EURODEMO

European Co-ordination Action for Demonstration of Efficient Soil and Groundwater Remediation

Sixth Framework Programme (2002-2006)

Project no. 003985

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Project coordinator name: Dietmar Müller
Organisation: Umweltbundesamt GmbH

Revision [draft, 1, 2, …]

1 Project execution

The summary description below contains the requested elements. It has also been submitted recently to the "Land Contamination and Reclamation Journal".

1.1 Abstract

EURODEMO has been initiated in order to counter market barriers and support the market uptake of innovative technologies in the field of soil and groundwater remediation. Therefore, the project has worked to make existing information about innovative technologies, demonstration projects and possible funding sources accessible at one central place. Additionally, accompanying measures for carrying out "good quality" demonstration projects have been developed. These strategic measures aim at increasing stakeholder confidence and acceptance regarding innovative methods. Thus, more and more efficient implementations of existing innovative soil and groundwater remediation technologies shall be facilitated. In this article, the main project results are summarized and proposals for a continuation of strategic support for innovative remediation technologies are made.

1.2 Introduction

Whilst sustainability issues increasingly gain political and public attention, an expectation for eco-efficient and cost-effective environmental technologies has arisen, in a European remediation market which has pre-existing issues of confidence in remediation technology applicability, efficacy and non-uniform development. Such pre-existing confidence issues may lead to situations where promising solutions in form of already demonstrated innovative soil and groundwater remediation technologies which may either complement or even be superior to traditional technologies, are abandoned in favour of the traditional remediation options.

With regards to the existing market barriers for innovative technologies, the European Commission has launched a coordination action under the 6th Framework Program for Research and Technology Development and EURODEMO is the carrier of this strategic initiative to promote these technologies.

EURODEMO tackles market barriers primarily by supporting technology information transfer across Europe aiming to raise confidence levels of remediation stakeholders. Nevertheless it has to be recognised that it is within the responsibility of all involved stakeholders to discuss which prerequisites are needed to increase flexibility and efficiency in site remediation. Most likely these prerequisites will be a sequence of social, legal, administrative and technical aspects, like needs for (i) new visions, (ii) changed perceptions, (iii) improved process understanding, (iv) technological innovation, (v) adaptive and flexible projects, (vi) legal and administrative instruments. Therefore EURODEMO as a strategic initiative needed to build an integral approach.

The project was divided into seven coordination groups which addressed different topics related to confidence raising and acceptance building through information. Two groups covered factual information regarding technologies and applications. In the coordination group "Technical reliability" technology specific information for selected innovative technology groups was collected and compiled. The other coordination group "Programs and projects" created an overview on technology applications across Europe, but also contributed some strategic guidance for project implementation. Two other groups complemented the factual information by dealing with strategic issues like how to improve decision-making processes in order to better account for consideration of innovative solutions and how to implement environmental efficiency criteria in decision processes and in field projects. In order to make sure that EURODEMO effectively targets end-user needs, one coordination

group was entirely devoted to end-user exchange. The remaining two groups "Knowledge transfer" and "Information flow" addressed external networking, dissemination and knowledge transfer. In the following, some main findings of the working groups will be given, followed by future perspectives.

1.3 Factual information: technical reliability, project information sources and guidance

Factual information is a main basis for responsible decision making. This is especially true for innovative issues, as good information in the first place enables decision-makers to consider innovative solutions.

In order to provide decision-makers with a comprehensive understanding of innovative remediation, information has been compiled regarding selected technology groups which already have some European application history and therefore are expected to play a major role in the next years in Europe. The selected technology groups cover permeable reactive barriers, *in situ* thermal remediation, *in situ* chemical oxidation and enhanced *in situ* bioremediation. Within four status reports, each of these technology groups has been described, covering a general introduction to the technology, technology principles, design possibilities, case studies, applicability and current European status [Birke, Parbs, 2005]. Based on the experiences made in the case studies, technical criteria for assessing technical feasibility and performance effectiveness have been summarized in a guideline and model protocols [Birke, 2007]. In addition, the rich Dutch experience regarding *in situ* bioremediation has been supplied in order to complement the compiled factual information [Langenhoff, 2007].

