

ANNUAL REPORT 2009
Industrial Symbiosis System Boundaries (ISSB) – Consortium



RESEARCHERS OF THE CONSORTIUM

Subproject 1: Conceptual Analysis of Industrial Symbiosis System Boundaries, Åbo Akademi University:

- Jouni Korhonen, Academy Fellow (in charge of Subproject 1)
- Rupert Baumgartner, Senior Researcher
- Kaisa Pihlatie, Researcher

Subproject 2: Modelling Industrial Symbiosis System Boundaries, Finnish Environment Institute SYKE:

- Matti Melanen, Research Professor (in charge of Subproject 2)
- Laura Sokka, Researcher, PhD student (until March 9, 2009)
- Suvi Pakarinen, Researcher (from March 9, 2009 onwards)
- Tuomas Mattila, Researcher, PhD student
- Ari Nissinen, Senior Researcher

UPDATED SYNOPSIS OF THE PROJECT

Studies of environmental performance of industrial symbiosis (IS) systems usually concentrate on one or a limited number of factors or individual actors or organizations. IS often uses a narrow approach to system boundaries considering just the impacts taking place within the arbitrarily defined symbiosis boundaries. These hypotheses are now verified through exploration orientated literature and conceptual analyses. Tools potential for quantitative assessments of industrial systems have developed rapidly in recent years – both in number and in capacity. However, the ISSB consortium observes that such tools are usually developed in a universal sense, i.e., not designed to the specific conditional and contextual factors of IS networks. The main research questions of the project are as follows:

- *How should the system boundaries be accounted for in the definition and development of industrial symbiosis systems?*
- *How can the environmental performance and sustainability of ISs be evaluated?*

An IS case system for this study has been chosen from the Kymenlaakso Region located in South East Finland. The case IS system consists of an industrial complex developed around the UPM Kymmene Kymi paper mill. Using data and research findings from this case and relevant literature, a framework is developed through which the environmental performance and overall sustainability of IS networks can be assessed.

PUBLICATIONS AND PRESENTATIONS

Articles published 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*, Volume 6 Number 1. pp. 1-10.
- Sokka, L., Pakarinen, S. & Melanen, M. 2009. Industrial symbiosis contributing to more sustainable energy use – an example from forest industry in Kymenlaakso, Finland. *Journal of Cleaner Production*. In press, available online 9 September 2009.
- Korhonen, J. & Baumgartner, R. 2009. The industrial ecosystem balanced scorecard. *International Journal of Innovation and Sustainable Development*. Volume 4 Number 1. pp. 24-42.

Manuscripts submitted to peer reviewed international scientific journals

- Sokka, L., Pakarinen, S., Nissinen, A. & Melanen, M. Analyzing the environmental benefits of an industrial symbiosis – life cycle assessment (LCA) applied to a Finnish forest industry complex. *Journal of Industrial Ecology*. Revised version submitted in December 2009.
- Mattila, T., Pakarinen, S. & Sokka, L. Quantifying the external impacts of an industrial symbiosis with hybrid life cycle assessment. *Environmental Science & Technology*. Revised version submitted in January 2010.
- Pakarinen, S., Mattila, T., Melanen, M., Nissinen, A. & Sokka, L. Sustainability and industrial symbiosis – the evolution of a Finnish forest industry complex. *Resources, Conservation and Recycling*. Submitted in November 2009.
- Baumgartner, R. & Korhonen, J. Toward Strategic Thinking in Sustainable Development. *Sustainable Development*. Accepted in December 2009.

International conference, poster and other presentations

- A poster presentation 'Kymi Eco-Industrial Park – historical evolution of an industrial symbiosis in Finland' (Sokka, L., Pakarinen, S., Melanen, M. & Nissinen, A.) at the *5th International Conference on Industrial Ecology*, Lisbon, Portugal, June 21-24, 2009. The poster abstract was published in the Book of Abstracts.
- 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 PhD dissertation of Alexander Dahlsrud at the 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 the 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.

Other publications

- Pakarinen, S. 2009. Energia- ja materiaalivirrat ekoteollisissa puistoissa – mahdollisuudet ilmastonmuutoksen hillinnässä [Energy and material flows in eco-industrial parks – the possibilities for curbing climate change]. Suomen ympäristökeskuksen raportteja 11/2009. (In Finnish with an English abstract.)
- Pakarinen, S. & Sokka, L. 2009. Kilpailukykyä ja ympäristönsuojelua – ekoteollisen puiston mahdollisuudet ilmastonmuutoksen hillinnässä [Competitiveness and environmental protection – eco-industrial park for climate change mitigation]. *BioEnergia* 5/2009, 32-34. (In Finnish.)

OTHER ACTIVITIES

Conference arrangement

- The ÅA team arranged the annual conference of the Finnish Society for Industrial Ecology (<http://www.teollinenekologia.fi>) together with the FINLCA research consortium. The conference was held on December 14-15, 2009 at the 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.

