Energy and Material Flows

Carbon Flows between Eastern and Western Europe (CFEWE)

IT Research Project
No. A/2001/01

Partners:

- Fondazione Eni Enrico Mattei (FEEM), Italy.
- Czech Ecological Institute (CEI), Czech Ministry of Environment, Czech Republic.
- Warsaw Ecological Economics Center (WEEC), Warsaw University, Poland.
- Institute of World Economy and International Relations, Russian Academy of Sciences, Russia.
- Science and Technology Policy Research (SPRU), Sussex University, United Kingdom.
- Institute of Environmental Studies (IVM), Vrije Universiteit, The Netherlands.

Financed by: The European Commission – Directorate General Research, Technology and Development, under the Fifth Framework Programme (EESD-ENRICH, EVK2-2000-00570).

Goal of CFEWE

The goal of the CFEWE project is: to investigate the extent to which carbon flows can assist the EU in making radical reductions in carbon intensity through substitution of high-carbon for low-

carbon energy (gas and biomass for coal) and through trade in emission rights and: to investigate the degree to which maximizing carbon flows between the EU-28 and the Former Soviet Union (FSU) will contradict concerns related to energy security and policy goals for the restructuring of the EU energy economy.

Plot and Actors

Eastern Europe is endowed with large natural gas reserves and vast areas with huge stocks of forest. Western European lifestyles are highly energy intensive, thus there is a high potential for interdependent relations between East and West.
The CFEWE project:

- Explored developments influencing the flows of energy and carbon resources between Eastern and Western Europe.
- Encompassed key issues of the role of carbon flows in reducing Western Europe's carbon intensity and possible contradictions between maximizing carbon flows and the energy security and policy goals of actors in Eastern and Western Europe.
- Examined the relationship between tangible and intangible flows of carbon.
- Used a post-Kyoto timescale, studying flows over the next 30 years.
- Set a normative target for carbon emissions reductions of 30% in the EU-28.
- Drew upon the input of a broad range of participants representing the European Union, International Energy Agency, national governments, and private industry.

Crystal Gazing: Two Scenarios

The project developed two scenarios: *Independence Scenario* – where carbon flows are limited as part of strong EU climate and energy policies promoting self sufficiency and energy sector adjustments; and *Interdependence/trading Scenario* – with high carbon flows due to a general emphasis on free trade and liberalization, and as a way of reducing the costs of carbon emissions reduction.

Workshops

Two workshops were organized under the CFEWE project. The first workshop was held in Milan, and was dedicated to scoping out issues and gathering suggestions for scenario design. The CFEWE 2nd workshop was held in Amsterdam, in September 2002. At this workshop the issues of energy security, market liberalization, and climate change policy were discussed.

Some Interesting Conclusions

- In 1999 total carbon flows between the Former Soviet Union (FSU) and the EU-28 were about 180 million tonnes of carbon. Under the two scenarios elaborated for 2030, carbon flows could range between about 130 and 530 MtC by 2030, the majority of the difference being explained by trade in intangible carbon credits.
- Climate change policies are likely to have little effect on energy dependency, but they could create '**carbon dependency**' – EU dependency on the FSU to help meet carbon emissions reduction targets through the import of low carbon fuels and emissions trading. Avoiding carbon dependency, while still seeking to reduce emissions, is expensive.

- The *interdependence/trading* scenario raises serious questions regarding **carbon dependency**. Maximizing carbon flows and using flexible mechanisms would increase EU **carbon dependency** on Russia, creating serious new vulnerabilities for EU climate policy.
- However, the *independence* scenario requires rapid changes to the efficiency of energy supply and use, and a radical shift to renewable energy supply. There is a widespread belief that such a change may to be too large a shock for political, social and economic systems to withstand.
- Interestingly, even a combined or middle-way approach – including some carbon trade, increased natural gas from the FSU, and renewables expansion and energy efficiency in the EU-28 - still requires significantly more rapid change than is currently planned if a 30% cut in EU carbon emissions is to be achieved by 2030.
- Market liberalization brings a new market-driven approach to flexibility of energy supply. Looking to the future of opening to competition markets of both the enlarged Europe and Russia, price will be only one of the instruments to balance supply and demand. Today, the energy security is not only about reducing the level of energy imports and managing the associated risks, but also about high investment in infrastructure and diversification of energy suppliers. An open access to infrastructure will offer incentives to use it very intensively and to reduce the costs.
- Kuik, O., Berkhout, F., Wieczorek, A., "Russian Carbon and Europe's Climate" Special issue of the International Environmental Agreements: Politics, Law and Economics, Vol 3, no 3 2003, Kluwer, the Netherlands.