However, accessibility of related data and experience was not always given for European demonstrations, and this lack of factual information became obvious in the EURODEMO status report on "substantiated" projects in Europe [Henstock, 2007a], meaning projects that have undergone some degree of peer review. This report illustrated, that the number of adequately reported projects in the most reliable sources[1] remains with 254 pilots and demonstrations far behind expected numbers of reported projects, and in fact represents only a very small fraction of actually performed projects in practice. But good quality reporting is the basis for providing a feedback mechanism to transform isolated demonstration projects into demonstrations with a lifecycle, where previous learning can benefit future projects, both for individual technologies and within the generic parts of a demonstration. Following this reasoning, EURODEMO has delivered a generic project guidance [Henstock, 2006], which aims to support project setup, performance and reporting in order to provide the desired lifecycle for good-quality remediation projects. With the reporting, the project performer demonstrates his competence, which has a great marketing effect.

For the purpose of co-ordinating and taking a wider view of real remediation projects that have taken place across Europe, a *Remediation Projects Directory* has been set up in collaboration with EUGRIS, to stimulate the recording of remediation practice and of technical aspects for differing remediation technologies. This directory acts as a shop window for specialists and is described in more detail within a separate article in this Special Issue [Henstock, 2007b].

1.4 Strategic issues: decision-making processes and environmental efficiency

In the first place, responsible decision-making accounting for innovative issues relies a lot on factual information, but decision-makers' awareness of sustainability and eco-efficiency

[1] Consoil; NATO CCMS Pilot Study; CL:AIRE Technology Demonstrations; SKB Demonstration and Pilot Projects; and NOBIS Projects

issues is most probably equally important for supporting innovation uptake in remediation practice. Therefore, integration of sustainability and eco-efficiency issues either at technological or methodological levels in decision making procedures is required in order to develop efficient, effective and responsible best practices and methodologies for soil remediation. Hence, non-technical recommendations have been developed within a *Remediation Technologies Promotion Programme (RTPP)* in EURODEMO [Gaboriau, Merly, 2007]. This *RTPP* aims at promoting use of sustainable remediation technologies by:

- Creating a favourable policy, regulatory and economic context.
- Encouraging decision makers to use innovative and sustainable remediation technologies in a favourable context.

In order to illustrate the key role of decision-making procedures, RTPP recommendations are described in more detail in the following:

RTPP recommendations are classified into five categories with convergent objectives. The first category relates to ***communication*** and training, i. e. to all actions which contribute to raise awareness about innovation. The other four categories comprise all actions which contribute to the improvement of general market conditions, namely

- ***regulatory mechanisms***,
- ***fiscal and financial incentives***,
- ***actions related to environmental performance***, and
- ***public authorities commitment***.

The *RTPP* recommendations are developed at a generic level and are adaptable to national contexts and specificities.

Communication – Communication is a key issue in the uptake of innovative sustainable remediation technologies. Here, two types of communication can be considered (i) Strategic communication which aims at creating a favourable context and (ii) Technology oriented communication which aims at encouraging decision makers to use innovative and sustainable remediation technologies (see Figure 1).

The RTPP proposes three types of recommendations to achieve successful communication: general principles for communication, specific recommendations for strategic communication and specific recommendations for technology oriented communication.

General principles for communication include:

- Communicate at all levels (European, national, local) but emphasize communication at the national level. This can be achieved through national groups and using existing networks (i.e. Nicole) or working groups.
- Develop national platforms: national platforms aim to relay national experience at the EU level and vice versa, to facilitate dialogue between the different actors and to clear language barriers
- Include all target groups in the communication process
- Adapt communication objectives and content to target groups by presenting simple and easy to grasp examples and by demonstrating the quantitative benefits for each category.
- Encourage direct communication across the different actors and disciplines: It can be promoted by (i) developing partnership, networking between different actors of contaminated land management (ii) developing of environmental technology information and collaboration portal and (iii) encouraging communication across disciplines but also among same types of actors as people communicate most frequently and effectively with those who are most similar to themselves.