- Research seminar with the group of Prof. Karl-Henrik Robèrt (Blekinge Institute of Technology, Sweden) in October 2009: Framework of Strategic Sustainable Development; Application of this framework in Life Cycle Assessment.

Editorial activities (peer reviewed international scientific journals)

- Editing a Triple Special Issue on 'System Boundaries of Industrial Symbioses' 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*.

Referee activities (peer reviewed international scientific journals)

- Jouni Korhonen:
 - 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)
- Matti Melanen:
 - four reviews for *Journal of Cleaner Production*, one review for *Progress in Industrial Ecology – An International Journal*
- Laura Sokka:
 - one review for *Journal of Environmental Management*, one review for *Business Strategy and the Environment*, one review for *Progress in Industrial Ecology –An International Journal*
- Ari Nissinen:
 - one review for *Journal of Cleaner Production*

Website of the project

A website (in English) for the ISSB project was maintained: www.environment.fi/syke (> Research > Production and Consumption > Themes and projects ... > Industrial symbiosis system boundaries)

PROGRESS MADE IN RELATION TO THE PROJECT PLAN

The ÅA subproject, *Conceptual Analysis of Industrial Symbiosis System Boundaries*, started in January 2007. The most important results have been the triple special issue on 'System Boundaries of Industrial Symbioses' of *PIE* in 2008/2009. For this, we organized a special track in an international conference¹ and followed through with collaboration with the partners in manuscript drafting, evaluation, editing and publication processes. Dr. Korhonen and Dr. Baumgartner also published an article in the *International Journal of Innovation and Sustainable Development* on bridging the balanced scorecard with the common industrial ecosystem principles in 2009. Dr. Baumgartner and Dr. Korhonen have also been commissioned to publish a special issue in *Sustainable Development* on this broad theme. What is timely and very important for the continuation of our work is the fact that we achieved additional funding focusing on strategic life cycle assessment within the large TEKES consortium on Finnish Platform on Life Cycle Assessment (FINLCA) starting in summer 2009 and continuing until summer 2011.

¹ Track 10 "How Can Industrial Ecology Contribute to Regional Sustainability?" at the *13th Annual International Sustainable Development Research Conference*, Mälardalen University, Västerås, Sweden, June 10-12, 2007.

The ÅA subproject team will organize steps to brainstorm and develop a strategic vision for ecological sustainability of industrial ecosystems. We will engage into international peer-review utilizing the direct channels we have established. First, we will call for international research papers and oral platform presentations for the 16th Annual International Sustainable Development Research Conference in Hong Kong in 2010 of the International Sustainable Development Research Society (ISDRS, www.isdrs.org). Dr. Korhonen, the leader of the project, and Dr. Baumgartner, the main researcher, are key members of the board of ISDRS (Korhonen is the Chairman and Baumgartner a board member). Ms. Kaisa Pihlatie, the researcher of the project, is the coordinator of ISDRS. We will organize a special track at the conference on 'Visions of strategic sustainable development'. Second, we will ask the contributors of this workshop and also of other selected presentations at the conference to revise their work into a full manuscript submission to *Progress in Industrial Ecology* (Inderscience Publishers) of which the Editor-in-Chief is the research leader Dr. Jouni Korhonen. The project aims for a 2012 published double special issue (e.g. 12 articles) of PIE on 'Strategic vision of the industrial ecosystem'. ISDRS, its associated refereed journals and the Åbo Akademi's Academy of Finland research projects are already working together with The Natural Step organization that has developed rigorously reviewed suggestions for principles that could be used as a vision in all strategic management toward sustainability (Robèrt *et al.*, 2002). We will utilize these networks in the process of the research conference and of the subsequent journal special issue.

The SYKE subproject, *Modelling Industrial Symbiosis System Boundaries*, proceeded according to the ISSB project plan in 2009. The industrial complex, developed around the UPM Kymmene Kymi paper mill, chosen as the in-depth case study industrial symbiosis, was modeled using life cycle assessment (LCA), hybrid life cycle assessment (hybrid LCA) and environmental input-output analysis (I/O analysis). The modelling results were published in (Sokka *et al.* 2009, above) and submitted to (Sokka *et al.* 2009 and Mattila *et al.* 2009/2010, above) international peer reviewed journals. A manuscript analyzing the historical development (1890–2005) of the case symbiosis, highlighting the stages of the system's progress by IE typology and drawing from The Natural Step (TNS) system conditions, was also submitted (Pakarinen *et al.* 2009, above). Furthermore, a MSc thesis of Suvi Pakarinen (supported by a grant received from the Fortum Foundation) was written and also published in the Reports of the Finnish Environment Institute series. The 2010 activities of the SYKE team will focus on the role of policy instruments of sustainable consumption and production (SCP) in advancing symbiosis-type industrial activities. We will also further analyze the applicability of different methods (LCA, hybrid LCA, I/O, qualitative analysis) for modelling the environmental impacts and sustainability of industrial symbioses.

Helsinki, January 15, 2010

Jouni Korhonen and Matti Melanen