LECTURES

ETH SUSTAINABILITY SUMMER SCHOOL 2011

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Songs by the Swiss Students during the Cultural Night.

Participants

Caio Bosso,
Charles Bourrier,
Stefano Castelanelli,
Tasha Chan,
Nicky Chang,
Christina Chin,
Filippo Corsini,
Maheshi Danthurebandara,
Klaus Fuchs,
Martina Galler,
Melanie Haupt,
Pascal Hendrickx,
Liane Honda,
Dominique Jaquemet,
Jonathan S. Krones,
Rafael Laurenti,
Christian Marti,
Grégoire Meylan,
Nicolas Nägeli,
Severin Olloz,
Max Parknäs,
Sofia Poulikidou,
Simonne Rufener,
Rafael Schmitt,
Saranya Seetharaman,
Mark Simmons,
Rubina Singh,
Carolina Villamil,
Gege Wang,
Hannah Polly Williams.

Abstract

The ETH Sustainability Summer School „All Just Rubbish?“ discussed subjects related to greed product design, waste and material flows. For three weeks, 30 students from 18 disciplines and 18 countries had the opportunity to gain theoretical knowledge and to apply it later in practical case studies. The various Bachelor, Master and PhD students did not only show academic strength, creativity, technical and design-related expertise, but also a strong dedication to solving humanity‘s grand challenges.

During the first week, students received an introduction to all topics relevant to their case studies. This occurred through a series of lectures and workshops conducted by both local and international experts as well as inputs speeches by and discussions with stainability pioneers. The introduction to topics such as life cycle assessment, resource and waste management but also concepts such as cradle to cradle, biomimicry and sustainable design strategies have been documented by the students and can be found in the following report.

Acknowledgements

We would also like to thank the following people and institutions for initiating, planning, financing and implementing this summer school: the president of the ETH Zurich, Ralph Eichler; the ETH Sustainability advisory board; the Department of Civil, Environmental and Geomatic Engineering (D-BAUG) and the Department of Environmental Sciences (D-UWIS), the chair of Ecological Systems Design, especially Stefanie Hellweg, An de Schryver, Ronnie Juraske and Tobias Walser; the Institute of Construction and Infrastructure Management, especially York Ostermeyer and the Club of Rome, especially Ian Johnson and Vera Narodnitzkaia.

Furthermore we would like to thank Christian Capello, Annina Coradi, Walter Eschenmoser, Albin Kälin, Françoise Krattinger, Daniel Lang, Christian Ludwig, Lutz Osterbrink, Michael Pawlyn, Andreas Schläpfer, Mathias Schluep, Ernst-Jan van Hattum, Bernhard Wehrli and Christan Zurbrügg for sharing their knowledge, time and enthusiasm during the lecture week in Emmental. Daniel Freitag and Claude Martin for the Evening Talks in Zurich. For the Creative Workshop, Gunnar Green, Bernd Hopfengärtner, Jörg Hülsmann. And The HUB Zurich and Vitra for their support.

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RETREAT TO EMMENTAL

INTRODUCTIONS

Ian Johnson and Christine Bratrich during the Keynote Speech.

Economy of Waste

Sunday, June 26. Keynote Speech.

Ian Johnson's keynote address can be generally divided into three smaller sections: Broader context of sustainability, the reality, challenges and opportunities. History and mission of Club of Rome. Question and Answer session. In total the speech and discussion lasted for 90 minutes.

Key issue: how to translate the rhetoric buzz word "sustainability" into real action and results?
Failings of Copenhagen and disappointments in the UN
Limit to Growth, 1972 (refer to the sequel publication by Club of Rome, Beyond the Limits, 2002):
Herman Damen, ecological growth vs. ecological growth; physical vs. economic limit.
Six crises we're facing today: world population 6 billion (arguments in place to battle the question , All just rubbish?')

1. Poverty crisis
2. Warning signs of food crisis: latency of responsiveness of food suppliers vs. increasing demands of consumers
3. Financial/economic crisis: global chain reaction
4. Ecological crisis: climate change and loss of ecological diversity
5. Unemployment: immediately linked to poverty. leads to social, cultural and community Issues. Dignity. Declining labor intensity and how to include social sustainability when dealing with the technical issues related to unemployment?
6. Energy: oil electricity coal (CO_2 issue)+nuclear(waste disposal and safety issue) ?

