11th Annual Meeting

NATO Science for Peace and Security Pilot Project on

Clean Products and Processes

Berlin, Germany
4th to 9th May 2008

This activity is supported by: The NATO Science for Peace and Security Programme

Umwelt Bundes Amt
Für Mensch und Umwelt

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Meeting Agenda

Sunday, May 4, 2008

	Participants arrival and check-in at the Hotel
18h00	Reception and Get-Together at the Hotel Albrechtshof
	Horst Pohle, Meeting Director, Federal Environment Agency (Germany)
	Subhas Sikdar, Pilot Study Director, U.S. Environmental Protection Agency (USA)
	Daniel Murray, Pilot Study Co-Director, U.S. Environmental Protection Agency (USA)
20h00	End of Reception

Monday, May 5, 2008

TECHNICAL PROGRAM

8h00	Registration at Magnus-Haus
8h30	Welcome to Final Pilot Study Meeting, **Subhas Sikdar**, Pilot Study Director, US Environmental Protection Agency (USA)
9h00	Introduction of Country Delegates and Meeting Participants
9h30	Overview of the Meeting Agenda, Technical Program and Tours, **Daniel Murray**, Pilot Study Co-Director, U.S. Environmental Protection Agency (USA)
9h45	**Teresa Mata**, University of Porto, Review of 2007 Annual Meeting in Porto (Portugal)
10h00	*Coffee Break*
10h30	Sustainable consumption and production - how to make it possible? **Jurgis Staniskis**, Kaunas University of Technology (Lithuania)
11h00	Evaluation of the eco-efficiency of the Flemish industry (1995-2006). **Carlo Vandecasteele**, University of Leuven (Belgium)
11h30	Surviving Lead: The grave has been dug, the coffin prepared, the service arranged, but the body just would not lie down in coffin. **Alexander Omelchenko**, University of Manitoba (Canada)
12h00	Energy Efficiency in Moldova. **Alexandru Stratulat**, Advisor to the Prime Minister (Moldova)
12h30	*Lunch*
13h30	From Cleaner Production (CP) to Corporate Social Responsibility (CSR) - an overview of tools and methods. **Annik Magerholm Fet**, Norwegian University of Science and Technology (Norway)
14h00	Technical and organizational problems accompanying a design of symbiotic connections between enterprises. **Andrzej Marcinkowski**,Technical University of Lodz (Poland)
14h30	Industrial ecology from theory to practise. **Viorel Harceag**, Ministry of Development, Public Works and Housing (Romania)
15h00	Eco-industrial parks, a collaboration between Flanders, Poland and Romania, outgrowth of the NATO/SPS Pilot Project on "Clean Products and Processes. **Chantal Block**, University of Leuven (Belgium)
15h30	*Coffee Break*
16h00	Cleaner production theory, tools, methods and experience of realization. **William Zadorsky**, Pridneprovie Cleaner Production Center, Ukrainian State University of Chemical Engineering (Ukraine)
16h30	Pilot Study Retrospective
17h30	Departure for “Nicolai-Viertel” visit
19h00	Boat trip

Tuesday, May 6, 2008

TECHNICAL PROGRAM

8h30	Arsenic removal from water streams using Fe-modified zeolite: A column study. Miroslawa Vaclavikova, Institute of Geotechnics of Slovak Academy of Sciences (Slovakia)
9h00	Application of Membrane Flotation for Fuel Containing wastewater treatment. Georgui Kagramanov, D. Mendeleyev University of Chemical Technology (Russia)
9h30	Manufacturing in Nano-Scale: Environmental Opportunities and Pitfalls. Farhang Shadman, University of Arizona (USA)
10h00	Removal of colour from water streams by advanced oxidation methods. George Gallios, Aristotle University of Thessaloniki (Greece)
10h30	*Coffee Break*
11h00	New application of membrane contactors. Alessandra Criscuoli, University of Calabria (Italy)
11h30	Update on Sustainable Water Infrastructure and Water Reuse in the U.S. Daniel Murray, U.S. Environmental Protection Agencyc (USA)
12h00	Sustainable consumption – the human dimension. Gyula Zilahy, Corvinus University of Budapest (Hungary)
12h30	*Lunch*
13h30	Hazard Prevention and Emergency Planning at Transboundary Rivers in the UN ECE Region. Gerd Winkelmann, Federal Environment Agency (Germany)
14h00	Catalytic conversion of ethanol to chemicals as examples of catalysis in a sustainable fine chemical industry. Vagif Baghiyev, ELKO Ltd. (Azerbaijan)
14h30	Problems of Biomass Exploitation in the Czech Action Area. Ales Komar and Frantisek Bozek, Military University (Czech Republic)
15h00	Technical And Economic Evaluation Of Biodiesel Production By Enzymatic Catalysis. Jose Coca, Department of Chemical and Environmental Engineering, University of Oviedo (Spain)
15h30	*Coffee Break*
16h00	The Role and the Importance of Biomass in Sustainable Development. Aysel Atimtay, Middle East Technical University (Turkey)
16h30	Prospects for Biodiesel Production and Future Evolution. Teresa Mata and Antonio Martins, University of Porto(Portugal)
17h00	Overview of Technical Excursion to Biogas Facilities. Horst Pohle, Federal Environmental Agency (Germany)
17h30	City tour
19h30	Dinner

Wednesday, May 7, 2008

TECHNICAL EXCURSION

8h00	Departure from outside the Hotel
	Field Trip – Biogas Facility Visits
8h50	Visit to Biogas Facility (Nauen)
10h00	Visit to Biogas Facility (Fehrbellin)
12h00	Visit to Biogas Facility (Ketzin)
13h30	*Lunch* at Spargelhof Beelitz
15h00	Visit to Biogas Facility (Schwanebeck)
17h30	Visit to a Werder Biofruit Farm
19h30	*Dinner* at Villa Kellermann, Potsdam

Thursday, May 8, 2008

SPECIAL TOPICAL SYMPOSIUM

Biomass: Resources, Conversion, Markets, and Policies

8h00	Registration
8h30	Welcome, Thomas Holzmann, Vice President, Federal Environment Agency (Germany)
8h30	Opening, Özlem Özgul Yilmaz, NATO Science for Peace and Security (SPS) Programme (Belgium)
8h45	Welcome and Overview of Environmental Issues. Subhas Sikdar, Pilot Study Director, US Environmental Protection Agency (USA)
9h15	Political and legal framework in Germany. Michael Herr, German Energy Agency (Germany)
9h45	Availability and Utilization of Biomass Resources – Overview and technological options at the example of biogas production. Frank Scholwin, Institute for Energy and Environment (Germany)
10h15	*Coffee Break*
10h45	The Biogas Chain: Economic Aspects. Gepa Porsche, German Biogas Association (Germany)
11h15	Production of biogas at different German Biogas plants in agriculture and waste management. Frank Scholwin. Institute for Energy and Environment (Germany)
11h45	Overview Biofuel-Technologies. Franziska Müller-Langer, Institute for Energy and Environment (Germany)
12h15	*Lunch*
13h15	Sustainability Standards for Biofueles in Germany: Status and Perspectives. Uwe Fritsche, OEKO Institut (Germany)
14h45	Biofuel and Eco-efficiency – Exemplified by Small Recreation Boats,. Annik Magerholm Fet, Norwegian University of Science and Technology (Norway)
14h15	Life Cycle Assessment Study Comparing Biogas for Transportation with other Biofuels. Henrik Wenzel, University of Southern Denmark (Denmark)
14h45	*Coffee Break*
15h15	BioFuels: The Dialectics of Energy Security and Food Security. Gilbert L. Rochon, Purdue University (USA)
15h45	Biomass and Biofuels - the Solution or another Illusion? Peter Glavic, University of Maribor (Slovenia)
16h15	An integrated membrane system for advances biogas production, recovery and valorisation. Enrico Drioli, University of Calabria (Italy)
16h45	End of Symposium
16h45	Visiting of the “Reichstag”
19:00	Conference Dinner at “Altes Zollhaus”

Friday, May 9, 2008

TECHNICAL PROGRAM

8h30	The Kamal Ewida Earth Observatory – NATO SPS Grant. Gilbert L. Rochon, Purdue University(USA
9h00	The development of projects and activities on Environmental Security. Jurgis Staniskis, Kaunas University of Technology (Lithuania)
9h30	Group Discussion of Pilot Follow On Activities
10h15	*Coffee Break*
10h45	Group Discussion on Development of Final Report
11h30	Final Comments from Delegates and Participants
12h30	Meeting Wrap Up. Subhas Sikdar, Pilot Study Director, US Environmental Protection Agency (USA)
12h45	*Lunch*

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List of Participants

Prof. Atimtay, Aysel	Middle East Technical University, Ankara, Turkey
Prof. Baghiyev, Vagif	ELKO ltd., Baku, Azerbaijan Republic
Prof. Block, Chantal	University of Leuven, Leuven Engineering College Groep, Leuven, Belgium
Prof. Bozek, Frantisek	University of Defence, Brno, Czech Republic
Prof. Coca, Jose	University of Oviedo, Department of Chemical and Environmental Engineering, Oviedo, Spain
Dr. Ing. Criscuoli, Alessandra	University of Calabria, Institute on Membrane Technology (ITM-CNR), Rende, Italy
Prof. Drioli, Enrico	University of Calabria, Institute on Membrane Technology (ITM-CNR), Rende, Italy
Fitzpatrick, Dawn	Tetra Tech, Inc., Miesenbach, Germany
Fritzsche, Uwe R.	Oeko-Institut, Darmstadt, Germany
Dr. Gallios, George	Aristotle University of Thessaloniki, Thessaloniki, Greece
Emeritus Prof. Glavic, Peter	University of Maribor, Department of Chemical Engineering, Maribor, Slovenia
Harceag, Viorel	Ministry of Development, Public Works and Housing, Bucharest, Romania
Herr, Michael	German Energy Agency (dena), Berlin, Germany
Prof. Kagramanov, Gueorgui G.	D. Mendeleyev Uneversity of Chemical Technology of Russia, Moscow, Russia
Colonel (R), Prof., PhD Komar, Ales	University of Defence, Brno, Czech Republic
Prof. Magerholm Fet, Annik	Norwegian University of Science and Technology, Trondheim, Norway
Dr. Marcinkowski, Andrzej	Technical University of Lodz, Lodz, Poland
Martins, Antonio	University of Porto, Faculty of Engineering, Porto, Portugal
Dr. Mata, Teresa	University of Porto, Faculty of Engineering, Porto, Portugal
Müller-Langer, Franziska	Institute for Energy and Environment, Leipzig, Germany
Murray, Daniel J.	U.S. Environmental Protection Agency, Cincinnati, USA
Dr. Omelchenko, Alexander	University of Manitoba, Winnipeg, Canada
Dr. Pohle, Horst	Federal Environment Agency, Dessau, Germany
Porsche, Gepa	German Biogas Association, Berlin, Germany
Dr. Rochon, Gilbert	Purdue University, West Lafayette, USA
Dr.-Ing. Scholwin, Frank	Institute for Energy and Environment, Leipzig, Germany

Prof. Shadman, Farhang	University of Arizona, Tucson, USA
Sikdar, Subhas	U.S. Environmental Protection Agency, Cincinnati, USA
Prof. Dr. hab. Staniskis, Jurgis	Kaunas University of Technology, Institute of Environmental Engineering, Kaunas, Lithuania
Stratulat, Alexandru	EC PCA Project, Chisinau, Republic of Moldova
Dr. Vaclavikova, Miroslava	Slovak Academy of Sciences, Institute of Geotechnics,, Kosice, Slovak Republic
Prof. Vandecasteele, Carlo	University of Leuven, Leuven Engineering College Groep, Leuven, Belgium
Dr. Vitale, Ksenija	University of Zagreb, School of Public Health "A. Stamper", Medical School, Zagreb, Croatia
Welschot, Tamara	Springer SBM NL, Dordrecht, The Netherlands
Wenzel, Henrik	University of Southern Denmark, Odense, Denmark
Winkelmann, Gerd	Federal Environment Agency, Dessau, Germany
Yilmaz, Özlem Özgul	NATO Headquarter, Section Public Diplomacy Division, Science for Peace and Security (SPS), Brussels, Belgium
Prof. Zadorsky, William M.	Ukrainian Ecological Academy of Sciences, Ukrainian State University of Chemical Engineering, Pridneprovie Cleaner Production Center, Dnepropetrovsk, Ukraine
Dr. Zilahy, Gyula	Corvinus University of Budapest, Budapest, Hungary

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Abstracts

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1. Sustainable Consumption and Production - how to make it possible?

