



*Institute of Systems Sciences,
Innovation & Sustainability Research*
University of Graz

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Editorial

Another year of intensive interdisciplinary research and teaching at ISIS is over. Several changes occurred in 2015 and, once more, we made many considerable achievements at our institute. Perhaps the most striking event, the establishment of a new professorship, strongly supported the third pillar of our activities. In the autumn of 2015, Tobias Stern (coming from the University of Natural Resources and Life Sciences in Vienna) accepted an offer from the University of Graz to fill the position of Professor of Energy and Resource Innovation, thus, representing an important addition to one of ISIS's central fields of activity. As an outstanding expert in the field, Prof. Stern will lend his profound expertise on wood processing, forestry and innovative forms of energy to our team.

Other relevant changes took place in 2015 in the fields of Sustainability Management and Systems Sciences involving personnel. In the field of Systems Sciences, some unexpected staff member losses needed to be compensated. The future research and teaching activities in the field of Sustainability Management will be supported by two of our long-standing institute members. Romana Rauter and Thomas Bruderermann have managed to negotiate their tenure agreements with the university and, henceforth, will contribute to our institute as assistant professors. In addition, two highly competent researchers, Evamaria Knechtl-Grabner and Martina Zimek, chose to conduct their research at ISIS.

However, not everything changed, and many good things remained the same. The second year of the doctoral program "Climate Change - Uncertainties, Thresholds and Coping Strategies" brought with it a couple of well-attended workshops, providing further support for the interdisciplinary nature of our research and teaching activities. The program is funded by the Austrian Science Fund and is successfully conducted together with colleagues from four faculties of the University of Graz, ranging from philosophy to physics. These activities fit perfectly together with other study programs and the externally-funded research projects conducted at the institute.

ISIS was able to demonstrate continued success in terms of research project acquisition in 2015. Altogether, the institute instigated and continued 16 third-party funded projects during the past year. Above all, two EU-H2020-research proposals (TRIBE and InBee) were approved and began in 2015. In addition, researchers at ISIS continued to demonstrate their success in publishing, with more than 20 publications appearing in scientific journals and 10 contributions appearing in conference proceedings in 2015. In particular, the attendance of conferences was very high in 2015: 44 presentations were given at conferences and seminars. This high level of activity was honored with four awards.

Finally, ISIS was recognized for its teaching activities. "Restl-Festl", an event that was organized during an interdisciplinary practical training session conducted in 2014, directed toward raising awareness for food waste, was awarded with the Energy Globe Styria Award and the Viktualia, the Austrian State Prize for commitment against food waste. Furthermore, Dr. Ulrike Gelbmann ranked third in the "Ars docendi", the State Prize for university teaching, and won the University of Graz teaching award. The science-to-public activities continued to be successful and included the Science Talks-series, during which renowned national and international experts were invited to report on topics and issues related to research and teaching at ISIS.



These achievements are the result of our strong commitment to sustainability, high-quality teaching and research that addresses complex, real-world problems. Most importantly, they illustrate the hard work done by an excellent and highly motivated team, members of which are part of a supportive national and international network. We are confident that our annual report describes achievements that will contribute to fostering this network and lead to even more collaboration.

A handwritten signature in black ink, appearing to read 'Rupert Baumgartner'.

Univ.-Prof. Dipl.-Ing. Dr. Rupert Baumgartner

A handwritten signature in blue ink, appearing to read 'Manfred Füllsack'.

Univ.-Prof. Dr. Manfred Füllsack

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1 THE INSTITUTE

1.1 Mission statement

The Institute of Systems Sciences, Innovation and Sustainability Research is investigating possibilities for the transition towards a more sustainable world. Therefore, we study transition, innovation, and adaptation processes within human-environment systems, with a focus on firms and regions. We base our research on systems sciences, innovation and transition sciences as well as on sustainability science, and develop inter- and transdisciplinary methods to analyse and model human-environment systems, develop scenarios and transition pathways, and assess regulatory strategies.

ISIS is characterized by the disciplinary diversity of its members. Highly motivated researchers originating from diverse fields of natural, social and formal sciences collaborate along real-world problems.



Figure 1: The ISIS-team

ISIS is unique in several ways:

- Scientific work focuses on three central topics: systems sciences, innovation and transition sciences, as well as sustainability science and management.
- It is open to external collaboration with scientists from social as well as natural sciences.
- The transdisciplinary research focus facilitates high quality applied research and leads to strong collaborative ties with regional stakeholders and with business and industry.
- Research projects apply a mix of both qualitative and quantitative approaches.
- Offering one of the few curricula on Environmental Systems Sciences, ISIS grew into additionally coordinating two international joint master's programmes.
- ISIS is well embedded in international networks in both teaching and research.



ISIS is a part of the Faculty of Environmental, Regional and Educational Sciences and features a broad interface within the faculty as well as beyond. Together with the “Wegener Center” ISIS plays a central role within the university’s research core area “Environment and Global Change”.

1.2 The ISIS Website

The ISIS website with an up-to-date news section and plenty of information about the institute can be accessed via <http://isis.uni-graz.at/> (english version: <http://isis.uni-graz.at/en/>).

While central information items like contact information, opening hours, news as well as important links can be found already on the start page, the rest of the new website is organised in four categories:

- **Institute:** This category includes a mission statement, venue information including trip advisor and public transport planning tool, the annual reports since 2010 as well as further up-to date information.
- **Studying:** This category involves information for both current and potential future students of ISIS study programmes: Environmental Systems Sciences, Joint Degree Sustainable Development, Master Industrial Ecology (MIND) and the recently founded doctoral school. A list of master theses and links to the alumni clubs can also be found there.
- **Research:** This section gives an overview on ISIS research aims and activities, ongoing projects, recent publications as well as existing co-operations with national and international partners. There is also a sub-category dedicated to the ISIS science talk, which is forum for invited (international) guests to present their research.
- **People:** Finally, one category is dedicated to introduce people who work (or worked) at ISIS, including their research interests and publications. Open positions are also announced there.

The screenshot shows the website layout for the Institute of Systems Sciences at the University of Graz. At the top, the ISIS logo is on the left, and the university name 'KARL-FRANZENS-UNIVERSITÄT GRAZ UNIVERSITY OF GRAZ' is on the right. Below the logo is a navigation menu with 'INSTITUTE', 'STUDYING', 'RESEARCH', and 'PEOPLE'. A search bar is located to the right of the navigation. The main content area is divided into several sections: 'Helpful Links' featuring logos for the Coordination Office for Environmental Systems Sciences and Systems Sciences at ISIS; 'Related initiatives' featuring logos for EGC Graz (Environmental and Global Change) and Education for Sustainable Development; 'Institute of Systems Sciences, Innovation and Sustainability Research' with a photograph of the building; 'News' with a post about 'Einreichfrist für IPs für das Studienjahr 2016/17' and 'ISIS Science Talk' about 'Circularity - A closer look into Waste Management's 6th Development Stage'; and 'Contact' information for Univ.-Prof. Dr. Rupert Baumgartner, including address, phone numbers, and email.

Figure 2: Website <http://isis.uni-graz.at/>

1.3 Faculty and Staff members

Professors:



Univ.-Prof. Dipl.-Ing. Dr. **Rupert Baumgartner**

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Director of the Institute, Vice Dean at the URBi Faculty
Professor for Sustainability Management

Research Interests: Corporate Sustainability, CSR, Strategic Management, Life Cycle Analysis, Industrial Ecology, Management systems, Sustainable Supply Chain Management, New Business Models



Univ.-Prof. Dr. **Manfred Füllsack**

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Vice Director of the Institute
Professor for Systems Sciences

Research Interests: Systems, Complexity, Networks, Games and Computational Theory, Work (History, Sociology, Economy, Philosophy), Computer-Based Modelling and Simulation



Ao. Univ.-Prof. Mag. Dr. **Alfred Posch**

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Dean for studies at the URBi Faculty
Academic coordinator of the International Joint Master programme in Sustainable Development.

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Research Interests: Environmental Psychology, Social Dynamics and Crowd Psychology, Behavioural Economics and Neuroeconomics, Economic Psychology, Agent-based Modelling in Social Sciences, Sustainability-related bottom-up initiatives



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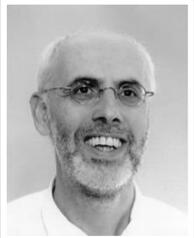
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Doctoral Programme DK Climate Change:



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Christoph Harg, Bsc.	Bernhard Schrempf, BSc.
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David Kogler	Jan-Stephan Steiner
Angelika Meißl	Melanie Troppe
Michael Peer, BSc.	Sandra Unger, Bsc.
Birgit Propst	Sandra Viczek, Bsc. Msc.

1.4 E-Textbook Systems Sciences @ISIS

The rise of tablet computers and smartphones is accompanied by new possibilities for students as well as professors. It allows providing eBooks and especially electronic textbooks with interactive elements. Besides the incorporation of audio and video material, educational examples like dynamic models and simulations can be made accessible out of the text, giving the students the possibility to better understand and comprehend the teaching subject.

The following talks were held in 2015:

- Dr. Lukas Zenk (Danube University Krems), "*Applied social network analysis*", November 17, 2015.
- Prof. Dr. Helge Löbler (University of Leipzig), "*Service as operational mode to understand the environment as a separate system*", December 15, 2015.

Up-to-date information and the whole list of speakers can be found on our website at <http://isis.uni-graz.at/en/forschen/science-talk>.

In addition to these talks, the following events were organized by the Coordination Office for Environmental Systems Sciences (USW Koordinationsbüro):

- Awarding of USW-Mastertheses 2015:
 - Susanna Falle, Bakk. MSc: Nachhaltigkeitsmanagement mit der Sustainability Balanced Scorecard - Konzept, Nutzen und Erstellung am Beispiel eines KMUs (USW-Nachhaltigkeitsorientiertes Management)
 - Julian Fink, MSc: Analysis of Material Flows in Production Processes of the Electronic Industry - A Case Study at Europe's largest Manufacturer of Printed Circuit Boards (USW-Nachhaltigkeitsorientiertes Management)
 - Ing. Bernhard GEIBLER, MSc MSc: Sustainable Phosphorus Mining - Actors, Sustainability Standards and Performance Evaluation of a Business Case (USW-Nachhaltigkeitsorientiertes Management)
 - Petra GSODAM, MSc: Business Models for Renewable Energies in the Electricity Sector in Austria (USW-Nachhaltigkeitsorientiertes Management)
 - Mag. René KOLLMANN: Ökologische Bewertung von landwirtschaftlichen Erzeugnissen durch den Sustainable Process Index (USW-Geographie)
 - Mag. Florian ORTNER: Validierung des Schneemodells AMUNDSEN in der Region Schladming (Steiermark) (USW-Geographie)
 - Carlos VARELA MARTÍN, MSc: Indicators for Smart Cities: Overview and proposals with emphasis in Energy, Carbon and Mobility issues (Joint Master Programm in Industrial Ecology)
 - Ricardo Gibran VITA GARZA, MSc: „Energy Optimization and Design of a Trigeneration System for a Printing Company: Insights towards a Smart Grid in Graz, Austria“ (Joint Master Programm in Industrial Ecology)
 - Yanzhu ZHANG, MSc: Strategic Scenario Study on International Cooperation of E-waste Management and Metal Recycling (Joint Master Programm in Industrial Ecology)
- USW- Practical activity for students - January 2015
- USW- application check for students - June 2015
- Course enquiry for Environmental System Science - Business administration and Environmental System Science - Sustainability Management (USW BWL und USW NM) - summer semester 2015
- IP - presentation - June 2015
- „How to write a Bachelor Thesis“ for students - March 2015

Up-to-date information on events organized by the Coordination Office for Environmental Systems Sciences can be found at <http://umweltsystemwissenschaften.uni-graz.at/>.

2 RESEARCH PROJECTS AND ACTIVITIES

2.1 Research profile

Research at ISIS is based on **three pillars**: systems sciences, innovation and transition research and sustainability research. By combining these three science fields, we seek to enhance the ability of human-environment systems to deal with global change.

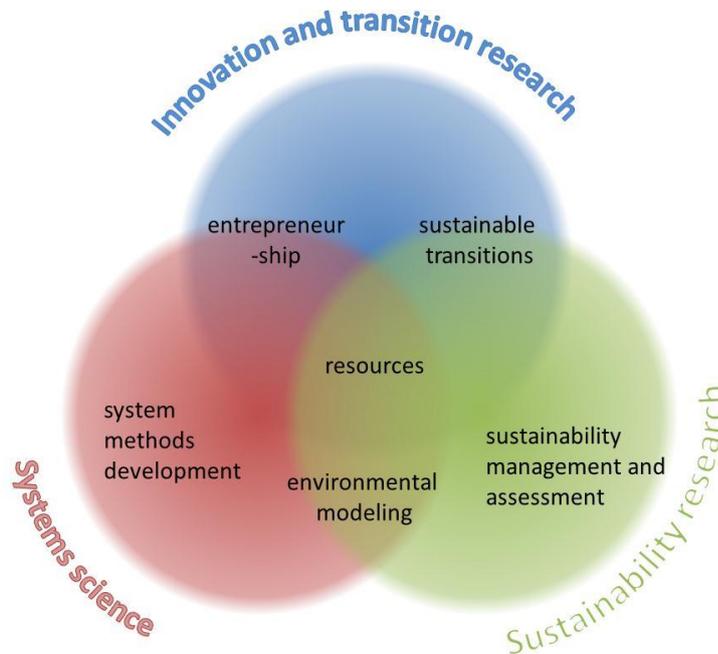


Figure 4: Science fields of ISIS

Systems sciences. Systems modelling (e.g. agent-based modelling or system dynamics) and environmental systems assessment provide a better understanding of different kinds of human-environment systems and their adaptation processes to challenges of global change. We are engaged in system methods development, improving computer-based (multi-agent) simulations of systems, in particular of complex adaptive systems. Special emphasis is put on the interaction between physical and social systems in order to develop concepts and strategies for sustainable development.

Innovation and Transition research. Management of innovations at different levels is a significant challenge for the transition towards sustainable development. It is our goal to gain insight into innovation processes for new products, services, and technologies, but also into transition processes in society, organizations, and sectors, like the energy sector. Therefore, it is necessary to generate an understanding of logics and patterns of human decision making and action. On this basis, we can develop inter- and transdisciplinary concepts for supporting decisions that influence sustainability, and we can help initiate sustainability-oriented transition, innovation and adaptation processes in a variety of human-environment systems.

Sustainability research. Regions and corporations are important actors and entities for sustainable transitions. Thus, we investigate systems and processes for sustainability management and corporate social responsibility (CSR) initiatives at corporate level including the value chains and the regional level. Key aspects include developing environmental evaluation and controlling concepts and methods such as life-cycle-assessment (LCA), strategic management, corporate sustainability management and strategies, industrial ecology, integrated management systems, and management of resources (like waste or energy).

2.2 Research Projects

2.2.1 SustainHub - Sustainability Data Exchange Hub

Sustainability Data Exchange Hub (SustainHub) is a research project with the goal of developing an integrated network solution for managing product compliance and sustainability data along global supply chains. The project is carried out by a research consortium of 15 partners from 6 European countries under the coordination of the Fraunhofer Institute for Manufacturing Engineering and Automation.

There is an increasing demand for eco-efficient products and services, provoked by public opinion, and being incorporated into legislation worldwide. Customer-driven requirements and company strategic goals go beyond the law and are becoming integral to company policies. For the global Electronics and Automotive industries, eco-efficient products are emerging as a critical competitive factor in the marketplace. Large original equipment manufacturers (OEMs) have internalized this trend and passed the requirements on to their suppliers. However, due to complicated and dynamic reporting requirements, suppliers are frequently overwhelmed. The lack of data and the insufficient options for integration into internal processes have inhibited data transparency and compliance, which significantly impedes product innovation.

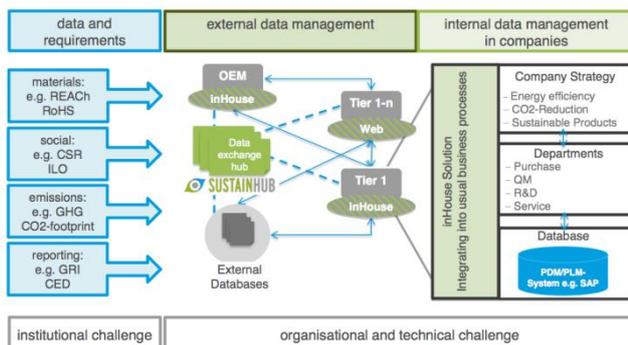


Figure 5: Sustain Hub Project

SustainHub is set to solve these problems. It will provide an efficient, integrated system for the generation, validation and transmission of sustainability data across the entire supply chains. SustainHub's data architecture is designed to meet all data exchange needs in a sustainable world, allowing for maximum traceability and transparency.

Initially, relevant sustainability aspects are defined and a new set of sustainability indicators for a holistic evaluation are created. Then, the data requirements are defined and methods for the aggregation of sustainability data along supply chains are developed. In a third phase, plausibility checks are carried out and measures for the integration into corporate decision-making are identified. Link: www.sustainhub-research.eu

Project team at ISIS:

Univ.-Prof. Dipl.-Ing. Dr. Rupert Baumgartner,
Morgane Fritz, MIM,
Josef-Peter Schöggel, Bakk. MSc.,
Mag. Sabrina Engert, Bakk.



Duration:

Februar 2012 - January 2015

Funding:

Seventh Framework Programme
of the European Commission



2.2.2 RESHAPE - Reshaping Institutions and Processes in the Transition towards Renewable Energy: Lessons from Bottom-up Initiatives

Taking into account disappointments in recent climate negotiations on the international level as well as the lack of supranational authorities, it becomes clear that there is a need for reshaping processes and institutions for a further progress in climate policy. Here, bottom-up initiatives may become important cornerstones in the transformation towards a carbon neutral and adaptive society.

The project explores different examples of bottom-up initiatives that emerged in the recent years in Austria in the field of photovoltaics. It contains empirical analyses of different case studies and reflects the Austrian situation with experiences from Germany. The empirical analysis and selection of the cases will follow the conceptual systematization of different types of bottom-up initiatives. Qualitative and quantitative empirical research on institutional settings on the macro- and meso-scale and actor's behaviour on the micro scale go along with the development of an agent-based system model. This allows for different scenario developments regarding the diffusion of participation in those initiatives.

The methodology used in the project includes: literature research, qualitative and quantitative methods of empirical social research (interviews, survey, and statistical data analysis), system modelling (agent-based modelling) and stakeholder dialogue. In this way, the two research streams - system modelling and empirical social research - are highly interwoven.