Fast forward to 2050: world population 9.5 billion
x2 food demand: increasing income level in developing countries; increase in demand in food consumption; increase in demand in live stock consumption (7kg of wheat 1kg of meat).
x3 energy, x3 GDP growth (what contributes to this growth?) 60 trillion now, 180-200 trillions in 50 yrs. How can this x3 of good and service as well as infrastructure be managed?

Why are these issues taking place?
1. We often fail to look at long terms (policies makers, economists are both against long term trajectory)
2. ,Public Good': We often fail to recognize that we live in a highly interconnected world and that what you do affects your community and the larger global network. Again, economic cost vs. social cost. Who bears the costs? What's the global and long term goal?
3. Equity: equitable solutions tend to be sustainable solutions. Extreme rich vs. extreme poor.

MISSIONS OF THE CLUB OF ROME

- +100 individuals, +30 global leaders, +1800 thinkers of the long term global strategies
- facilitates discussions and dialogs
- foster interdisciplinary practices
- produce reports and publishing them such as Limit to Growth
- Value/Ethics. ,It's a serious question whether we care.'

Values are poorly or mis-reflected into our economical system. Economic model today produces the wrong results. Natural resources must be accounted. Economic wealth

doesn't necessarily produce equitable results.

Pricing: technical issues of full cycle analysis, what would we advise the government? Pricing incentives, tax incentives? What technical issues that can be resolved in the market? i.e. Carbon could be the largest commodity in the world. How to create a market for it?
Technical issues and their implementations must be linked to social solutions and employment.

Q+A SESSION, A VERY ROUGH SUMMARY

Q (Jonathan): Herman's text and how relevant it is in our practice?
A (Ian): There is a time lag. What we haven't achieved is the shift in radical thinking.

Q(Hannah): Developed countries' responsibility and impacts on developing countries
A: i.e. ,2 Chinas' that are going on: the dilemma of investment in sustainability vs. brutal development. China will see a major shift in 5-10 yrs. Global equity doesn't mean equal consumption/demand. Consequences of expecting all developing countries' population to consume as much as countries such as the US.

Q(Stefano): Carbon Market. Isn't it dangerous if not regulated/ is a free market?
A: Market shouldn't operate without the public. It would have to be a much more transparent and socially responsible market. But there is no other choice – it has to be a market solution.

Q(Nicky): Can you talk a little more and more specifically on the economy of waste in a global context?
A: recycling: pro or anti environment? Are we producing more waste to recycle? Nuclear waste disposal. The issue of waste dumping into developing countries has softened over time because of the increasing pressure from NGOs and increase in transparency.

Q(Carolina): Observes inequality in power and influence between richer and poor countires. What are the steps we can take as less powerful countries in fighting the battle of sustainability?
A: Facebook society. We're moving from vertical communication to a more lateral one. It's now much easier to make the issues transparent and globally heard overnight.

Q(Klaus): How to make the CO_2 market global?
A: It is a question from the beginning if we need a global market. What are the regional market values?

Q(Tasha): Recommendations for making/maintaining long term ethical choices.
A: A value system on a global level starts with education. Teaching of ,Global Citizenship'. There must a shift in value in economic system.

Q(Stefano): Is it smart to develop sustainability based on our situations and interests today?
A: we need to look at transitions more carefully. Evidences and drivers of transitions, instead of trying to get everything right at once.

Q(Rafael S.): all about money?
A: Need to look at the full effect of the value chain. At the moment it is a highly distorted economy system. $ value vs. added social value. i.e. ,Real Value Index'.

Q(Max): value in terms of GDP vs. value in terms of happiness in life? Better good/service vs. better living?
A: unemployment is again about poverty. Is it better to have ,23 hour working week'? Employment and migration (i.e. Japan).

Q(Johnathan): Is there a way for individuals to push appropriate evaluation?
A: How do we promote it in understandable ways? Again the differences in price and value.

Summation by Nicky Chang and Caio Bosso.

Ian Johnson
The Club of Rome,
Secretary General

Ian Johnson, a British national, has experience in the areas of sustainable development, energy and economic policy. He joined the World Bank in 1980 and worked as an economist in the energy sector and subsequently as an advisor in the Policy and Research Department of the Bank. In 1991, he was appointed to the Global Environment Facility (GEF) and later became its Assistant CEO. In 1997 he was promoted to senior manager of the Environment Department and in 1998 he was promoted to Vice President with responsibilities for sustainable development, environment, agriculture and social policy. He was also appointed as Chairman of the Consultative Group on International Agricultural Research (CGIAR).
Prior to joining the World Bank he worked with UNICEF and spent five years in Bangladesh. He left the World Bank in 2006 and has since then undertaken a number of advisory positions in the public and private sector. Mr Johnson is an economist and studied at the universities of Wales, Sussex and Harvard. In April 2010, Ian Johnson became Secretary-General of the Club of Rome.