Jurgis Staniškis

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During the last decades the centre of attention has gradually shifted from production and manufacturing towards consumption. To some degree it is also recognized a shift from consumption, as an economic and material category, to consumers as economic and political actors. One reason behind this shift is the fact that eco-efficiency of products has been countered by increased consumption. This is called the rebound effect when technological improvements are offset by volume effects resulting from behavioural, social or demographic factors. However, the responsibility for a sustainable development cannot be put on the shoulders on consumer alone. We need stakeholder approach where the behaviour of industries, retailers, NGOs and political authorities at local, national, regional and global level are even more important. Only when the actors work together and are committed sustainability will become reality.

1. Consumption as a process

When we discuss the environmental impact of consumption it is imperative first of all to include the entire consumption process: planning, buying, using and disposal. In the traditional marketing the main focus has been on the planning and buying phases, while the use phase to a large degree has been neglected. Publications of consumer organizations full of misleading information on “best buys” and “value for money”. A more radical approach within this paradigm has to be formulated to help consumers to choose environmentally friendly products in the market, instead of more polluting or energy consuming goods. Labels, consumer’s education, specific information and tests are regarded as the main tools. The product disposing phase when we recycle and prepare some of the products for re-use has to be also included.

2. Consumers as actors in markets and politics

Consumers have to play a substantial part both in their role as classical consumers and in their new role as political consumers or citizens/voters. At the same time, environmental goals will not succeed if the solution to the problem remains at micro level alone. We need a movement from the micro to macro level and simultaneously from market to politics, i.e. discuss two fundamental scientific and political issues:

1. The relationship between market and state in modern welfare society,
2. The relationship between micro and bottom-up activities on the one hand and macro and top-down initiatives on the other.

3. Product-Service System (PSS) approach

The central thesis of PSS is that by redesigning systems of provisions that deliver function of product by alternative to private ownership means, additional environmental gains can be made. There are three levels of changes towards sustainable consumption and production:

1. System optimization that includes the improvement of existing systems of production and consumption by existing tools, such as eco-design of products and services, informing consumers and partners about environmentally sound alternatives and consumption patterns (eco-labels, EPD, etc.).
2. System redesign where system of provision is redesigned to become less environmentally burdensome and is often based on function innovation. For example, integrated mobility system, comprising public transport where feasible and car sharing systems instead of fulfilling mobility need by private car ownership.
3. System innovation where not only products, services and production systems are optimized and new ways of satisfying consumption needs are found within existing institutional frameworks and infrastructures, but new infrastructures, spatial planning and incentive systems are developed and implemented that promote more sustainable lifestyles. As an example could be community-based washing centres in Sweden that become a part of urban planning, follow energy and water efficiency standards and provide washing function to million of households.
4. Shift in ownership is one of the main features of PSS changing the nature of relationships between producer and user. In traditional sales the point of transaction is tied to material product, while in PSS profit in many cases is tied to the number of functional units the material product delivers. This provides incentives for increasing product durability, design products for easy upgrading, reuse and remanufacturing, reducing the costs associated with the use phase, including costs for consumables and auxiliary products, as well as costs for maintenance and upgrading services. In markets the shift typically occurs in the form of switching from owning the product to leasing-renting-sharing systems. For example, chemical leasing.

Government needs to implement a smarter use of policy tools to create markets that reward improved sustainability performance (demand-side), for example, green or sustainable public/private procurement and stimulate sustainable innovation (supply-side). There is fundamental need for governments to implement sustainable development and innovations policy – and then create bridges between the two areas to enable sustainable innovation.

Finally, when formulating sustainable consumption policies for Lithuania and the European Union, it is important to consider the different past of people living in the new member states as well as the positive and negative effect it might have on the implementation of policies. People in post-socialist societies, for instance, have experience of shared use but they associate it with the economy of shortage and otherwise unsatisfied needs. Therefore, a policy designed to popularize and encourage sustainable consumption should frame it very carefully to avoid evoking negative associations while taking advantage of the experience and skills people have.

At the same time it is important to mention, that relatively good economic indicators in new member states were achieved at the cost of several social, cultural and environmental problems. For instance, in Lithuania practically there is no systematic development of environmental consumer behaviour (waste separation, eco-labelling, etc.). Consumer behaviour as well as overall environmental consciousness is strongly influenced by their Soviet past and rapid transition during 1990ies.

Paper presents the Lithuanian Action Plan on sustainable consumption and production and the rationale behind the different possible actions which aims to achieve economic growth, whilst respecting environmental carrying capacity, find ways to minimise environmental impact and make sustainable use of earth's resources.

2. Evaluation of the Eco-Efficiency of the Flemish industry (1995-2006)

C. Vandecasteele*+, J. Van Caneghem*, C. Block*, H. Van Hooste**

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The evolution of the eco-efficiency of the Flemish Industry is evaluated over the period 1995-2006 using 9 relative pressure indicators (partial eco-efficiency indicators) each related to an important environmental theme:

- climate change;
- acidification;
- photochemical air pollution;
- human toxicity;
- ecotoxicity;
- eutrophication;
- production of waste;
- (energetic) energy use;
- water use.

The polygone in figure 1 gives for each theme the environmental pressure for 2006 divided by the production index for 2006 expressed in %. This percentage is compared to 76 %, the ratio of the production indices of 1995 (100 %) and 2006 (131 %). These 76 % form the border between absolute and relative decoupling. When the environmental pressure increases less rapidly than the production index one speaks of relative decoupling. When the production index decreases in spite of increasing production one speaks of absolute decoupling. From Figure 1 it appears that for waste production (exclusive of building waste) and (energetic) energy use in the period 1995-2006 relative decoupling occurred. For the other 7 themes decoupling was absolute.

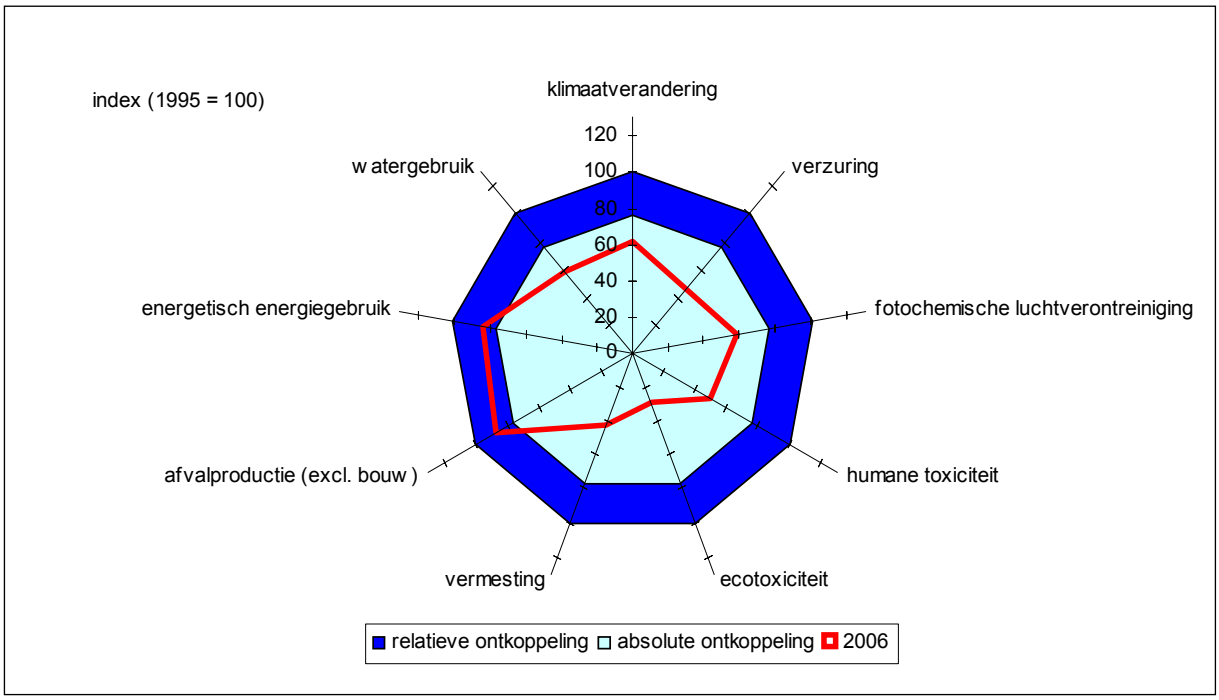

Figure 1: Eco-efficiency of the industry (Flanders, 1995-2006)

For climate change, photochemical air pollution, waste production and (energetic) energy use, the chemical industry and the food industry showed the largest increase of the eco-efficiency; the textile industry and the chemical industry showed the largest increase for acidification and human toxicity; the paper industry as well as “other industries” for ecotoxicity.

The contribution of industry to the environmental themes considered is compared for 1995-2006. It appeared that industry still is an important contributor to environmental pressure. For (energetic) energy use, water use, human toxicity, climate change and ecotoxicity the contribution for 2006 is lower than for 1995. For production of waste, photochemical air pollution, eutrophication and acidification the contribution of the industry increased.

3. Surviving Lead: The grave has been dug, the coffin prepared, the service arranged, but the body just would not lie down in the coffin

Alexander Omelchenko

Institute of Cardiovascular Sciences, University of Manitoba,
Winnipeg, Manitoba, Canada

Despite of strong anti-lead campaign started in 1970s and various strict regulations and prohibitions, lead has survived in products and processes and the population around the globe is still exposed to dangerous level of lead.

The analysis of the available US-based data shows that geometric mean blood lead level (BLL) among general US population decreased from 15.8 in 1976 to 1.6 µg/dL in 2002. However, this trend follows the one-exponential decay function plateaued at the minimal BLL of 1 µg/dL. It suggests the existence of sustained level of the current human lead intake of about 25 µg Pb daily. The BLL of 1 µg/dL cannot be considered as safe, since a significant relationship between all-cause mortality, and impairment of children's intellectual functioning and BLL was established well below 5-10 µg/dL. Moreover, a safe BLL level for children has not been demonstrated.

There are two major sources of sustained environmental lead contamination. Firstly, this is lead from gasoline. In US, leaded gasoline is still legally allowed in aircraft, trains, racing cars, watercraft, and farm machinery. In 2006, the annual U.S. lead emission from use of avgas alone was 500 tons. The US is not currently planning to ban or restrict the use of leaded fuels in car racing events. Although the use of any lead additive in the production of unleaded gasoline in US is strictly prohibited, in fact, the unleaded gasoline is allowed to contain not more than 0.05 g/gallon Pb.

Around the globe, just a handful number of countries are using unleaded gasoline only. As of 1996, 93 percent of all gasoline sold in Africa contained lead, 94 percent in the Middle East, 30 percent in Asia and 35 percent in Latin America. Even the localized use of leaded gasoline produces global effect, as generous atmospheric lifetime of lead aerosol allows it to travel over thousands of kilometers and to reach even the most remote and pristine areas.

Lead in paints constitute second major source of lead pollution. White house paint extensively used in the US prior 1980s contained about 50% by weight of lead carbonate. Accordingly, 3 million tones of lead remain in 57 million US houses. Lead-based paint is still allowed for industrial, military, marine, and some outdoor uses, such as structural components of bridges. In the USA, lead-based paint covers five billion square feet of non-residential surface area and almost 90 % of the bridges.

Among the others, some rather minor sources of lead should be recognized, as they may significantly contribute to overall lead intake by humans. Lead is found in lead-glazed ceramics and leaded crystal, in consumers goods made of PVC (mini-blinds, lunch-boxes, etc), in some pharmaceutical products and dietary supplements. In 1997 alone, about 4500 tones of lead sinkers for recreational fishing were sold in USA and Canada, and about 1600 tones of lead are released to the environment through spent lead shot from hunting and target shooting in Canada alone.

4. Energy Efficiency in Moldova: overview

Alexandru Stratulat

EC PCA Project, Chisinau, Republic of Moldova

Moldova's energy sector is marked by an almost complete absence of primary energy resources and a low hydro-energy potential. The country is highly dependent on energy imports mainly from Russia and Ukraine, with only 3% of the demand for primary energy covered by domestic sources. The Republic spends about 1/3 of its GDP annually on energy and about 60% of the final energy consumption is in the form of electricity and heat. Such situation creates high risk in energy supply security and requires implementation of measures on both energy supply and demand sides.

