aspects for decision support in industry and policy):
  Per Mickwitz, SYKE, Finland - Pascal Mallard, Cemagref, France
- 1c - Sustainable Consumption (Social perception, awareness and behaviour related to environmental technology):
  Carolin Baedeker, Wuppertail Inst., Germany - Gabrielle Bouleau, Cemagref, France
- 1d - Environmental Impact Assessment (Potential for a consistent framework with many beneficial applications):
  David Pennington, JRC IES - Anne Ventura, LCPC, France
- 1e - Developing Environmental Technologies (Eco-design, R and D, verification-testing and labelling, green purchasing, etc.):
  Daniel Froelich, ENSAM, France - Klaus Rennnings, Zew, Germany
- 2a - Solid Waste Management (LCA as a tool for different waste management options) :
  Emmanuelle Aoustin, Veolia, France - Laurence Toffoletto, Veolia, France
- 2b - Integrated Water Resource Management (Preparing tomorrow's tools and technologies)
  Rolland Muller , UFZ , Germany - Jean-Philippe Torterotot, Cemagref, FRANCE
- 2c - Environmental Restoration (remediation and/or protective technologies for soil, groundwater, surface water, contaminated sediments/sites)
  Kirsten Jörgensen, SYKE, Finland - Joop Okx , Alterra, The Netherlands
- 2d - Sustainable Energy Generation and Use: Bioenergy and Bioproducts (The challenges of sustainable mobilization and conversion of biomass in the context of land use competition)
  J.F. Dallemand , JRC IES - Abigail Fallot, CIRAD, France
- 2e - Technology for landscape management and sustainable agriculture (The challenge of minimising energy and inputs into cultivation through precision farming, phytotechnology, automated environmental surveillance, etc.)
  Jean Marc Merillot , ADEME, France - Simon Blackmore, UniBots Ltd, UK

Environmental Technology definition

"Environmentally sound technologies protect the environment, pollute less, use resources in a more sustainable manner, recycle more wastes and products, and handle residual wastes in a more acceptable manner than the technologies which they replace. Environmentally sound technologies in the context of pollution are technologies that generate low or no waste, and they may also cover end of the pipe technologies for treatment of pollution after it is generated. Environmentally sound technologies are not just individual technologies, but total systems which include know-how, procedures, goods and services, and equipment as well as organisational and managerial procedures"[1]

[1] *Modified from: Stimulating Technologies for Sustainable Development: An Environmental Technologies Action Plan for the European Union (ETAP) - Brussels, 28 January, COM(2004) 38 final*