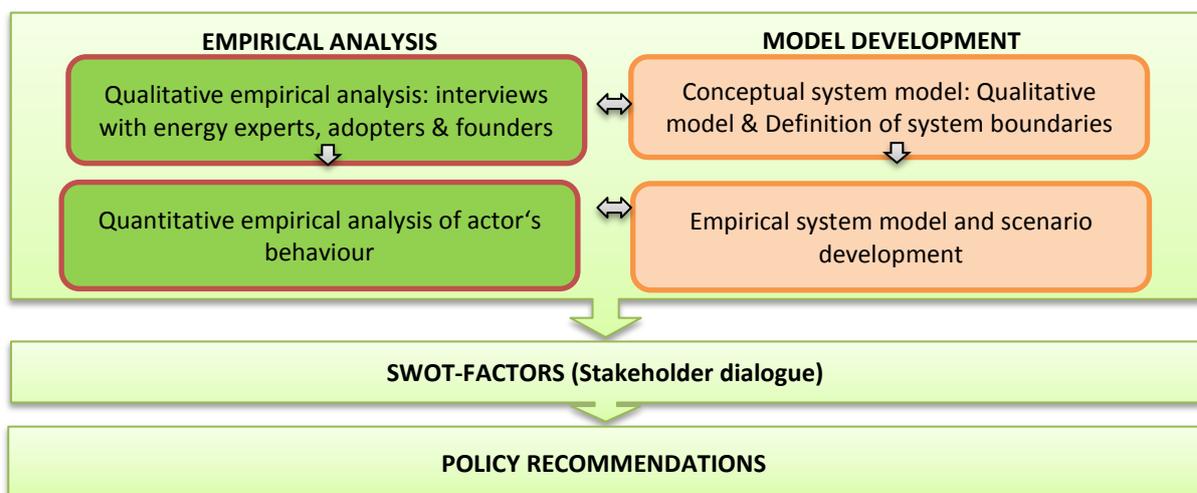


Figure 6: RESHAPE Project

The main outcome of the project will be appropriate policy recommendations for bottom-up initiatives, for reshaping institutions and processes in the transition towards a renewable energy system.

Project team at ISIS: Ao. Univ.-Prof. Dr. Alfred Posch, Eva Fleiß MA, Mag. Stefanie Hatzl, Mag. Martin Kislinger, Dipl.-Ing. (FH) Dr. Gernot Lechner, Univ.-Prof. Dr. Manfred Füllsack, Mag. Kathrin Reinsberger, Ass.-Prof. Dipl.-Ing. Dr. Thomas Brudermann

Duration: March 2013 - Februar 2015

Funding: Austrian Climate Research Program (Climate and Energy Fund)

2.2.3 FLIPPR - Future Lignin and Pulp Processing Research

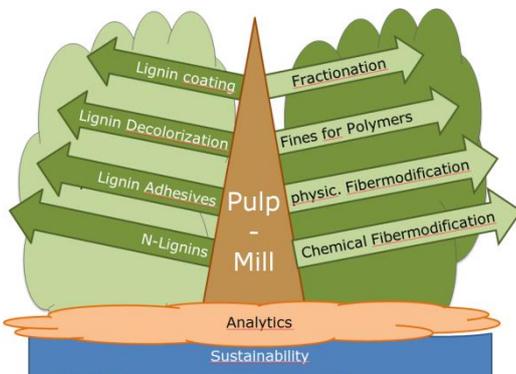


Figure 7: Integration of FLIPPR Areas

In this COMET K-Project, the efforts are focused on establishing structural know-how to make more efficient use of major raw materials streams of the paper and pulp industry - cellulose and lignin. The project focusses on applications in the pulp and paper value chain but also in areas outside the classical product chain. The goal of FLIPPR is to transform this empirical domain into a science-based endeavour and to give the current product and process development approaches in the field of lignin and fibre usage a new direction.

Together with the Wegener Center, ISIS is responsible for the area of sustainability. ISIS will conduct a life cycle sustainability assessment (LCSA) of “high potential” biorefinery-products, based on the innovations from other project partners. Besides the ecological assessment, additional emphasis is placed on social impacts, sustainability and life cycle costs. Thus an integrated system for life cycle sustainability assessment (LCSA) is developed and applied.

ISIS is specifically responsible for the following tasks:

- Environmental LCA for standard industrial feedstock of project partners from the paper and pulp industry
- Environmental LCA of state of the art products, which may be substituted by innovations coming from the pulping industry
- Life cycle sustainability assessment (including environmental LCA, social LCA and life cycle costing) of bio-refinery products based on the results of other project parts

The purpose of these tasks is to find the critical issues (hotspots) for the three pillars of LCSA - environmental LCA (E-LCA), social LCA (S-LCA) and life cycle costing (LCC) - that really determine the contribution of the lignin and cellulose-derived products to the emergence of sustainable low carbon systems. Link: www.flippr.at

Project team at ISIS:	Ao.Univ.-Prof. Dr. Alfred Posch, Mag. Julia Gruber, Univ.-Prof. Dipl.-Ing. Dr. Rupert Baumgartner, Dipl.-Ing. Dr. Ralf Aschemann, Ass.-Prof. Mag. Dr. Romana Rauter, Josef-Peter Schöggel, MSc.
Lead Institution:	Future Lignin and Pulp Processing Research Project GmbH
Company Partners:	Sappi Gratkorn-Produktions GmbH, Mondi Frantschach GmbH, Norske Skog Bruck GmbH, Zellstoff Pöls AG
Scientific Partners:	University of Natural Resources and Life Science, Graz University of Technology (Graz), University of Graz (Wegener Center)
Duration:	April 2013 - March 2017
Funding:	FFG, COMET K1-Project

2.2.4 PURPUR

PURPUR is a research project with the aim of reducing the weight of automotive parts by applying several innovative lightweight materials. The project is carried out by a consortium of Austrian and German companies and the University of Graz, led by Magna Steyr Engineering AG & Co KG.

Over the last decade, the topic of sustainable development has gained importance in the European automotive industry. Because of the significant impacts cars have on our environment and society over their life cycle, sustainability-related legislations have become increasingly stringent in the recent past. Particularly in Europe car manufacturer have furthermore recognized their responsibility for the environment and the society, and therefore voluntarily agreed on continuously reducing the CO₂-emissions of their fleets. One of the most important keys to reduce a vehicle's CO₂-emissions is the reduction of the vehicle's weight.

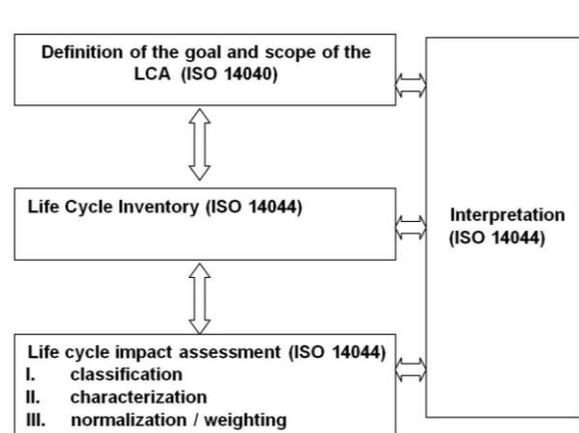


Figure 8: LCA according to ISO 14040/14044

Such a weight reduction is also the aim of the PURPUR project in which firstly the potential of certain innovative lightweight materials for optimizing automotive parts are assessed. Secondly these materials are used for producing the parts and conducting necessary tests regarding mechanical parameters and legal requirements.

ISIS firstly supports this project by applying the Checklist for Sustainable Product Development (CSPD) for finding sustainability-related improvement options. The CSPD allows integrating a life cycle perspective into automotive product engineering and supporting decisions from a sustainability perspective. Secondly ISIS conducts a Life Cycle Assessment (LCA) for estimating and comparing the environmental impacts of the newly developed part with a comparable state-of-the art part.

Project team at ISIS: Univ.-Prof. Dipl.-Ing. Dr. Rupert Baumgartner,
Josef-Peter Schögggl, Msc.
Duration: November 2013 - March 2015
Funding: Austrian Research Promotion Agency (FFG)



2.2.5 Health Impact Assessment Case Study - B 68 in South-East Styria

Since 1994 it is mandatory in Austria to conduct an environmental impact assessment (EIA) process for certain infrastructure projects according to its EIA Act, which is implementing the requirements of the EIA Directive of the European Union. The health issue is not explicitly addressed in this federal Act, as it only considers “human beings” as one of the factors to be protected. Recently, the Austrian Health Impact Assessment (HIA) Action plan 2010 and a national HIA Support Unit (in 2011) were established in order to foster the implementation of HIA in Austria in a voluntary basis. Therefore, the development of tools and methods for performing HIAs is a necessary task. Moreover, it would be important to test those for certain application areas that are of strategic importance for human health.

As there are only a few experiences available on HIA projects in Austria, yet, a pilot HIA of a road traffic project (highway route B 68) was conducted in order to demonstrate how HIA can be applied under consideration of the objectives (i) to co-operate with the Styrian transport authority on how HIA can be implemented and used in an EIA framework and (ii) to perform this case study at local/regional (in particular, regarding the affected municipalities Fladnitz im Raabtal, Kirchberg an der Raab and Studenzen) as a starting point to undertake further HIAs in the transport sector.

A steering group consisting of representatives from relevant authorities (e.g., provincial transport authority of Styria, Health Board Styria), municipalities, research organizations, HIA experts and affected citizens has submitted valuable comments during the course of the project. A participation concept was developed to promote involvement of affected persons and relevant companies within the HIA case study. In order to reach the objectives, a mix of methods has been applied: (a) a comprehensive literature survey; (b) a survey, sent to all households in the area affected; (c) two focus groups; (d) a scoping process; (e) an environmental appraisal and (f) a recommendation workshop involving national and regional opinion leaders.

As a main result, ten recommendations have been drafted, discussed and derived for the project proponent and the municipalities. This case study shows how an HIA can supplement an EIA in order to bring both environmental and social sustainability to the analysis.

Project team at ISIS:	Dipl.-Ing. Dr. Ralf Aschemann
Project partners:	FH Joanneum Graz/University of Applied Sciences (Austria, lead partner; co-ordinator: Bianca Neuhold MA)
Duration:	November 2014 - October 2015
Funding:	Province of Styria and Municipality Kirchberg an der Raab

2.2.6 Energieschwamm Bruck

The development of energy supply systems in small and medium size urban regions with 10,000 to 20,000 inhabitants is usually slower than the urban development itself. The strategies developed by large cities concerning energy supply also differ from such urban regions but little research has been carried out to assess it in the energy field.

The research project “Energieschwamm Bruck” or “Energy-Sponge-Bruck” focusses on the urban region of Bruck an der Mur in Styria, Austria, where about 16,000 people live. The goal of this project is to assess the status quo of the urban region in a technically, economically and socially way regarding energy supply and identify potentials for improvement. This is aimed at supporting the development of the energy system towards sustainable and renewable energy supplies.

Such an approach is based on the development of technical scenarios where current and possible technologies are assessed by collecting data on the needs for energy, the intensity of energy demand per “cell” (each cell representing one area of the urban region) and the current and possible infrastructure. The energy supply in Bruck for electricity, gas and district heat is in the hand of different local stakeholders (Stadtwerke Bruck, Brucker Biofernwärme, Energie Steiermark, private owners of PV and hydro-plants) who have different roles concerning the current and future energy supply of the region. The project team at ISIS focusses on the identification of stakeholders in place and the development of innovative business models that would make these scenarios feasible and support strategies for the development of the energy system.

This transdisciplinary approach is meant to deliver an energy development concept for the region of Bruck and a cadastre for short-term implementation measures. The outcome is expected to provide a solid and flexible framework to allow replicability of the method for urban regions with 10,000 to 20,000 inhabitants.

Further information: <http://www.hausderzukunft.at/results.html/id8155>

Project lead:	University of Leoben
Project team at ISIS:	Univ.-Prof. Dipl.-Ing. Dr. Rupert Baumgartner, Ass.-Prof. Mag. Dr. Romana Rauter, Morgane Fritz, MIM
Project partners:	Stadtwerke Bruck an der Mur GmbH, Brucker BIO Fernwärme GesmbH, Stadtgemeinde Bruck an der Mur
Duration:	June 2015 - May 2016
Funding:	Austrian Research Promotion Agency (FFG)

2.2.7 Business Case for Corporate social responsibility (CSR) @ AT&S

This project aims to identify monetary effects and benefits related to CSR activities of the company AT&S in Leoben. CSR activities are known as the responsibility of businesses towards the community and environment (ecology and society). The activities have been analyzed based on the fifteen main topics of the company: Energy, Water, Raw materials, Investment Efficiency, Technological Innovation, Competence profile, Internal communication, Employee retention, Health & Balance, Diversity, Suppliers, Customers, Cooperation, Volunteering & Donating and Corporate Governance. Based on studies and research from scientific papers all fifteen CSR main topics of AT&S have been assessed showing potential environmental and social performance. As shown with Figure 1 CSR activities positively influence the environmental and social performance, hence increasing the productivity within the company. Finally this leads to the following monetary effects:

- Cost effect (minimal principle): costs can be saved as less input is needed for same output
- Revenue/output effect (maximum principle): revenue can be increased as more output can be generated with a given input

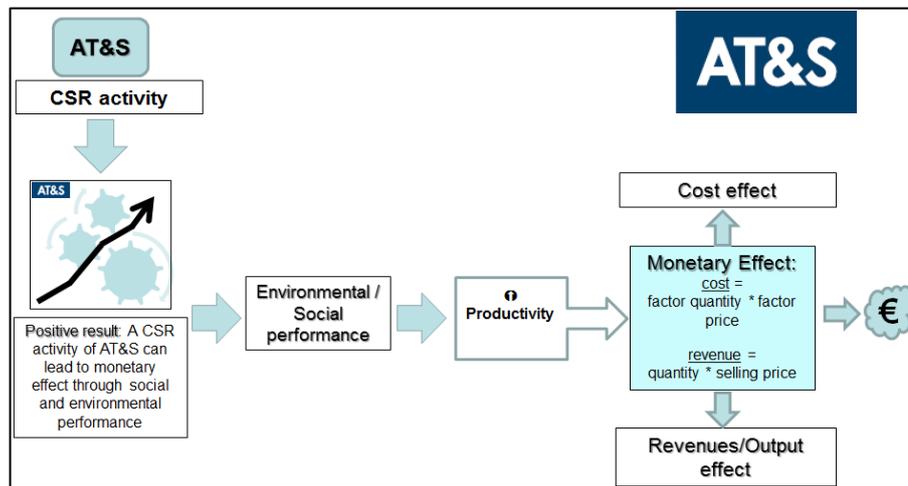


Figure 9: CSR activities of AT&S related to monetary effects

Additionally potential quantification methods are given to support AT&S in performance measurement related to environmental and social aspects. Therefore key performance indicators (KPIs) for strategic sustainability topics have been developed to reflect the companies' goals and achievements. Preferences on KPIs can vary between different industries and therefore the evolved indicators focus on the priorities and performance criteria of AT&S. These were identified in a workshop in Leoben with several responsible employees and through several meetings with the sustainability manager of AT&S Leoben.

Project team at ISIS: Univ.-Prof. Dipl.-Ing. Dr. Rupert Baumgartner,
Ass.-Prof. Mag. Dr. Romana Rauter,
Martina Zimek, BSc. MSc.

Project partner: AT & S Austria Technologie & Systemtechnik Aktiengesellschaft

Duration: April 2015 - June 2016

2.2.8 HTD - Heating Technology Decisions: Homeowners' decision-making process for heating system replacements and new installations

Energy demand from buildings is of particular importance as it accounts for a significant amount of the final energy use, offers massive savings in terms of environmental impacts, and restricts the speed of change through the long lifetime in our build environment. State-of-the-art technologies such as heating systems present a major opportunity to reduce buildings' energy demand and mitigate environmental impacts drastically in the next couple of decades. In this context, an important issue is to get a deeper understanding of homeowners' decision-making process identifying factors which foster or hinder heating system adoption decisions.

The purpose of this study is to empirically research private homeowners' decision-making process for heating system replacements and new installations identifying their motives to invest, information channels, actors and factors influencing the adoption to specific types of heating systems. In this context, a systematic literature analysis and four guided interviews with experts in the field of heating engineering were conducted (April 2015).

These interviews aimed at validating and exploring the decision-making process of private homeowners. The results of the literature analysis and interviews served as a valuable basis to design a quantitative questionnaire. In an empirical survey (September - October 2015) data was

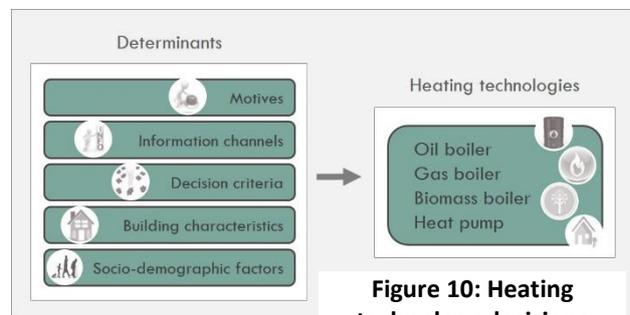


Figure 10: Heating technology decisions

collected from private Austrian homeowners of existing or newly build single and double-family houses. A representative sample of 1.000 homeowners was randomly selected by the professional research survey service provider Qualtrics, the world's leading panel survey software company (adopters with N = 560, non-adopters with N = 440).

The results of the empirical study show, that decisions for heating systems are not only dependent on building characteristics and economic factors, but are also determined by the (i) motives homeowners have to invest in a new system; (ii) type and quantity of information channels they use and suggestions by contacted actors; (iii) ecological factors and factors concerning supply security issues. To foster renewable energy technologies in the private building sector it is important to address homeowners who renovate their heating system and especially those who find themselves in a crisis or problem situation. Besides the information from the installer, it is essential to provide homeowners with more specialized information (magazines, fairs, etc.) raising their awareness for regional, ecological and/or independent fuel supply.

Project team at ISIS: Ao. Univ.-Prof. Mag. Dr. Alfred Posch, Mag. Maria Hecher, Bakk., Mag. Stefanie Hatzl

Project partners: ETH Zurich, Department of Management, Technology and Economics

Duration: January 2015 - December 2016

Funding: Land Steiermark - Fachabteilung Energie und Wohnbau

2.2.9 IN-BEE - Assessing the intangibles: the socio-economic benefits of Energy Efficiency

While there is abundant research in the field of energy efficiency (EE) and the related energy savings expected from EE measures, the socio-economic impacts of EE are underestimated. In this context, the overall benefits of EE improvements cannot be fully assessed. IN-BEE addresses this issue by focussing on the intangible benefits (or “multiple benefits”) of EE (i.e. all benefits related to EE except energy savings).

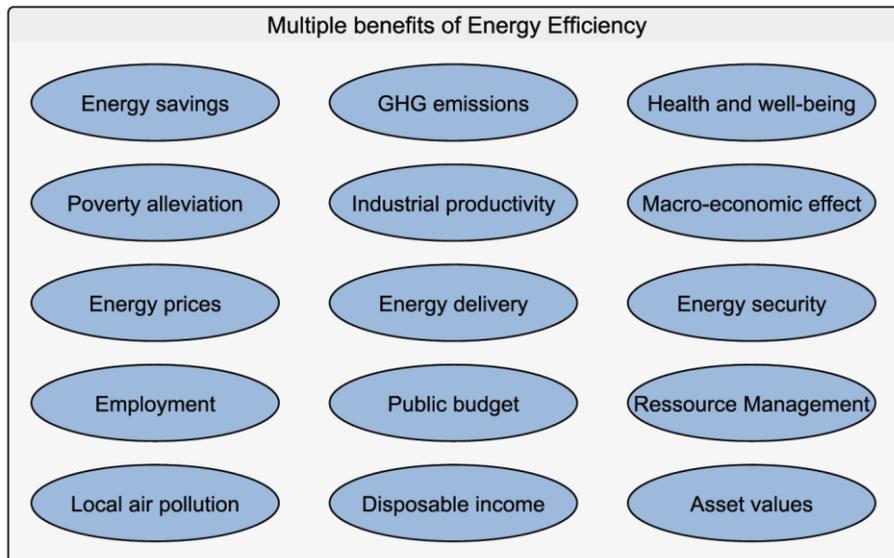


Figure 11: Categorisation of multiple benefits of EE according to OECD/IEA (2014)

The main goal of the project is to identify the intangible benefits of EE and non-EE projects, programmes or policies in country-specific case-studies involving regional and local stakeholders. The overall outcome is a consolidated set of policy recommendations for the EU and public/private institutions that promote EE and sustainability. The role of our institute is to contribute to the definition of intangible benefits, to analyse the social, environmental and economic benefits or negative impacts of EE in Austrian cases (e.g. in Energy Regions) and support the development of a framework to measure the intangible benefits of EE and derive best practice recommendations.