Fostering Sustainability Transitions in Waste and Resource Management

Monday, June 27. Morning Lecture.

Realizing sustainability transitions in the area of waste and resource management requires going beyond purely technical solutions. For instance, education plays a key role as a mechanism of changing unsustainable and undesirable patters of consumption and behaviour, which in turn could reduce the quantity of waste. A comprehensive perspective of the complex interrelations of related human environment systems is crucial, which integrate knowledge from different disciplines as well as experimental knowledge. In both human and natural systems, sustainability is an outcome relationship among the parts. The students identified local, regional and international challenges during the workshop.

Nicky and Hannah Polly with Daniel Lang.

CHALLENGES CLUSTERS

- *Education:* awareness of waste problem missing, lack of political will and education for recycling.
- *Land use:* land fill, knowledge and action gap, lack of infrastructure, how to use sustainably local natural resources.
- *Incentives:* too strong focus on recycling rather than waste minimisation (recycling becomes an end on itself), too low "waste-bag" prices, not burning paper.
- *Supply:* REE, waste/recycling (take-back) strategy (e-waste), Issues for special metals (rare elements <-> clean technologies).
- *Social aspects*: many jobs in the informal sector related to waste.
- *Trade:* binding of multinational companies on environment issues, imbalance between ecological & economical development, cheap transportation costs.
- *Culture:* awareness of waste problem missing, lack of political will and education for recycling, fashion of sustainability.
- *Fairness:* urban mining, exploitation of natural and human resources on the south hemisphere.

3 BASIC SUSTAINABILITY CONCEPTS

Human Environmental Systems (Hierarchy): analyzing regulatory feedback and control systems on different hierarchical levels can help to better understanding of Human Environmental Systems, anticipating secondary feedback-loops is essential for sustainability learning.

Sustainability Transition: barriers / carriers of (sustainability) transition can be found on all of the three interconnected conceptual levels (niche, regime, and context), governing transition processes requires specific types of knowledge.

Transdiciplinary Sustainability: crucial aspect of transdiciplinary-research are: (i) problem-oriented, (ii) theoretical/methodological founded, (iii) mutual learnings; integration of the problems in the beginning and (re)-integration oft the result is crucial in the transdiciplinary process.

Summation by Simonne Rufener and Rafael Laurenti.

Daniel Lang
Professor for Transdisciplinary Sustainability Research
Leuphana University, Germany.

Dr. Daniel Lang is Professor in Transdisciplinary Sustainability Research and co-director of the Institute of Ethics and Transdisciplinary Sustainability Research at the Leuphana University of Lüneburg. Furthermore, he is the Vice-Dean responsible for research of the Faculty Sustainability and Dean of Study Affairs of Leuphana College's Leuphana Semester and the Comprehensive Studies. He studied geo-ecology at the University of Bayreuth and environmental sciences at ETH Zurich, where he graduated in 2001. He then completed his PhD thesis in 2005 at the Department of Environmental Science at ETH Zurich. His research revolves around transdisciplinarity, sustainability science, systemic sustainability assessment and prospective analysis of human-environment systems mainly in the fields of waste and resource management as well as urban and regional transitions.

Application of LCA in the Power Industry

Monday, June 27. Evening Talk.

Axpo is the leading electricity producer in Switzerland. It owns a multitude of run-off and lake hydro power plants, three nuclear power plants (four reactors of the five currently operational in Switzerland), a gas turbine and a "Kompogas" plant, in which biowaste from households and gardens is anaerobically digested (i.e. no oxygen in the digestion process) in order to deliver energy, heat and fertilizers to the community. Next to their electricity production, Axpo also distributes electricity to final consumers in Switzerland and trades with other Swiss and European electricity actors. Besides Axpo, there are two other major electricity producers and a multitude of small producers in Switzerland.

SUSTAINABILITY AT AXPO

The sustainability department of Axpo performs life cycle assessments (LCA) in order to support the Executive Board in decision-making regarding environmental aspects.