Recommendations specific to strategic communication include:

- Raising awareness about sustainability and eco-efficiency
- Convincing of the need of an incentive regulatory and economic framework

This can be achieved through development of non-technical materials demonstrating the quantitative social, environmental and economic benefits resulting from innovative and eco-efficient approaches.
Recommendations specific to technology oriented communication include:

- Increasing knowledge and expertise
- Increasing confidence in innovative technologies.

This requires that for each technology validated information about technology performance and applicability and validated and quantitative information about the expected benefits (social, environmental, economic) are developed.
Regulatory mechanisms - The measures which can be proposed will vary from one country to another, depending on their respective current regulatory frame. Recommendations to improve regulatory context and to promote the uptake of innovative remediation technologies include the generalization of risk-based approaches (see also [Gaboriau, 2007]), the systematic consideration of sustainability aspects and long term benefits in the regulation, the production of performance-based standards and the decoupling of waste and soil remediation legislations.
Fiscal and financial incentives – Recommendations could include incentives or tax reduction for remediation projects which aim at supporting sustainability and promoting best dissemination of experience and feedback. The success of any incentive will largely depend on the quality of criteria/standards/principle which will guide the support.
Actions related to environmental performances – Besides Environmental Technology Verification (ETV) initiatives such as the EC projects PROMOTE and TESTNET, instruments like Eco-label, award for successfully implemented demonstration projects or qualification of service providers could be developed in the field of innovative remediation technologies.
Public authorities commitment - The commitment of public authorities to use innovative technologies and to consider sustainability for the remediation of contaminated state-owned sites (either for demonstration or for fully-commercial projects) can lead to several benefits: (i) setting the example; (ii) guarantee about the quality and the access to information; and (iii) improved communication. Two specific instruments could be used by public authorities to boost innovation: i) specific funds to share the financial risk of using innovative remediation technologies and ii) green public procurement.
As pointed out before, the RTPP considers sustainability as being a key argument to influence decision-making procedures in future. In this context emphasis is to be given to eco-efficiency, hence the ratio of gained environmental value related to invested costs.

1.5 Environmental or Eco-efficiency

Eco-Efficiency is an instrument to illustrate and evaluate the environmental performance and impacts of human activities and can be generally defined as the ratio between value (cost, wealth, environmental benefits or social welfare) and environmental impacts. Therefore it focuses on the environmental and economic dimension and enables to combine performance along two of three axes of sustainable development.
So far soil and groundwater remediation projects are being realised to reduce risks, improve the environmental status of land as a resource, prevent the spreading of pollution, and limit potential liabilities. It is obvious that these core objectives generally intend positive environmental impacts. As for the environmental dimension of eco-efficiency it is important to recognise that remedial activities also cause wider environmental effects like consumption of natural resources (inputs, e.g. water consumption), the subsequent emissions (outputs, e.g. waste water) and secondary environmental impacts (e.g. eutrophication). These supplementary effects will vary from site to site and the treatment employed but, aiming at sustainability for land remediation, should also be considered in a consistent way.

Therefore a *Framework for Sustainable Land Remediation and Management* has been drafted. The proposed framework aims to develop an indicator based measurement system for the environmental dimension of sustainability and refers to the basis of the already given European policies on Resource Management (6th Environmental Action Plan, Environmental Technology Action Plan, Thematic Strategy on the Sustainable Use of Natural Resources, Green Paper On Energy Efficiency). Such a framework shall in particular comprise common principles and criteria to assess environmental effects and structure assessment processes in order to allow comparison of environmental effects of different remediation technologies and projects. Furthermore the framework needs to address and be consistent over different process levels (from a specific site remediation project to the policy level) and operational to be implanted along a remediation project (from the planning phase until the aftercare). Consequently the following levels (see Figure 2) are to be considered:

- A site and technology level (micro level) where a remediation is actually implemented and where remediation performance should be monitored.
- A technology level, where technologies as such are to be compared.
- A site level, where the best technology for a given site is selected.
- A policy level (macro level) where the progress of land remediation as such is monitored for a given region.