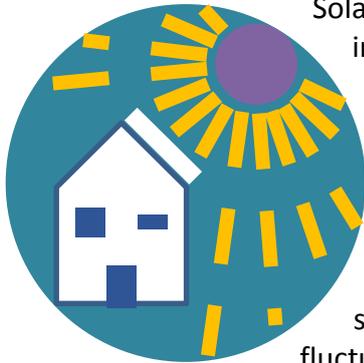
Project team at ISIS: Univ.-Prof. Dipl.-Ing. Dr. Rupert Baumgartner, Morgane Fritz, MIM, Josef-Peter Schöggel, Msc.

Project partners: Università Degli Studi Del Piemonte Orientale Amedeo Avogadro (IT), Deloitte Advisory SL (ES), Environmental Change Institute - University of Oxford (UK), Teknologian Tutkimuskeskus VTT Oy (FI), Instytut Energetyki (PL), Sofia Energy Centre Ltd (BG)

Duration: March 2015 - April 2017

Funding: Horizon 2020 “EE-12-2014: Socioeconomic research on energy efficiency”

2.2.10 URSOLAR - Optimierung der SOLARenergienutzung in URbanen Energiesystemen



Solar energy technologies for heat and electricity still play a minor role in the urban energy system. Numerous benefits, such as zero emissions of noise, greenhouse gases and air pollutants or the general availability of the energy source, make these technologies attractive for urban regions. Therefore, a more important role of solar energy is desirable in the city of the future. The local usage of solar energy depends on different conditions, i.e. energy infrastructure, limited roof/facade areas as well as competition for space between technologies. Due to daily and seasonal output fluctuations, the supply of energy often does not equal its demand. Moreover, the implementation of energy systems depends on interests and scopes of action of different stakeholders (i.e. acceptance factors, legal conditions) ranging from market actors to owners and tenants of houses, apartments, etc.

For the effective usage of solar energy, technical systems solutions have to be identified which are adjusted to specific city quarters and their infrastructural conditions as well as to avoid transformation losses and to relieve the variable load on the grid. To implement these technical system solutions successfully in city quarters, the following aspects have to be addressed:

1. What types of city quarters are well suited for the implementation of solar energy systems?
2. Which technical, legal or social barriers may emerge?
3. What types of business models are well suited for this purpose?
4. Which system solution performs best in an economic and sustainability assessment?

Based on the interdisciplinary analysis of three selected city quarters in Graz, the main outcome of this project will be a roadmap for urban decision makers. Therefore, urban characteristics in terms of city quarters' architectural attributes, current energy-related infrastructure, and social factors are considered. Moreover, an analysis of legal framework conditions together with identification of technical system solutions and adequate business models for the respective city quarters provide information for the roadmap-development.



Project team at ISIS: Ao. Univ.-Prof. Mag. Dr. Alfred Posch, Ass.-Prof. Dipl.-Ing. Dr. Thomas Brudermann, Eva Fleiß, MA, Patrick Hart, Mag. Stefanie Hatzl, Christiane Reischl, MA Msc., Mag. Dr. Sebastian Seebauer

Project partners: Energy Agency Graz GmbH (GEA); Institute of Public Law and Political Science, University of Graz; University of Applied Sciences Graz

Duration: November 2015 - October 2016

Funding: FFG, Stadt der Zukunft (2nd Call)



2.2.11 TRIBE - Training Behaviours Towards Energy Efficiency - Play it!

The general objective of TRIBE is to contribute to a citizens' behaviour change towards energy efficiency in public buildings, through their engagement in the experience of playing a social game, linked by ICT to real time data collected from 5 pilot buildings including three different environments: residential, workplace and academic.

The achievement of TRIBE objectives allows the development of:

1. The TRIBE game: A serious game providing the possibility to engage public buildings users in a behavioural change towards energy efficiency,
2. The TRIBE pack: A package including a number of tools and guidelines for public building owners and operators, providing the opportunity to implement the project solutions in their buildings, addressing their particular challenges.

TRIBE project is based on real time as well as empirical data collected in 5 public pilot facilities:



Scientific & technical objectives:

- Development of public building users' behaviour profiles in relation to energy-related behaviours, identification of different conduct patterns and drivers towards behaviour change based on different psycho-social behavioural theories.
- Collection of real time comparable and reliable data about the energy performance of the pilots and their users' behaviour.
- Modeling and simulating the effects of the set of energy efficiency actions on the building and on the users' behaviour.
- Assessment of the evolution of the players' behaviour towards energy efficiency at individual and building level.
- Development of an EU-wide virtual community for exchanging knowledge and positive attitudes towards energy efficiency.

The goal is to foster the spread of the public building users' behaviour change as well as to support the deployment of ICTs for energy efficiency among public building owners and operators. (see also under: <http://tribe-h2020.eu/>)

Project team at ISIS:	Ao. Univ.-Prof. Mag. Dr. Alfred Posch, Christiane Reischl, MA Msc., Eva Fleiß, MA, Mag. Stefanie Hatzl, Mag. Dr. Sebastian Seebauer, Ass.-Prof. Dipl.-Ing. Dr. Thomas Brudermann
Project partners:	CIRCE Foundation, Spain, ACCIONA Infraestructuras, Spain, Zaragoza Vivienda, Spain, Özyeğin University, Turkey, bio by Deloitte, France, Interactive Institute - Swedish ICT, Sweden
Duration:	March 2015 - March 2018
Funding:	European Union's Horizon 2020 research and innovation programme, grant agreement No 649770

2.2.12 AKRoSA - Aufbereitung von kritischen Rohstoffen aus speziellen Abfallströmen

Within the Resource Initiative the European Commission defined a number of elements and raw materials (e.g., REE, gallium, germanium, PGE and tantalum) as critical raw materials (CRMs) because of their limited resource availability in Europe and their dependency on imports. To tackle this challenge an increased recycling and the use of these CRMs as secondary raw material in the sense of a circular economy is promising but not readily available. Therefore, a consortium of medium-sized and large enterprises and the Universities of Leoben and Graz has formed to develop new innovative approaches and fundamentals for processing and recovering certain critical raw materials.

The objective of AKRoSA is to investigate the following three waste streams with respect to processability and suitability for critical raw material recovery:

- Residue and waste streams of waste treatment plants
- Waste from special industrial processes, including e.g. mixed waste and by-product streams of the industry
- Landfilled waste

This includes the identification of waste and residue streams, the guidance of mass flows and the enhancement and adaption of current processing and recycling technologies. In order to conduct an appropriate recycling in the field of critical raw materials, besides the registration and collection and technological aspects, also the economic evaluation plays a crucial role.

The role of ISIS is to complement the technical research with the analysis of material flow analysis and the subsequent development of a system dynamics model based on the results. This aims at providing a comprehensive understanding of the underlying causal relationships with regards to the three analyzed waste streams, which can facilitate the decision-making of relevant stakeholders.

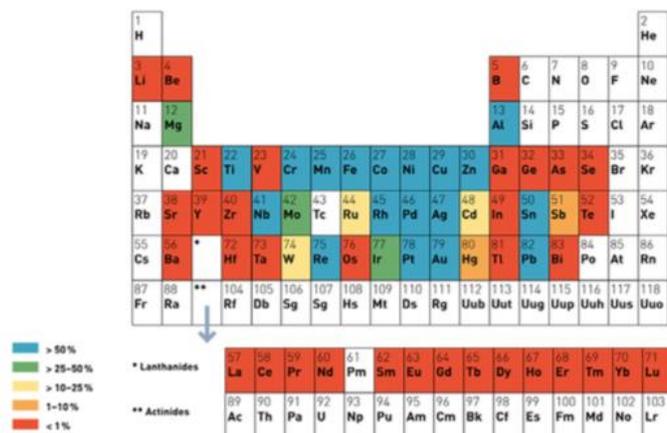


Figure 12: Recycling rate of different metals (Gradel et al. 2011)

Project team at ISIS: Univ.-Prof. Dipl.-Ing. Dr. Rupert Baumgartner, Morgane Fritz, MIM, Mag. Andreas Schober, Josef-Peter Schögggl, Bakk. Msc.

Duration: April 2015 - March 2018

Funding: Austrian Research Promotion Agency (FFG)

2.3 Research cooperations and networks

2.3.1 EGC - Environment and Global Change

The University of Graz has defined seven “research core areas”, four of them with inter-university-cooperation. One of them is the research core area „Environment and Global Change“. Within this core area, global and regional climate and environmental changes are investigated and monitored. The role of humans contributing to this change, as well as possible ways for transformation towards a sustainable society through innovation, is the central theme of EGC. Researchers from climate and environmental physics, environmental chemistry, hydro-geology, environmental biology, environmental economics, sociology, geography and regional sciences, systems sciences and sustainability research and management, environmental ethics and law collaborate cooperate interdisciplinary in this research core area.

There are main research areas:

- GlobEOS (Global Earth Observation and Stewardship)
- RegIMOS (Regional and Local Integrated Modelling System and Studies)
- EnviSYS (Changing Ecosystems and Earth-external Environmental Systems)
- GreenPROTEC (Green Processes and Technologies)
- RegiKNOWS (Regional Changes and Knowledge Transfer for Sustainability)
- HDChange (Human Dimensions of Climate and Global Change)



Figure 13: EGC Logo

2.3.2 AIT Knowledge & Talent Development Programme: Innovation & Sustainability

The Foresight & Policy Development Department of the Austrian Institute of Technology (AIT) established the Knowledge & Talent Development Programme “Innovation & Sustainability” in order to meet the „grand societal challenges“, which are characterized by increasing dynamics and complexity of the involved and interacting systems. In the field of



Figure 14: Structure of Knowledge & Talent Development Programme

“Sustainable innovation oriented Infrastructure Policy” (SIIP) the Foresight & Policy Development Department cooperates with the Institute of Systems Science, Innovation &



Sustainability Research, University of Graz and the Institute of Transportation, Vienna University of Technology.

This programme provides selected master and PhD students with an excellent scientific environment that allows the flexibility to pursue in-depth research in a broad variety of critical areas related to sustainable innovation oriented infrastructure policy. PhD and master students are not only scientifically mentored by AIT- and ISIS-scholars; they are also financially supported with scholarships.

Two master projects were completed successfully at ISIS (Claudia Enzi and Thomas Wagner), and two PhD Projects (Vivianne Aggestam and Roman Seidl) are still ongoing.

2.3.3 ISDRS - International Sustainable Development Research Society

The International Sustainable Development Research Society (www.isdrs.org) was formally founded in 2006 and builds upon a 20 year history of the International Sustainable Development Research Conferences. The vision is to establish a forum where diverse research communities can come together creating a transparent dialogue on key problems, issues, initiatives, policies and strategies needed to make sustainable development a reality. It aims to foster and communicate the importance of sustainable development in a global society, to promote high quality dialogue and collaboration and to build bridges between different research communities and also between research and its applications in society. In 2015, the 21st annual International Sustainable Development Research Conference was held in Geelong, Australia, from 10 to 12 July. Rupert Baumgartner is board member and executive secretary of the ISDR-Society.

2.3.4 ISIE - International Society for Industrial Ecology

ISIE (www.is4ie.org/) was founded in 2001 and promotes industrial ecology as a way of finding innovative solutions to complex environmental problems. Its mission is to promote the use of industrial ecology in research, education, policy, community development, and industrial practices. It facilitates communication among scientists, engineers, policymakers, and managers interested in better integrating environmental concerns with economic activities.



2.4 PhD projects (ongoing)

2.4.1 Individual Mobility as Climate Challenge - Climate Change Risks and Corporate Vulnerability in the Automotive Sector

The transportation sector accounts for 22% of global CO₂ emissions. It thus significantly contributes to human-induced global warming. Moreover, CO₂ emissions from global transport increased by 52% between 1990 and 2011. This rapid growth of emissions is mainly driven by road traffic, i.e. passenger and freight transport, being responsible for about three quarters of total sector emissions. In face of national and international GHG emission reduction targets, the transportation sector - and especially individual transport - is therefore a major area of concern for policy-makers.

On the assumption that there has to be a significant reduction of global GHG emissions, there will be an increasing pressure to reduce the emissions of car traffic in particular. These reductions will necessitate a different usage pattern of cars and the use of different technologies and services provided by the business sector. Hence, climate change contributes to the reshaping of both the regulatory and the societal environment of the automotive industry. This is of increasing relevance both from an environmental and an economic viewpoint as the classical business model of this sector is expected to undergo a fundamental change.

The main research objective of this dissertation is to develop a better understanding of business responses to climate change in the automotive industry by analysing the characteristics, drivers for and barriers to corporate climate change strategies.

The main research questions are:

- Which uncertainties, risks and thresholds in terms of climate change are identified by companies and how are they dealt with in the automotive industry?
- Which factors influence the development, adoption and avoidance of corporate climate change strategies?
- How does the implementation of climate change strategies affect companies' economic and environmental performance?

It is planned to implement a research methodology that becomes increasingly interactive over time. After a preliminary secondary data analysis of companies' annual and sustainability reports and newspaper articles, a survey among companies will be conducted, complemented by in-depth interviews with company representatives, NGOs, chambers of commerce, etc. at a later stage of research.

PhD student: Matthias Damert, MSc.
Duration: 2014 - 2017
Reference: Doctoral Programme DK Climate Change

2.4.2 Corporate Sustainability Strategies: An Analysis of the European Automotive Industry

Sustainable development in the context of corporations in the automotive industry is a frequently discussed issue. There is an on-going discussion relating to corporations and their commitment to sustainable development. In the centre of this discussion, stakeholders debate whether the corporations are tracking the intention to be “good citizens” or the improvement of the corporations’ image and therefore the profitability. Furthermore, topics such as: efficiency, quality and innovation capacity play a prominent role in considering ecological and social aspects in the automotive industry. In the past, numerous journal articles were dealing with the question, “why are corporations choosing to commit or not to sustainability aspects and activities”? The connection between corporate sustainability and the corporation’s performance is often discussed in the context of strategic management and the implementation process of sustainability in the corporation’s strategy. Nowadays, a significant amount of corporations assume responsibility and implement the concept of corporate sustainability in their corporate strategy. In doing so, they focus on different models and tools. Corporations are responding to external pressure by creating tailor-made sustainability strategies which may not necessarily cater to the balance between the sustainability strategy, competitive strategy, and the normative justification of the corporation. In addition corporations discriminate social and environmental issues from traditional strategic issues and therefore they interrupt the positive contribution to economic performance.

The objective of the dissertation is to identify influencing factors of implementing sustainability from a strategic management perspective; especially to bridge the gap of corporate sustainability strategy formulation and implementation. Managers are faced not only with crafting corporate sustainability strategies but also with translating them into action while balancing economic, ecological and social issues. The focus is on global acting car manufacturers that are already on the path to sustainability integration. The aim is to provide new insights into how the corporate sustainability strategy implementation process can be fostered and what factors prove to be relevant in literature and practice.

PhD student: Mag. Sabrina Engert, Bakk.
Duration: 2012 - 2016



2.4.3 Scenarios for a Low Carbon Society: Sector Agriculture

Accumulation of greenhouse gases (GHGs) in the atmosphere has led to rising temperatures, variable precipitation, and other extreme events like droughts and floods. In order to limit negative impacts to climate, the environment, and human livelihoods in general, emissions of these compounds need to be strongly reduced. International agreements have not been effective, in part due to missing concepts of realistic “low carbon” situations. Hence there is a need to devise scenarios for a low carbon society that is technically and economically viable.

The agricultural sector is a source of food and is indispensable to society. However, it is associated with significant GHG emissions. The Intergovernmental Panel on Climate Change’s (IPCC) 5th assessment report, identifies the agricultural sector as one of the major GHG emitting sectors, responsible for almost a quarter of GHG emissions (~10–12 GtCO₂ eq./yr) mainly from deforestation and agricultural emissions from livestock, soil and nutrient management. Reports have also shown that agricultural yields are vulnerable to climate impacts, as seen by a decreasing rate in production increase over recent years. Hence agriculture is not only a major source of GHG emissions but is also affected by the accumulation of the GHG’s in the atmosphere and subsequent changes in climate. The economic mitigation potential in the supply-side is estimated to be around 7.2 to 11 GtCO₂ eq./yr in 2030 consistent with carbon prices (IPCC 5th Assessment Report, 2014). Although it is characterized by a high level of GHG emissions, the agricultural sector is indispensable for society. Understanding the negative impacts of climate change due to GHG accumulation and accounting for the potential that exists to mitigate emissions, it is necessary to devise low carbon scenarios to reduce GHG emissions in the agricultural sector.

This study, using international emission inventories, country specific reports and the International Institute for Applied Systems Analysis’s (IIASA) Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model will assess the policies and measures undertaken by the European Union (EU) countries to mitigate GHG emissions in the agricultural sector. Additionally, the study will also identify and evaluate other novel mitigation options and estimate their subsequent costs using the GAINS model. Overall, the results would identify and describe low carbon scenarios in the agricultural sector to mitigate climate change. This holistic framework analyzing the mitigation potential of current and proposed measures is more complete than previous research. The results are helpful for farmers, crop advisors, and policy makers struggling to identify economically viable mitigation strategies and understand the impact of a changing climate on commodity agriculture.

PhD student: Sajeev Erangu Purath Mohankumar, MSc. Eng.

Duration: 2014 - 2017

Reference: Doctoral Programme DK Climate Change

2.4.4 Sustainability and supply chain management in a multiple stakeholder context

Sustainability and supply chain management are concepts that are still under development in the academic and business world. In contrast, the field of stakeholder management is well established but often limited to the company perspective only. This PhD thesis aims at combining the two concepts and shows the relevance of sustainability and supply chain management concepts in the field of stakeholder management. The research questions structuring this thesis are:

- Which sustainability aspects are the relevant to assess sustainability along the supply chain?
- How effective is the supply chain perspective in helping to understand global sustainability problems?
- To what extend can sustainability and supply chain management contribute to the field of stakeholder management?