It resulted in the Government, Business and International community joining their efforts in order to implement actions in the areas of Energy Conservation (Efficiency) and Renewable Energy Sources.

The main institutions responsible for these sectors are the Ministry of Industry and Infrastructure, National Agency for Energy Conservation (which is to be re-organised into National Agency for Energy Efficiency), National Agency for Energy Regulation and, to some extent, the Agency for Innovation and Technology Transfer of the Academy of Sciences of Moldova.

The legal framework in this area is relatively new, the main legal acts being developed in the last two years, while the secondary legislation is still in the drafting phase. For instance, the Law on Renewable Energy Sources was approved only last year. It envisages, among others, a support scheme for RES producers, mandatory purchase of electricity from RES and a mandatory percentage of bio fuel in the fuel mix.

Among the main activities in this sector it should be noted that the RES projects are heavily promoted by the Agency for Innovation and Technology Transfer of the Academy of Sciences of Moldova; an Intergovernmental Commission for RES promotion was created; and a number of technical assistance projects have been implemented.

These technical assistance projects are characterized by the fact that they are implemented mostly on the local level (village, town), and in their majority these are bilateral projects. Main areas of these projects are bio-mass energy production, bio-fuel production, small and medium co-generation units and to a less extent solar and wind energy generation.

Though the number of implemented RES projects implemented in Moldova is quite low, they are attracting increasing interest. In the last 3 years the number of renewable energy technology transfer projects went from 0 to 10.

There is a potential in Moldova for solar and wind energy projects, but at the moment they are only in study phases, probably because of their novelty and initial high investment.

In the conclusion, we would like to summarise the advantages of the use of the RES for Moldova:

- Improved National Energy Security;
- Use of the agricultural wastes, which otherwise would be burned on the field;
- Increased national export of the bio-fuel, as well as of the raw material for its production;
- Increased compliance with the EU requirements regarding use of bio-fuels;

- Reduced price for fuel on local market;
- Introduction of sustainable agriculture technologies for production of the raw material;
- Production of clean fertilisers for agriculture (ashes resulted from the bio-mass energy production);
- Creation of the new jobs in the rural regions.

5. From Cleaner Production (CP) to Corporate Social Responsibility (CSR) - an overview of tools and methods

Prof. Annik Magerholm Fet

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The international conventions such as the Global Compact, the Millennium Development Goals, and the Global Reporting Initiative offer important guiding principles to businesses that want to meet the sustainability challenges. Cleaner production (CP) techniques, environmental accounting (EAc), input–output (I/O) analyses, life cycle assessment (LCA), and environmental management (EM) are being used by companies to evaluate their overall environmental performance. These tools and techniques can be classified as process-, product-, or management-related. These techniques can also be applied at different system levels, for instance at a corporate site, for a product's life cycle, or at a global supply chain.

In CP, site-specific input–output analyses have been the traditional approach. Input–output analyses examine material- and energy-flows into and out of a production system as well as the emissions of pollution to air, water, and soil. Industrial ecology (IE) is the study of the flows of materials and energy in industrial and consumer activities. It includes the study of the effects of these flows on the environment. Product-related tools and methods focus on the entire life cycle of the product. Data from the production phase, the use phase, and the end of life phase are needed to do a complete LCA. The results from an LCA will show the hot-spots and potential for environmental performance improvements of the product. Most environmental management systems are structured according to ISO 14001. The latest version that came in December 2004 shows a shift toward a stronger focus on larger systems and on the products that companies are responsible for.

In its widest sense, CP, IE, LCA, and EM involve not only the supply chain, but a network of actors with stakeholders. This means that business is facing new challenges of the environmental and societal aspects of sustainability. As a result of globalization, corporate social responsibility (CSR) has become a focus of interest. CSR concerns must be conceptualized and implemented not only in several business units, but also through a series of market relations.

The presentation will give an overview of tools and methods that can help business change from site to global focus in their efforts towards sustainable solutions.

6. Technical and organizational problems accompanying a design of symbiotic connections between enterprises

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Eco-industrial parks as industrial ecosystems are a very promising concept in the light of sustainable development assumptions. The Project which is going on at the Technical University of Lodz covers several issues related to creation of symbiotic connections between enterprises. One of the important subjects is a way of management of material, energy and waste streams within industrial areas. Some achievements of this field in reference to Polish conditions will be presented.

The problem of balancing of the exchanged streams is really complex, so that computer aid is very helpful. An attempt to use the particular software for this purpose has been made.

7. Industrial ecology from theory to practice

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Throughout history, human productive activity has occurred in what can be called an open system. People have taken natural materials, transformed them into products for use, and discarded worn-out products and left-over materials. The current global situation suggests that our open industrial system cannot be sustained indefinitely. We consume too many natural resources to produce the things we want or need while generating too many by-products (toxic substances, emissions, solid waste etc.) that harm us and the environment. For these reasons, we need to re-conceptualize and redesign the ways that industrial systems operate to place more control over the flow of materials.

Natural ecosystems do not generate waste since the wastes produced by one organism form the food source for another. Natural systems do not create an abundance of persistent toxic compounds that cannot be utilized by other organisms in the system. Hypothetically, in a completely efficient economy functioning in harmony with ecosystems, there would be no waste.

The application of the field ecology analogy to industrial systems is based on the observation that in a biological ecosystem some organisms use sunlight, water, and minerals to grow, eliminate waste products, and die. These organisms are consumed by others, which produce wastes of their own. These wastes are in turn food for other organisms, some of which may convert the wastes into the minerals used by the primary producers, and some of which consume each other in a complex network of processes in which everything produced is used by some organism for its own metabolism. Similarly, in the industrial ecosystem, each process and network of processes must be viewed as a dependent and interrelated part of a larger whole. One of the most important concepts of industrial ecology is that, like the biological system, it rejects the concept of waste. Nature has adopted this approach because acquiring these materials from their reservoirs is costly in terms of energy and resources, and thus something to be avoided whenever possible.

Industrial ecology views industry's impact on the environment in terms of a comprehensive system that uses and disposes of materials. Minimizing toxic pollution and the waste of natural resources are not strategies for real change. When a product returns to industry at the end of its useful life and its materials are used to make equally valuable new products, the minerals or plastics of which it is made do not need to be minimized-because they will not become waste in a landfill.

Industrial ecosystems refer to situations in which a number of different companies, usually in close proximity to each other, exchange a variety waste outputs. The exchange of wastes between independent firms in some sectors has been taking place for over a century, simply because it makes good business sense. Industrial ecology and the development of technologies which eliminate waste and maximize efficiency will be critical to achieving the required reductions in material and energy throughput in order to maintain a basic quality of life into the twenty-first century.

Industrial ecology is a complex, largely interdependent systems engineering problem in which the metabolization of materials and energy is subject to economic, environmental,

social, and political factors. Governments, industry, academics-and other organizations which focus on establishing the right institutional, fiscal and policy environment for the practical implementation of pollution prevention technologies, sustainable technologies and industrial ecology-can help to ensure prosperity for their citizens and secure an important role for their countries in global efforts to achieve sustainable development.

Ecoparks are industrial facilities clustered to minimize both energy and material wastes through the internal bartering and external sales of wastes. One industrial park located in Kalundborg, Denmark has established a prototype for efficient reuse of bulk materials and energy wastes among industrial facilities. The companies in the park are highly integrated and utilize the waste products from one firm as an energy or raw material source for another. Other two good examples of developed eco-parks are located in Canada: Burnside, Nova Scotia and Portland's Industrial District-Toronto, Ontario.

Becoming an eco-industrial park requires collaboration among industrial park management, the park's companies, and a number of national, provincial, and local agencies. Implementing Industrial ecology in the diverse industries that form the economy requires both technological innovations and economic, regulatory, and legal incentives, or at least fewer disincentives.

The barriers to industrial wastes recycling can be classified into six interrelated areas: technical hurdles, economic barriers, information barriers, organizational obstacles, regulatory issues, and legal concerns. When recycling is technically feasible, it may be economically unsound. When it is technically and economically satisfactory, a lack of information may block its adoption. Even when the requisite information is at hand, organizational problems can still stymie implementation. Finally, when all else is satisfactory, a recycling scheme can founder on the rocks of regulatory or other legal barriers.

Technical hurdles. Waste and product materials sometimes contain unwanted "tramp" elements. These contaminants can ruin the reuse potential of the materials or make handling difficult or dangerous; purification is often problematic.

Economic Barriers. The manufacturing process tends to mix materials that are further mixed in the process of waste disposal. In remanufacturing, one generally wants to separate things into their original components and materials. There are costs involved in collecting, sorting, and transporting used-up products, scrap, and waste. Such separation requires information, effort, and energy, which must all be paid for. These costs must be compared with the costs of new materials. Even when the operating costs of recycling are attractive, there may be capital costs that pose barriers. The cost of eliminating or reusing certain materials must be balanced against the cost of disposal.

Information Barriers. The requisite information about costs is not usually available to everyone in the firm who might be able to use it to good advantage. In the larger economy, outside the firm, where waste and scrap materials may be transferred and used, information is needed about potential customers and suppliers of these materials. In materials sectors where traditional recycling networks do not exist, information may be difficult to find, especially if users and providers are in very different geographical areas or different parts of the industrial system. Existing waste exchanges and brokerage systems are generally small, local, and ineffective on a large scale.

Organizational Obstacles. The internal organization of a firm can be difficult to change. Changing the whole concept of a product or adding new criteria for environmental compatibility to the design process may not fit the ideas on which the firm operates or its internal incentive system. External to a firm, the idea that anything secondhand must be second rate has become institutionalized in the distinction between dealers in new and the used materials and products.

Regulatory Issues. The regulatory systems for industrial wastes has been designed mainly around disposal, and the rules treat recycling and reuse as forms of disposal. Recycling an industrial waste material is likely to require the recycler to become a legal disposer of that material under the regulations. Obtaining a permit has significant time, financial, and bureaucratic costs attached, which are a nontrivial barrier to reuse of industrial waste materials.

Legal Concerns. Under current legal practices, liability considerations for a hazardous material often favor its disposal over its sale or transfer for reuse. Liability is often targeted at the original seller of any material used in a product implicated in a damage suit, even if the material has been reused and remanufactured by several parties en route to that ultimate product. A supplier of a generally harmless, minor component material in a product might be assessed high liability damages because the product caused harm, even if that supplier was not a party to the product design and the material was not at fault. This practice has serious implications for commerce generally, and it appears to explain why firms often choose to dispose of scrap and waste rather than seek users for them.

In Romania there are 42 industrial parks, 27 of them forming an association. Two of these parks, ROMPETROL Industrial Park and CARFIL Industrial Park, are included into a Belgian – Polish – Romanian project “Material, water and energy management in industrial parks: industrial symbiosis”, financed by the Flemish Government. The project is lead by Professors Carlo Vandecasteele and Chantal Block from Belgium, Professor Andrzej Andoniec from Poland and Viorel Harceag from Romania. It aims to find the ways to improve the industrial parks management and fluxes of energy, water and materials into the two Romanian parks and other two Polish parks. The project will be completed next year, but implementing the project’s findings will be more difficult because implementing phase implies important financial investments.

8. Material, energy and water management in industrial parks in Belgium, Poland and Romania (industrial symbiosis): outgrowth of the NATO SPS program

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In the frame of the previous NATO Science for Pease and Security program, and more particularly in Alesund and Istanbul, partners from Belgium (Katholieke Universiteit Leuven, Universiteit Gent, VOKA Halle-Viloorde, Interleuven), Poland (Technical University Lodz, Boruta Industrial Park) and Romania (Rompetrol Industrial Park, Carfil Industrial Park), established contacts aiming at the improvement of industrial parks in Poland and Romania.

Eco-industrial parks are sites where different companies work together, according to the principles of industrial ecology/symbiosis, in order to achieve sustainability concerning process management, site organisation, exchange of materials and of energy, utilities management, waste and waste water management. Design and management of industrial parks is in practice however often limited to the collective organisation of road construction, green services, utilities management and security.