Project results:

1. IHDP-IT Report No. 26:Carbon Flows between Eastern and Western Europe (CFEWE), Final Report
   September 2002, Amsterdam, The Netherlands (pdf 1.3Mb)
2. IHDP-IT Report No. 25:Carbon Flows between Eastern and Western Europe (CFEWE), Report on the Second Workshop
   October 2002, Amsterdam, The Netherlands (doc 1.3Mb)
3. IHDP-IT Report No. 20:Carbon Flows between Eastern and Western Europe (CFEWE), Report on the First Workshop
   July 2001, Milan, Italy (pdf, 1.1Mb)
4. EPCEM Report Number 2002-1:
   The role of biomass in carbon flows between Eastern and Western Europe: potential and perspectives
   May 2002, Amsterdam, The Netherlands (pdf 1.2Mb)
   This report is a result of collaboration with a project team of the European Postgraduate Course in Environmental Management (EPCEM 2001/2002)
5. Report on the CFEWE project by Nina Poussenkova (RAS) and Anna Wieczorek (IHDP-IT), in IHDP Update No. 2 2002
6. Report on the first workshop by Polina Averianova (FEEM), in FEEM newsletter No. 2 December 2001
7. CFEWE Brochure
8. CFEWE Posters

The Sustainability of Large Scale International Trade of Energy from Biomass Potentials, Options, Criteria and Implementation for Large Scale Export of Energy from Biomass from the MERCOSUR to NW-Europe

IT Research Project
No. A/2001/03

Partners:

- Department of Science, Technology & Society, Utrecht University, The Netherlands.
- Institute of Environmental Studies (IVM), Vrije Universiteit, The Netherlands.

Goal of the Project

Altogether, bio-trade schemes have a very large potential to mitigate greenhouse gas emissions and contribute to sustainable development. Thus, in general, international bio-energy trade has very promising prospects and could in fact be a key component of the future world's energy system. However, when the bio-trade schemes fail to meet stringent objectives on a multitude of criteria, public support for them may dwindle soon. Therefore, considering large-scale implementation of such schemes requires answering a large number of (research) questions covering ecological, social and economic dimensions.

Project Results

Faaij, A., Minnesma, M. & Wieczorek, A. (2003), "Sustainability of Large Scale International Trade in Energy from Biomass" - Amsterdam, report international workshop

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New Econometric Model for Environment and Strategies Implementation for Sustainable development (NEMESIS)

IT Research Project
No. A/2001/04

Partners:

- Center for Marine and Climate Research, University of Hamburg, Germany.
- Fondazione Eni Enrico Mattei (FEEM), Italy.
- Institute for Environmental Studies, Vrije Universiteit, The

Netherlands.

The overall NEMESIS project aims at providing researchers and policy makers with a better understanding of the short-, medium-, and long-term effects on the economy of environmental policies. Due attention is paid to induced (or endogenous) technological change. The project consists of two subprojects. The first subproject: 'New Econometric Models' (NEMESIS/NEM) specifically aims at the development of new econometric models to complement the studies based on general equilibrium (GE) models, applied in the second subproject: 'Endogenous Technological Change' (NEMESIS/ETC). Econometric models have the advantage that they are econometrically estimated, based on empirical data, and therefore they are well suited for short- and medium-term forecasts. The GE-models are more often based on calibration techniques, and focus on the economic mechanisms that drive economic development. This annex specifically describes the ETC-subproject. The NEM-subproject is described as part of the annex for the overall project. The linkages between the two projects can also be find in the overall project description.

Endogenous Technological Change (ETC)

Recent results of theoretical and empirical modeling suggest that recognising the endogenous nature of technological innovation substantially modifies the presumed impact, on both the environment and the economy, of environmental policies. This project's objective is to research endogenous technological change (ETC) in the economic modeling of environmental problems such as global warming. The objectives of and actions carried out under the project are:

- The comparison of different approaches to ETC, including learning, innovation, diffusion and spill-overs;
- The development of an integrated approach to ETC that encompasses the positive features of existing approaches;
- The use of different models of ETC, including newly developed models, to quantify the role of ETC in controlling climate changes and to assess its interactions with climate policies;
- The analysis of different policy tools to foster climate related technical change and its diffusion;
- The integrated evaluation of a policy mix designed to achieve multiple objectives (growth, innovation and diffusion of technical change, emission reduction, employment) with the end of creating the conditions for a global action on climate change control.