LCA aims at evaluating the local and global environmental impacts of a human activity over its whole life cycle: resource extraction, processing, manufacturing, use and waste disposal. The method is divided into four steps:

1. Goal and scope definition
2. Life cycle inventory analysis
3. Life cycle impact assessment
4. Interpretation

However, the steps are followed in an iterative way. Applied to the power industry, Christian Capello distinguishes upstream processes (e.g. gas extraction and transport, uranium enrichment), electricity production itself (e.g. CO_2 emissions of the gas turbine, radiations of the nuclear power plant) and the downstream processes (e.g. nuclear waste treatment and storage). The environmental impacts of infrastructure are taken into consideration, for instance, the impacts of the construction and demolition of a lake hydro power plant.

There are a number of difficulties linked to the harvesting of data they feed into the models of electricity production. While some processes don't even exist yet and are thus modeled based on theoretical assumptions and calculations (e.g. nuclear waste storage), others have taken place in a more or less far past (e.g. construction of lake hydro power plants). In the latter case, one has to rely on archives (if they exist).

CASE STUDIES

Until now, Axpo has performed LCAs on several of its plants using different electricity production technologies (run-off hydro power plant, nuclear power plant and Kompogas).

In the case of Kompogas, Axpo has obtained CO_2 certificates from the Federal Office of the Environment (FOEN), the so-called Environmental Product Declaration (EPD). Axpo can sell these certificates on the Swiss carbon market. Actual prices are around CHF 80/ton, allowing Axpo to earn some CHF 200'000/year, which makes this production process profitable! However, Axpo is not allowed to sell this electricity as "ecopower".

Communicating LCA results to the Executive Board is a difficult task. Hence, Christian Capello is in the process of developing an appropriate set of indicators. These include for instance impacts on climate and radioactive emissions. It is important to communicate the results in a smart way in order to make them understandable for the board.

Summation by Charles Bourrier and Grégoire Meylan.

Christian Capello
Head of Sustainability
Axpo AG, Baden, Switzerland.

Christian Capello is currently working as head of sustainability at Axpo AG – the leading Swiss electricity producer. His main tasks are supporting the Executive Board regarding corporate sustainability, developing the sustainability strategy and evaluating existing power plants as well as important projects with respect to environmental and social impacts. From 2002 to 2006 he worked at ETH Zurich as teaching and research assistant of the ETH continuing education programme „risk and safety" and worked as representative in the Swiss Centre for Life-Cycle Inventories (ecoinvent). In 2002 he obtained a Master degree in environmental sciences and in 2006 he completed his PhD at ETH Zurich.

Nicolas, Melanie, Jonathan, Martina, Rafael and Stefano during the Triple Bottom Line Workshop.

Triple Bottom Line

Monday, June 27. Afternoon Workshop.

The triple bottom line concept of sustainability looks at both the distinct and overlapping themes in sustainability for Environmental, Economic and Social factors.

ENVIRONMENTAL SUSTAINABILITY

Environmental sustainability involves the development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. The aim here is to benefit the natural order as much as possible, and curtailing the environmental impact. Common indicators used are the standard measures (carbon dioxide emissions, GWP, etc), ecotoxicity and humantoxicity (how much, on average is the life of a person shortened by a product), the ecological footprint, cumulative energy demand, and material intensity per service unit. Taking the ecological footprint as an example, the Triple Bottom Line concept aims to reduce its ecological footprint by managing the consumption of energy and non-renewables and reducing manufacturing waste. Life cycle analysis is also done in order to determine the true environmental costs from the first stage of growth and harvesting of raw materials, to the manufacturing to distribution and finally the disposal by the end user.

SOCIAL SUSTAINABILITY

Social sustainability is largely concerned with the equitable distribution of wealth and the promotion of civil society. As well as balancing both intergenerational and intragenerational equality, we need to consider the complex relationship between the needs of humans and the performance of nature. Social sustainability was conceptualised through various international conferences, in particular the Stockholm conference in 1972, and the UNCED conference in 1982, with its follow up in Rio. Agenda 21 is also crucial, essentially being a blue print for social sustainability. Of its many controversies, perhaps the most elucidating are the discrepancies in the manner in which social sustainability is approached; the conviviality paradigm. Methodological issues also cause problems as finding an accurate, feasible quantitative index proves almost impossible. Key indexes currently used are the Human Development Index, on which Scandinavian countries excel, and the Happy Planet Index, on which Central American countries are notably successful.