The aim of this project is:

- to document basic criteria/principles with which new and existing industrial parks have to comply in order to be catalogued as eco-industrial park based on the knowledge of the Flemish partners. This will result in a checklist on eco-industrial park design, which may also serve as a tool for reorganising existing industrial parks. Special attention will be paid to the exchange of material (raw materials, waste, waste water) and energy streams (industrial symbiosis) by interconnected companies.
- to develop a tool for data gathering on potential material and energy streams in industrial parks of interest, helping in selecting opportunities for the application of industrial symbiosis.
- to use this tool for data gathering for the selected industrial parks (Boruta, Zgierz, vicinity of the city of Lodz, Poland; Rompetrol Navodari Park, Constanta and Carfil Industrial Park, Brasov, Romania) in order to obtain a number of future scenarios for activities (including innovative ones) according to the principles of industrial ecology. It will be attempted to incorporate the residues from the treatment of domestic waste from the city of Lodz into the Boruta industrial park activities. In Poland this project is complementary to a project on industrial symbiosis, financed by the Polish government.
- to disseminate the checklist containing the basic criteria for eco-industrial parks, the tool for data gathering, and the results obtained, by workshops, seminars and educational curricula

9. Cleaner production theory, tools, methods and experience of realization

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As the major principle of cleaner economy, the systems approach is taken that deals with perfecting any nature-technology system at the various hierarchic levels, from environmental pollution sources to consumers. This type of analysis will reveal relationships between the ways to improve processes and the challenges of risk management and nature conservation. The main task is therefore to harmonize the nature-technology relation and, ideally, to engineer high-performance systems featuring desired environmental characteristics at each hierarchic level, so that the favorable environmental background is not impaired and, where possible, even restored.

Following are the basic assumptions underlying the cleaner economy concept for Ukraine:

- At this time of a deep economic crisis, the economic and environmental challenges must be met simultaneously, in keeping with one strategy of cleaner economy.
- A move towards a cleaner economy must focus not on consumption, but rather on perfecting those entities that are actual or potential polluters.
- The success of a cleaner economy policy will be largely determined by the availability of professionals well trained in the theory and practice of “economy clean-up” and environmental management.
- No cleaner economy will be possible without creating a civilized environmental market.

These strategical principles determine some tactical measures for pursuing them. Such measures are applicable to any industry and include:

- no waste due to improved selectivity,
- neutralizing wastes directly at the origin, rather than at the exit,
- flexible technologies,
- recycling materials and energy, industrial symbiosis,
- conservation of resources,
- waste treatment, etc.

These tactics must be combined with certain design and process engineering techniques, such as

- providing a considerable excess of the least hazardous agent,
- minimizing dwell times,
- recirculation of materials and energy via closed loops,
- concurrent reactions and product separation,
- introduction of heterogeneous systems,
- adaptive processes and apparatuses,
- increasing throughputs,
- multifunctional environmental facilities, etc.

It is necessary to joint techniques development with restructuring in the area of material

- production to be based on:
- developing a socially oriented market economy that would guarantee a proper life standard for the population,
- cleaner production, minimizing environmental loads, material conservation, adoption of new types of activity grounded on environmentally safe technologies,
- making a more balanced economy by shifting from production of means of production to consumer goods, and
- environmental impact assessment and auditing for all economic projects.

10. Arsenic removal from water streams using Fe-sorbent: A column study

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The presence of arsenic in groundwater has been recognized as a major problem for many parts of the world. It has been found at higher levels in underground drinking water sources and also in some surface waters. Recently several headline news reported widespread arsenic poisoning e.g. Bangladesh, West Bengal, India, etc. Most of arsenic in drinking water is in inorganic form either as As(III) or As(V). Studies have established a long-term exposure to small arsenic contamination with cancer and cardiovascular, pulmonary, immunological, neurological, and endocrine effect. As a result EU and USA authorities have set new maximum contaminant level (MCL) for arsenic in drinking water, from 0.050µg/L to 0.010µg/L. It is believed that with the new standards around 5000 community water systems in US (of the 74.000 in total) would need to take corrective actions to lower arsenic level in drinking water. 94% of these water systems serve fewer than 10.000 people each.

A variety of treatment processes have been studied for As removal such as precipitation-coagulation followed by filtration, lime softening, reverse osmosis, electrodialysis, nanofiltration, ion exchange and sorption. Even though these techniques are effective, it is difficult to achieve the required limit. Sorption/surface precipitation on iron oxides based materials has been found to be effective in removing both As(III) and As(V) as well.

In our previous studies we have described the removal of arsenic under static conditions (batch-sorption experiments). This contribution describes the sorption of arsenic species from water under dynamic conditions (column studies). The experimental set-up consisted of a packed bed made up of particles of Fe-sorbent. Column with diameter of 1 cm was packed with sorbent up to the height 1.5 cm (sorbent mass – 1.1 g). The arsenic solution with inlet concentration of 50 ppm of As was passed through the fixed bed with flow rate of 3.0 ml/min. Samples were taken and outlet concentration was measured every 1.5 minutes during first 60 minutes, then every 5 minutes for 1 hour. After that every 10 minutes for 4 hours and finally every 30 minutes for 2 more hours. The breakthrough time was found at 33 minutes.

11. Application of Membrane Flotation for Fuel-Containing Wastewater Treatment

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Research of wastewater treatment by combined membrane-electroflotation method was carried out. Integrated membrane-electroflotation unit combining co-current membrane flotation and counter-current electroflotation was used for treatment of model wastewater containing diesel fuel or gasoline. Air dispersion was realized in the tubular membrane saturator with the bubbling of air through ceramic microfiltration membrane to the water flow. The two-phase flow with gas content about 15-25% and average bubble size 0.5 mm was directed to the first chamber of flotation machine. The second chamber was designed for electroflotation polishing of membrane flotation effluent from the first one.

Hydrodynamics of membrane saturator were studied to optimize Reynolds number in the membrane channel. Surfactant dose was optimized as well. It was shown that average bubbles diameter was decreased with increase of Re up to 15000, but no more after this value. Addition of 10 ppm of surfactant (sodium dodecyl sulfate) was followed by 5 times decrease of average bubble size (2.5 to 0.5 mm).

Influence of fuel concentration in feedwater was studied. It was shown that flotation method is effective for treatment of fuel-containing wastewater (effluent fuel concentration is about 0,05 ppm). Fuel rejection was drastically increased with increase of feedwater fuel concentration: from 50% at 0.1 ppm up to 99% at 10 ppm.

Influence of surfactant dose and wastewater residence time in the unit was analyzed too. It was found that increase of surfactant dose can slightly increase the rejection. Residence time in flotation unit about 10 minutes was enough for high rejection treatment; extension of the time was not affected on rejection.

Use of combined membrane-electroflotation method decreases energy consumption because of lower electric current is needed compared to electroflotation alone.

Keywords: wastewater treatment, flotation, fuel.

12. Manufacturing in Nano-Scale: Environmental Opportunities and Pitfalls

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Manufacturing in nano-scale is not a simple extrapolation of the current and conventional manufacturing practices. The shift to nano scale creates both major issues as well as significant opportunities in performance, cost, and environmental impact for electronics industry. ESH assessment of nano-manufacturing is complex and needs timely consideration and optimum "point of introduction" in the chain of process development and improvement. Underestimating this complexity often results in narrowing down the focus too far and too much and in losing the opportunities to make significant environmental gains. While sufficient data is usually not available to do a global assessment, narrow approach often leads to measures and actions that are not environmentally sound.

The conventional high-technology manufacturing has been traditionally a subtractive processing which is intrinsically wasteful in both energy and material usage. The root of the approach has been in the way manufacturing tools were originally developed and the type of materials that were used for early devices. However, both the materials and the methods of manufacturing have changed. This presents a great opportunity for a significant and fundamental change in the way design and fabrication is done in this industry in future. The additive processing that has been traditionally expensive has now the potential to become sustainable economically and environmentally as we move deeper in to the nano-scale manufacturing.

This presentation focuses on both the positive and the negative environmental impacts of this inevitable paradigm change. The inter-relationship between the three sustainability factors (performance, cost, and environmental impact) for future electronics manufacturing will be analyzed. In particular, the challenges related to resource requirements and utilization (water, energy, and chemicals) will be discussed. Examples of unique opportunities for environmental gain, that nano-scale manufacturing can provide, will be presented. The importance of system approach will be analyzed using examples of current state-of-the-art research in semiconductor manufacturing. In particular, the emphasis of the presentation will be on the following areas: surface preparation and wafer cleaning, water use and reuse, use of global warming gases (in particular, PFCs) and hazardous air pollutants (HAPs).

13. Removal of color from water streams by electrochemical oxidation

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Textile industry worldwide produces large quantities of wastewaters containing significant amounts of colored substances. Synthetically produced dyes, which are generally not biodegradable, replace the natural coloring agents. Synthetic reactive dyes, which constitute around 30% of the total amount of dyes produced, are hardly eliminated under aerobic conditions and are probably decomposed into carcinogenic aromatic amines under anaerobic conditions. Recently, strict limits have been set for the amount of color in wastewaters. The current limit is 1 mg/L of color for pure substances and 300 ADMI units for mixtures of dyes. Unfortunately, there is no direct limit regarding the toxicity of the uncolored products.

Current treatment methods are not very effective for the removal of reactive dyes from water streams. The high solubility of dyes in water makes chemical coagulation ineffective. Sorption and membrane filtration methods seem to be promising. However, these methods do not solve the problem, because the toxic substances, which have been removed from water streams, still constitute a solid residue.

A clean way to eliminate such substances is to destroy their structure and produce biodegradable or less toxic products. The ideal would be to transform all organic carbon to harmless inorganic compounds. In this work electrochemical oxidation was studied as an alternative treatment method for the removal of synthetic reactive dyes from water streams. Synthetic solutions, containing single, binary and ternary mixtures of commercially available synthetic dyes (blue, red and yellow color) were treated in an electrochemical cell. The effect of solution pH, applied current density (I) and applied voltage (V) on color removal was studied. The results were very promising. From solutions containing initially 100 mg/L the final concentrations were less than 1 mg/L. Even binary and ternary mixtures of the above dyes with initial concentrations 10, 50 and 100 mg/L of each dye had final concentration (after treatment) less than 300 ADMI units, which is the current limit, and were suitable for rejection to natural resources. Initial analysis has shown a decrease of TOC by 30 %. The reaction mechanism is currently under investigation.

14. New applications of membrane contactors

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In last years membrane contactors have been successfully applied to liquid-liquid extractions, gas-liquid operations and membrane/osmotic distillation, covering many fields of industrial productions. In this work, the performance of membrane contactors has been investigated for a new application: the determination of the ethyl alcohol content in hydro-alcoholic solutions.

In particular, a correlation between the permeate flux and the alcohol content of the feed solution has been derived. Experimental tests have been carried out on flat microporous hydrophobic membranes by feeding hydro-alcoholic solutions prepared in lab at one side of the membrane, while applying vacuum at the other side. During tests, different operating conditions (temperature, ethanol content in the feed solution, etc.) have been varied. Some preliminary runs on commercial beverages have been also carried out. From the achieved results it can be concluded that the developed alternative technique well responds to the requirements of the process intensification theory.

15. Update on U.S. EPA's Aging Water Infrastructure Research Program

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In FY 2007, the U.S. Environmental Protection Agency's Office of Research and Development initiated a new research program to generate the science and engineering to improve and evaluate promising innovative technologies and techniques to reduce the cost and improve the effectiveness of operation, maintenance, and replacement of aging and failing drinking water and wastewater treatment and conveyance systems in the United States. This research program directly supports the Agency's Sustainable Water Infrastructure Initiative. This update will provide information on the status of the research program, especially in the areas of infrastructure condition assessment, system rehabilitation, application of advanced concepts, and innovative treatment technologies for wastewater and water reuse. Major projects were initiated in FY 2007 that will assess the "state of the technology" for infrastructure inspection and condition assessment, especially buried pipelines; drinking water distribution and wastewater collection system repair, rehabilitation and replacement; and advanced concepts, especially green infrastructure and dual distribution systems. Upon the completion of these technology assessments, the program will move into its technology demonstration phase, where emerging, innovative technologies will be selected and field demonstrated. For these major projects and others, status updates will highlight outputs expected in the coming year and plans for FY08.

16. Sustainable consumption – the human dimension

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The abstract was not available at the editorial deadline.

17. Hazard Prevention and Emergency Planning at Transboundary Rivers in the UNECE Region - The Role and Strategy of the UNECE Joint Ad Hoc Expert Group on Water and Industrial Accidents

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Hazard Prevention and Emergency Planning in the UNECE Region are focused to the following key elements:

1. Identification and Notification of Accidental Risk Sites (ARS).
2. Guidelines for Safety Measures minimizing the risk potential.
3. Emergency preparedness in the case of an accident and mutual assistancy.