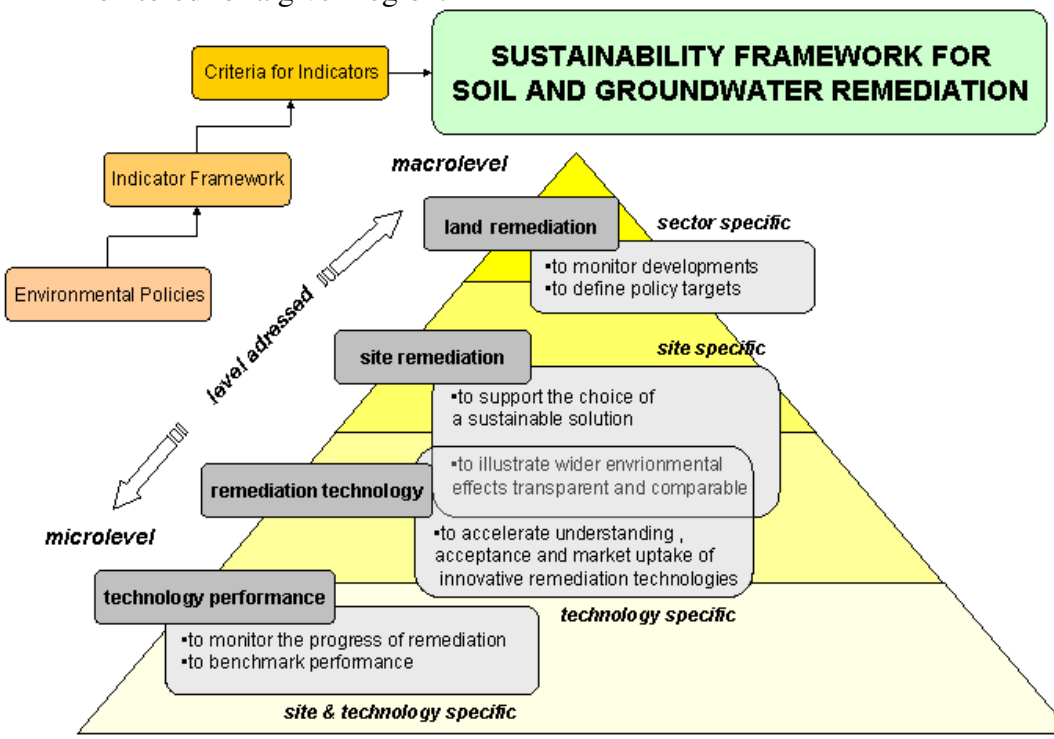

Figure 2: A *Framework for Sustainable Land Remediation and Management* needs indicators or indicator sets at different spatial and sectoral levels (i.e. site specific, technology specific, sector specific)

Giving an emphasis to the policy level it has to be admitted that the benefits of land remediation are generally defined by the core objectives of projects, usually aiming at risk reduction and the improvement in soil and groundwater quality. As it is not possible to aggregate these criteria and the general comprehensibility is also limited, it is suggested to express the value of the services provided by land remediation along more generic positive environmental effects, such as

– area of rehabilitated land,
– mass of treated contaminants, and
– mass or volume of treated soil / groundwater.

The environmental benefits indicators could be used to illustrate eco-efficiency as environmental improvement costs as a ratio of costs related to environmental benefits:

- EURO / m² rehabilitated land
- EURO / kg treated contaminant
- EURO / kg soil (or groundwater)

Wider or secondary environmental impacts of land remediation can be related to politically agreed sustainability objectives as defined by the 6th European Environment Action Plan and coupled to further commonly recognised objectives (see above). The following indicators to monitor environmental impacts of the land remediation sector are suggested:

- total energy consumption
- water consumption
- waste generation
- CO2 emissions

The suggested indicators are important in relation to environmental policy objectives like the 6th European Environmental Action Plan and also compatible to commonly recognised indicators used to assess the eco-efficiency of other service sectors or for national economies. In particular energy (total energy consumption) is suggested to be a core indicator as several other wider environmental impacts (e.g. CO2 emissions and global warming) are directly related and energy consumption, costs and efficiency are a major future challenge for sustainable development of societies.

