

ANNUAL REPORT 2009

Indicator Framework for Eco-Efficiency (IFEE) – Consortium

RESEARCHERS OF THE CONSORTIUM

Partner 1: *Åbo Akademi University (ÅA)*, Coordinator of the consortium:

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Partner 2: *Turku School of Economics and Business Administration, Finland Futures Research Centre (FFRC)*:

Jarmo Vehmas, Senior Researcher

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Marileena Koskela, PhD student

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Pekka Kauppi, Professor

Laura Saikku, Ph.D student

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UPDATED SYNOPSIS OF THE PROJECT

Many metrics and indicators exist to evaluate eco-efficiency (EE) of products, processes, organisations, or of larger systems. EE is defined as *units of value generation per unit of environmental influence*. EE applications that are not strategic and lead to problem shifting have been recently observed. We use the strategic sustainable development model (SSD) constructed in consensus by ten pioneering sustainability scientists. The aim of SSD is to prevent problem shifting and problem displacement when different sustainability concepts and approaches are used. *The objective is to develop an indicator framework for eco-efficiency*. Six hypotheses on the limitations of EE are considered in an explorative conceptual analysis of EE against SSD. Different EE indicators are studied to learn how they can be used in the evaluation of the six hypotheses. We apply the results in 'what if?' scenarios with case study data from VTT Finland, Statistics Finland, Finland Futures Research Centre, mainly from the forest industry of Finland. In case of each hypothesis, the results are transformed into criteria producing the indicator framework. The framework enables parallel and complementary use of different indicators to study where and how EE can be applied and where it cannot be applied.

PUBLICATIONS AND PRESENTATIONS

Articles published and accepted in peer-reviewed international scientific journals

Melanen, M. & Korhonen, J. 2009. Editorial II: The dimensions of industrial symbioses and their system boundaries. *Progress in Industrial Ecology – An International Journal*, Vol. 6 No 1. pp. 1-10.

Korhonen, J. and Baumgartner, R. 2009. The industrial ecosystem balanced scorecard. *International Journal of Innovation and Sustainable Development*. Volume 4 Number 1. pp. 24-42.

Kirkinen, J., Soimakallio, S., Mäkinen, T. & Savolainen, I. Greenhouse impact assessment of peat-based Fischer-Tropsch diesel life-cycle Energy Policy, Volume 38, Issue 1, January 2010, Pages 301-311

Kirkinen, J., Sahay, A. & Savolainen, I. Greenhouse Impact of Fossil, Forest Residues and Jatropha diesel: A Static and Dynamic Assessment. *Progress in Industrial Ecology, An International Journal* 2009 - Vol. 6, No.2 pp. 185 – 206

Peters, G., Marland, G., Hertwich, E., Saikku, L., Rautiainen, A. & Kauppi, P.E. 2009. Trade, Transport, and Sinks Extend the Carbon Dioxide Responsibility of Countries. An editorial essay. *Climatic Change*, 97 (3-4), 379-388.

Rautiainen, A., Saikku, L. & Kauppi, P. 2009. Carbon gains and recovery from degradation of forest biomass in European Union during 1990 to 2005. *Forest Ecology and Management*, in press.

Kauppi P. E., Rautiainen, A., Korhonen K. T., Lehtonen A., Liski J., Nöjd, P., Tuominen S., Haakana M. & Virtanen T. 2009 Changing stock of biomass carbon in a boreal forest over 93 year. *Forest Ecology and Managements*, in press.

Saikku, L. & Asmala, E. Eutrophication in the Baltic Sea: The role of fish consumption and international trade. *Journal of Industrial Ecology*, in press.

Asmala, E. & Saikku, L. Closing a loop: substance flow analysis of nitrogen and phosphorus in the Finnish marine aquaculture. *Ambio*, in press.

Vehmas, Jarmo (2009) Decomposition analysis of CO₂ emissions from fuel combustion in selected countries. *International Journal of Environmental Technology and Management* 11:1/2/3, 47-67. Special Issue on Assessment and Modelling of Environmental Resources and Risks, Guest Editors: Peter Nijkamp and Daniela-Luminita Constantin.

Manuscripts submitted to peer-reviewed international scientific journals

Baumgartner, R. & Korhonen, J. Toward Strategic Thinking in Sustainable Development. *Sustainable Development*. Accepted on December, 2009.

Pakarinen, S., Mattila, T., Melanen, M., Nissinen, A. & Sokka, L. Sustainability and industrial symbiosis – the evolution of a Finnish forest industry complex. Manuscript, submitted to *Resources, Conservation and Recycling*, November 2009.

Mattila, T., Pakarinen, S. & Sokka, L. Quantifying the external impacts of an industrial symbiosis with hybrid life cycle assessment. Manuscript, submitted to *Environmental Science & Technology*, September 2009.

Ekholm, T., Krey, V., Riahi, K. & Pachauri, S. Determinants of household energy consumption in India, *Energy Policy*, December 2009.