Major industrial accidents may cause far-reaching transboundary effects and may lead to accidental water pollution. Therefore, the Signatories to the Industrial Accidents Convention and the Parties to the Water Convention decided to cooperate on issues related to the prevention of accidental pollution of transboundary waters and founded the so-called Joint Expert Group to support and provide guidance on the prevention of accidental water pollution.

The strategy, major accomplishments and future activities of the UNECE Joint Expert Group will be presented.

18. Catalytic conversion of ethanol to chemicals as example of catalysis in a sustainable fine chemical industry

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Recently taken calculations show that based on assessment of proven oil fields, era of oil depletion is approaching. It will, in turn, lead to energy related problems in most part of the world. At present, ethanol that is obtained from renewable sources, namely biomass, considered to be a likely substitution to oil in future. Thus, annually, 30 billions of tons of carbon are being consumed by plants via photosynthesis process, whereas oil consumption is dozen of times lower. Nowadays, more than a half of globally produced ethanol is being used as an additive to fuel for internal combustion engines running purposes. Another significant application of vegetable-derived alcohol is synthesis of different sorts of valuable chemical monomers (green chemistry). According to the state program adopted in USA it is expected that in 25 years, 25% of chemical industry will be switched to the use of vegetable-derived raw material. Program of a similar nature has been approved in developed countries of Europe. Not only will starch, but also previously burned by farmers cellulose and cellubiose contained in wood, stems, leafs and straw be used in order to obtain alcohol.

For a quite long time we have been involved in the investigation of ethanol conversion into different products. The main objective of the given investigation is to synthesize active and selective catalysts used in reactions of ethanol conversion into various types of monomers and to investigate reactions mechanism.

Process of ethanol dehydration into ethylene might be attractive in the way, that if the price of 1 ton of ethanol drops to $200 and lower, it will be reasonably practicable to start synthesizing ethylene, currently being processed from oil, from vegetable-derived alcohol, and use it in chemical industry needs. It will allow refraining use of oil as a raw material in production of ethylene. Generally, ethylene found its use as a raw material in production of such important chemical products as ethylene oxide, ethylene glycol, polyethylene, ethylene-propylene rubber, polyvinyl chloride, ethanol amines etc.

Partial oxidation of ethanol into acetic acid is important because acetic acid is well known as one of the widespread solvents and monomers for petrochemical synthesis. Synthesis of acetyl chloride, amides, complex ethers and many other chemical compounds involves uses of acetic acid as a raw material.

Conversion of ethanol into acetone is a new and perspective method of acetone production. It is the fact that acetone is also known to be as one of the most widespread solvents. In chemical industry acetone is being used for production of such monomers as ketene, isoprene.

Production of ethyl acetate, widely applied as a solvent and also used in food and perfumery industries, via conversion of ethanol is also of interest.

One of the most important processes of ethanol conversion is considered to be its oxidative dehydrogenation into acetaldehyde. On industrial scale acetaldehyde is used for production of acetic acid, butadiene and other valuable products.

19. Utilization of Biomass in the Czech Republic

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The utilization of biomass is part of landscape cultivation. It helps to increase soil fertility, eradicate pests and diseases and use wood waste in heat production. Plant production which is utilized for non-agricultural purposes is subsidized by the EU. Such support helps farmers to make profit, but on the other hand it breaks the core business through limiting the food industry and reducing the soil fertility.

Production of biofuels and its stabilization on the market results in the destabilization of food production, which is intensified by soil shortage. The size of non-productive areas increases. It is caused by the annexation of arable soil for the building of infrastructure, its conversion to soil with permanent cultures, and the development of alternative agriculture.

The area of arable soil decreased by more than 5% during the last five years. It is 1/3 of the area considered by the Ministry of Agriculture to be utilized for biofuel production. Due to long history of soil purpose specification there are not any reserves of suitable soil in the Czech Republic. The size of land per one inhabitant continuously decreases and amounts to 0,42 ha of agricultural land, out of which 0,30 ha is arable soil (31/12/2005; mid-year number of inhabitants - 10 234 092). Biomass should be produced in co-operation with agricultural and food production.

The EU draft action plan for biomass and biofuels may be successfully implemented only under the conditions that it complies with the agrarian development of countryside. The economic potential of energetic biomass should support the sustainable development of cultural landscape and life in the countryside.

20. Technical and Economic Evaluation of Biodiesel Production by Enzymatic Catalysis

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Biodiesel is produced by transesterification of triglycerides present in animal fats or vegetable oils, with a low molar mass alcohol. The resulting ester mixture has physico-chemical properties similar to those of diesel fuel although the fuel consumption is about 10% higher because of the lower energy efficiency.

In this presentation the synthetic paths that lead to biodiesel by catalytic transesterification of vegetable oils will be briefly reviewed. Although transesterification with methanol is the current process at industrial scale, the use of ethanol, which can be produced by fermentation of sugar and starch, is also considered, since it would lead to a cleaner and more biocompatible fuel.

The experimental part of the work will focus on the kinetics and optimum reaction conditions for the synthesis of biodiesel from different oil sources using ethanol, by enzymatic transesterification. Several lipases had been used, such as Pseudomonas cepacia and Candida antarctica (CALB), the latter in its free and immobilized form. Immobilized CALB yielded the best results, and it was possible to reuse it for several transesterification cycles. Reaction operating conditions such as temperature, alcohol/oil ratio, and enzyme load have been studied. An excess of alcohol leads to higher conversions, but above a certain concentration enzyme catalysis inhibition takes place.

An NMR spectroscopy method has been developed for a fast analysis of the reaction mixture, including esters, triglycerides, diglycerides and monoglycerides.

Moreover, a preliminary economic evaluation has been performed, and compared with the conventional reaction system, which involves alkali catalysis with NaOH.

21. The Role and the Importance of Biomass in Sustainable Development

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World population and economic development is increasing every year. This uncontrolled increase results in an ever growing global primary energy demand. In 1850 the world population was over 1 billion and this amount has reached over 6 billion in 2007. Accordingly, the energy demand of the world population was less than 0.5 Gtoe* before 1850 per year. However, at the end of 20th century this demand has increased to almost 10 Gtoe per year. As a result, in 150 years there has been a 20-fold increase in the energy demand of the world.

Since this energy picture is getting worse every day, it is necessary to search for alternative and renewable energy sources. This has lead to renewed interest in biomass energy. It is the 4th largest energy source worldwide accounting for approximately 15% of total energy supply and the predominant renewable energy source. The total amount of available biomass exceeds 25% of our current coal consumption on energy basis. Most people agree that 15% of the current coal consumption could be displaced by biomass. Biomass plays a key role in cutting greenhouse gas emissions, namely CO_2. Moreover, the use of biomass is important also for diversifying sources and reducing energy dependence through reliance on local sources and in view of sustainable development.

Globally, sufficient biomass is available for energy applications to substitute up to 60% of the global energy consumption in the long term, without competition with biomass applications for food and materials. Therefore, it is realistic to assume that biomass can play the projected role in the global energy infrastructure. Biomass currently accounts for approximately 14% of world's final energy consumption. About 25% of the usage is in industrialised countries, while the other 75% is used in developing countries. Developing countries as a whole derive 33% of their energy from biomass. In many of these countries biomass provides over 90% of total energy use in the form of traditional fuel such as fuelwood, residues and dung. At present the use of biomass as traditional fuel is about 38±10 EJ/yr, and as modern energy, such as fuel and electricity, about 7 EJ/yr.

Sustainable development is often defined as "development that meets the needs of the present, without compromising the ability of future generations to meet their own needs". Therefore, in order to achieve the goal of "sustainable development" we need much more renewable energies. Biomass energy is attracting more and more attention worldwide, because it is a potentially CO_2- neutral and renewable energy source. Energy from biomass is important to society since it does not produce any net greenhouse gases. So it can be easily said that biomass is the form of energy which helps "Sustainable Development". This paper outlines the sustainability issues associated with biomass: its carbon neutrality, its use in heat and power generation, its use in biofuels.

(*Gtoe: Gigatone oil equivalent, i.e., 109 tons of oil)

22. Prospects for Biodiesel Production and Future Evolution

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When addressing the need to reduce greenhouse gas emissions, especially carbon dioxide, the transportation sector represents a particularly difficult challenge. To deal with this problem, in recent years there is an increased interested in the production of alternative fuels for transportation from a broad range of different feedstocks. Examples include ethanol from sugar cane fermentation and biodiesel produced by transesterification of vegetable oils. Also, the current high prices of oil make these fuel sources more interesting to reduce the dependence on external fuel sources coming from politically volatile countries.

Although it is consensual that biofuels are useful to reduce the net emissions of greenhouse gases to the atmosphere, their production raise many questions at the environmental, political and economic levels. For example, from a life cycle assessment point of view it is not clear that the production of certain crops specifically for biofuels leads to a reduction in the environmental impact when compared with the fossil fuel they replace. Also, changing crops due to their increase demand for energy may lead to an increase in food prices. In the production process there is also space to improvement and to boost its efficiency.

Taking into account all the aspects presented above, this work tries to present an overview of the current status and state of development of biofuels, with a focus in biodiesel. Aspects that are considered are the contribution to sustainable development, and how the further increase of biodiesel production is impacting the economic and environmental aspects. Also discussed are the current and future trends for biodiesel, such as possible new feedstocks, improved processes, promotion of the utilization of biofuels policies, and how coherent and sustainable strategies for the sector can be developed.

23. Political and legal framework in Germany

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Already since the middle of the 1970´s in Germany, during the course of the two oil crises, discussions arose over economic development with a stronger focus on environmental and supply questions. Beginning in the 1980´s, with problems of dying forests and discussions around nuclear power, criticism arose regarding the existing energy industry. Then the Chernobyl disaster occurred, causing the current crucial reorientation in the broad public awareness. New policies measures were enacted. Beginning in 1991, with the start of the feed-in tariff laws promoting renewable energy, the German government set forth the first incentives for the development of a new industry. Initially, this new industry was not taken very seriously.

But the law, which guaranteed a minimum tariff price, was met with an unexpected expansion of wind energy facilities. During the course of the 1990´s some amazing trends were seen in this field. Wind turbines developed technically and economically to a substantial degree. With the passage of the German Renewable Energy Act (EEG) in 2000, the existing support policies were further developed and revised to be even more effective at promoting alternative technologies while their basic ideas remained unchanged. This law, and its 2004 amendment, continues to stimulate the renewable energy industry in Germany. In particular, the fixed tariff price specified by this law is an important aspect to secure the basic conditions needed to foster a whole new industry.

By examining thetrends in installed generation capacities, the influence of regenerative energy market incentives is clearly seen: since 2000, the generation of energy from renewable energy sources almost doubled to 74 billion kWh in 2006, whereby the EEG accounts for approximately 50 billion kWh and approximately €5.6 billion in financial incentives. The expansion of regenerative energy technologies has been so successful that the stated goal of at least 12.5% of the energy generation from renewable sources by 2010 will actually be achieved already in 2007. If these trends continue in such a manner, the minimum goal of 20% of the energy generation of from renewable sources by 2020 is likely to be exceeded by a large margin.

The largest contributor to renewable energy generation in 2006, with 30.5 billion kWh, was wind energy. Also in 2006, Wind energy generation capacity saw a large growth, with an additional installation of 2,233 MW, an increase of approximately 23% over the previous year. Within the field of biomass energy, biogas has the highest growth rate in the generation of electricity. Here an almost doubling can be seen from 2.8 billion kWh per year in 2005 to approximately 5.4 billion kWh in 2006. Photovoltaic electricity generation has also seen a significant increase, from 1.3 billion kWh in 2005 to approximately 2 billion kWh in 2006.

Not only used to supply electricity, regenerative energy sources are also used for the function of heating. Within this field, the market incentive program supports the growth of renewable energies. For example, in 2006 approximately 140,000 individual projects with an investment volume of 1.5 billion Euros were realised because of this program. Most of these projects were solar thermal systems for households. The efficiency guidelines of the

European Commission for buildings will also increase the use of renewable energies. Recently, the members of the Federal Government of Germany held a conference at Meseberg where they also discussed details of a new national climate protection program. In the context of this conference, measures were decided upon that will have a strong positive effect on the use of renewable sources in the future heating market.