The socio-economic impact is determined of policies designed to bring about an accelerated development and deployment of new non-carbon and renewable energy technologies. The sustainability aspects are analysed and published in a number of publications and presented in successive workshops, organised by the project participants. Policy relevant findings are formulated that are communicated to national governments and the European Union, international organisations and industry, allowing them to promote a radical technological energy transformation in a cost-effective way.

An Asian Dilemma

IT Research Project
No. A/2001/07

Partners:

- Institute of Environmental Studies, Vrije Universiteit, The Netherlands.
- Department of Science, Technology and Society, Utrecht University, The Netherlands.
- Institute for Environment and Climate Research, Wageningen Agricultural University, The Netherlands.

The research question dealt with in this project is: What are the feasible policy and technology options to modernise the electricity sector in China and India taking into account the supply and demand for electricity and given the conflict between the need for economic growth and the need to anticipate future developments in relation to the reduction of greenhouse gas emissions?

The project essentially integrates three methodological approaches, a scenario approach, a bottom-up technology approach and an institutional cum stakeholder approach. Following an initial appraisal of the 'business-as-usual' scenario for the electricity sector for both countries, a range of policy and technology options was identified, as well as their potential and technical, economic and political feasibility. These options were combined and compared to the business-as-usual scenario to develop emission reduction scenarios for China and India and were tested with stakeholders to identify their feasibility and to assess the potential of using instruments at national and international level to facilitate their implementation.

The report concludes that although climate change is not a priority for these countries, the measures taken since 1990 are likely to lead to greater electricity efficiency and increased investments in renewables, which in turn would result in the reduction of greenhouse gas emissions. This shows that both countries are now decoupling their emissions from their output. The study shows that for both countries, in fact, the energy (but not necessarily electricity) consumption per tonne of product in the end use sectors has reduced significantly between 1990 and 2000. The Business-as-usual (BAU) (2000) scenarios used in this project also indicate that the earlier projections made by researchers about the future had to be revised downwards as a result of the adoption of these policies. Thus although the countries are unwilling *de jure* to take on commitments, they are *de facto* making progress.

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The Business-As-Usual scenario for the electricity sector shows that emissions of greenhouse gases from the power sector in China and India are calculated to increase by a factor of three to four respectively between 1990 and 2020 in the BAU scenario, while total electricity production increases by a factor of five, illustrating that total emissions per unit of electricity are expected to decrease considerably over time. The maximum potential energy savings on top of the energy savings already included in the BAU scenario is around 30% for the two countries in 2020. This implies a reduction in the rate of growth of demand for electricity which means that a total reduction of up to 45% of greenhouse gas and sulphur dioxide emissions relative to the BAU scenario is possible by making maximum use of the possibilities to improve energy efficiency.

The analysis of the potential effect of a number of strategies to reduce emissions of greenhouse gases (CO_2, CH_4 and N_2O) and sulphur dioxide from the power sector in China and India indicates that fuel switch, closing small power plants, efficiency improvement in power plants, increasing use of cogen and reduction of technical losses in T&D can reduce emissions by 1 – 45% for both countries.

Although some measures have a high technical potential for reducing greenhouse gas emissions in both countries, these are not seen as particularly feasible by the stakeholders. For example end use efficiency has a very high technical emission to reduce emissions but is not given much priority in China and India (especially in the small-scale sector). Efficiency improvement in power plants and in transmission and distribution can also yield results in terms of emission reductions but are not seen as important in China. The project discusses the barriers and opportunities in relation to the various options.

Copies of the final report are available from IVM. Please e-mail Ineke Ligterinkfor copies.

See the project website for more information.

Technology Innovation for Global Change: Role of Assessment, R&D, and Regulation

IT Contributing Project No. A/2001/10

Partners:

- John F. Kennedy School of Government, Harvard, United States.