ECONOMIC SUSTAINABILITY

The aim of the economic pillar is to ensure that not only the quantity and quality of capital (be it human, social, natural, manufactured or financial) and resources but also the risk involved are treated and managed in a sustainable manner. Several indicators can be used to assess these goals such as profit, cost, utility and wealth - these indicators are all measures of real value realised from a project rather than of money in order to take into account inflation and to distinguish between what money and value may represent. The methods used to evaluate any potential project from an economic perspective may be a mixture of any of the 4 indicators mentioned above. However, each potential project should be placed in its relevant context i.e. the

structural issues (e.g. new markets replacing older ones) and speculation concerning the project so that one can identify what mixture of the 4 indicators should be used.

Summation by Tasha Chan, Saranya Seetharaman and Hannah Polly Williams.

York Ostermeyer
Senior Researcher at D-BAUG
ETH Zurich, Switzerland.

Mr Ostermeyer studied architecture at the University of Hanover, specializing in construction. Since 2008, he has worked as a post-doc at the Chair of Sustainable Construction at ETH Zurich's Institute for Construction Engineering and Management. He has been a group leader since 2010 handling projects to adapt sustainable buildings in different climate zones and cultures.

Annina Coradi
Junior Researcher
W.I.R.E., Zurich, Switzerland.

Annina Coradi, born 1982, studied geography and political economy in Zurich, Switzerland. She wrote her master's thesis about sustainable city development, which has been presented at the Alliance for Global Sustainability at Tokyo University. Since 2010 she works for the independant think tank W.I.R.E. Additionally she is a member of the commission of use and operation from the residential and commercial housing development Kalkbreite and is developing the social sustainable city project „reclaim the street by the kids."

Lutz Osterbrink
Quantitative Analyst
Credit Suisse, Switzerland.

Lutz Osterbrink works as a Quantitative Analyst in the Investment Banking division of Credit Suisse, based in Zurich. He is part of the Global Modelling and Analytics group (GMAG). GMAG is responsible for the development & implementation of models and trader tools for the Equity Department globally. Mr Osterbrink studied at the University of Hamburg as well as the ETH Zurich and the University of York. He holds a diploma in physics and a PhD in Mathematics.

Life Cycle Assessment

Tuesday, June 28. Morning Lecture.

LCA "studies the environmental aspects and potential impacts throughout a product's life from raw material acquisition through production, to use and disposal".
LCA can be used in order to:

- Compare alternatives
- Identify improvement potentials
- Certification and Eco-labeling

GOAL AND SCOPE DEFINITION

When starting with an LCA it is crucial to carefully think about the purpose and audience (company internal communication, external communication, research) of the study.
Another important point is the functional unit. It defines the reference for all the analysis. For a comparison of beverage packaging system you could go for the packaging for 1 liter, but for waste treatment you would rather choose 1kg of treated waste of a certain waste.
The system boundaries define how wide the scope of the study is set in time and space. It includes therefore also the limitations of the study and should state if there are any allocations and how they have been done (i.e. System expansion, economic allocation).
To perform an LCA study data is needed. Generic data from life cycle inventory databases or more detailed data in cooperation with the industry can be used.

INVENTORY ANALYSIS

During the inventory analysis all necessary information are collected in relation to the technical inputs and outputs (i.e energy demands, materials etc.) as well as the environmental inputs and outputs (i.e use of resources, emissions of substances, waste etc.) of the studied product system. A flowchart of the system can be also created including all relevant flows and processes within the studied systems boundaries. Data is collected in order to quantify the amount of inputs and outputs through available databases (i. e. Ecoinvent) as well as from the involved companies, suppliers, from literature etc. Finally the collected data have to be normalized and presented in relation to the predefined functional unit. Usually computer software can be used (for example Sima Pro) for the calculations.

LIFE CYCLE IMPACT ASSESSMENT

The aim of the LCA is to assess the impact of a product or service. Therefore the inventory list is not yet, what we want. We not only do list the used materials but also to find out what is their impact. We assign the emissions to different impact classes (i. e. CO_2 and CH_4 are Greenhouse gases). Then we do Characterization, where different emission substances are compared to the reference substance (CH_4 = 24 CO_2 eq).