The targeted promotion in Germany of renewable energy technologies, in both heat and power supply, has led to the fact that the portion of primary energy consumption covered by renewable energy rose to approximately 5.3% in 2006.

Setting the International Renewable Energy Agenda

A sustainable and safe energy supply is ranked as a high priority for the German government; this has become even clearer during the German European Union Council Presidency and the German G8- Presidency.

On the European level, in March 2007, a mandatory goal for all types of renewable energy generation, electricity, heat and biofuels - was specified to be at least 20% of the entire energy consumption by the year 2020. This very ambitious goal makes high demands of all member states of the European Union, and requires further development in the field of renewable energy generation. Regarding the actual portion of each individual member state within the European Union commission was an issue of great debate. In these debates the question was posed, “What should the promotion of renewable energy look like in the future?” Germany, as one of the most important markets, will surely continue to play an important role for the future of regenerative energy in Europe.

At the G8-Summit, under the German presidency, it became clear that G8 leaders would endorse emission reductions in an international framework. Reducing CO2-emissions was acknowledged as a further general goal by all partners.

The Federal Government of Germany has set new standards by Europe-wide comparison, with power generation presently over 12% renewable energy, to be increased to 30% by 2020.

The Most Recent Climate Protection Package of the Federal Government

Additionally, the new integrated climate protection program of the Federal Government of Germany, discussed at the conference at Meseberg, insures that measures will be taken which contribute to energy efficiency and sustainable energy use, with an emphasis on the development of renewable energy. With 29 individual measures addressing energy efficiency and sustainable energy use, a comprehensive climate program is being created that will reduce the carbon dioxide (CO2) emissions by 36% from 1990 to 2020. The goal is to increase energy productivity by 3% per year. The quintessential points of the program are higher energy efficiency for buildings, higher taxation on cars with poor gas mileage, and strong mandates to conserve energy.

As previously mentioned, the market incentive program plays an important role in the national heating market. The federal government integrated into its most current climate protection program an increase of heat from renewable energies in buildings in order to use the large potential for renewables.

In the area of bioenergy, the feed-in of biogas into the existing natural gas network will be made easier in the near future. In Germany, some model projects already show that feeding biogas into the existing network is possible. Decentrally or regionally produced biogas can then be used for efficient cogeneration and transportation applications. The natural gas industry has committed to a fixed target, to cover by 2010 10 % of the methane used in vehicles with biogas. Since the beginning of 2007, companies which provide fuels for transportation are obligated to sell a certain percentage of biofuels. By the use of biomass within all three areas of the energy supply - electricity generation, utilisation for heat and fuels for transportation – pressures on the scarce biomass resource are known and criticisms around imported biomass exists. Government plans include using regulations to guarantee sustainable agricultural practises for the production of inputs for biofuel products.

About the German Energy Agency

The Deutsche Energie-Agentur GmbH (dena) – the German Energy Agency – is the competence centre for energy efficiency and renewable energies. Its manifold objectives include the rational and thus environmentally friendly generation, conversion and use of energy, and the development of sustainable energy systems with a greater emphasis on renewable energy sources.

24. Availability and Utilization of Biomass Resources – Overview and technological options at the example of biogas production

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The use of biomass has a very long tradition and plays world wide a very high importance in local energy supply. Nowadays most political strategies for sustainable energy supply include biomass as one of the most promising renewable energy sources in the near future.
The use of renewable energy sources (RES) seems to be a promising option for covering the increasing energy demand worldwide. Heat, electricity and fuels for transportation purpose from solar radiation, wind energy, geothermal energy, hydropower and biomass can contribute substantially to cover the given energy demand in an environmentally sound way with already existing technologies. From the different RES options biomass seems to be a very promising option for the following reasons:

Biofuel is rarely directly affected by energy crises, being an indigenous energy source (i.e. biomass is, in most cases, produced close to the place where it is used) characterized by short supply chains with low risks of failure. Also the production and utilization of biomass is widely accepted (unlike nuclear and coal power in some countries) and offers benefits for rural areas related to employment, rural infrastructure, the conservation of cultivated areas, and hence increases the attractiveness of rural regions.

On this background the aim of the presentation is to present the possibilities and restrictions of biomass for covering the given energy demand within a sustainable energy provision system for industrialized as well as developing countries world wide.

The use of biomass has a very long tradition and plays world wide a very high importance in local energy supply. Nowadays most political strategies for sustainable energy supply include biomass as one of the most promising renewable energy sources in the near future.

Therefore, first the state of technology for an energy provision from biomass is presented. The possible conversion routes based on a thermo-chemical, a physical-chemical or a bio-chemical conversion are presented as well as the degree of market introduction for the different options.

The potentials and use of biomass are shown on a regional basis in relation to the world wide energy demand. Further explanations will point out where still unexploited biomass resources are and where the main markets for biofuels exist at the moment.

Summing up some conclusions are drawn on the future contribution of biomass within an environmentally sound energy system.

25. The Biogas Chain: Economic Aspects

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Preconditions to make the production and utilisation of biogas an economic success are investment security and the possibility for a profitable sale of the product: energy (power, heat, fuel).

In Germany, for example, the sustainable growth of the biogas sector was initiated by the Renewable Energy Law first passed in 2000 (amended in 2004). The Renewable Energy Law creates this preconditions by ensuring a consistent fee for renewable electricity paid by the grid operators, generally for a 20-year period, for biogas plants and other renewable energy installations.

As electricity from biogas is produced in combined heat and power units (CHP units) utilization of co-produced heat can increase the proceeds. Next to direct utilisation of biogas other income alternatives are the injection of bio-methane (biogas upgraded to natural gas quality) into the gas grid or the utilization of bio methane as vehicle fuel.
The residue of anaerobic digestion is an excellent organic fertilizer. Therefore parallel to the valuation of the energetic products (power, heat, bio methane) digestate - respectively the circuitry of the nutrients contained in the input materials - becomes growing economic relevance. The value of digestate residues increases as the prices of mineral fertilizers increase.

These income options are counter parted by different cost pools. Depending on the substrates – if they have to be bought or if for example disposal fees are paid – the costs for biomass input can amount the highest share of operating expenses (up to 50 %). In addition, capital expenditure (calculated interests, accrual), cost for maintenance, repairs, labour, process energy (power, heat), consumables and other cost as laboratory analysis, consultancy, administration, lease etc.. Further conditions of economic relevance are distance to a connection point to the grid (power/ gas) and resulting costs for a connection, the availability of agricultural land in the surrounding, transport connection or the availability of consumers for heat nearby. But also the legal framework and resulting requirements effect economics.

Therefore – to minimize costs and optimise proceed – an accurate and critical analysis of the biogas specific conditions regarding location is elementary.

26. Production of biogas at different German Biogas plants in agriculture and waste management

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The use of biogas has developed very fast in Germany and in the whole Europe. During the growth of this sector very many problems got visible and technologies were developed. Mainly the legislative framework forced this development and high level research was conducted.

Due to the fact that a very broad range of substrates can be converted into Biogas as energy source a very broad range of technologies is available. Thus the presentation shows typical applications for biogas technology for different sectors:

Utilization of separated organic household wastes. Organic wastes must not be dumped and have to be seen as a very valuable resource. Organic household wastes can be used as fertilizer after composting. Anaerobic treatment can achieve comparable compost qualities but reduces the energy demand considerably. Thus it is an interesting option for the treatment.

Utilization of manure from livestock breeding. Manures from cow, pig and chicken breeding are very easily accessible for anaerobic digestion and biogas production. Beneath energy production key effects are:

- reduction of odours during spreading on the field
- improved fertilizer effects
- improved liquidity
- reduction of methane losses during storage

Utilization of energy crops. Energy crops play a major role in the discussion about substitution of fossil energy sources with renewables. Energy crops and biogas production offer the chance for closed nutrient circles in combination with secure and local energy supply. Greenhouse gases can be reduced in comparison with fossil energies.

Utilization of sewage sludge. It is very typical to use sewage sludge from waste water treatment plants for energy production. But it is not the energy being in the focus of the investment. Much more important are other effects of anaerobic sludge treatment. That are:

- the sludge can be dewatered easily
- the sludge will be reduced

27. Overview Biofuel-Technologies - Trends and perspectives

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The continues increasing transport sector not only depends on fossil fuels (primariiy mineral oil) but is also one of the most relevant emitter of greenhouse gases. Therefore, targets with regard to the security of supply, climate protection as weil as the System technological and economic efficiency have taken centre Stage within the context of sustainability. On that background the question comes up, which of the many different options for the provision of transportation fuels based on biomass seem to be particularly promising in the medium and long term. To increase the market share of transportation fueis based on biomass significantly, efficient operating produetion technologies and sufficient deducible biomass potentials are required. Moreover, economic and ecoiogical aspeets have to be taken into account.

Focused on the opportunities to produce biofuels of the future generation (e.g. biogas, ethanol from lignocelluloses, synthetic biofuels based on thermo-chemical conversion such as Fischer-Tropsch diesel, dimethylether, methanol and synthetic natural gas as weil as biohydrogen), the fuei specific benefits and drawbacks were investigated in comparison to biofuels of the 1st generation (i.e. biodiesel, bioethanol). Therefore, within a comprehensive study different options to produce biofuels have been analysed in depth. Based on a technical analysis promising concepts have been identified and then assessed by specific technical (e.g. functionality and R&D potential), economic (e.g. costs of biofuel production and well-towheel) and environmental (e.g. greenhouse gas emissions and mitigation potential) criteria. Options for biofuel distribution and use are considered as weil. Furthermore, with regard to the competition of biomass use (e.g. to power generation and heat provision) the availability of biomass potentials for biofuel production will be assessed for different medium and longterm scenarios. This also includes an estimation of the possible market break through of different biofuel options and their prospected market share at different time horizons.

Based on the resuits, following conclusions can be drawn: Depending on the concepts compared to biofuels ofthe 1st generation as weil as lignocelluloses-EtOH, biomethane (SNG and biogas) and biohydrogen there is a concept specific higher complexity for the production of FT-diesel, DME and MeOH at lower conversion efficiencies. The total production costs of biofuels of the future generation are partly significantly more expensive than biofuels the 1st generation. In terms of WTW-costs these differences are widely compensated (i.e. per driven kilometre). While distribution costs are of less impact to these costs, hut are higher for gaseous biofuels and for biofuels that require a new infrastructure (e.g. hydrogen), vehiele costs, which are much higher for hybrid and fuel cell propulsions, are dominant. With regard to GHG-emissions all biofuels contribute to C02-mitigation. This is especially true for the synthetic biofuels FT-diesel and biomethane. However, for a market implementation of the future biofuel generation existing technical and techno-economic barriers along the entire supply cham have to overcome. This cannot be expected before 2015-2020. Thus, it can be assumed that fuels such as FT-diesel and biomethane will be easier impiemented because

of there direct application within the currently available distribution and use infrastructure. Despite of this, in context of the entire supply cham of transportation fuels synthetic biofuels can be seen as a bridge into a future energy economy that includes hydrogen in the long term.

28. Sustainability Standards for Biofueles in Germany: Status and Perspectives.

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The question of sustainable production of biomass for energy, transport fuels, and materials is currently discussed in a variety of fora, and organizations with a special focus on liquid biofuels. The legal provisions to ensure sustainability if biofuels are discussed at national levels (e.g. Belgium, Germany, The Netherlands, United Kingdom), the European Commission, and in international bodies (e.g. FAO, GBEB, UNEP). Furthermore, sustainability issues are raised in the context of the CDM and global biomass trade.

The German Federal Ministry for Environment (BMU) and the Federal Environment Agency (UBA) sponsors scientific work of Oeko-Institut and IFEU to define **sustainable biomass** with respect to emissions of greenhouse gases from biocrop farming and land use changes, biodiversity concerns and soil erosion, water use, air and water pollution, and social impacts of associated with bioenergy. A cross-sectoral, integrated approach using **life-cycle analysis** is taken to address these challenges, and first results of the ongoing research are presented.

Furthermore, the current status of **legally implementing sustainability standards for biofuels** is given with respect to Germany, and the EU.

Finally, prospects of initiatives in the global context (FAO, GBEP, IEA Bioenergy Task 40, MDB Biofuels Working Group; RSB, UNEP) are briefly presented.