This research seeks to better understand how and under what conditions public policy can effectively and efficiently support and stimulate private sector investments in the development and adoption of cleaner energy technologies. Our focus is on three causal pathways through which government policy can influence strategic R&D decisions of firms: (a) demand-pull policies, which are aimed at creating/expanding markets for new technologies, such as production tax incentives, information dissemination, technical assistance, and market development for overseas investments; (b) supply-push policies, which increase direct

investments in R&D, including public funding of R&D and R&D tax incentives; and (c) assessment activities, which develop credible information regarding current or possible future environmental impacts from products or processes, for example, linked to concerns about global climate change. We do not expect to find that any of these pathways dominate in all instances. Rather, our interest is in understanding the conditions under which, and ways in which, each pathway and the interplay among them affects firms' R&D investment behavio0r. By improving our understanding of the conditions under which these potential pathways of public influence on private investment actually work, we hope to provide some practical guidance to those faced with the task of promoting technological innovation for managing global environmental change.

This research is empirical, historical and comparative. It focuses on 30-year histories of the development of three technologies: gas turbines, wind turbines and solar photovoltaics. We are exploring the issues discussed above by examining the decisions of firms to invest in innovation and/or become lead adopters of these three "clean" energy technologies. We plan to conduct interviews in 3 to 5 firms for each of the three technologies. In addition, we will be interviewing government officials and undertaking extensive archival work.

See the project website for more information.

Energy Self-Sufficiency in the Countryside of Central Finland

IT Contributing Project No. A/2001/15

Partners:

- Department of Biological and Environmental Sciences, University of Jyväskylä, Finland.

The purpose of this project is to produce national examples of synergetic solutions of societal problems and a business model that can offer such solutions. The project includes technology development, demonstration and transfer and analysis of societal obstacles of technological change.

Societies have large impact in many natural biogeochemical cycles. Mankind has strengthened carbon cycle by a third, doubled nitrogen cycle and has influence to over half of the hydrological cycle. This has resulted in serious negative side effects on nature and societies, such as pollution of air and water, climate change and declining biodiversity. In the future the risks of additional damages increase.

On the other hand, technological solutions to these problems exist in abundance. But they are often not used even if they are competitive or even if they would have a very short payback time.

The most important part of this project is biogas technology, i.e. development, use and analyses of obstacles in its use. After first year of operation other distributed energy generation technologies will be added to the project. The project is divided into three interacting programmes in the fields of technology, science and social sciences. The project will be a part of the activities of a multidisciplinary renewable energy institute that will be established at University of Jyväskylä in 2002.

The multidisciplinary project studies technological possibilities for increasing energy self-sufficiency in the countryside of district of Central Finland. Obstacles preventing technological change into using more environmentally benign local renewable energy sources are studied and means to overcome them are suggested. Technological pilot projects are carried out in selected farms, houses, small companies and municipalities. Scientific research is conducted in the bottlenecks of the introduced technologies.

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Understanding Biocomplexity: Developing Methods of Defining Sustainable Uses for Agricultural Products

IT Contributing Project No. A/2002/01

Partners:

- Office of Biorenewables Programs, Iowa State University, United States.

The transition to a sustainable raw material base will be one of the most important challenges facing society in the 21st century. As part of this endeavor, substantial increases in the use of biomass-derived feedstock in the chemical industry are expected over the next 50 years. This project is aimed at developing the people, skills and tools needed for understanding the system-wide sustainability of bio-based products.

One task of the project was hosting a two-day international workshop on assessing the sustainability of bio-based products. The team developed background materials for workshop participants that included a survey of the technologies that underlie bio-based material production and a survey of the literature on bio-based material assessment techniques and sustainability indicators. Some results of the workshop have been presented in a conference report published in the International Journal of Life Cycle Assessment.

Drawing on the expertise of the interdisciplinary research team, the literature, and the output of the consensus workshop, the team has developed a framework for evaluating the complex environmental-social-industrial system comprising bio-based material production, use, and end-of-life disposition.

The team is now applying the evaluation framework to several bio-based products as case studies. Tasks include defining potential bio-based products in terms of feedstock used, processing technology, and final uses; defining technical and economic characteristics of selected products; and production of case studies applying assessment techniques to the selected products.

The team will be working throughout the project with the Authentic Teaching Alliance (ATA) to prepare a teaching module appropriate for secondary math and science classes. A team of two ATA Fellows and one secondary math or science teacher will partner with our team to develop and evaluate a learning module. This module will serve as a template for planned future module development. Case studies applying the evaluation framework to the life cycle of several bio-based materials will also be distributed as education resources.