The environmental impacts indicators once established can be related to the environmental benefits gained (e.g. kg waste / m² rehabilitated land; kWh / kg treated contaminant) and used as additional operators to follow developments of land remediation. Depending on environmental and societal needs, economic and environmental goals for the total beneficiary value could be envisaged subsequently, as well as policy targets to decouple and decrease environmental impacts (e.g. reduce the use of non renewable energy / m² rehabilitated land). Finally in an ideal Framework interaction between process levels should be possible. It is therefore proposed to define the indicator set flexible using generic criteria at the highest level and leaving the opportunity open to make specifications at lower levels. For example a the generic indicator ‘waste generation’ used at the policy level can be specified into different waste categories (hazardous waste, non-hazardous and inert waste) as a basis to analyse and compare different remediation options for a specific site.

1.6 End-user exchange and external networking

Factual information and strategic measures may only influence remediation practice when being considered as useful by the relevant stakeholders, and when being successfully disseminated to the relevant stakeholder groups. Therefore, continuous end-user exchange and dissemination of information, results and experiences was achieved through workshops, conference sessions, questionnaires, and articles, presentations, newsletters respectively.

On the one hand, regularly held workshops were organized in order to ensure that EURODEMO ideas are targeted to meet end-user needs (Katowice 2005), that intermediate project strategies and results find end-user agreement (Rimini 2006), and that final outcomes can be useful in remediation practice (Budapest 2007).

On the other hand, the end-user dialogue has been underpinned by regular and active involvement in events organised by other initiatives, to ensure that a full interchange of stakeholder objectives and ideas would occur. This involvement included presentations and discussions at Eco-innovation Forum events in Poznan and Paris, the NICOLE 10th Anniversary meeting in the Netherlands, joint meetings with the related *ETV Networks of Testing Centres* projects PROMOTE, TESTNET, AIRTV and with the TRI-TECH project in Frankfurt and Stuttgart and Special Sessions at ConSoil in Bordeaux and Milan. This

involvement also included opinion-sharing regarding the CEN-Workshop Agreement *Environmental Technology Verification – Soil and Groundwater Remediation and Monitoring Technologies* (CWA32 ETV-SGS) from the related project PROMOTE, and providing overarching information regarding the related EC projects under http://www.eu-etv-strategy.eu.
With the primary objective of being open to the widest possible range of stakeholder groups, all information collected in and created during this project, including a compilation of end-user needs [Edwards, 2005], a strategy for funding projects [Edwards, 2006] and a summary of technology demonstration priorities is contained at http://www.eurodemo.info, with project and funding directories directly available via http://www.eurodemo.eugris.info, for freely available public access.
External networking and better tangibility is also achieved through linkages to existing example sites, technologies and strategies as *EURODEMO Feature Initiatives*. These initiatives meet EURODEMO priorities in "real life", and thus make EURODEMO ideas and priorities more concrete for interested stakeholders. Currently, *The Avenue* (UK), *Thermal Enhanced Soil-Vapour Extraction (DE), Holland In-Situ Proeftuin* (NL), and *Cluster* (UK) are featured sites, featured technologies and featured strategic initiatives, respectively. As a European information platform, EURODEMO has also collected and published weblinks to interesting national information sources on contaminated land management and weblinks to existing national project catalogues.

1.7 A look into the future? Proposal for a EURODEMO+

After almost three years of project work, EURODEMO has provided a promising foundation of information on actual field applications of innovative soil and groundwater technologies, and generic guidelines and protocols for undertaking good quality and sustainability-aware remediation. With this foundation, the demonstration and implementation of cost-effective and eco-efficient remediation technologies across Europe shall be further increased and better targeted within EURODEMO+. A network of national or regional technology demonstration platforms, consisting of relevant national stakeholders from e.g. research, consultancy, administration, policy advice and/or vending, together with a European umbrella would form a European information platform for credible knowledge and technology transfer, which would support technology transfer for use within Europe and the global market.
The basic idea is to work on a bottom-up basis, by supporting practical remediation on individual level, which in turn supports good quality remediation practice across Europe.
On a national or regional level, each technology demonstration platform shall specify aims and activities to meet national stakeholder needs and to give most effective support. The demonstration platforms shall get involved in real-life projects. In order to be accepted as additional partner in real projects, it may be necessary to prove and communicate the added value and it may be desirable for the platforms to be able to offer special benefits such as e.g. project co-funding, close cooperation with authorities or special permissions under scientific supervision.
On a European level, project publication, project cataloguing and supporting the development of harmonized documentation are key activities. Overall, the proposed efforts are geared to support

- remediation actors in „good practice" land remediation
- acceptance of regulators regarding a wider selection of innovative technologies
- national remediation activities
- European and international technology transfer.