29. Biofuel and Eco-efficiency – Exemplified by Small Recreation Boats

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Biodiesel has been widely used to fuel diesel engines for onshore vehicles, particularly, for agriculture machinery. Application of biodiesel for merchant ships' propulsion in a large scale has been seen a non-near future option due to the lack of availability and supply chains of the fuel. However, this has already changed, and powering recreational boats with biodiesel has shown some market in pursuing marine environmental protection.

The paper presents a feasibility study of biodiesel applied in recreational boats in the UK for the purposes of rational utilisation of energy resources and environmental protection.

The study reviews the current status of using biodiesel on recreational boats and analyses the market in the UK based on a master thesis at Newcastle University. The results are further analysed and seen as part of the current debate on the use of land to produce biofuel. The concept of eco-efficiency is used to compare the efficiency of biofuel against conventional fuel. As the interest for making investments in bio-fuel technologies is increasing, it is important to avoid solving one problem by merely shifting it out of the system analyzed.

30. Life Cycle Assessment of Biogas from Maize silage and from Manure- for transport and for heat and power production under displacement of natural gas based heat works and marginal electricity in northern Germany

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This paper presents an environmental Life Cycle Assessment (LCA) of biogas produced from both maize silage (1) and animal manure (2) based on the technologies developed at Xergi A/S in Aalborg, Denmark. The LCA comprises both environmental impacts (with focus on global warming impacts) and impacts on resource consumption and covers utilisation of the produced biogas for either heat and power generation (A) or for transport (B) in an upgraded (cleaned) and compressed form. In biogas heat & power scenarios, the generated heat is assumed to replace natural gas based heat works, whereas the generated power will replace marginal power on the grid. The study is comparative and shows the environmental consequence of making biogas instead of the alternative use of the substrate. Biogas from manure is, thus, compared to the conventional storage and use of the manure as agricultural fertilizer, and biogas from maize silage is compared to using the same agricultural land for other bioenergy purposes, i.e. growth of maize for bioethanol production, growth of rapeseed for biodiesel production and growth of willow for heat and power production allowing to compare Xergi's biogas to other biofuels.

The assessment, thus, comprises:

1. Biogas made from whole-crop maize (silage)
   1A Biogas used for heat & power
   1B Biogas cleaned, compressed and used for transport
2. Biogas made from animal manure
   2A Biogas used for heat & power
   2B Biogas cleaned, compressed and used for transport
3. 1st generation biodiesel made from rapeseed
4. 1st generation bioethanol made from maize kernels
5. 2nd generation bioethanol made from whole-crop maize
6. Willow production for power and heat production

In this context, 1st generation biofuels are defined as biofuels based on raw materials that alternatively could be used as food, whereas 2nd generation biofuels are based on energy crops, residues and waste streams.

The environmental assessment is based on the EDIP method (Wenzel et al., 1997) and further up-dates of this method (Weidema et al. (2004), Weidema (2004), Stranddorf et al. (2005)) which are in agreement with the standards of the International Organisation for Standardisation, ISO.

Moreover, the study is conducted according to the principles of consequential LCA, which is today's best scientific practice. It implies that the LCA is comparative and dedicated to identify the environmental consequence of choosing one alternative over the other. The consequential and comparative approach ensures that all compared alternatives are equivalent and provide the same services to society, not just regarding the primary service, which in this case is a specified transportation service together with a heat and power production, but also on all secondary services. Secondary services are defined as products/services arising e.g. as co-products from processes in the studied systems, and in the case of biofuels, such secondary services can typically be energy-services (electricity and/or heat) and animal feed. The consequential LCA ensures equivalence on all such services by identifying and including the displacements of alternative products that will occur when choosing one alternative over the other.

Biomass has become a priority resource to substitute fossil fuels in the energy sector (heat & power) and is increasingly seen to be so in the transport sector as well. In e.g. Denmark, wood chips, wood pellets, and straw are increasingly used to substitute fossil fuels for heat & power production. Moreover, it has been shown that the amount of biomass, that is or can be made available for energy purposes, is limited compared to the potential use of it for fossil fuel substitution in the energy (heat & power) and transport sector as a whole (Jensen and Thyø, 2007), and so is the fraction of agricultural land that can be made available for energy crops. Any area of land that is made available for energy purposes has, thus, a potential customer in both the heat & power sector and the transport sector. As such, any use of such biomass for transport fuels will happen at the expense of using it for heat & power and, thus, with the consequence of using an equivalent amount of fossil fuels there. Moreover, any use of biomass for biofuels will require subsidies for a long period ahead (and covering the time perspective of this study), and money to support a given biofuel or technological pathway is limited as well. Therefore, any use of biomass for energy purposes or of money to support biomass for energy purposes will happen at the expense of an alternative use of the same biomass, land, and/or the same money.

The situation to be modelled in a consequential LCA approach is, thus, clear: the use of the limited amount of agricultural land will happen at the expense of utilisation of agricultural land for alternative uses.

The Figures next page show key results of the assessment. The unit for greenhouse gas emissions is ton CO2-equivalents, and the unit for fossil fuel consumption is PR, standing for person reserves, which is a common unit for assessing resource consumption based on their scarcity and supply horizon.

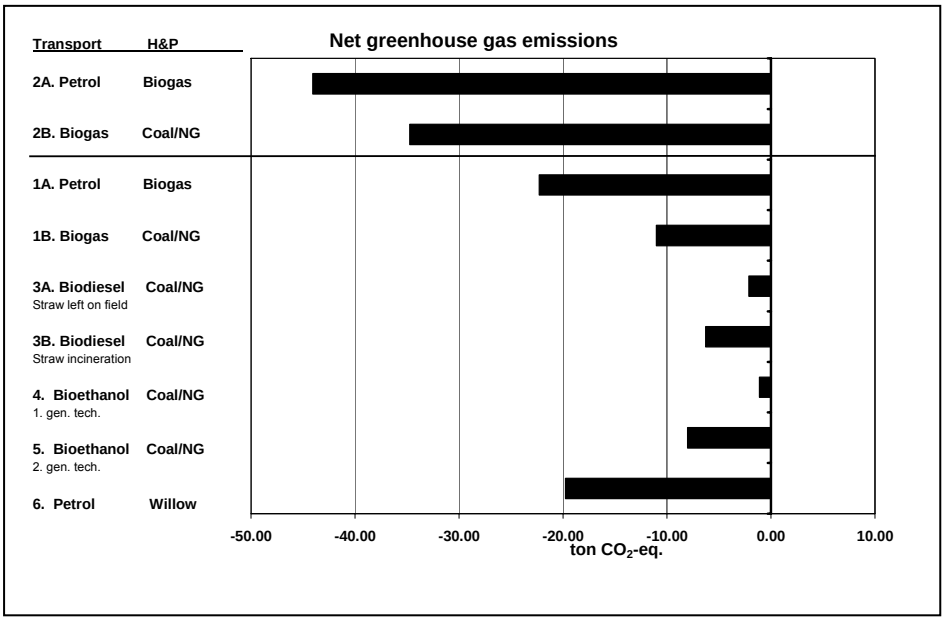
The scenarios 2A and 2B of manure based biogas are included in the comparison, however, it should be emphasised that they are "stand alone", while the rest of the scenarios are each others alternatives e.g. the prioritising of utilizing land for one option shall be seen to happen at the expense of the other options.

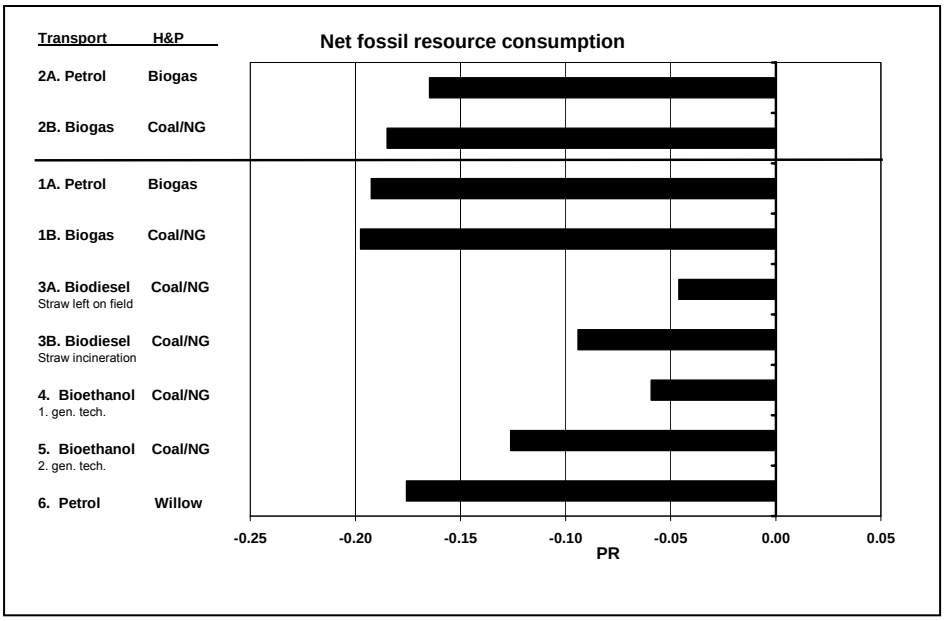
Biogas based on manure is not an alternative strongly correlated to the other scenarios, because it does not include any utilization of agricultural land. However, since it provides the same services to society as the other scenarios, it still compares to them and enters into the overall prioritisation of which type of bioenergy technology society should promote with subsidies and other incentives. The conclusion of this comparison is unambiguous: biogas from manure implies by far the highest reduction of greenhouse gas emissions per unit of services provided to society. This being due to the fact that it implies CO2 reductions not only from the fossil fuel replacement by the generated biogas, but equally significantly from the reduced methane emissions from manure storage, reduced nitrous oxide emissions from soil application of the manure and improved plant availability of the nitrogen in the manure.

The brief and overall conclusions on manure based biogas can, thus, be expressed as:

Biogas from manure stands out as having very high reduction in greenhouse gas emissions and very high fossil fuel savings compared to the conventional storage and soil application of the manure. Environmentally and in terms of resource savings, manure should be utilised for biogas production prior to the soil application.

Biogas from manure stands out as having much higher reduction in greenhouse gas emissions as the other bioenergy types and equal savings in fossil fuels. As cost aspects point to the same direction, manure based biogas should have the highest priority of all the compared bioenergy types.





The other scenarios are strongly correlated by their competition for the same agricultural land. Based on the comparative approach, the LCA shows that environmentally and in terms of fossil fuel savings, energy crops should be prioritised for heat and power purposes either 1) through a preceding biogas generation or 2) by direct incineration or gasification, the two leading to almost equal CO2 reductions and fossil fuel savings. Energy crops converted directly into a transport fuel implies significantly lower CO2 reductions due to the energy losses in the conversion processes.

The brief and overall conclusions on maize based biogas can, thus, be expressed as:

Among the compared types of bioenergy requiring agricultural land and energy crops, biogas from maize silage and heat and power from willow imply the highest reductions in greenhouse gas emissions and the highest fossil fuel savings. Environmentally and in terms of fossil fuel savings, land for energy crops should, thus, be prioritised for crops for heat & power or for biogas.

The explanation of this outcome of the LCA can be found within 3 main reasons:

1. The yield of the energy crop per hectare of land
2. The fossil fuel substitution efficiency, including the energy efficiency of the conversion of the calorific value of the crop's dry matter content
3. The energy infrastructure aspects of the bioenergy technology

The explanation within these 3 categories of why the rape seed biodiesel and the 1st and 2nd generation bioethanol comes out with lower CO2 reductions and fossil fuel savings are given below.

Rape seed biodiesel: Rape has a very low energy yield per hectare, and this is the one reason for rape seed biodiesel to come out as the environmentally least preferable of the biofuels. Prioritising land for rape through choosing (and subsidising) rapeseed biodiesel for transport means depriving society the higher yield of other energy crops on the same land.

There is no sign that this will change. The conversion efficiency of the rape seed oil to the biodiesel is comparably high, i.e. only 10% conversion loss or less. There are no infrastructure disadvantages.