Vehmas, Jarmo & Luukkanen, Jyrki & Kaivo-oja, Jari (2009). Benchmarking CO₂ emissions from fuel combustion in the ASEAN countries: Decomposition analysis of changes in 1980-2005. Submitted to *Energy Policy*, 15.9.2009.

Edited international journals applying the referee-practice

Other publications

Pakarinen, S. & Sokka, L. Kilpailukykyä ja ympäristönsuojelua – Ekoteollisen puiston mahdollisuudet ilmastonmuutoksen hillinnässä. *BioEnergia* 5/2009.

Kauppi, P.E. & Saikku, L. 2009. Biofuels: Forest and Carbon. *Letter. Science* 326, 1345.

Koskela, Marileena & Vinnari, Markus (eds.) (2009) Future of the Consumer Society. Proceedings of the Conference "Future of the Consumer Society", 28–29 May 2009, Tampere, Finland. FFRC eBooks 7/2009. Finland Futures Research Centre, Turku School of Economics.

Luukkanen, Jyrki & Vehmas, Jarmo & Mustonen, Suvisanna & Allievi, Francesca & Karjalainen, Anne & Värttö, Mikko & Ahoniemi, Maria (2009). Finnish Energy Industries – Energy Scenarios and Visions for the Future. Background Report. Turku School of Economics, Finland Futures Research Centre, FFRC eBook 10/2009.

Conference presentations

Professor Jouni Korhonen was a keynote speaker of *Corporate Social Responsibility – where ethics meet business practice in the global economy*, Trondheim, Norway, August 13, 2009 and he was the Chairman of the conference on *Systems Analysis and Systems Diagnosis*, Trondheim, Norway, August, 2009.

Professor Jouni Korhonen was the opponent of the Ph.D. dissertation of Aleksander Dahlsrud at Norwegian university of science and technology (NTNU) in Trondheim, August, 2009. Dahlsrud, Alexander. Corporate social responsibility as a business contribution to sustainable development. A study based on data from the Norwegian shipping industry. Doctoral Thesis IØT, NTNU 2009:142

Rupert Baumgartner was a keynote speaker of Finnish Society for Industrial Ecology conference *Window of Opportunity for Real Change*, Åbo Akademi University, Turku, Finland, December 2009.

Baumgartner, Rupert J.: The strategic relevance of sustainability concepts: implications for corporate sustainability management. *Corporate Responsibility Research Conference*, Vaasa, Finland, September 8, 2009

Baumgartner, Rupert J.: Corporate Sustainability Analysis: Measuring Eco-Efficiency and Eco-Effectiveness in Production Systems. *15th International Sustainable Development Research Conference* International Sustainable Development Research Society - Utrecht, Netherlands, July 6, 2009

Asmala, E. & Saikku, L. 2009. Fish consumption and eutrophication – nutrient emissions from rainbow trout aquaculture. The Baltic Sea Science Congress. August 17-21, 2009, Tallinn, Estonia.

Saikku, L. & Mickos, M. 2009. Implications of international trade in the Finnish forest industry carbon balance. 5th international conference on industrial ecology. 21-24 June 2009. Book of abstracts, p. 353.

Asmala, E. & Saikku, L. 2009. Closing a loop: substance flow analysis of nitrogen and phosphorus in the Finnish coastal aquaculture. 5th international conference on industrial ecology. 21-24 June 2009. Book of abstracts, p. 195

Koskela, Marileena (2009) Eco-Efficiency in Environmental Reporting in Finnish Forest Industry. In: Koskela, Marileena & Vinnari, Markus (eds.) (2009) Future of the Consumer Society. Proceedings of the Conference "Future of the Consumer Society", 28–29 May 2009, Tampere, Finland. FFRC eBooks 7/2009. Finland Futures Research Centre, Turku School of Economics. p. 111-116.

OTHER ACTIVITIES

Organised International Scientific Conferences

FFRC organized the 11th International Conference of Finland Futures Research Centre and Finland Futures Academy titled *Future of the Consumer Society* at University of Tampere on May 28-29, 2009. PhD student Marileena Koskela was a member of the organizing committee, author of a conference paper and co-editor of the published conference proceedings. Dr. Vehmas was a reviewer of the conference papers. A special issue related to the conference theme is under discussion with Progress in Industrial Ecology.

The Åbo Akademi team arranged the annual conference of the Finnish Society for Industrial Ecology (<http://www.teollinenekologia.fi>) together with FINLCA research consortium. The conference was held on December 14-15, 2009 at Åbo Akademi University, Turku, Finland. The theme of the conference was 'Window of Opportunity for Real Change' and the program included keynotes e.g. from Prof. Karl Henrik Robért and Prof. Jyri-Pekka Mikkola. The conference had some 80 participants.

Organised Domestic Scientific Conferences

Research visits

PhD Student Marileena Koskela (FFRC), researcher exchange in the Center for Technology and Society at Technical University of Berlin, Germany, 5.10.-31.12.2009.