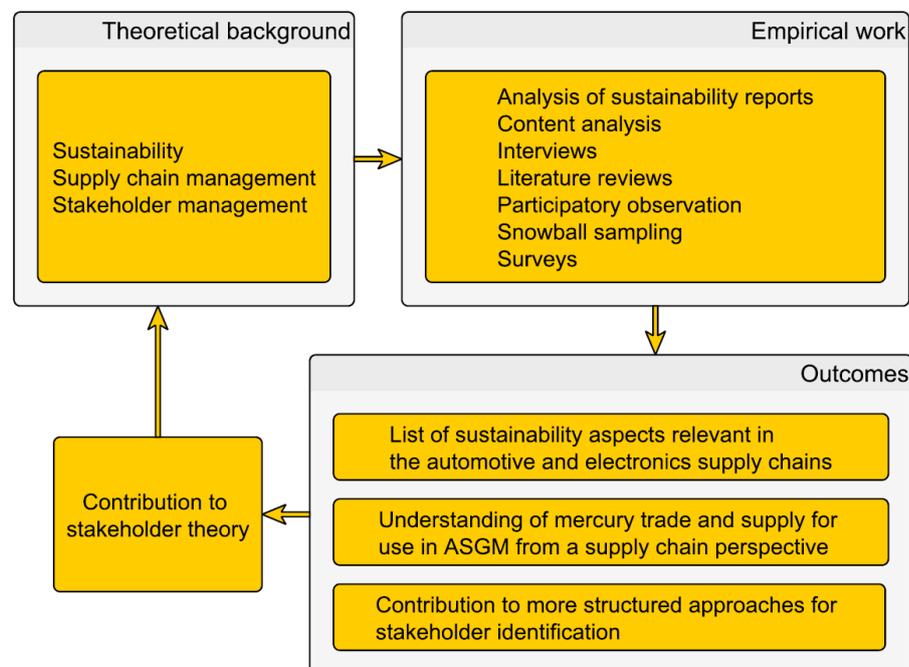


Figure 15: Thesis framework (ASGM: Artisanal and Small-scale Gold Mining)

First, it is examined which sustainability aspects are relevant for companies to be exchanged along the supply chain with the case of the automotive and electronics industry (1st paper). Second, a focus is set on the importance of chemicals management along the supply chain as a result of the outcomes from the first step. In particular, the case of mercury trade and supply for use in Artisanal and Small-scale Gold Mining (ASGM) is explored (2nd paper). Finally, based on the previous analysis, a procedure for stakeholder identification from a supply chain perspective is presented (3rd paper).

PhD student: Morgane Fritz, MIM
Duration: 2012 - 2016



2.4.5 I Shine, Not Burn. An Empirical Study on Actor's Decisions in the Field of Photovoltaic in Austria

Environmental issues became a central topic in sociology since the 1970s. Environmental sociology is concerned with societal causes of and reactions to ecological problems.

One of the most prominent problems is the need to reduce CO₂-emissions. This is especially important in light of the increase in global energy consumption today. One major contributor to global CO₂-emissions are private households: A total of 23% of the energy consumption in OECD-countries can be attributed to private households. Studies indicate that there is a large potential for reducing energy consumption in this area. If private households would adapt their behavior in different areas, a 20% reduction of CO₂-emissions could be possible. These examples depict the importance of understanding the factors influencing individuals' actions. A fitting theoretical framework often applied in environmental sociology and other disciplines - rational choice theory (RCT) - perceives ecological problems as being a (sometimes unintended) macro consequence of individuals' actions.

The work at hand aims at contributing to this field of research by analysing factors influencing individuals' actions in the field of photovoltaic (PV) in Austria using the example of Bottom-up initiatives (BUIs). Empirical results on motives of relevant actors - individuals who are involved in the founding-process or individuals who participate in already established BUIs - will be delivered by addressing the following research questions.

Research questions and studies:

- 1) **Study 1**, based on qualitative interviews: Which motives drive actors to initiate and/or implement a PV-BUI in Austria? Which motives/goals can be identified to be most important?
- 2) **Study 2**, based on a large-scale survey: Which motives drive actors when they decide to (not) be part in a BUI? Which motives can be identified to be most important?
- 3) **Study 3**, based on a laboratory experiment: How do people make trade-offs between themselves and benefits to the environment? How are these payoffs related to different survey measures on self-reported environmental behaviours and attitudes?

According to the research questions the goals are (study 1) to construct a typology of actors/initiatives based on motives to initiate a BUI, (study 2) to explain individuals' motives to (not) participate in a BUI according to an appropriate Rational Choice framework, and (study 3) to further investigate rational decision making by analyzing what role other-regarding preferences play in the decision making process.

The PhD-project is embedded in the project RESHAPE.

PhD student: Eva Fleiß, MA
Duration: 2013 - 2016

2.4.6 Behaviour and Behaviour Change in the context of the transition towards a sustainable energy system

The problem of climate change is closely related to globally increasing energy consumption which is at the moment by 80% covered by fossil fuels and thus producing 32.3 Gt of global energy-related CO₂ emissions in 2014 (IEA 2015). Consequently, international and European policy strategies aim at reducing carbon emissions, decreasing dependencies on fossil fuel imports, and achieving other ambitions for a transformation towards a sustainable energy system (WBGU 2011).

In general, energy consumption practices should change towards more sustainable ways. Various energy policies that are supported on the European level are implemented on national scales. Initiatives in this context involve technical measures (e.g. usage of energies from renewable resources), and non-technical measures like behavioural changes at the individual level. Interventions need to address people in a bottom-up manner and are characterized by external, structural and internal/personal drivers for behaviour change.

Thus, policy strategies need to consider behavioural change both, at home and at the workplace as well as the use of renewable energies in order to increase energy efficiency. Important input for policy-makers is the better understanding of factors affecting energy-relevant behavior as well as the influence of initiatives on the currently prevailing socio-technical energy system in order to design and implement policies that will more effectively promote energy efficient behaviour and investments. Therefore the purpose of the thesis is to gain an integrative perspective on factors (e.g. interventions, innovations, change agents) influencing energy-relevant behaviour in order to understand system change towards a sustainable energy system.

The main research question in this context is: What are factors (from internal behavioural determinants to external agents, interventions and innovations) influencing a change in the prevalent energy system in the lens of behavioural (change) theories? In order to answer this question the focus lies on four different sub-aspects, which can be assigned to different behaviour as well as behavioural change theories from an individual up to a system perspective.

1. Do the aims of bottom-up initiative programmes of local agents get through to the citizens in respective regions to support a transformation towards a sustainable energy future?
2. How do bottom-up initiatives in the field of photovoltaics evolve towards a “global niche” and what is the transition potential to break through to the energy regime?
3. In which way do change agents as well as individual psychological factors influence household heating technology decisions?
4. How do social context and interactions in the case of public building offices influence energy consumption?

Results and findings of the four sub-questions provide an essential contribution to behaviour and behavioural change theories in the energy context. Thus, different behavioural theoretical frameworks are considered, drawing a interface from the individual level, to the social context up to a system perspective.

The PhD-project is embedded in the projects RESHAPE, TRIBE - Play it! and HTD

PhD student: Mag. Stefanie Hatzl

Duration: 2014 - 2016



2.4.7 Energy Transition in Energy Regions: An Analysis of Heating System Adoption Decisions and its Impact on the Environment

An important component in the shift towards a sustainable energy system is the transition from a mainly centralized, fossil-fuel system to a more localized, renewable one. 'Energy regions' address the issues of energy transition at the regional level and aim at promoting energy self-sufficiency through the use of local, renewable energy sources. It is of key interest to understand how energy supply and demand as well as institutional settings in these regions change over time. In this context, the energy demand from buildings is of particular importance as it accounts for a significant amount of the final energy use, offers massive savings in terms of environmental impacts, and restricts the speed of change through the long lifetime in our build environment. State-of-the-art technologies such as heating systems present a major opportunity to reduce buildings' energy demand and mitigate environmental impacts drastically in the next couple of decades.

The main objective of this research is to understand the socio-technical transition in energy regions especially focusing on the adoption of heating systems and its environmental consequences. The specific objectives are:

- To analyse the transition dynamics in two Austrian energy regions from their establishment until today in terms of energy generation and consumption as well as key actors, milestones and factors supporting the energy transition (based on energy flow analysis combined with actor and institution analysis);
- To develop further an agent-based building-energy model which portrays the building stock's energy demand with behavioural elements regarding heating system adoption decisions reflecting the interplay between policy interventions, technical and social structure, and individual behaviour (empirical operationalization of decision-making process based on systematic literature review, qualitative interviews, and quantitative survey);
- To assess the environmental impact of the building stock's heat demand for different scenarios, where the results of the agent-based model are combined with life-cycle inventory data changing over time due to expected technology-driven dynamics (link of agent-based building-energy model with dynamic LCA).

The results of this research project provide important insights into the energy transition of energy regions engaged in promoting energy self-sufficiency from a socio-technical perspective. The combination of dynamic modelling and LCA allows for developing and assessing scenarios of the building stocks' energy demand and heating system transition for an entire region capturing the complex socio-technical interrelations typically found when it comes to energy demand of buildings. The results shed light on what policy instruments could be most effective in reducing environmental impacts caused by energy demand from buildings.

The PhD project is funded by a doctorate scholarship from the URBI Faculty.

PhD student: Mag. Maria Hecher, Bakk.
Duration: 2013 - 2016

2.4.8 Social and Economic Uncertainties and Thresholds for the Diffusion and Adoption of Renewable Energy Systems

Due to its low environmental impact and decentralized character, photovoltaic technology is often regarded as a key technology that is able to contribute significantly to the establishment of a more sustainable energy system. Its rapid increase in competitiveness over the recent years seems to confirm the promising role of the technology. However a successful implementation on a large scale will not only require economic viability of the technology but also an enabling set of socio-technical factors including institutional and political structures, user practices and lifestyles, complementary technologies, etc.

In order to investigate the socio-technical configuration photovoltaic technology is embedded in, the research project at hand draws on a conceptual framework that combines the multi-level perspective (MLP) approach and the technological innovation system (TIS) approach. This framework suggests that innovative technologies, which are accompanied by supporting actors and institutions (i.e. technological innovation system), usually emerge in protected niche spaces from which they assert pressure on regimes, which constitute coherent and established socio-technical configurations (e.g. fossil fuel based energy structures). External landscape factors (e.g. oil prices, climate change, etc.) either support or hamper innovation systems and their activities. The same holds for other innovation systems that emerge at the niche level - while some might act as complementary systems others might create a situation of rivalry.

The research at hand investigates the latter aspect; i.e. it aims at analyzing how the innovation system of photovoltaic technology correlates with other innovation systems. As the scope of the project will not allow considering every innovation system that correlates with photovoltaic technology, the analysis will focus on two exemplary cases: the first case refers to innovation systems that evolved around storage technologies, the second case to the system which encompasses solar thermal collectors. While storage technologies serve as an example of complementary technologies, solar thermal collectors are considered to be rather in conflict with photovoltaic technology.

In order to triangulate the analytical process, the research project applies multiple methods that are both quantitative and qualitative in nature. However the central method will be a qualitative as well as a quantitative content analysis of various text types (newspaper articles, scientific articles, interviews etc.).

The research is expected, first, to decrease the high level of uncertainty that currently exists in terms of interaction patterns within socio-technical configurations and, second, to provide decision makers with ideas on how to stimulate diffusion and adoption processes.

PhD student: Michael Kriechbaum, MSc.
Duration: 2014 - 2017
Reference: Doctoral Programme DK Climate Change

2.4.9 Sustainable Strategies of Companies in Energy Intensive Sectors to Cope with Climate Change

The objective of the thesis is to provide a comprehensive understanding of the perception and strategic responses of energy intensive companies to the challenges and effects of climate change. The following research questions will be studied:

1. How energy intensive companies perceive the challenges and effects associated with climate change?
2. How to establish the linkages between the perception of climate change challenges and the strategic responses associated with it undertaken by the energy intensive companies?
3. How to define the thresholds for progression between various maturity levels of corporate climate change strategies in the energy intensive companies?

The following figure provides an overview of the research design. Three to four sectors with high gross GHG emissions among the energy intensive industries in Europe will be identified for assessment. A simplified methodology will be developed to choose a representative sample of companies within each sector based on their climate change performance across three categories, namely best performers, average performers and poor performers. Generic normative framework for corporate climate change strategy for each sector will be prepared based on Baumgartner (2010). These sector specific frameworks will then be used to develop structured interview questionnaires for collecting information from individual companies. This information will then be used to understand the perception to climate change challenges and

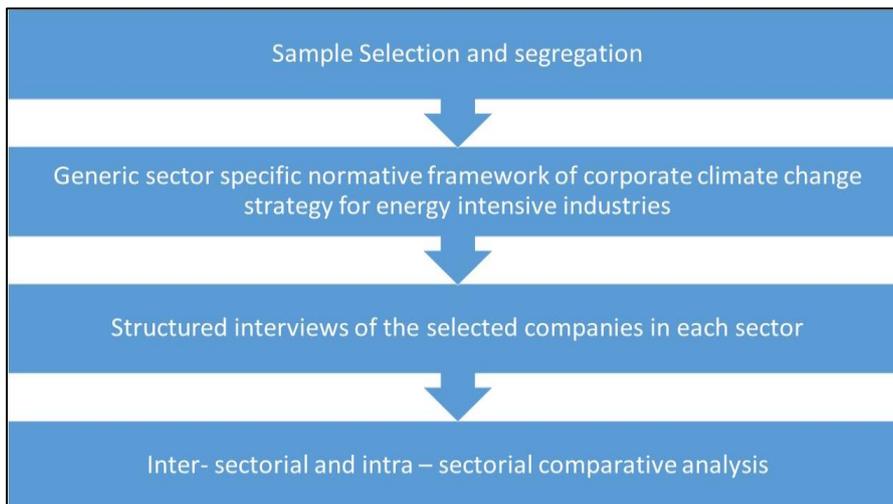


Figure 16: Overview of the research design

various profiles and maturity levels of corporate climate change strategies of selected companies. The profile and maturity levels will be developed following the theoretical framework of Baumgartner and Ebner (2010). These results will then be compared to establish the linkages between

perception to climate change challenges, strategic responses and maturity levels of corporate climate change strategies. These linkages are expected to reveal the thresholds for progression between each of the various maturity levels of corporate climate change strategies.

PhD student: Arijit Paul, MSc.
Duration: 2014 - 2017
Reference: Doctoral Programme DK Climate Change

2.4.10 Measuring and Improving Sustainability in Global Supply Chains: An Example from the Electronics and Automotive Industries

During the last two decades the concept of sustainability has found consideration in different areas of business operations, from product design to post-consumer product management. Its consideration in supply chain management operations however is still lagging behind. The field of Sustainable Supply Chain Management (SSCM) intends to fill this gap. From a company's profit-oriented point of view SSCM makes sense, since it has the potential to decrease costs due to efficiency improvements. It also avoids non-compliance with increasingly stringent regulations and legislation, such as REACH, RoHS or the End of Life Vehicle Directive in the automotive industry. From an environmental and social perspective supply chain sustainability is of particular importance, because of the global impacts a product can have today. The depletion and the pollution of the environment and massive violations of human rights are just some of these challenges that have to be overcome. Thus the efficient management of natural and human resources at all supply chain stages, as well as the application of measures to minimize the negative impacts on people and the environment is a necessary and promising approach.

The objective of this dissertation is to facilitate sustainability assessment in supply chains and to shed light on important interdependencies between different supply chain actors and stakeholders. Therefore, firstly, a comprehensive set of supply chain sustainability indicators is suggested. Secondly, methods for checking the plausibility of suppliers' sustainability data as well as for aggregating sustainability information along an entire supply chain are developed. Thirdly drivers and barriers for the successful implementation of SSCM are investigated. As part of this research aim a case study with the company "Fairphone" on consumer perceptions of sustainability in supply chains is conducted.

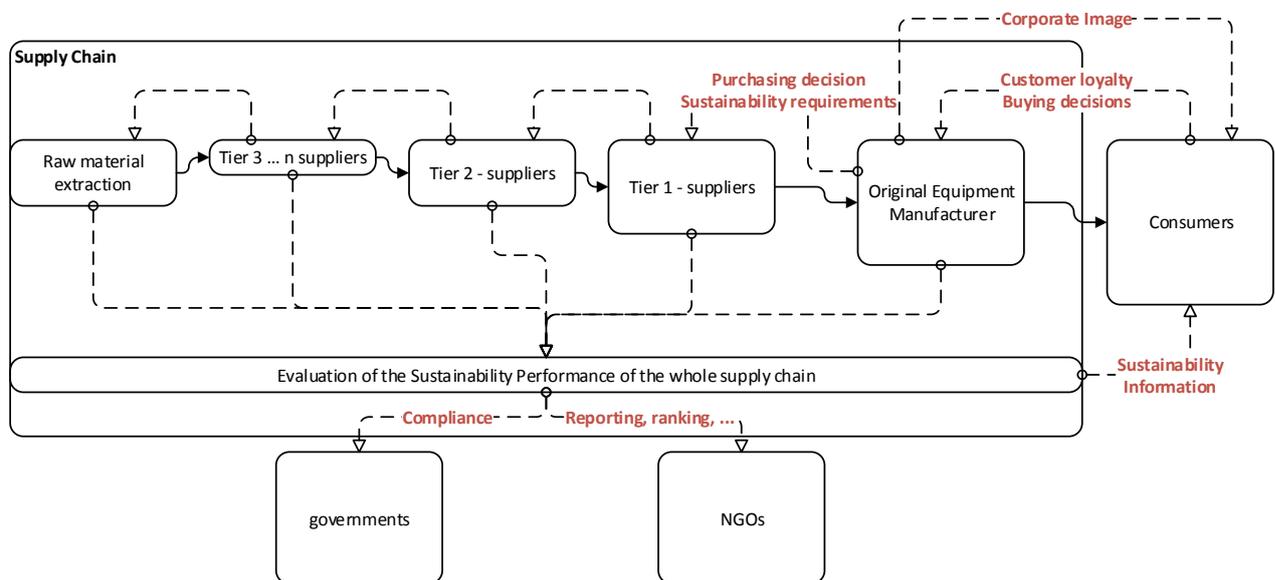


Figure 17: Sustainability related interdependencies in a supply chain

PhD student: Josef-Peter Schöggel, Bakk. MSc.
Duration: 2012 - 2016

2.4.11 A Nitrogen Budget for Austria's Agricultural Sector

Bio-available nitrogen is an important nutrient in the agriculture. It stimulates plant growth and therefore it is added to fields as fertilizer. Further distribution of nitrogen to the environment is uncontrolled and almost impossible to avoid. Due to excess nitrogen, unintended biogenic processes are promoted and environmentally adverse substances (ammonia, nitrogen oxide or nitrous oxide) are released to the atmosphere, or (nitrate) to the ground water. Furthermore, nitrogen release may trigger eutrophication or reduce biodiversity in the ecosystems.

The objective of this dissertation is to optimize application efficiency of bioavailable nitrogen in agriculture and to minimize losses and impacts on the environment. Concrete investigative questions are:

- What are the intervention points in the Austrian agricultural nitrogen cycle?
- Which measures for optimizing the nitrogen cycle are possible?
- How can future scenarios for the application of nitrogen in the agriculture be developed, concerning the intervention points as mentioned above?