Bioethanol: The yield of maize per hectare is the highest among the compared energy crops, and in this study, the bioenergy technologies using maize have for this reason an inherent advantage. For the first generation bioethanol, however, the advantage is of course lost when the stover is not used for energy purposes. On the energy conversion, however, the bioethanol technologies have large losses and an inherent disadvantage: Firstly (for the 2nd generation technology), a thermal pre-treatment of the maize stover is required, and this implies an energy consumption. Secondly, the metabolism of the ethanol fermentation is not as efficient as the methane fermentation, and much remains unconverted to ethanol in terms of metabolic side-products and un-degraded residues. It implies among other things that energy must be spent on drying/dewatering in order to render the residues suitable for subsequent incineration or gasification based energy conversions. Thirdly, energy is needed to separate the ethanol from the fermentation liquor, requiring a distillation process. The biogas has the inherent advantage of leaving the fermentation liquor voluntarily. On the infrastructure side, finally, the bioethanol technologies have an inherent requirement of being very large scale, mainly due to the necessity of the distillation to be large scale; in small scale the cost of bioethanol becomes much worse and detrimental to any real life implementation. It implies that bioethanol cannot enter into a decentralised heat & power production infrastructure and, thus, cannot, like biogas, realise the multiplication effect of full heat utilisation at the same time as delivering the electricity to the grid under marginal electricity replacement.

The assessment is robust to changes in boundary conditions including the key issues for the sensitivity of the results. The most crucial boundary condition behind the assessment in this LCA is the acknowledgement of the fact that energy crops/land for energy crops will be a constrained resource and require subsidies in order to reach any utilisation for energy purposes, with the implication that any use of land for energy crops should be assessed against the lost opportunity of using it for other purposes in the fulfilment of the same aims.

31. Bio-Fuels: The Dialectics of Energy Security and Food Security

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The authors examine the recent past, current and anticipated competition between food production and bio-fuels production for arable land, water resources, agricultural inputs and labor, as well as the subsequent impact on food security, food prices and commodity surplus availability for global famine relief. Moreover, the implications of United States government policies are examined, which purport to delimit both dependence upon foreign-supplied energy, reduce pollution and curtail over-utilization of depleting domestic fossil fuel reserves, through increased cultivation of bio-fuels. Finally, the life cycle of bio-fuels production is delineated for corn and cellulose biomass, so as to better understand the environmental, nutritional and economic impacts of increased bio-fuels production, in relation to alternative renewable sources of energy.

32. Biomass and biofuels – the solution or another Illusion?

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The world is entering a new era when it comes to energy sources and seeking for a liquid fuel replacement for oil. Peaking of petroleum extraction rates and concerns about global climate change stimulate many countries across the globe to establish support measures and create alliances to promote the use of biofuels from biomass. Moreover, an increasing need for chemicals to be produced from biomass may be expected in the coming years.

Industry, government and scientific proponents promote biofuels as a promising alternative to fossil fuels claiming that they will serve as an alternative to nowadays transportation fuels, mitigating climate change by greenhouse gas emissions reduction, enhancing farmer incomes, and promoting rural development.

Our contribution sets out critical concerns regarding the ecological, social and economic implications of the biofuel and chemicals production from biomass. Different technological options for converting biomass to biofuel (e.g. decomposition for generation of biogas, burning for cogeneration of heat and power, and extraction and transformation for producing alcohol fuel or biodiesel) will be considered, in order to assess their adequacy for biofuel production systems that will be in synergy with food production systems needed to feed the world population. The evaluation will focus not only on crops and trees grown specifically for the production of agrofuels on a large scale, but also on industrial and agricultural by-products and wastes (e.g. manure or landfill for biogas, waste vegetable oil for biodiesel, molasses from beet sugar production for bioethanol, etc.).

The aim of our contribution is to discuss the ability of biofuels to really mitigate climate change, the effects of large scale agrofuel production on biodiversity, the significance of crop residue to sustainable management of soil and water resources, the threats on food security caused by the structure of global agrofuel production and the real impact of biofuels on rural development and jobs. These outcomes will serve as a background for comparison of biofuel production systems with other energy production alternatives. Furthermore, other measures tackling the energy crisis and climate change (e.g. education for sustainability, sustainable consumption, energy supply chain management, energy-efficiency etc.) will be proposed. Biomass can cover a small fraction of our today needs, but it will not be sufficient to substitute fossil fuels – changes in everyday life are badly needed for sustainable development.

33. Integrated membrane processes to enable process intensification in biofuel production

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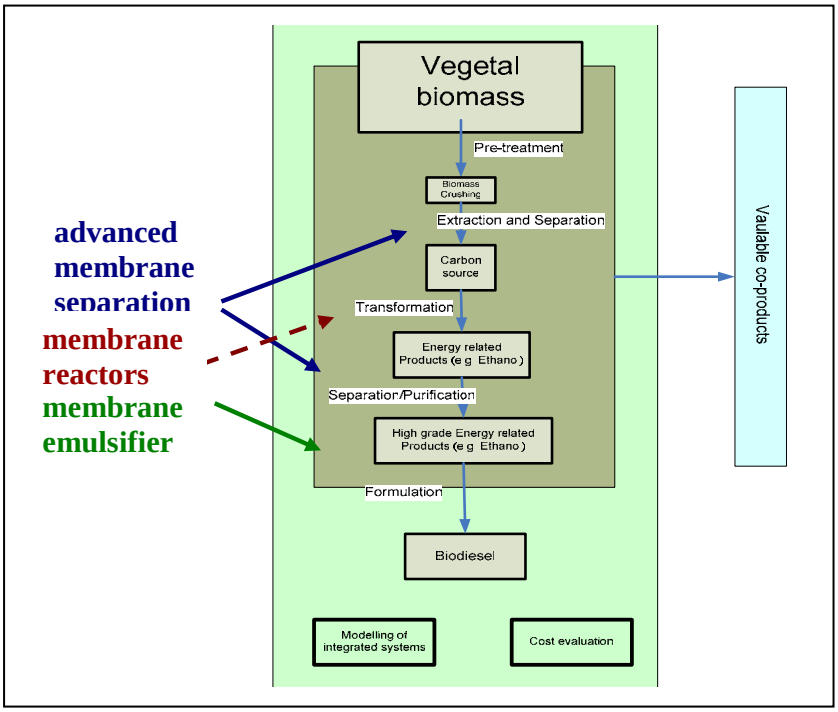
Significant progresses can be reached in the production of biofuel from biomass, by introducing integrated advanced membrane separation processes, membrane reactors, membrane emulsifier in the overall process design in the logic of the process intensification strategy (Fig 1). The development of improved systems of production is an important issue for reaching the objective of a sustainable growth.

Fig. 1



The achievement of an industrial growth able to preserve and to improve the quality of life without compromising the needs of future generations is one of the main challenges of modern society. Also the advantages resulting from the valorisation of safety; reduction of raw materials, energy losses and recyclables by-products; improvement of health and environmental aspects; non-polluting technologies are important parameters to take into account.

Membrane operations are technologies responding efficiently to the requirement of Process Intensification because they have the potential: to replace conventional energy-intensive techniques (such as distillation and evaporation);to realize the selective and efficient transport of specific components; to improve the performance of reactive processes; to reach advanced levels of automatisation and remote control.

Therefore the possibility to realise Integrated Membrane Operations combining Membrane Fermentors (eventually in submersed membrane module configuration) with molecular separation in downstream processing and final product formulation based on: membrane emulsification, membrane crystallizer and in general membrane contactor appears as a quite interesting attractive opportunity. New metric introduced for a correct evaluation of the Process Intensification strategies, were applied to energy and cost analysis of these integrated system confirms these potentialities.

34. The Kamal Ewida Earth Observatory:

A NATO Science for Peace (SfP) Planning Grant in Collaboration with Egypt, Turkey and the USA

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The authors reveal the raison d'être, evolution, anticipated deployment and multiple applications for a real-time remote sensing groundstation in Egypt, to be shared by Cairo University, celebrating its centennial anniversary on Dec. 21, 2008, with a student enrollment of over 200,000, by Al Azhar University, founded in 988 A.D., with a current multi-campus student enrollment of 500,000, and by a wide array of governmental and multi-lateral agency collaborators and satellite data end-users. Both Cairo University and Al Azhar University have major departments of Meteorology and each have affiliated research centers focusing on environmental hazard mitigation. The groundstation has been designated the Kamal Ewida Earth Observatory (KEEO), named in honor of Dr. Mohamed Kamal Tolba Ewida (Departed, Nov. 4, 2006), Egypt's distinguished delegate to the North Atlantic Treaty Organization (NATO) Committee on the Challenges to Modern Society's (CCMS) Pilot Study on Clean Products and Processes, for ten years, and formerly, Professor & Dean, Faculty of Engineering, Zagazig University – Egypt. The primary function of this initiative is to facilitate early warning and mitigation of biogenic and anthropogenic disasters, including epidemics and epizootics. The project has received a NATO Science for Peace (SfP) Planning Grant. Both the Mediterranean Dialogue/Partner country Project Director (PPD) and the NATO country Project Director (NPD) have been invited to present the final Project Plan in early June, 2008, at NATO Headquarters in Brussels, Belgium, before the NATO Expert Panel on Environmental Security.

The NATO country partners include Purdue University, Rosen Center for Advanced Computing's Purdue Terrestrial Observatory (PTO), based in West Lafayette, Indiana, USA. Purdue was founded in 1869, has a current student enrollment of 69,000, with 22 astronaut alumni and was one of the first universities in the United States to establish a research Laboratory for Applications of Remote Sensing (LARS), over forty years ago. Boğaziçi University's Kandilli Observatory and Earthquake Research Institute (KOERI), now celebrating its 140th year, was founded in Istanbul, Turkey in 1868, as the Imperial Meteorological Observatory, during the reign of Abdülâziz, the 32nd Sultan of the Ottoman Empire, who reigned from 1861-1876, succeeding his brother, Abdülmecid I, both being sons of Sultan Mahmud II. It is anticipated that the Kamal Ewida Earth Observatory, in collaboration with Egypt's National Authority for Remote Sensing & Space Sciences (NARSS), which just launched EgyptSat I, with the Prime Minister's Crisis & Disaster Management Sector, the Ministry of Agriculture, the WHO Regional Office for the Eastern Mediterranean, and the World Bank-funded Eastern Nile Technical Regional Office, inter alia, will be positioned to make significant contributions to disaster preparedness, to research on vulnerability assessment and disaster mitigation, as well as to training the next generation of decision makers, who will have technical facility in making decisions within an information-rich environment.

35. The Development of Projects and Activities on Environmental Security

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The Science for Pease and Security (SPS) Programme was launched in 2006, replacing the programmes that had been run under the previous Science Committee on the Challenges of Modern Society (CCMS). The SPS Programme offers grants for collaboration between scientists in NATO member states and countries that are associated with NATO through the Euro-Atlantic Partnership Council and through the Mediterranean Dialogue. Grants are also offered to assist academic communities in Partner countries to set up basic computer networking infrastructure.

The Key Priorities lie in three general scientific and technical areas:

- Defence against terrorism: detection of chemical, biological radiological or nuclear weapons or agents, physical protection against such weapons or agents, etc.
- Countering other threats to security: environmental security such as desertification, land erosion and pollution of common waterways (which may lead to regional or cross– border disputes); defence–related environmental issues; technical, economic and social factors underlying the management of vital resources, such as food and energy.
- Partner–country priorities: topics in documents agreed by NATO and individual Partner countries, which provide the overall framework for cooperation according to each country's particular interests and needs.

Whether an SPS–sponsored activity is initiated by a nation, by NATO or by an individual expert it consists of one or a combination of the following mechanisms:

- **SPS Workshops:** meetings conducted for purposes of information exchange, sharing experiences, or for training. The following sub-mechanisms are included in this category: Advanced Study Institutes (ASIs), Advanced Research Workshops (ARWs) and Advanced Networking Workshops (ANWs), Advanced Training Courses (ATs), Topical workshops (TWs);
- **SPS Expert Exchange:** temporary arrangements for specialists from Partner countries to work in laboratories or other facilities either in NATO member states or, in case of Partner nationals returning from abroad, in their own countries. The following sub-mechanisms: Collaborative Linkages Grants (CLGs), Reintegration Grants RIGs);
- **SPS Projects:** activities of a more prolonged and targeted nature. The sub-mechanisms: Networking Infrastructure Grants (NIGs), Science for Pease Projects (SIP), Pilot Studies (PSs).

An applicant must be expert in the field for which he/she is applying and must be resident in a NATO, Partner or Mediterranean Dialogue country with mailing address and contact details in that country. An application is only eligible if submitted jointly by two persons from a NATO and a Partner country, or a NATO and a Mediterranean Dialogue country.
Some practical guidance how to develop the proposal on Environmental Security and how to apply will be discussed in the presentation.