See the project website for more information.

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Steps towards a 2000 Watt-Society. Developing a White Paper on Research & Development of Energy-Efficient Technologies.

IT Contributing Project No. A/2003/01

Partners:

- Eidgenössische Technische Hochschule Zürich (ETHZ), Germany;
- Ecole polytechnique fédérale de Lausanne (EPFL), France;
- Paul Scherrer Institute (PSI), Germany;
- Swiss Federal Laboratories for Materials Testing and Research (MPA), Switzerland.

The project fills an important gap in present day mainstream research on new renewable fuels to reduce CO2 emissions. The transition from a 6000 to a 2000-Watt per capita is a major transition and thus requires both technological and institutional change. When other renewable fuels come in, a more efficient energy economy will support the introduction of low CO_2 energy systems. The research questions of your initiative strongly relate to *Energy and Material Flows* focus of IT and the issue of systemic change.

Through national and international interdisciplinary research and advisory activities, the Centre for Energy Policy and Economics (CEPE) is developing new concepts for identifying promising technologies and entrepreneurial innovations as well as new policy concepts for governments, companies and trade associations; it points out opportunities, risks, and obstacles related to developments in energy technology and industry, suggests necessary transformations, and contributes to energy innovations in business and technology. Sustainable energy systems, energy efficiency and industrial transformation towards increased resource efficiency and dematerialization are corner stones for collaboration or co-operation within the IHDP IT network.

See the project website for more information.

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Sustainable fuels for transport. Risks and challenges on the road to the hydrogen economy

IT Contributing Project
No. A/2003/02

Partners:

- CSIRO, Commonwealth Scientific and Industrial Research Organisation.

The aim of this network is to bring together researchers who can examine, from a multi-disciplinary perspective, the potential risks, economic challenges and environmental considerations involved with the possible transition pathways from fossil fuel based transport to sustainable transport.

Background
Access to inexpensive transport is a cornerstone of Western society, shaping both our economic structures and our national cultures. With increasing economic growth, urbanisation, and globalisation of commerce, rapid innovations in telecommunications and related technology, the role of transport in our lifestyles can only be expected to gain in importance.
Transport is enabled by the extraction and use of natural resources. The unprecedented growth of transport in the last century, however, has had strong repercussions upon the resource use and environmental quality. Addressing the intensity of energy use is a high priority issue in Australia, especially the increasing dependence on imported fossil fuels and the associated national security implications.
Alternative fuels can relieve such problems and hydrogen (H2) is likely to be a crucial fuel in the longer term. But, in the interim, as oil becomes more expensive and the infrastructure for the hydrogen economy is not in place, there will need to be a large scale transition to alternative fuels such as biofuels (biodiesel, ethanol), liquefied petroleum gas (LPG), compressed natural gas (CNG), or liquefied natural gas (LNG).Similarly, concerns regarding the transport sector's impacts on quality of natural environment (air and water pollution, climate change, fragmented habitats, ecosystem imbalances, and resulting losses of wildlife and biodiversity) and the built environment will determine the acceptability of alternative fuels.

Research remains critical to defining new approaches, solving problems, and applying new techniques and methodologies for more effective use of current resources to ensure an

ecologically sustainable transport infrastructure. The nature of the problems suggests multi-disciplinary research as no single discipline can adequately encompass the full spectrum of knowledge required to identify potential solutions.

Research questions

The innovative nature of the network will be manifested through the feasibility analysis of alternative fuels and pathways for large-scale adoption and implementation. The environmental balance sheet of new fuels depends substantially on large numbers of micro-decisions by consumers and suppliers. This requires a broader vision of the links between transport and sustainability, embedding research on social and decision sciences. This will have impact on crafting and promoting policy structures to encourage and accelerate the adoption.

The network will explore manufacturers and fuel providers on the market, and the role of government policy in counteracting market failures. In addressing the environmental benefits of new fuels, research will incorporate the role of emission inventories on the accuracy of air pollution modelling results. Additional emphasis will be placed on the effects of transport emissions on human health.