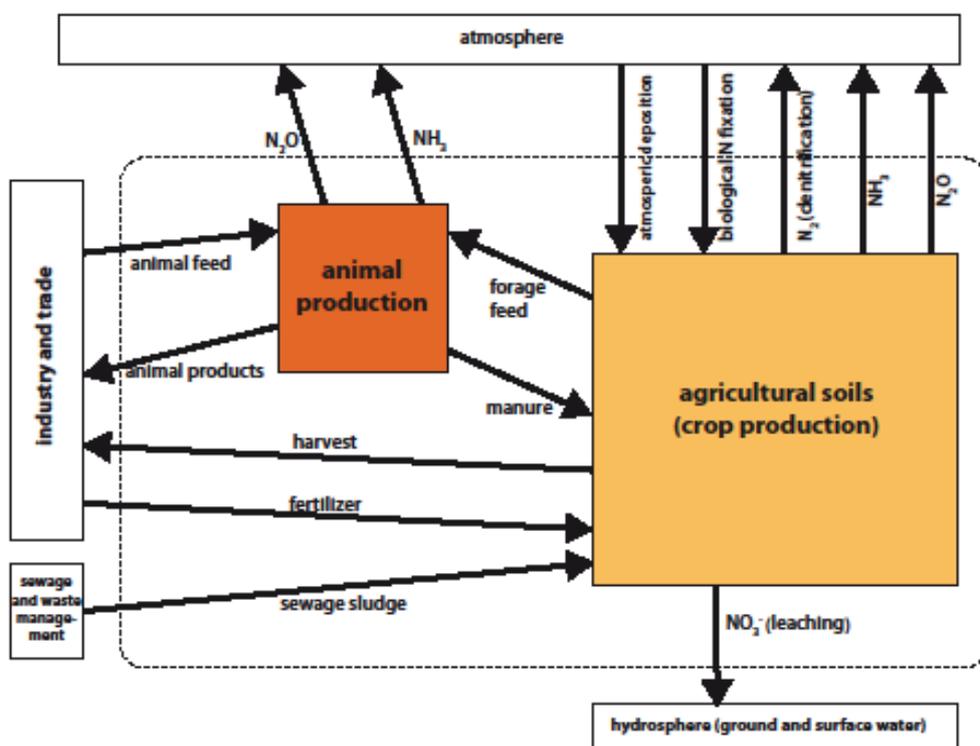


Figure 18: Nitrogen in- and output flows in the agricultural sector

Contributing to the national project "Farming for a better climate by improving nitrogen use efficiency and reduce greenhouse gas emission" (Farm-Clim), specified tasks within the PhD thesis will be developed together with the project partners.

PhD student: Dipl.-Ing. Andrea Schröck, Bakk.
Duration: 2013 - 2015

2.4.12 EMAS in Tertiary Education: The Case of the EMAS-System at the University of Graz

Environmental management system (EMS) standards are available since the 1990s. Different organizations developed standards defining the structure and content of such a system. In Europe, the European Union also carried out an own environmental management system called Eco-Management and Audit Scheme (EMAS) which is in focus of this dissertation. The main goal of environmental management systems is to reduce the organizations negative impact on the environment and to achieve continuous improvement of the organizations environmental performance.

In Austria there are 277 organizations certified according to EMAS (as of 10th November 2014) but there are only two universities and one university of applied sciences certified. Although not many universities are certified according to EMAS, they play an important role in diffusion of this EMS. On the one hand, universities are often big organizations, with a high number of employees and even more “customers”, their students. As big organizations their demand of resources like energy, water or paper is comparably high. Especially as they not only provide infrastructure and resources for their employees but also for the students. On the other hand, at universities future managers and decision makers in companies as well as politicians are educated. As education is responsible for decisions, environmental awareness can be taught at this stage of education and influence future management style of the graduates. In addition, graduates can add valuable contributions to sustainability research, if the interest in this area is being drawn. But as mentioned above, only few research and teaching institutions in tertiary education (universities and universities of applied sciences) have already implemented an EMS according to the European Eco-Management and Audit Scheme.

Universities are organization meant to be pioneers in environmental responsible behaviour and spots where future managers and decision makers are educated. Therefore, the University of Graz decided to implement an EMS according to EMAS in cooperation with four other Austrian universities, starting the implementation process in the end of 2013. The University of Graz is a university with six faculties without a technical or a medical focus. With about 4,000 employees the University of Graz is one of the biggest employers in Styria, Austria. Around 31,500 students are studying at this institution. As the project is led by the author of this dissertation, a deep insight into the organizational structure, changes expected and achieved as well as different motives and barriers can be examined from an insider’s perspective.

Thus, the goal of this dissertation is threefold, namely (i) to identify which reasons motivate organizations in tertiary education to implement an environmental management system (EMS) according to EMAS, (ii) to point out the expected benefits and (iii) to investigate how the EMS changes the organization. In this sense, the particular case of University of Graz will be considered.

The PhD project is funded by the “Hochschulraum-Strukturmitteln” (HRSM).

PhD student at ISIS: Anita Ulz, Bakk. MSc.
Duration: 2013 - 2016

2.4.13 Scenarios for Future Greenhouse Gas Emissions in Austria

Future emissions and concentrations in Austria will be assessed with the help of the RCPs (Representative Concentration Pathways) and the SSPs (Shared Socioeconomic Pathways) published in the 5th Assessment Report of the IPCC. One of the main drivers at the beginning of the research project is the search for crossovers between the international scenarios and the national policies. This has to be seen as the main knowledge gap in this area as the Austrian's emission scenarios of the Austrian Environmental Agency are based on different methods and calculations than the RCPs.

The main objective of the dissertation is the analysis of future GHG in Austria in order to answer the main research question: "What are the main influences on future emissions in Austria till the end of the century?" The (theoretical) background for this analysis is based on the RCP scenarios as well as national and European emission scenarios. The main drivers for climate change and the increase in radiative forcing in Austria should be identified and qualified. The connection and similarities between the RCPs and Austria's climate policy shall be identified and, if possible, combined with adapted storylines specifically for Austria. Furthermore, it should be possible to use this method to create a framework which can be used by different single nations to assess their emissions and concentrations.

The first paper aims at comparing emission scenarios on a national, European and global level. It can be derived if the Austrian climate policy is in line with the EU climate goals and the, so called, 2°C target. The second paper is focusing on greenhouse gas emissions from livestock in Austria, comparing inventory emissions, emissions considering the whole life cycle and different emission scenarios.

The following figure gives a short overview of the thesis' framework:

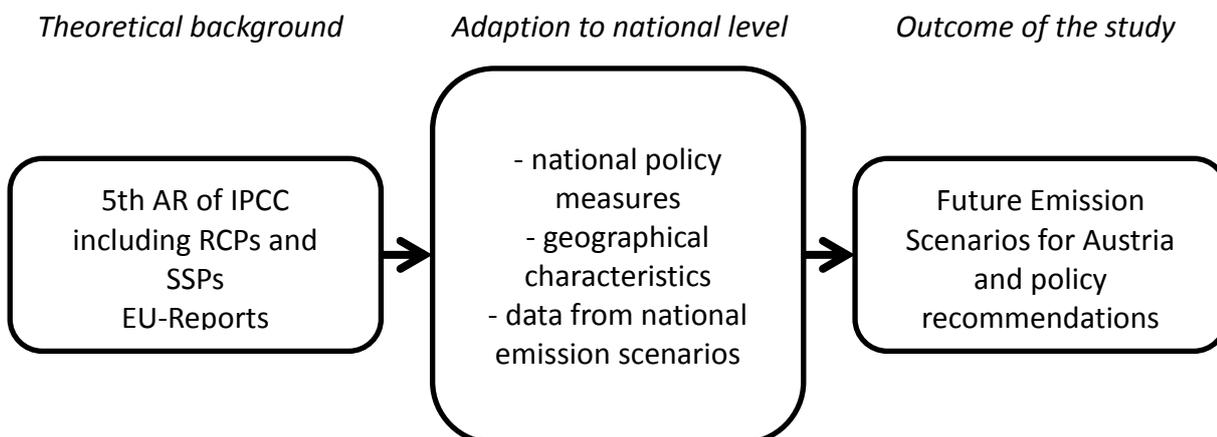


Figure 19: Thesis framework

The PhD project is funded by the PhD-scholarship from the Faculty of Environmental, Regional and Educational Sciences.

PhD student: Mag. Thomas Winkler, MSc.

Duration: 2013 - 2016

2.4.14 Data Generation for Systems Scientific Approaches in Sustainability and Labor Market Research by Use of Text Mining

Economic growth and technological development induce a continuous transformation of the labor market. This transformation manifests for employees in altered labor conditions and education requirements. In labor market research these changes have been investigated on the microscopic and macroscopic scale separately. On the macroscopic scale the research is based on employment statistics, whereas on the microscopic scale questionnaires and interviews are employed. Combining these approaches is not appropriate to gain a labor market analysis with both wide coverage and high resolution. That is due to the huge effort questionnaires and interviews require especially for extensive investigations. However, data mining methods, which have been developed since the end of the twentieth century, provide capable instruments to describe the labor market. Such a representation can be created on both the macroscopic and microscopic scale by using an extensive collection of job announcements. Sources for suitable datasets are found on the internet and newspapers. While the internet allows real-time analysis, newspapers are appropriate to investigate historical developments and higher-level systemic correlations moreover. Those correlations are for example Job Polarization in the labor market context and Critical Transitions in general. Both concepts are part of current systems scientific research. The combination of information retrieved from newspapers and from the internet allows to analyze in particular rise, development, presence and quality of Green Jobs.

The research questions are:

1. Does the usage of Text Mining allow to generate data suitable for systems scientific investigations?
2. What can be revealed in the systems scientific context regarding the economic development?
 - 2.1. Can Text Mining in job announcements published via newspapers depict labor market parameters of past decades?
 - 2.2. Is it possible to determine indicators for Critical Transitions in these datasets?
3. Can real-time monitoring of the labor market be developed basing on the answers to the above questions? What can be concluded regarding the development of Green Jobs?
4. Based on the data provided by the use of Text Mining, is it possible to develop alternative economic indicators?

PhD student: Mag. Andreas Schober, Bakk.

Duration: 2014 - 2018



2.4.15 Resilience in decentralized infrastructure networks: Modeling dynamic systems

Infrastructures are a crucial requirement for working societies. Without basic infrastructures (e.g. electrical power, water, communication technology, ...) growth in health, education and productivity is hindered. Therefore, establishing resilient infrastructures is one of the goals of the United Nations Sustainable Development Goals.

Smart Grid initiatives try to address the challenges of sustainable and reliable supply of energy. However, the integration of high shares of renewable energy, large scale demand management and the resilient control of energy networks still face major (technological) obstacles. In the thesis these aspects are addressed by combining network science and further systems scientific methods. The focus of the planned work is on deploying methods of modeling and simulation to develop and test options for building resilient and decentralized supply networks with the help of self-organizing dynamically adapting agents.

To approach this goal, various steps are foreseen. In a first step a general theoretical framework for robust infrastructures will be developed:

- Systems scientific concepts (for example adapted network processes, early-warning signals in network context, machine learning methods) will be screened in regard to recognition and prevention of breakdowns ("critical transitions") in dynamical infrastructure networks.
- Different methodological approaches will be compared and their resilience evaluated.
- After finding suitable methods the goal is to identify distinctive network properties of resilient and susceptible networks.
- In a second step the findings are then applied to the development of smart grids and the main research questions are:
 - How do the results of the general framework compare to the applied case?
 - Can the used concepts enrich traditional smart grid modeling approaches?
 - Is it possible to derive recommendations for the development and improvement of smart grids?

PhD student: Christian Hofer, Bakk. BSc. MSc.

Duration: 2015 - 2018

2.4.16 URBAN-TRANSITIONS: Behaviour-Related Transition Management Approaches towards Urban Sustainability

At the beginning of the 21st century, half of the world's population lived in cities. In industrialized countries cities encompass over eighty percent of the population. These developments pose complex challenges for metropolitan policy-making such as technical and socio-economic ones as well as challenges related to the impact of urban life. Political and scientific discussions about metropolitan aggregation and its associated problems become more crucial in relation to climate change which is largely caused by greenhouse gas emissions that are the result of a continuously growing (especially in cities) population's demand for energy. Furthermore, cities are particularly challenged by climate change, for example in relation to heat burdens. Cities around the world are recognizing the potential danger of climate change to disrupt their social and economic fabric. Thus, they develop strategies for reducing greenhouse gas emissions, modify programs to adapt a warmer future, and engaging civil society in this effort. There is a commonly accepted scientific consensus that global sustainability is for an important part an issue of urban sustainability. In this sense, different concepts of cities, such as smart, sustainable and resilient ones, are a current matter of interest in relation to a sustainable urban future.

Urban sustainability requires the realization of sustainable urban places, which is the aim of sustainable urban transformation and thus, encompasses sustainable urban structures and environments as well as economic, social, cultural, organizational, governmental and physical change processes. The effective implementation of change processes in different contexts relies to a large part on human behaviour change. The resistance against behaviour change is a major challenge with regard to sustainable developments. Change is a source of stress for individuals and habits are a source of resistance.

Change processes on different societal levels can be described by transition theory which distinguishes three mutually interacting levels: landscape, regime and niches. Niche developments may break through to the regime level during so-called "windows of opportunity", leveraging irregular tensions and misalignments in the regime. The strategic preparation for taking the chance of a window of opportunity in different city as well as thematic contexts as reference points for the development of change strategies towards sustainable cities is the focus of this PhD thesis. Three different framing conditions, which are all related to the sustainable city subject area pose the basis for the investigation of different methods for strategically preparing windows of opportunity, which favour long-lasting change in cities. Within these framing conditions the investigation of the following research questions is the centre of the thesis:

1. What are key issues for the adaptation to climate change induced heatwaves in urban areas?
2. What are drivers for behaviour change of different types of energy consumers in urban public buildings?
3. How do current regime structures favour the niche breakthrough of renewable energy technologies in urban quarters?

This PhD project is embedded within the projects TRIBE - Play it! and URSOLAR

PhD student: Christiane Reischl, MA MSc.

Duration: 2015 - 2018

2.5 PhD Projects (finalized)

2.5.1 A Socio-Technical Perspective on Innovations in Energy Transition: Empirical Research on Community Involvement to integrate Renewables

Increasing debate concerning greenhouse gas emissions and energy related issues shows that a system-wide transformation of our current energy system towards greater sustainability is becoming more necessary than ever before. This so-called ‘energy transition’ also involves further usage of decentralized renewable energy sources. Photovoltaic technology (PV) appears to be highly promising in this respect. It continues to offer high technological potential as well as the benefit of rapidly decreasing costs. At present, PV is the fastest growing renewable energy source worldwide, growing at an annual rate of 35–40 per cent. In Austria, which is the focus of this study, PV technology can still be seen as a niche technology, since at present approximately 1 per cent of electricity generated in Austria originates from PV plants.

In recent years scholars have used a number of different concepts and frameworks to investigate the restructuring of the energy system into a more sustainable form. In the present PhD thesis the starting point for gaining a more comprehensive view regarding the transformation of the current energy system in Austria is transition and innovation theory. Thus, the underlying approach of this thesis is to combine two closely related concepts - technological innovation systems (TIS) and the multi-level perspective of socio-technical innovation (MLP) - in order to investigate how innovations can contribute to energy transition in Austria. In terms of technical innovations the focus is on photovoltaic technology, related prospects and challenges, and the circumstances and factors influencing the further development of PV in Austria. Social innovations, in contrast, aim at involving local communities and citizens in energy provision issues. Hence, particular emphasis has been placed on providing an overview of the different models concerning local energy cooperatives and on stressing the associated key factors in their establishment. First, in order to outline the status-quo, this entailed an analysis of behavioural aspects, e.g. agent motives, concerns, and attitudes with respect to citizen participation in local energy cooperatives. It also entailed work on defining how current framework conditions for community energy in Austria can be adjusted in an effective way.

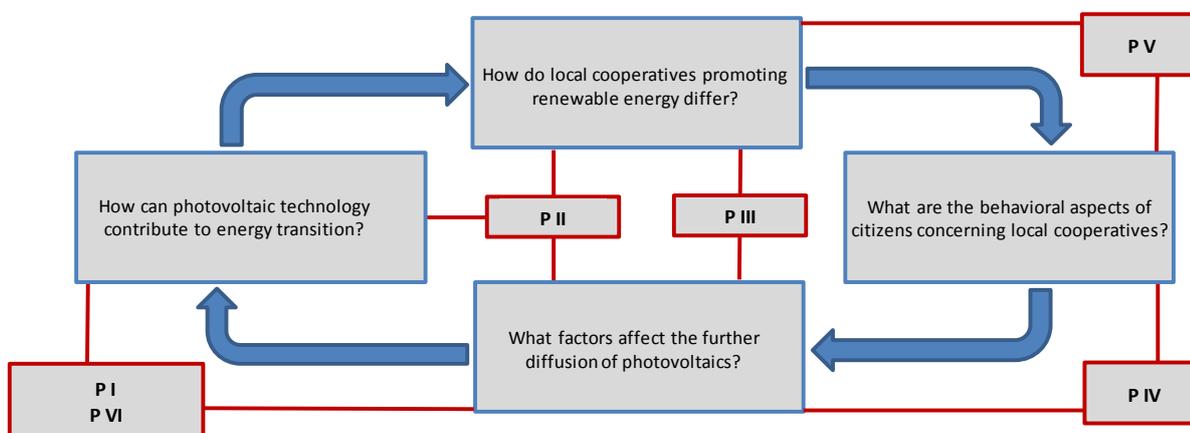


Figure 20: Relationship between the research questions and the publications

All the findings and conclusions of this thesis are based on the results of six publications. Regarding the prospects for photovoltaic technology it was found, that positive factors (strengths and opportunities) dominate over negative factors (weaknesses and threats) and that as current circumstances appear to be particularly beneficial for the development of PV, a potential regime shift is conceivable. The empirical analysis on energy cooperatives in Austria revealed that the main focus of policy interventions has tended to concentrate on creating market incentives. Nevertheless, more attention needs to be placed on the social aspects of community energy projects. Thus, analysis of social learning processes, awareness raising, the provision of support for social network generation, communication and interaction, etc. are all necessary measures for engaging civil society more intensely in energy transition processes.

Publications

- P I:** Reinsberger K. Brudermann T. & Posch A. (2015): The role of photovoltaics in energy transition: An integrated SWOT-AHP approach. *GAIA - Ecological Perspectives for Science and Society* (forthcoming).
- P II:** Reinsberger K. & Posch A.: Community engagement in niche development processes of social innovations. Submitted to *Renewable Energy*.
- P III:** Brudermann T., Reinsberger K., Orthofer A., Kislinger M. & Posch A. (2013): Photovoltaics in agriculture: A case study on decision making of farmers. *Energy Policy* 61, 96 - 103.
- P IV:** Hatzl S., Brudermann T., Reinsberger K. & Posch A. (2014): Do public programs in 'energy regions' affect citizen attitudes and behavior? *Energy Policy* 69, 425-429.
- P V:** Reinsberger K. & Posch A. (2014): Bottom-up initiatives for photovoltaic: Incentives and barriers. *Journal of Sustainable Development of Energy, Water and Environment Systems* 2(2), 108-117.
- P VI:** Reinsberger K. & Posch A. (forthcoming): Dezentrale Energieversorgung - Die Rolle der Photovoltaik in der Energietransition, in: Egger R. & Posch A. (Eds.): *Lebensentwürfe im ländlichen Raum. Ein prekärer Zusammenhang*, Springer Verlag Wiesbaden, Reihe Lernweltforschung.

PhD student: Mag. Kathrin Reinsberger
Duration: 2011 - 2015

2.5.2 The Impacts of Food Choice on the Environmental Nitrogen Pollution in Austria

Nitrogen (N) is crucial for life on our planet, primarily as component of proteins and as an essential nutrient providing the basis for our food production. Whereas it constitutes the major part of the earth's atmosphere in its molecular form N_2 , it is only reactive nitrogen (Nr - i.e. all biologically, chemically, and radiatively active nitrogen compounds, such as NH_3 , NO_x , N_2O , NO_3) that can be used and is needed by most organisms.