Research seminar with the group of Prof. Karl-Henrik Robèrt (Blekinge Institute of Technology, Sweden) in October: Framework of Strategic Sustainable Development; Application of this framework in Life Cycle Assessment.

Editorial activities (peer-reviewed international scientific journals)

Kauppi is a member of the editorial board of *Environmental Science and Policy* (Elsevier Science).

Dr. Vehmas and Dr. Luukkanen are members of the editorial board of *Progress in Industrial Ecology*.

Editing a Triple Special Issue on 'System Boundaries of Industrial Symbiosis' for *Progress in Industrial Ecology – An International Journal (PIE)*, Matti Melanen as Guest Editor. The second part of the issue materialized as *PIE*, Vol. 6 (2009), No. 1. (The first part: *PIE*, Vol. 5 (2008), Nos. 5 and 6.) The Special Issue comprises 12 peer reviewed article contributions and an editorial article written by Matti Melanen and Jouni Korhonen.

Matti Melanen and Jouni Korhonen as members of the Guest Editorial Team, Special Issue on 'The Role of Academia In Regional Sustainability Initiatives', *Journal of Cleaner Production*, Vol. 17 (2009).

Korhonen, J. Editor in Chief, *Progress in Industrial Ecology – An International Journal*. Six issues in 2009.

Volume 6 – Issue 1 – 2009 Special Issue on System Boundaries of Industrial Symbioses: Part 2

Volume 6 – Issue 2 – 2009

Volume 6 – Issue 3&4 – 2009 Strategic Sustainable Development

Volume 6 – Issue 5&6– 2009 Consumer Society and Future of Sustainability

Baumgartner, R. Subject Editor, *Journal of Cleaner Production – An International Journal*.

Referee activities (peer-reviewed international scientific journals)

Jouni Korhonen is a reviewer of about 50 scientific articles in *Progress in Industrial Ecology* (Editor-in-Chief), *Journal of Cleaner Production* (Associate Editor), *Business Strategy and the Environment*, *Sustainable Development*, *Corporate Social Responsibility and Environmental Management* and the *International Journal of Innovation and Sustainable Development* (Member of the editorial board)

Rupert Baumgartner is a referee in international peer reviewed journals of *Journal of Cleaner Production* and *Sustainable Development*.

In relation to eco-efficiency and the FFRC duties in IFEE, Dr. Vehmas has reviewed 2 article manuscripts to *Energy Policy*, one manuscript to *Environmental Science & Policy*, one manuscript to *Progress in Industrial Ecology*, and two papers to the conference *Future of the Consumer Society*, Tampere 28-29 May 2009.

PROGRESS MADE IN RELATION TO THE PROJECT PLAN

IFEE consortium was started in January 2006. The publications of the coordinator, Åbo Akademi team, as well as of the partners of the consortium are attached to this intermediate report. The ÅA team has found, and argued with documentation, that eco-efficiency indeed is a problematic approach both in theory as well as in practice. The resilience concept has been put forward to critically analyse eco-efficiency. The ÅA team has engaged international networks and published a journal double special issue (guest editor Dr. Hoffren) on 'Strategic Eco-Efficiency' (*PIE*, Inderscience Publishers). It has also been observed that majority of eco-efficiency research has taken place in natural science/engineering communities while the social science, e.g. management or organisational approaches are largely missing from the discourse. The ÅA team published a special issue in *Journal of Cleaner Production* in 2007 addressing this problem. The ÅA team has annually organised international research conferences on the

theme, e.g. with the International Sustainable Development Research Society (www.isdrs.org) and the Finnish Society for Industrial Ecology (www.teollinenekologia.fi).

PhD student Johanna Kirkinen has submitted her doctoral thesis "Greenhouse impact assessment of some biogenic fuels - methodological aspects and examples" for prereview.

At VTT, Ph.D. student Laura Sokka participated in writing two manuscripts on the environmental impacts of a forest-industry eco-industrial park, and also began writing the summary of her Ph.D. thesis. In addition, Ph.D. student Tommi Ekholm finalized his paper analyzing the prerequisites for improving energy efficiency in developing countries, with a special focus on India.

At Turku School of Economics, Finland Futures Research Centre, PhD student, M.Sc. (Eng.) Marileena Koskela has proceeded in the preparation of her PhD thesis following her research plan under supervision of Dr. Jarmo Vehmas and Tampere University of Technology. Her PhD thesis focuses on eco-efficiency and corporate social responsibility in forest industry. She has written manuscripts for articles to be included in the PhD thesis, and given related presentation in one international conference where she was also one of the central organizers.

At university of Helsinki, during the third year of the project, many articles written in the project during 2008 and 2009 were published. Carbon sinks were studied in relation to climate policy. Forest sinks in Europe were addressed and the implication of forest sinks in relation to climate change was discussed. The ImPACT model was applied to study eco-efficiency of fisheries as well and also a substance flow analysis related to fish farming was performed.

Turku, January 15, 2010

Jouni Korhonen