Outcomes

The network is viewed as a live open system that grows, pushes its borders, and assimilates continuously new actors from Australia and overseas. The direct outcomes and outputs of the network are:

- Creating and supporting opportunities for researchers and research students to work together, identify the most important sustainability research problems, and develop methods to solve these problems;
- Facilitating deep exploration of common and complementary approaches to the problem from numerous disciplinary perspectives;
- Opening new avenues for contact between researchers and practitioners, government and community that have interests in the research portfolio or the outcomes of the research;
- Supporting Australian-initiated research activities in an international setting; participation in international research programs or networks;
- Development of shared technologies for communication and interaction, knowledge management tools, new databases.

We foresee significant benefits for Australia from both methodological/theoretical and practical results.

The issues addressed by the network are critical for Australia and the Government initiatives and community voices confirm this. The inter-disciplinary research shared within the network and with the "outside world" will lead to:

- better understanding of the mechanisms of choice and possibility of designing "tailored" solutions for Australian automobile market;
- providing informed decision support systems to Government for "pump priming" in the triad: vehicle technology - fuel availability - consumer adoption;
- developing analytical tools for assessing the multi-dimensional impact of adoption and implementation of alternative fuels.

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Exploring the Conditions for Adapting Existing Techno-industrial Processes to Ecological Premises - CondEcol

IT Contributing Project No. A/2004/01

Partners:

- ProSus (Programme for Research and Documentation for a Sustainable Society), Centre for Development and the Environment, University of Oslo (IT Partner Institute), Norway

Overview and Goal of the Project

The research project CondEcol is structured as a multi-disciplinary study of the conditions for moving existing production and consumption patterns in the direction of sustainable development. In accordance with the focus of RAMBU, this will be achieved through knowledge-sharing and partnership with industry. Working closely in the initial phase with two industrial partners, the project is given access to high-profile cases of technology and product development as an empirical basis for identifying factors that may hinder or promote innovation and diffusion of new technologies with a high eco-efficiency potential. Using the Industrial Ecology approach as an academic framework, and looking to socio-economic analysis and the network approach to environmental management, the aim is to seek a deeper understanding of the barriers and possibilities for industrial transformation of production, distribution and consumption.

The principal objective for CondEcol is to produce a better understanding of the factors that hinder or promote a more effective transformation towards sustainable production and consumption in business sectors with high energy-environment impact.

The specific sub-goals of the project are to develop:

1. New perspectives on industrial planning and decision-making with respect to the introduction and consolidation of more eco-efficient products and processes;
2. An interactive network model derived from case-studies of innovation processes which will (1) focus the responsibilities of interdependent actors in specific product-market constellations, and (2) allow for a better identification of obstacles to, and potentials for, greater eco-efficiency;

3. A set of practical guidelines and procedures for effectively disseminating the lessons and implications of the project to relevant strategic actors: managers, authorities, labour leaders and NGOs.

Background

The underlying concept of the project is that the innovation model will encompass new concepts and ideas supplementary to conventional business management and strategic thinking in the areas in question, and that the lessons learned will have general viability for the introduction of more sustainable production and consumption.

An important contribution in promoting sustainability is to look for solutions that reduce the environmental strain per consumed unit (eco-efficiency), and to "de-couple" economic growth from environmental impacts. Public authorities and private enterprises have placed these ideas on the agenda, and pragmatic discourse within the field of industrial ecology is already underway.

In the initial phase of the project three cases will be mapped and synthesized according to the project research protocol:

- Heating and cooling technology based on CO2 - Shecco - A heating and cooling technology that will reduce emissions of GHG from heat pumps significantly by replacing HFCs with natural carbon dioxide reused from industry;
- Wafer technology for solar panels - Scanwafer - Cost and energy effective production of silica wafers for the solar panel industry. Contributing to a truly renewable energy technology;
- Hydrogen energy plant with CO2 handling - HydroKraft - Hydrogen extracted from natural gas. The technology produces hydrogen suitable for combustion in existing turbine technology and enables injection of "pure" CO2 in oil reservoirs on the Norwegian Continental Shelf. Besides producing eco-efficient energy HydroKraft may function as a stepping stone towards a "hydrogen society".

With the selected cases as a highly relevant point of departure, the project aims to contribute significantly to this discourse. Of particular importance in this regard, is the fact that the cases in question involve major attempts by industrial actors to introduce more eco-efficient technologies, and that it is the actors themselves who experience, and problematize, the obstacles encountered. Insights from the social sciences have only recently come to bear on decision-making in business, so that the output of the project should have relevance for promoting more sustainable processes of change internally in firms as well as in the market and society as a whole.

A new report is available (PDF).