As humans today artificially create amounts of reactive nitrogen (e.g. as fertilizer for food production) that far exceed natural terrestrial creation, the natural nitrogen cycle is altered. Excess nitrogen ultimately accumulates in the environment, causing significant effects on humans and ecosystems. These effects include eutrophication, soil acidification, nitrate pollution of groundwater, formation of particles hazardous to health, ozone formation and climate change. Thus, the use of nitrogen has both "good and bad" effects.

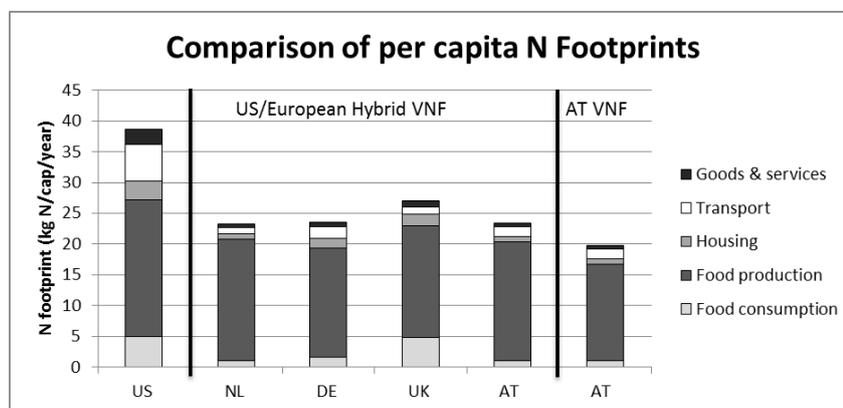


Figure 21: Comparison of per capita N footprints (source: Pierer et al. 2014)

As a starting point, the PhD project draws on the "N-Print project" (www.n-print.org), which is an integrated nitrogen footprint model focusing on food and energy consumption.

The objective of the dissertation is firstly to take stock of Austria's nitrogen footprint of food consumption by adapting and further developing one module of the N-Print, the N-Calculator. Secondly, possible points of intervention shall be identified and analyzed regarding their suitability and (cost-)effectiveness as potential policy measures. They shall serve an integrated policy approach that considers various interactions and interlinkages.

Thus, the dissertation is intended to raise awareness among the public and policymakers regarding the relationship between food consumption and nitrogen and its effects in Austria. In that sense, the dissertation might also contribute to an Austrian national nitrogen budget to be established in the future. Finally, the project shall yield recommendations regarding possible improvements and policy measures and their effectiveness. The PhD project is supervised by Prof. Wilfried Winiwarter and funded by a doctorate scholarship from the URBI-Faculty.

PhD student: Magdalena Pierer, MSc

Duration: 2012 - 2015

Publication: Pierer, M.; Winiwarter, W.; Leach, A.M.; Galloway, J.N. (2014). The nitrogen footprint of food products and general consumption patterns in Austria. *Food Policy* 49:128-136

3 PUBLICATIONS AND OTHER RESEARCH OUTPUT

In this section a detailed report on the institute's research output is presented. An overview is given in the following table:

ISIS research activities and output	2012	2013	2014	2015
Publications				
Publications in scientific journals	10	18	22	22
Scientific monographs	0	1	1	0
Editorships of scientific monographs	1	2	0	0
Book Chapters	12	13	8	5
Contributions to conference proceedings	9	16	11	11
Posters presented at scientific conferences	4	5	3	6
Other scientific publications	4	3	3	2
Projects				
Third-party funded projects	11	12	12	16
Functions				
External scientific functions and functions in external scientific committees	6	17	13	3
Functions in international journals	10	9	6	4
Networking activities				
Presentations at scientific conferences and seminars	30	42	26	44
Awards	2	5	4	4



3.1 Publications

3.1.1 Publications in scientific journals

- Aschemann, Ralf; Neuhold, Bianca; Gruber, Gabriele; Türscherl, Elisabeth: Gesundheitsfolgenabschätzung in Österreich - ein aktueller Überblick, in: UVP Report 29, 4 (2015), S. 201-206.
- Braun, M; Schwarzbauer, P; Stern, T: Langfristige Auswirkungen einer verstärkten Energieholznachfrage auf Österreich Kohlenstoffbilanz: Eine Szenarienanalyse. , in: Jahrbuch der Oesterreichischen Gesellschaft fuer Agrarökonomie 24 (2015), 193-202.
- Brudermann, Thomas; Bartel, Gregory; Fenzl, Thomas; Seebauer, Sebastian: Eyes on social norms: A field study on an honor system for newspaper sale, in: Theory and Decision: an international journal for multidisciplinary advances in decision sciences 79,2 (2015), 285-306. DOI: 10.1007/s11238-014-9460-1
- Brudermann, Thomas; Kelz, Christina; Klettner, Silvia; Röderer, Kathrin; Seebauer, Sebastian; Wicher, Magdalena: Mensch und Umwelt: Umweltpsychologische Forschung in Österreich [Humans and Environment: Environmental Psychology Research in Austria], in: Psychologie in Österreich 35,2 (2015), 116-125.
- Brudermann, Thomas; Mitterhuber, Corinna; Posch, Alfred: Agricultural biogas plants - a systematic analysis of strengths, weaknesses, opportunities and threats, in: Energy Policy 76 (2015), 107-111. DOI: doi:10.1016/j.enpol.2014.11.022
- Ledl, Caroline; Stary, Philipp; Schwarzbauer, Peter; Stern, Tobias: Substitution potential of bio-based packaging films in food industries, in: Jahrbuch der Oesterreichischen Gesellschaft fuer Agrarökonomie 24 (2015), 161-170.
- Engert, Sabrina; Baumgartner, Rupert: Corporate sustainability strategy - Bridging the gap between formulation and implementation, in: Journal of Cleaner Production (2015), DOI: 10.1016/j.jclepro.2015.11.094
- Füllsack, Manfred: Who downed MH-17, or Do collective observations interact non-linearly? in: Constructivist Foundations 10,2 (2015), 238-239.
- Gsodam, Petra; Rauter, Romana; Baumgartner, Rupert: The renewable energy debate: how Austrian electric utilities are changing their business models, in: Energy, Sustainability and Society 5, 28 (2015), DOI 10.1186/s13705-015-0056-6.
- Haydn, Annemarie; Werner, Andrea; Stern, Tobias: Assessing the potential price range for bioactive food additives from wood by using the van Westendorp method, in: Jahrbuch der Oesterreichischen Gesellschaft fuer Agrarökonomie 24 (2015), 101-110.
- Hermann, Robert; Baumgartner, Rupert; Vorbach, Stefan; Ragossnig, Arne; Pomberger, Roland: Evaluation and selection of decision-making methods to assess landfill mining projects, in: Waste Management and Research 33/9 (2015), 822-832.
- Klade, Manfred; Seebacher, Ulrike; Baumgartner, Rupert: Life-Cycle-oriented Origin Analysis - a method for calculating the geographical origin of products, in: Journal of Cleaner Production (2015), 1-11.

- Mayr, Melanie; Eckhart, Rene; Summerskiy, Ivan; Potthast, Antje; Rosenau, Thomas; Schöggel, Josef-Peter; Posch, Alfred; Timmel, Thomas: Flippr° — an industrial research project in Austria, in: TAPPI Journal 14,3 (2015), 209-214.
- Pierer, Magdalena; Schröck, Andrea; Winiwarter, Wilfried: Analyzing consumer-related nitrogen flows: A case study on food and material use in Austria. , in: Resources, Conservation and Recycling 101 (2015), 203-211.
- Posch, Alfred; Brudermann, Thomas; Braschel, Nina; Gabriel, Magdalena: Strategic energy management in energy-intensive enterprises - a quantitative analysis of relevant factors in the Austrian paper and pulp industry. in: Journal of Cleaner Production 90 (2015), 291 - 299. DOI: doi:10.1016/j.jclepro.2014.11.044.
- Rauter, Romana; Jonker, Jan; Baumgartner, Rupert: Going One's Own Way: Drivers in Developing Business Models for Sustainability. in: Journal of Cleaner Production doi:10.1016/j.jclepro.2015.04.104 (2015), 1-11. DOI: 10.1016/j.jclepro.2015.04.104
- Reinsberger, Kathrin; Brudermann, Thomas; Hatzl, Stefanie; Fleiss, Eva; Posch, Alfred: Photovoltaic diffusion from the bottom-up: Analytical investigation of critical factors. in: Applied Energy 159 (2015), 178-187.
- Reinsberger, Kathrin; Brudermann, Thomas; Posch, Alfred: The Role of Photovoltaics in Energy Transition - An integrated SWOT-AHP Analysis, in: Gaia: oekologische Perspektiven in Natur-, Geistes- und Wirtschaftswissenschaften 24,1 (2015), 49-55.
- Steiner, Gerald; Risopoulos-Pichler, Filippina; Mulej, Mathias: Social Responsibility and Citizen-Driven Innovation in Sustainably Mastering Global Socio-Economic Crisis, in: Systems Research and Behavioral Science 32, 2 March/April 2015 (2015), 160-167. DOI: 10.1002/sres.2255
- Sukitsch, Martina; Engert, Sabrina; Baumgartner, Rupert: The Implementation of Corporate Sustainability in the European Automotive Industry: An Analysis of Sustainability Reports, in: Sustainability 7, 9 (2015), 11504-11531. DOI: 10.3390/su70911504
- Winkler Thomas, Winiwarter Wilfried: Scenarios of Livestock - Related Greenhouse Gas Emissions in Austria. Journal of Integrative Environmental Sciences 12(SI) (2005): 107-119. DOI10.1080/1943815X.2015.1110186.
- Winkler, Thomas; Winiwarter, Wilfried: Greenhouse gas scenarios for Austria: a comparison of different approaches to emission trends, in: Mitigation and Adaptation Strategies for Global Change (2015), 1-16. DOI: 10.1007/s11027-015-9642-3

3.1.2 Book chapters

- Baumgartner, Rupert; Fritz, Morgane; Schöggel, Josef-Peter: Sustainability and Supply Chain Management - Aspects, Indicators and Performance Measurement, in: Biedermann, Hubert; Vorbach Stefan; Posch, Wolfgang (Ed.), Innovation und Nachhaltigkeit. München: Rainer Hampp Verlag 2015, 31-44.
- Friesenbichler, Martina: Social Media im interdisziplinären Praktikum. 'Stakeholderkommunikation und -aktivierung gegen Lebensmittelverschwendung', in: M. Akin-Hecke/ D. Röthler/ P. Eiselmaier/ M. Andraschko (Ed.), Lehrende arbeiten mit



dem Netz. Wien: Institut zur Förderung digitaler Mediennutzung - WerdeDigital.at 2015, 208-211.

Füllsack, Manfred: Neighborhoods and Social Security. An Agent-based Experiment on the Emergence of Common goods, in: Tobias Harks, Sebastian Vehlken (Ed.), Neighborhood Technologies. Media and Mathematics of Dynamic Networks. Zürich-Berlin: diaphanes 2015, 151-164.

Gelbmann, Ulrike-Maria: Wahrheiten muss man erproben: Theorie-Lernen durch praktische Umsetzung, in: Austin, E./Hohenwarter, M./Salmhofer, G./Scheer, L (Ed.), Theorie, die ankommt. Wege der Theorievermittlung in der Hochschullehre. Graz: Grazer Universitätsverlag 2015, 115-121.

Vorbach, Stefan; Rauter, Romana: Werte und Kultur, in: Stefan Vorbach (Ed.), Unternehmensführung und Organisation. Grundwissen für Wirtschaftsingenieure in Studium und Praxis. utb. 2015, 411-449.

3.1.3 Contributions to conference proceedings

Damert, Matthias: Climate Change Strategies in the Automotive Industry:A Global Perspective, in: KEDGE Business School (Ed.), Corporate Responsibility Research Conference 2015. Marseille: KEDGE Business School 2015, 1.

Damert, Matthias: Individual Mobility as Climate Challenge - An Analysis of Corporate Climate Change Strategies in the Automotive Industry, in: Santander International Summer Schools for Doctoral Students (Ed.), ARISING AWARENESS - SUSTAINABLE DEVELOPMENT OF HUMAN SOCIETYWITHIN THE FRAME OF PLANET EARTH. Heidelberg: Universität Heidelberg 2015, 1.

Damert, Matthias: Individual Mobility as Climate Challenge - An Analysis of Climate Change Strategies in the Automotive Industry, in: University of Lisbon (Ed.), Sustainable Development Symposium 2015. Lissabon: Sustainable Development Symposium 2015 2015, 1.

Damert, Matthias; Baumgartner, Rupert: The Effects of Supply Chain Position and Institutional Environment on Corporate Climate Change Strategies, in: Elsevier (Ed.), Global Cleaner Production & Sustainable Consumption Conference - Accelerating the Transition to Equitable Post Fossil-Carbon Societies. Sitges: Elsevier 2015, 1-12.

Dennerlein, Sebastian; Gutounig, Robert; Kaiser, Rene; Barreiros, Carla; Rauter, Romana: Knowledge Strategies in Organisations - a Case for the Barcamp Format, in: 16th European Conference on Knowledge Management - ECKM 15 (Ed.), Proceedings. Reading, UK: Academic Conferences and Publishing International Limited 2015, 222-230. DOI: 10.13140

Erangu Purath Mohankumar, Sajeew: An integrated decision support framework to evaluate farm-level adaptations to climate change. European Climate Change Adaptation Conference 2015Aarhus University: Aarhus University 2015.

Erangu Purath Mohankumar, Sajeew: Scenarios for a low carbon society - Agricultural waste. RAMIRAN 2015 - 16th International Conference Rural-Urban SymbiosisTuTech Innovation GmbH: TuTech Innovation GmbH 2015.

- Globocnik, Dietfried: Does user-innovation theory explain employees' bootlegging behavior? An empirical investigation of a novel theoretical approach. in: EIASM (Ed.), 22nd Innovation & Product Development Management Conference - Improving Competitiveness with Innovation and Product Development. Kopenhagen: Eigenverlag 2015, 89-90.
- Paul, Arijit: A review of the status quo of the research on corporate climate inaction. Athens, Greece: 31st Colloquium of The European Group of Organisational Studies 31st Colloquium of The European Group of Organisational Studies 2015.
- Paul, Arijit: Carbon performance in energy intensive industry: A comparative case study. Sitges, Spain: Global Cleaner Production & Sustainable Consumption Conference Global Cleaner Production & Sustainable Consumption Conference 2015.
- Perl-Vorbach, Elke; Rauter, Romana; Globocnik, Dietfried; Baumgartner, Rupert: Sustainable Open Innovation and its influence on economic and sustainability innovation performance. 2015 (The XXVI ISPIM Conference - Shaping the Frontiers of Innovation Management, Budapest, Hungary on 14-17 June 2015).

3.1.4 Posters presented at scientific conferences

- Aschemann, Ralf: Erasmus Mundus Master's Programme in Industrial Ecology - Lessons learned so far and the way forward, for: Global Cleaner Production and Sustainable Consumption Conference, Elsevier, Sitges (Spain)
- Damert, Matthias: Strategic responses to climate change in the automotive industry, for: Arising Awareness - Sustainable Development of human society within the frame of planet Earth, Universität Heidelberg, Heidelberg (Germany)
- Hecher, Maria; Knoeri, Christof: Towards dynamic LCA: Insights from coupling a dynamic building-energy model with time-specific inventory data, for: Taking Stock of Industrial Ecology, International Society for Industrial Ecology, University of Surrey, Guildford (United Kingdom)
- Kriechbaum, Michael: Blocking mechanisms in technological innovation systems - A case study on distributed photovoltaic technology in the Western Cape Province of South Africa, for: International Sustainability Conference 2015, University of Sussex - Science Policy Research Unit, Brighton (United Kingdom)
- Schober, Andreas; Kittel, Christian; Baumgartner, Rupert; Füllsack, Manfred: Text Mining in 20 Years of the Journal of Cleaner Production, for: Global Cleaner Production & Sustainable Consumption Conference, Journal of Cleaner Production, Sitges, Barcelona (Spain)
- Winkler, Thomas; Aschemann, Ralf: Reduzierung von Treibhausgasemissionen aus der Fleischproduktion durch eine Minderung der Lebensmittelabfälle - Ein Sustainability Assessment-Ansatz, for: Österreichischer Klimatag, CCCA, Wien (Austria)

3.1.5 Other scientific publications

- Füllsack, Manfred: Digitale Rationalisierung. Wien: Die Furche 2015.



Kriechbaum, Michael: Transformative Forschung. Graz: CCCA Servicezentrum CCCA Servicezentrum 2015.

3.2 Presentations at scientific conferences and seminars

Aschemann, Ralf: Erasmus Mundus Master's Programme in Industrial Ecology: Objectives of the Programme and Impact at University/Individual Level, for: ASEM - Erasmus+ Information Day, European Commission, Asia-Europe Meeting, Riga (Latvia), 29.04.2015.

Aschemann, Ralf: Manual for stakeholder engagement for Graz, Austria, for: Impact Assessment in the Digital Era, Int. Association for Impact Assessment (IAIA), Florenz (Italy), 22.04.2015.

Aschemann, Ralf: The Erasmus Mundus Master's Programme in Industrial Ecology, for: Higher Education Talks on International Mobility Meeting the Neighbours, BMWFW, European Commission, Uni Graz, Graz (Austria), 15.10.2015.

Aschemann, Ralf; Lundqvist, Ulrika; van der Voet, Ester: Lessons learned from the Erasmus Mundus Master's Programme in Industrial Ecology, for: Taking Stock of Industrial Ecology, Int. Society for Industrial Ecology, Surrey (United Kingdom), 09.07.2015.

Baumgartner, Rupert: "Design for Sustainability Checklist" supporting Remanufacturing, for: International Conference on Remanufacturing, University of Strathclyde, Amsterdam (Netherlands), 15.06.2015.

Baumgartner, Rupert: Nutzbarkeit von Sekundärrohstoffen und Recyclingfähigkeit von Produkten, for: Zukunftslabor für nachhaltige Produktentwicklung, Ministerium für ein lebenswertes Österreich; Projektgemeinschaft Zukunftswerkstatt, Wien (Austria), 07.04.2015.

Baumgartner, Rupert: Strategic Sustainability Management, for: Rethinking the Frontiers of Management, Instituto Superior Técnico, Centre for Engineering and Management (CEG-IST), Lissabon (Portugal), 08.10.2015.

Baumgartner, Rupert; Rauter, Romana: Interpretations of sustainable development in business models for sustainability - evidence from Austrian companies, for: Global Cleaner Production and Sustainable Consumption Conference, Elsevier, Sitges (Spain), 03.11.2015.

Baumgartner, Rupert; Schöggel, Josef-Peter; Fritz, Morgane: Sustainability and Supply Chain Management: Aspects, Indicators and Performance Measurement, for: SMI Kongress 2015: "Innovation und Nachhaltigkeit: strategisch-operatives Energie- und Ressourcenmanagement", Montanuniversität Leoben, Leoben (Austria), 29.04.2015.

Brudermann, Thomas: Environmental Decision Making: How to guide human decisions towards more environmental friendly behaviours. Invited Lecture, Prince of Songkla University, Faculty of Environmental Management, Hat Yai (Thailand), 20.11.2015.

Brudermann, Thomas: Reshaping institutions and processes in the transition towards renewable energy: Lessons from bottom-up initiatives, for: 16. Österreichischer Klimatag, CCCA, WU Wien, 30.04.2015.