With the primarily national or regional scope and tasks of the individual demonstration platforms, they would require national or regional funding, while the European umbrella would be based on European or international funding together with national co-funding. This network is currently in its design stage. It needs commitment from interested organizations across Europe to become real.

1.8 Summary and Outlook

Today EURODEMO is a cross-linked contact point for Europe regarding information on innovative remediation demonstrations in the field of soil and groundwater remediation, and it participates in the current European discussion on Environmental Technology/Performance Verification. Activities beyond the end of the project with 2007 are envisaged and a design for a follow-up network has been proposed. First steps for the transition into an association of national or regional demonstration platforms with actual involvement into demonstration practice will be undertaken with the beginning of 2008.
EURODEMO was initiated under the umbrella of the *ETV Networks of Testing Centres*, which are involved in the development of a European ETV system. However, there are concerns regarding the applicability of an ETV system in the field of soil and groundwater remediation and regarding a reasonable cost-benefit balance for ETV in comparison to demonstration. Therefore, EURODEMO+ intends to complement the proposed ETV system by strongly supporting the need for good quality and sustainability-aware demonstrations with adequate reporting.

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1.9 Contractors involved

Umweltbundesamt (AT)

Contaminated Land: Applications in Real Environments (UK)

Bureau de Recherches Geologiques et Minieres (FR)

The Netherlands Organisation for Applied Scientific Research (NL)

Public Waste Agency Flanders (BE)

r^3 Environmental Technology Limited (UK)

Land Quality Management Ltd / University of Nottingham (UK)

Institute for Sustainable Development of Settlements (CZ)

VEGAS / University of Stuttgart (DE)

University of Latvia (LV)

Lebensministerium (AT)

Institute for Ecology of Industrial Areas (PL)

Agence de l'Environment et de la Maitrise de l'Energie (FR)

DEKONTA a.s.(CZ)

Geological Survey of Lithuania (LT)

University of Ljubljana (SI)

University of Bologna (IT)

Budapest University of Technology and Economics (HU)

Consorzio Venezia Ricerche (IT)

Water Research Institute of the National research Council Italy (IT)

Umweltbundesamt (DE)

Stichting Kennisontwikkeling Kennisoverdracht Bodem (NL)

Ministry of the Environment of the Czech Republic (CZ)

University of Lüneburg (DE)

1.10 Project Logo

EURODEMO

European Co-ordination Action for Demonstration of Efficient Soil and Groundwater Remediation

2 Dissemination and use

Publishable results (journal articles and conference proceedings only) of the final plan for using and disseminating the knowledge.

Planned /actual Dates	Type	Type of audience	Countries addressed	Size of audience	Partner responsible /involved
5/06	*Article in BATTELLE proceedings*	*Industry*	**USA**		*ULG, UBA-A*
9/06	*Article in Remediation Journal*		**USA, EU**		*UBA-A, CL:AIRE, LQM*
10/06	*Reference to presentation at "NICOLE 10 anniversary meeting" in "Land contamination and reclamation" Special issue*	*NICOLE members*	**EU**	*100*	*CLAIRE*
11/06	*Article in Siti Contaminiti (Italian remediation journal)*		**IT**		*CNR*
11/06	*Article in Ecomondo conference proceedings*		**EU**		*TNO, UBA-A*
4/07	*Article in conference proceedings of REVIT/CABERNET conference*		**DE, EU**	*20*	*UBA-A*
11/07	*Final conference in Vienna, incl. Proceedings CD*		**AT, EU**	*50*	*TNO, UBA-A*
12/07	*Article submitted to "La Chimica e l'Industria"*		**IT**		*UNIBO, CVR, CNR*
12/07	*5 Articles submitted to MOKKA Special issue of "Land Contamination and Reclamation" journal*		**EU**		*UBA-A, CL:AIRE, BRGM, DEKONTA*
6/08	*Article in conference proceedings of ConSoil2008 planned, with NICOLE and COMMON FORUM*		**EU, IT**		*UBA-A*