- Damert, Matthias: An analysis of climate change strategies in the automotive industry, for: Sustainable Development Symposium 2015, University of Lisbon, Lissabon (Portugal), 15.06.2015.
- Damert, Matthias: An analysis of corporate climate change strategies in the automotive industry, for: Arising Awareness - Sustainable Development of human society within the frame of planet Earth, Universität Heidelberg, Heidelberg (Germany), 30.09.2015.
- Damert, Matthias: An analysis of corporate climate change strategies in the automotive industry, for: Corporate Responsibility Research Conference CRRC 2015, KEDGE Business School, University of Leeds, Marseille (France), 15.09.2015.
- Damert, Matthias: Supply chain position, institutional environment and corporate climate change strategies - An analysis of the automotive industry, for: Global Cleaner Production & Sustainable Consumption Conference - Accelerating the Transition to Equitable Post Fossil-Carbon Societies, Elsevier B.V., Sitges (Spain), 02.11.2015.
- Erangu Purath Mohankumar, Sajeev; Benjamin M. Gramig: An Integrated Decision Support Tool to Evaluate Farm-Level Adaptations to Climate Change, for: The European Climate Change Adaptation Conference (ECCA) 2015, European Commission, European Environment Agency, Confederation of Danish Industry, Aarhus University and City of Copenhagen, Copenhagen (Denmark), 12.05.2015.
- Erangu Purath Mohankumar, Sajeev; Wilfried Winiwarter: Scenarios for a Low Carbon Society: Agricultural Waste, for: RAMIRAN 2015, 16th International Conference Rural-Urban Symbiosis, Technical University of Hamburg, Institute of Watershed Management and Water Protection, RAMIRAN, Hamburg (Germany), 07.09.2015.
- Fleiß, Eva: Money or Morale? A survey study on drivers of investment in citizen participation initiatives in the area of photovoltaics, for: SOWI Fakultätsforschungsseminar, Universität Graz (Austria), 03.06.2015.
- Fritz, Morgane: Integrating sustainability into core business areas of a company, for: Partnering day 2015, Graz (Austria), 29.09.2015.
- Füllsack, Manfred: Entwicklung der Erwerbsarbeitssituation, for: Global Campus Workshop, suedwind.at, Graz (Austria), 01.12.2015.
- Füllsack, Manfred: Rechnen mit Zukunft - aus systemwissenschaftlicher Sicht, for: Strategische Vorausschau in der Politikberatung, Umweltbundesamt Berlin, Berlin (Germany), 09.10.2015.
- Füllsack, Manfred; Hofer, Christian: Modeling human interaction, for: Modeling in human movement science. From movement control to human interaction, Markus Tilp, Sigrid Thaler, Universität Graz (Austria), 21.05.2015.
- Füllsack, Manfred; Schober, Andreas; Kittel, Christopher: Normalarbeit im Spiegel von Stellenanzeigen aus 50 Jahren Kleine Zeitung. Methoden automatisierter Textanalyse, for: Normalarbeit - Vergangenheit oder Zukunft? 20 Jahre Denkwerkstätte Graz in Gedenken an Hans Georg Zilian (1945–2005), FH-Joanneum, UNI Graz, AMS Steiermark, Graz (Austria), 29.05.2015.
- Gelbmann, Ulrike-Maria: Resilienz - die neue Nachhaltigkeit?, for: Vernetzungstreffen, STV und IG USW, Graz, 24.04.2015.



- Gelbmann, Ulrike-Maria: Resilienz als Neue Nachhaltigkeit, for: Homecoming Day, Alumni Graz, Graz, 26.09.2015.
- Gelbmann, Ulrike-Maria; Mesicek, Roman: Nachhaltigkeit und Innovation als Herausforderungen für die CSR-Forschung, for: Österreichischer CSR-Tag 2015, ResPACT Austria, Villach, 16.10.2015.
- Globocnik, Dietfried: Does user-innovation theory explain employees' bootlegging behavior? An empirical investigation of a novel theoretical approach, for: 22nd Innovation & Product Development Management Conference, IPDMC, Kopenhagen (Denmark), 15.06.2015.
- Hatzl, Stefanie: Niche development in market-based vs. grassroots citizen participation initiatives in photovoltaics, for: Global Cleaner Production & Sustainable Consumption Conference - Accelerating the Transition to Equitable Post Fossil-Carbon Societies, Elsevier B.V., Sitges (Spain), 04.11.2015.
- Kriechbaum, Michael: Expectation dynamics in technological innovation systems: the interaction of generalized and frame expectations in the German and Spanish PV Sector, for: Theories of Sustainable Transitions, University of Aalborg in Copenhagen, Copenhagen (Denmark), 21.05.2015.
- Paul, Arijit: A guiding framework for Multilevel Assessment of Corporate Response to Climate Change, for: Multinational Enterprises and Sustainable Development Conference 2015, AUDAX - Entrepreneurship Center of ISCTE-IUL which hosts the conference this year, the ICN Business School (France), the CEREFIGE of the Université de Lorraine (France), and the Center for International Business Education and Research, Georgia Institute of Technology, Atlanta, USA, Lisbon (Portugal), 14.12.2015.
- Paul, Arijit: A review of the status quo of the research on corporate climate inaction, for: 31st Colloquium of European Group for Organisational Studies, European Group for Organisational Studies, Athens (Greece), 03.07.2015.
- Paul, Arijit: Carbon performance in energy intensive industry: A comparative case study, for: Global Cleaner Production & Sustainable Consumption Conference, Elsevier, Sitges (Spain), 01.11.2015.
- Paul, Arijit: Corporate climate change strategy - A status-quo of the research, for: 5th Annual European Post Graduate Symposium, The Faculty of Architecture and the Institute of Social and Political Sciences of the University of Lisbon, Lisbon (Portugal), 16.06.2015.
- Perl-Vorbach, Elke; Rauter, Romana; Globocnik, Dietfried; Baumgartner, Rupert: Sustainable Open Innovation and its influence on economic and sustainability innovation performance, for: The XXVI ISPIIM Innovation Conference - Shaping the Frontiers of Innovation Management, International Society for Professional Innovation Management, Budapest (Hungary), 15.06.2015.
- Posch, Alfred: Spannungsfeld Ökologie und Wirtschaft, for: Tag der Schöpfungsverantwortung - Verantwortung übernehmen durch ökosoziales Wirtschaften, Ökosoziales Forum Steiermark, Graz (Austria), 01.09.2015.
- Reischl, Christiane: Behavioural Patterns of Individual Energy Use in Public Buildings, for: Global Cleaner Production and Sustainable Consumption Conference, Elsevier, Sitges (Spain), 02.11.2015.

- Schober, Andreas; Kittel, Christopher; Füllsack, Manfred: Normalarbeit im Spiegel von Stellenanzeigen - Von automatisierter Textanalyse zu alternativen ökonomischen Indikatoren, for: Österreichischen Soziologie Kongresses 2015, ÖGS, Innsbruck (Austria), 01.10.2015.
- Schögl, Josef-Peter: Bewusst konsumieren - Auswirkungen und Möglichkeiten des eigenen Handelns, for: Dialogveranstaltung mit SchülerInnen im Rahmen des Umweltzirkus, Panthersie für Europa, Graz (Austria), 24.04.2015.
- Schögl, Josef-Peter: Research overview on integrating sustainability topics in product development and supply chain management, for: Workshop at the Pre-Opening of the "InnoZet", Tobelbad, AT, 12.03.2015.
- Schögl, Josef-Peter; Baumgartner, Rupert: Design for sustainability in automotive product development - introduction and case examples, for: ECO2 Spring Seminar, Department of Aeronautical and Vehicle Engineering, KTH Royal Institute of Technology, Stockholm (Sweden), 21.05.2015.
- Ulz, Anita: Adapting organisational change management for sustainability frameworks to universities' context, for: Global Cleaner Production & Sustainable Consumption Conference, Elsevier, Sitges (Spain), 03.11.2015.
- Winkler, Thomas: Emission trends of greenhouse gases for Austria:Tracking livestock production on different system levels, for: Summerschool - Arising Awareness - Sustainable Development of human society within the frame of planet Earth, Universität Heidelberg, Heidelberg (Germany), 28.09.2015.
- Winkler, Thomas; Aschemann, Ralf: Decreasing greenhouse gas emissions of meat products through food waste reduction:Framework for a sustainability assessment approach, for: | Global Cleaner Production and Sustainable Consumption Conference, Elsevier, Sitges (Spain), 01.11.2015.
- Winkler, Thomas; Aschemann, Ralf: Decreasing greenhouse gas emissions of meat products through food waste reduction:Framework for a sustainability assessment approach, for: 7th German-Brazilian Symposium of Sustainable Development, Universität Heidelberg, Heidelberg (Germany), 06.10.2015.
- Winkler, Thomas; Winiwarter, Wilfried: Scenarios of livestock - related greenhouse gas emissions in Austria, for: Sustainable Development Symposium 2015, Lissabon (Portugal), 15.06.2015.

3.3 Functions

3.3.1 Functions in external scientific associations

- Baumgartner, Rupert: International Sustainable Development Research Society (United Kingdom), Executive Board, since 01.01.2006.
- Baumgartner, Rupert: PhD-Opponent, Blekinge Institute of Technology, Sweden
- Posch, Alfred: ITdNet (European Union), Membership, since 2002



3.3.2 Functions in international scientific journals

Aschemann, R.: Journal of Environmental Assessment Policy and Management, Member Editorial board, since 01.10.2009.

Baumgartner, Rupert: Journal of Cleaner Production, Editor, since 01.11.2008.

Baumgartner, Rupert: Sustainable Development, Member Editorial Board, since 01.10.2008.

Steiner, Gerald: International Journal of Transitions and Innovation Systems, Member Editorial Board, since 01.02.2009.

Reviews were undertaken for following journals:

- Business Strategy and the Environment
- California Management Review
- Computational and Mathematical Organization Theory
- Ecological Indicators
- Energy Efficiency
- Energy Policy
- International Journal of Transitions and Innovation Systems
- Journal of Business Ethics
- Journal of Cleaner Production
- Journal of Economic Psychology
- Sustainability
- Sustainable Development
- Systems Research and Behavioral Science

3.4 ISIS Reports

In 2012 ISIS decided to issue a report series of its own, called “ISIS Reports”. The series is dedicated to disseminating interesting scientific results from ISIS members and their colleagues as well as from excellent students. The aim is to provide a means of publication that works more quickly than journals would and an opportunity to publish excellent research work that has not been published in other ways. This includes research reports, excellent master’s or PhD theses as well as collections of papers from conferences (conference proceedings) or excellent reports from teaching projects. The series appears at irregular intervals with a minimum of two issues per year. It bears an ISSN number and is available in the form of hard copies and especially as a pdf online on our ISIS website. The language of publication is German or English.

Published reports:

- ISIS Report #1: Florian Hold, Informelle Abfallwirtschaft in Österreich – Chancen, Risiken und Praxis. Graz, October 2012 (in German).
- ISIS Report #2: Maximilian Mrotzek, Andreas Kreuzeder, Walter Gössler (Eds): Phosphorus: Papers of an Interdisciplinary Practical Training at the University of Graz. Graz, January 2013 (in English).
- ISIS Report #3: Manfred Füllsack (Ed.): Networking Networks. Graz, May 2013 (in English).

- ISIS Report #4: Rauter, R., Gsodam, P., Nguyen, T. D., Stabauer, P., Baumgartner, R. J.: New Business Models in Austria -Forerunners in Sustainable Economics. Graz, October 2013 (in English).
- ISIS Report #5: Gastinger, B.: Biologische Abfallbehandlung in der Steiermark und ihr Beitrag zum Klimaschutz. Graz, December 2013 (in German).
- ISIS Report #6: Baumgartner, R.J., Gelbmann, U., Rauter, R. (eds.): Making the Number of Options Grow. Contributions to the Corporate Responsibility Research Conference 2013. Graz, January 2014 (in English).
- ISIS Report #7: Rauter, R., Globocnik, D., Perl-Vorbach, E., Baumgartner, R. J.: Open Innovation und Nachhaltigkeit. Bedeutung von Kooperationen und formalen Managementpraktiken zur Steigerung des nachhaltigkeitsorientierten und wirtschaftlichen Innovationserfolgs. Graz, November 2015 (in German).

3.5 Awards

In 2015 the following awards were received by member of the institute and persons related to the institute.

3.5.1 Hans Roth Umweltpreis

Martina Zimek, BSc. MSc., was awarded for the Hans-Roth Umweltpreis 2015 (Environment Award awarded by the Saubermacher company) for her master thesis “Initiativen zur Lebensmittelabfallvermeidung auf der Konsumentenebene - Qualitative und quantitative Analyse der Initiativen in der Steiermark zwischen den Jahren 2011 und 2013 und Handlungsempfehlungen für die Zukunft” (supervised by Dr. Ulrike Gelbmann) on October 16 in Vienna.



Figure 22: Hans-Roth Umweltpreis 2015

3.5.2 Energy Globe Styria Award

In summer term 2014 a team of 23 motivated students and six teachers organized Rest-Festl, an event designed to raise public awareness for food loss and waste. The event took place on October 17th 2014 in Graz and attracted some 1500 visitors (cf. ISIS Annual Report 2014). For

this effort, the 'Restl Festl' organizer team led by Dr. Ulrike Gelbmann was awarded the "Energy Globe Styria Award" in the category "youth project" on 12th March 2015.



Figure 23: Energy Globe Styria Award 2015



Figure 24: Energy Globe Styria Award 2015

3.5.3 Viktualia Award

The 'Restl Festl' organizer team led by Dr. Ulrike Gelbmann was additionally awarded the "Viktualia Award" by the Federal Ministry for Agriculture, Forestry, Environment and Water Management, Reinhard Mang (in representation for Federal Minister Andrä Rupprechter) in the category "agriculture and regional projects" on May 18th 2015.



Figure 25: Viktualia Award 2015

3.5.4 Award of Excellence

On December 4th, Mag. Kathrin Reinsberger, PhD, received the Award of Excellence granted by the federal ministry of science, research and economy for the best dissertation in 2015. Her cumulative dissertation with the title „A Socio-Technical Perspective on Innovations in Energy Transition: Empirical Research on Community Involvement in Integrating Renewables“ was written within the doctoral school for Environmental Systems Sciences. Her research was supervised by Ao. Univ.-Prof. Mag. Dr. Alfred Posch.



Figure 26: Award of Excellence 2015

3.5.5 Award “Teaching: Excellent!”

The 2015 University of Graz Teaching Award “Teaching: Excellent!” focused on team- and co-operation oriented teaching. Ulrike Gelbmann, Barbara Hammerl, and Anton Peskoller, all teaching at the Institute of Systems Science, Innovations and Sustainability Research, were awarded for their Interdisciplinary Practical Training Course “Sustainability Groups in Graz” in winter semester 2014/15. The course focused on co-operation in several ways: Not only did the students co-operate in small teams when investigating several sustainability groups they had chosen in advance, they also collaborated closely with the teachers, thus contributing to research work. Finally, as students did their research by means of so-called “participatory research” they also worked for and contributed to the sustainability groups they investigated (e.g. oikos, a repair café or a neighborhood group). This special approach, combining work for society and teaching, is also called “service learning”. This approach was appreciated by the

jury, and the teachers (and actually also their students) received a prize consisting of a custom-made “chaotic pendulum” and a check amounting to € 2.000,--.



Figure 27: Award “Teaching: Excellent!” 2015

4 TEACHING

4.1 Study Programmes

4.1.1 Environmental Systems Sciences

In teaching, ISIS is the focal institute for the bachelor and master study programmes in **Environmental Systems Sciences (USW - Umweltsystemwissenschaften)** with its four subject foci: business administration (respectively sustainability oriented management), economics, geography, and NAWI-Tech.



Figure 28: USW logo

NAWI-Tech is the newest of all subject foci and was established in 2012. This unique study programme is provided by University Graz (KFUG) and Graz University of Technology (TUG) in their joint activity Natural Sciences. This study (USW Nawi-Tech) replaces the former subject foci physics and chemistry and is focussing predominantly on the aspects of natural sciences in the discussion of sustainability (for further information please see: <http://www.nawigraz.at/>).

The main idea of these study programmes is to generate interdisciplinary trained academics that are able to handle complex problems that are related to environmental protection and/or to the broader concept of sustainable development of different systems. Here, the capability to apply formal methods of systems sciences, in-depth knowledge in the respective subject focus and profound competences for working in interdisciplinary teams are the most important cornerstones of the profile of graduates in Environmental Systems Sciences.

The roots of the study programmes in Environmental Systems Sciences go back to 1991 when the first individual diploma studies were developed. Continuously increasing interests by students and high dedication of some professors finally led to the implementation of regular bachelor and master study programmes in October 2003 which are still unique in its conception in Europe. Now, about 1,300 students are enrolled in the bachelor and master programmes in Environmental Systems Sciences; the bachelor programmes comprise 180 ECTS credit points which equals a study period of six semesters, and the consecutive master programmes 120 ECTS credit points, or four semesters.



Figure 29: Teaching at ISIS

ISIS is responsible for the education in formal methods of systems sciences, mathematics and statistics, interdisciplinary education for basics in human-environment systems, for parts of the teaching subject business administration (bachelor level), for the teaching subject sustainability-oriented management (master level), and last but not least for the interdisciplinary practical courses. The latter is a special and unique course type where an interdisciplinary team of teachers and students with different subject foci work together on a complex real-world problem for sustainable development of a certain system.



Interdisciplinarity and transdisciplinarity are part of the teaching concept, aiming at the integration of stakeholders from outside the University in order to initiate a mutual learning process between academics and practitioners.

Comprehensive information on Environmental Systems Sciences can be found at <http://umweltsystemwissenschaften.uni-graz.at> or www.umweltsystemwissenschaften.at.

4.1.2 International Joint Master's Programme in Sustainable Development

In 2008, a curriculum for the International Joint Master's Programme in Sustainable Development was designed and approved by six partner universities, with the University of Graz (Austria) as co-ordinating university, Ca' Foscari University of Venice (Italy), Leipzig University (Germany), and Utrecht University (The Netherlands) as degree-awarding consortium members, and Basel University (Switzerland) and Hiroshima University (Japan) as associated mobility partners. In 2013, University of Stellenbosch (South Africa) and TERI University in New Delhi (India) joined the consortium as further mobility partners.



Figure 30: Joint Master Programme

In this master's programme sustainability issues are approached from an international as well as inter- and transdisciplinary perspective. The focus is set on applying the competences to the question of sustainable development and the needs and possibilities of societal transformation. It combines the strengths and specializations in teaching and top research of six partner universities, thereby offering the students a programme recognized in the countries of the consortium partners and the possibility of going on to PhD-studies as well as increasing the employability in the private, public and semi-public sector.

Admission to this Master's Programme is granted to students who have completed at least the equivalent of a Bachelor's or Diploma degree, and can demonstrate their research skills, their basic knowledge of the natural and/or social sciences, and a general insight in the subject of sustainable development and intervention strategies. The Master's Programme comprises 120 ECTS credits corresponding to a period of study of at least four semesters or two years. 60 ECTS credits have to be earned at the home university. Students are required to complete at least 30 ECTS credits at one of the partner universities. Besides the academic coordination, ISIS offers courses for the first semester in basics in Sustainable Development, for the third integration semester, and one specialization track (second semester) in Sustainable Business Management. Master theses are generally supervised by two teachers of two different partner universities.

Comprehensive information on the International Joint Master's Programme in Sustainable Development can be found at www.jointdegree.eu/sd.

4.1.3 Erasmus Mundus Master's Programme in Industrial Ecology (MIND)

The European Commission's "Education, Audiovisual and Culture Executive Agency" (EACEA) has selected the new Erasmus Mundus Master's Programme in Industrial Ecology (MIND) in July 2010. Beside the International Joint Master's Programme in Sustainable Development, this is the second Joint Master Programme, where ISIS is the co-ordinating institute.

MIND is a two-year programme with 120 ECTS, intending to train its students

- to conduct industrial ecology analyses of complex sustainability problems,
- to design industrial ecology solutions for these problems, and
- to develop implementation strategies for those solutions identified.

MIND has started with winter term 2011/12 and is co-ordinated by Dr. Ralf Aschemann as the academic co-ordinator and Mag. Ulrike Krawagna from the Office for International Relations as administrative co-ordinator. Partners in the MIND consortium are Leiden University and Delft University of Technology; Chalmers University of Technology Gothenburg; Asian Institute of Technology (Thailand); Rochester Institute of Technology (USA) and Waseda University (Japan).

In the first study year, the three EU universities offer basic modules on industrial ecology. In the second study year, all consortium universities offer a specialization module in industrial ecology (third semester), cf. the figure xx below, before the master's thesis has to be conducted in the fourth semester.

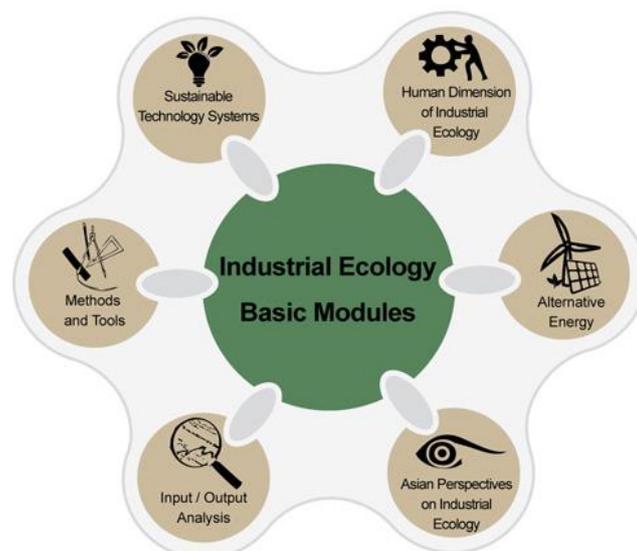


Figure 31: Structure of the MIND programme

According to the Erasmus Mundus regulations, MIND students have to study at least one semester at two different European countries of the consortium. Moreover, some students have the opportunity to spend one semester at one of the non-European MIND universities. It is intended to run MIND at least for five consecutive editions, i.e. study years 2011/12 to 2016/17. For the same period, the EACEA is supporting MIND by granting scholarships for students and scholars and by contributing to the running administrative costs.

In August 2015, the third generation of MIND students has been awarded with the Diplomas during the jointly organized MIND orientation week, summer school and graduation ceremony in Kungälv/Sweden.



With winter term 2015/16, MIND has started its fifth edition: 15 students from three continents began their courses at one of the three European partner universities. Comprehensive information on MIND can be found at www.emmind.eu.

4.1.4 Doctoral School for Environmental Systems Sciences

In October 2011, the new Doctoral School for Environmental Systems Sciences was founded. The main goal is to provide high-quality education for our PhD-students in the field of environmental systems sciences. The study programme is based either on the curriculum for interdisciplinary environmental systems sciences or on the curriculum for environmental systems sciences focused on natural science. The thesis has to be cumulative based on three peer reviewed journal publications instead of writing a monograph. This new form complies with international scientific standards and ensures that the valuable results achieved by our PhD-students are presented to an international audience.

4.1.5 Doctoral Programme DK Climate Change

In the winter semester 2014 the interdisciplinary doctoral programme **DK Climate Change** has been launched. The program is a joint effort of researchers associated with University of Graz's research core area "Environment and Global Change". Univ.-Prof. Lukas Meyer (Department of Philosophy) serves as a speaker for the programme, and Univ.-Prof. Dr. Gottfried Kirchengast (Wegener Center for Climate and Global Change) serves as co-speaker. Three of the eleven board members are affiliated with ISIS: Univ.-Prof. Dr. Rupert Baumgartner, Ao.Univ.-Prof. Dr. Alfred Posch and Univ.-Prof. Dr. Wilfried Winiwarter. The programme is supported by Dr. Bettina Lackner and Mag. Regina Brunnhofer.

So far 13 postgraduate students have been selected for this highly competitive programme. Four of these students are affiliated with ISIS. They will be employed for 3 years in pre-doc research positions with the option to extend their employment by half a year if they choose to spend at least 6 months at one of the programme's partner universities.

The programme is funded by the Austrian Science Fund (FWF). Detailed information on the aims of the programme, as well as information on all projects and involved researchers can be found on the following web site: <http://dk-climate-change.uni-graz.at/en/>

4.2 Completed theses (master and doctoral)

In 2015 30 master students completed their thesis within one of the ISIS study programs Environmental Systems Sciences, Sustainable Development and Industrial ecology. The list is ordered alphabetically, supervisors are named in brackets.

1. Buchner, Franziska Elisabeth: Kuba im Wandel - Ein Stromkonzept für die Zukunft, (Posch, Alfred).
2. Ebner, Tina: Entwicklung eines exemplarischen Business Models für einen Re-Use Park, (Gelbmann, Ulrike-Maria).
3. Eichelsdörfer, Ludwig Peter: Betrachtung ausgewählter Geschäftsmodelle von Energieversorgungsunternehmen in Österreich und Deutschland, (Baumgartner, Rupert).
4. Freiburger, Sebastian Josef: Energy analysis of an Austrian chocolate manufacturing company, (Vorbach, Stefan).
5. Ganster, Julia: Development of a waste management concept in the area of Pharmaceutical Engineering based on a case study, (Füllsack, Manfred; Ralf Aschemann).
6. Glettler, Sabine: Open Innovation - Kundenintegration bei nachhaltigen Dienstleistungsinnovationen, (Baumgartner, Rupert; Rauter, Romana).
7. Gumhold, Christof: Die Wahl des Heizungssystems - Eine Analyse der beeinflussenden Faktoren im Entscheidungsprozess, (Posch, Alfred).
8. Hirz, Daniel: Impact Investing in Österreich - Der Markt, die Akteure und die Rolle von Finanzintermediären, (Baumgartner, Rupert; Rauter, Romana).
9. Kallsperger, Teresa: Institutional Arrangements for Photovoltaic Participatory Projects, (Posch, Alfred; Hatzl, Stefanie).
10. Kandler, Nora Yucca: Lastverschiebungspotenziale durch Anwendung variabler Stromtarife in Privathaushalten - Datenanalyse eines Pilottests in ausgewählten österreichischen Städten, (Posch, Alfred).
11. Kohlmaier, Johannes: Power through the People - Drivers and barriers for the development and diffusion of community-financed renewable energy systems in urban areas, (Posch, Alfred).
12. Lippitz, Martin: Abfallwirtschaftskonzepte für Krankenanstalten im Spannungsfeld zwischen Abfallmanagement und Hygiene, (Gelbmann, Ulrike-Maria).
13. Maderebner, Romana: Die Bedeutung der Resilienz einer alpinen Tourismusregion am Beispiel der Kleinregion Schladming, (Gelbmann, Ulrike-Maria).
14. Marquardt, Klara: Engagement der deutschen Bundesregierung für Nachhaltigkeitsstandards in textilen Lieferketten am Beispiel des Bündnisses für nachhaltige Textilien, (Baumgartner, Rupert).
15. McQuiston, Pauline Catherine: Wind power expansion in Austria: A qualitative content analysis of stakeholders' views, (Posch, Alfred).
16. Mendez Alva, Fancisco: Sustainable and energy efficient emerging technologies for food processing, (Schnitzer, Hans).



17. Mohsenzada, Mohamad Sulaiman: Development of a Quality Management Concept for a Research Institute, (Baumgartner, Rupert).
18. Nusselder, Sanne: A Certification System for Sustainable Copper Production, (Baumgartner, Rupert; Aschemann, Ralf).
19. Pitter, Isabelle: Implementierung einer Sustainable Supply Chain Strategie, (Posch, Alfred).
20. Platisa, Jelena: Development of Waste Management Concepts for Electronic and Semiconductor Companies, (Gelbmann, Ulrike-Maria).
21. Propst, Birgit: Der Zusammenhang zwischen Fachkompetenz und Ideenqualität - Eine empirische Untersuchung, (Posch, Alfred; Globocnik, Dietfried).
22. Sajowitz, Silvia: Wirkung von Nachhaltigkeitsbildungsmaßnahmen, (Gelbmann, Ulrike-Maria).
23. Schmölzer, Patrick: Die Bedeutung von Stadtteilmanagement als integrative Komponente der "Stadt der Zukunft", (Gelbmann, Ulrike-Maria).
24. Schuster, Christoph: Die Vernetzung internationaler und regionaler Anforderungen und Interessen im Umweltmanagement eines ISO 14001-zertifizierten Industrieunternehmens als Chance für die Zukunft, (Baumgartner, Rupert).
25. Schwärzler, Marianne: Implementierung einer Sustainability Balanced Scorecard für eine Non-Profit Organisation, (Posch, Alfred; Hatzl, Stefanie).
26. Steiner, Jan-Stephan: Der Stadtteil als Marke - Handlungsempfehlungen für den Stadtteil Graz Reininghaus, (Gelbmann, Ulrike-Maria).
27. Untermayr, Martina: Konzept für die Umsetzung des Energieeffizienzgesetzes in einem österreichischen Entwicklungsdienstleistungsunternehmen, (Baumgartner, Rupert; Perl-Vorbach, Elke).
28. Urban, Herwig: Erhebung und Evaluierung von Methoden zur ganzheitlichen Bewertung von Landfill Mining Vorhaben, (Vorbach, Stefan).
29. Wagner, Nina: Die Förderung der Arbeitsfähigkeit alternder MitarbeiterInnen - Situationsanalyse und Maßnahmenentwicklung am Fallbeispiel eines Handelsunternehmens, (Gelbmann, Ulrike-Maria).
30. Wojtas, Wesley Adrian: Potentials of possible applications for a sustainable electricity provision in Byblos, Lebanon, (Posch, Alfred).

In addition two doctoral theses have been completed within the doctoral school for Environmental System Sciences which was founded in October 2011.

31. Pierer, Magdalena: Increasing the understanding of consumer-related nitrogen pollution in Austria: food production, nitrogen footprints and consumption patterns, (Winiwarter, Wilfried; Posch, Alfred; Amon, Barbara).
32. Reinsberger, Kathrin: A Socio-Technical Perspective on Innovations in Energy Transition: Empirical Research on Community Involvement in Integrating Renewables, (Posch, Alfred; Schleicher, Stefan; Vorbach, Stefan).

4.3 Course list

Summer term 2015			
Type	Courses	Lecturer	Contact hours
PS	Angewandte Systemwissenschaften	Hofer C, Kislinger M, Schober A, Tartiu V	2
PS	CSR-/Stakeholdermanagement	Seebacher U	2
SE	DissertantInnenseminar	Baumgartner R, Füllsack M, Posch A	2
KS	Eco-Controlling	Baumgartner R, Engert S, Rauter R	2
KS	Environmental Decision Making	Brudermann T	2
VU	Integral- und Differentialrechnungen für Umweltsystemwissenschaften	Batzel J, Peichl G, Eibel L	4
AG	IP - Analyse und Konzeption von energieeffizienten Gebäuden anhand wirtschaftlicher und technischer Aspekte	Kreiner H, Ninaus J, Perl-Vorbach E	4
AG	IP - Gestaltung der Umweltkommunikation der Universität Graz	Baumgartner R, Friesenbichler M, Ulz A	4
AG	IP - Globale Entwicklung, Klimawandel und sozioökonomische Transformation: eine systemwissenschaftliche Modellierung	Bednar-Friedl B, Füllsack M, Gross A, Steininger K, Tartiu V	6
AG	IP - Klimaneutralität: Ein realistisches Ziel?	Kollmann R, Kozina c, Maier S, Ninaus J	6
AG	IP - Konsum und Produkte: Nachhaltige Lebensstile und Nachhaltigkeitskommunikation	Klade M, Seebacher U, Von der Hellen C	4
AG	IP - Mobilitätsmanagement	Dullnig K, Reiter K, Seebacher U	4
AG	IP - Planspiel: Biotreibstoffe (Simulation game: Biofuels)	Aschemann R, Friedrich A, Mittelbach M, Schweitzer S, Tartiu V	6
AG	IP - Smart Learning in Smart Cities - Nachhaltigkeitslernen in partizipationsorientierten Startprojekten	Friesenbichler M, Gelbmann U, Hammerl B, Peskoller A	4
AG	IP - Urban Bee Keeping - Start einer Grazer Bieneninitiative	Crailsheim K, Friedrich A, Sammer K	4
PS	Management von Innovations- und Umweltprojekten	Posch A	2
SE	Masterseminar	Baumgartner R, Füllsack M, Gelbmann U, Posch A	2
VO	Mensch und Umwelt: Biosphäre und Ökosysteme	Raspotnig G, Tschernatsch M	2
AG	MIND Summer School	Aschemann R	2
OL	Orientierungslehrveranstaltung USW	Baumgartner R, Bednar-Friedl B, Fischer W, Füllsack M, Huber A, Kramer K	1
DQ	PhD Doktoratskolloquium II	Baumgartner R, Füllsack M, Posch A	2



KS	Product and Service Development	Globocnik D	2
PS	Proseminar zu Statistik für Umweltsystemwissenschaften	Feit T, Ring W	1
AG	Research Project Innovation Management	Brudermann T, Crockett S, Posch A	4
SE	Scientific article writing and research methodologies for sustainability studies	Lozano Ros R	2
SE	Scientific writing in English	Tiede K	2
SE	Seminar zu Systemintegration und Systembewertung	Füllsack M, Granigg W	2
SE	Seminar zu Systemmodellierung - Agent based modelling	Füllsack M, Schmickl T	2
SE	Seminar zur Forschungsmethodik	Baumgartner R, Posch A	2
KS	Strategic Sustainability Management	Gelbmann U	2
SE	Sustainability and Environmental Management	Posch A	2
KS	Sustainability Entrepreneurship	Kenik E, Steiner G	2
KS	Sustainable Innovation	Rauter R	2
VO	Systemmodellierung	Propst G, Tartiu V	2
VO	Systemwissenschaften 2	Desch G, Füllsack M	2
VU	Systemwissenschaften 3	Granigg W	2
UE	Übungen zu Systemwissenschaften	Hintermüller S, Hofer C, Kupsa S, Pierer M, Schröck A	2
PS	Umwelt- und Nachhaltigkeitsmanagementsysteme	Baumgartner R	2
KS	Value Chain Management	Aschemann R	2
VU	Vektorrechnung für USW	Batzel J, Friepertinger H, Prager W, Schwaiger J	3
KS	Waste and Recycling	Gelbmann U, Klampfl-Pernold H	2

Winter term 2015/2016			
Type	Courses	Lecturer	Contact hours
PS	Angewandte Systemwissenschaften	Granigg W, Hofer C, Lechner G, Schober A, Tartiu V	2
KS	Eco-Controlling	Baumgartner R	2
KS	Environment and Technology Assessment	Aschemann R	2
VU	Integral- und Differentialrechnungen für Umweltsystemwissenschaften	Batzel J, Hötzl E, Keeling S, Peichl G, Rosenberger S, Pieber S, Thaler F	4
KS	Integrated Management Systems	Dully S, Ulz A	2
VO	Interdisziplinäre Arbeitsmethoden	Aschemann R	2
AG	Inter- and transdisciplinary case study on Sustainable Development	Crockett S, Posch A, Winkler T	6
SE	Introduction to Industrial Ecology	Aschemann R	2
AG	IP - Ethisch-ökologische Bewertung von Unternehmen	Aschemann R, Baumgartner R, Paulesich R	6

AG	IP - Kleinwasserkraft - zukunftsfähige Energiegewinnung	Knoblauch H, Kriechbaum M, Saccon P, Schinko T	4
AG	IP - Resilienz - die „neue“ Nachhaltigkeit	Gelbmann U, Höflehner T, Peskoller A	4
AG	IP - Smart City - Transdisziplinäre Arbeitstechniken in Aktion	Aschemann R, Hammerl B, Handler R, Hecher M	6
AG	IP - Sustainable and Responsible Investment	Klatil C, Lernbass R, Pilaj H, Rauter R	6
AG	IP - Ursachen und Folgen von Obsoleszenz am Beispiel des Smartphones	Gelbmann U, Nessel S, Schöggel J	4
AG	IP - Wertschöpfung und Wertschätzung von Beekeeping	Brodtschneider R, Crailsheim K, Hasler A	4
VO	Management nachhaltiger Entwicklung	Baumgartner R	2
SE	Masterseminar	Baumgartner R, Füllsack M, Posch A	2
VO	Mensch und Umwelt: Anthroposphäre	Posch A, Steininger K	2
VO	Mensch und Umwelt: Geosphäre	Lazar R, Lieb G, Sulzer W	2
KS	Methods for inter- and transdisciplinary problem-solving	Aschemann R	2
PS	Nachhaltigkeitsberichtserstattung	Resel K	2
OL	Orientierungslehrveranstaltung USW	Baumgartner R, Bednar-Friedl B, Fischer W, Füllsack M, Huber A, Kramer K	1
PV	PhD Privatissimum	Baumgartner R, Füllsack M, Posch A	2
KS	Product and Service Development	Globocnik D	2
PS	Proseminar zu Statistik für Umweltsystemwissenschaften	Abros R, Feit T, Seebauer S	1
AG	Research Project Sustainability Management	Fleiß E, Hatzl S, Rauter R, Reischl C	4
SE	Seminar zu Systemintegration und Systembewertung	Füllsack M, Huber A	2
SE	Seminar zu Systemmodellierung - System Dynamics	Füllsack M, Schmickl T	2
SE	Seminar zur Forschungsmethodik	Füllsack M, Hecher M	2
SE	Social competences for managing sustainable development	Seebacher U	2
SE	Social competences for working in inter- and transdisciplinary teams	Seebacher U	2
VO	Statistik für USW	Feit T	2
KS	Strategic Sustainability Management	Gelbmann U	2
KS	Sustainability Entrepreneurship	Kenik E	2
AG	Sustainable Development - Integrating Perspectives	Posch A, Steiner A, Williams W, Winkler T	6
KS	Sustainable Innovation	Rauter R	2
VO	Systemintegration und Systembewertung	Füllsack M	2
VO	Systemwissenschaften 1	Füllsack M, Propst G	2
VU	Systemwissenschaften 3	Granigg W	2
SE	The Sustainability Challenge	Posch A	2
UE	Übungen zu Systemwissenschaften	Hintermüller S, Hofer C,	2



		Kupsa S, Pierer M, Schober A, Schröck A	
VO	Umweltorientiertes Innovations- und Technologiemanagement	Rauter R, Vorbach S	2
VU	Vektorrechnung für USW	Prager W	3
KS	Waste and Recycling	Gelbmann U, Schmidt G	2



*Institute of Systems Sciences,
Innovation & Sustainability Research*
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