INTERPRETATION AND PRESENTATION OF RESULTS

The findings of the inventory and impact assessment processes are analyzed and presented during the interpretation stage of the study. The way and level of details that the results will be presented depends highly on the purpose of the study as well as the audience as these were defined in the goal and scope definition stage. This can vary from direct interpretation and presentation of the inventory results with high level of detail to presentation of the characterization results in different impact or damage categories or even single aggregated indices. Conclusions and recommendations regarding the product systems are also an important part of the interpretation process. A sensitivity or uncertainty analysis can be also performed and presented in this part which assess the robustness and sensitivity of the LCA results.

Summation by Sofia Poulikidou and Dominique Jaquemet.

Stefanie Hellweg
Professor of Ecological Systems Design
ETH Zurich, Switzerland.

Stefanie Hellweg is professor for ecological systems design at the Institute of Environmental Engineering of ETH Zurich. After completing her PhD she worked as a post-doc and senior scientist at the Institute for Chemical and Bioengineering at ETH Zurich. Between 2004 and 2005 she was a visiting scientist at Lawrence Berkeley National Laboratory. Since 2006 she holds the Chair for Ecological Systems Design at ETH Zurich. Her main research interests are the environmental assessment of products and processes, e.g. food products, chemicals and waste treatment technologies. Together with her collaborators, she is developing methods for Life Cycle Assessment, e.g. for indoor pollutant exposure and water-use assessment.

Material Flow Analysis
Tuesday, June 28. Morning Lecture.

MFA is a book keeping method that provides information about Material Flow taking into account energy, spatial, informational and socio-economic issues. It follows the different pathways a certain material takes during its lifetime within a system boundary (e.g. local, global) and time frame. MFA seems to be simply defined, however, getting the data, choosing the system, understanding the processes, defining the transfer coefficients and quantifying the material complicates the issue. The following examples describe applications of MFA.

METAL STOCKS IN SOCIETY

By MFA the following points of the life cycle of metals are analysed: Ore – processing – fabrication – use – discard.

One finding of the MFA is that there is a substantial shift in metal stocks from below ground to above ground, as the metals stocks in society are increasing worldwide.

Several examples show the key function of recycling in order to reduce emission and extraction:

- The global production of primary steel causes 4-5% of total man made GHG. In Secondary steel production this emission is reduced by 75%.
- GHG emissions of secondary aluminium production are about 12 time less than primary aluminium production.

The recycling rate depends on the metal and the usage of it. Steel is often used in large units as construction material and is therefore easy to collect and recycle. On the other hand, indium is harder to recover since it is used in smaller units.

E-WASTE FLOW GHANA

In 2005, the Basel Action Network documented illegal export of e-waste to Nigeria and the subsequent informal recycling and dumping. The current situation is that the export of second hand EEE is however legal. In Ghana, these second hand goods make out 70% of the total EEE used. For Ghana population this is an opportunity to be able to afford such devices. The short lifetime of these second hand products produce a large amount of waste. This provides the population labour but at the same time jeopardizes health because of the questionable recycling procedures.

The model helped to identify the weak spots, of the complicated material flow chain. These are as mentioned the import of EEE from western countries and the recycling of WEEE.

Summation by Martina Galler and Nicolas Nägeli.

Mathias Schluep
Program Manager and Scientist
Empa, Dübendorf, Switzerland.

Mathias Schluep is a senior scientist leading Empa's e-waste related research. He is responsible for several co-operative e-waste management projects with developing countries in Africa and Asia. His special focus is in Africa, where he has implemented e-waste projects for the Swiss States Secretariat of Economic Affairs (SECO), Hewlett Packard, Microsoft, UNIDO, UNEP, the Secretariat of the Basel Convention and the European Union. Before that he worked in the private sector in the field of environmental and business consulting at national and international levels. He received his MSc in Environmental Engineering and his PhD in natural sciences from ETH Zurich.

Life Cycle Impact Assessment

Tuesday, June 28. Afternoon Lecture and Workshop.

The third phase of life cycle assessment is described in ISO 14042, and it provides a system-wide prospective of environmental and resource issues. It assigns Life Cycle Inventory results via characterization to impact categories.

There are varies impact over time and space: land use, climate change, human toxicity, acidification, etc. for each impact category there is a: Cause effect pathway i.e. emissions > atmosphere concentration (depends of lifetime of the substance) > Amount of radiative forcing (how much substance alters the balance of incoming and outgoing radiation) > temperature increase (depends on climate sensitivity: head absorbed by the oceans) > risks for species/ human (from temperature increase to ecosystem damage).

IMPACT ASSESSMENT METHODS

Depends on the indicator chosen > A reference situation is chosen to normalize > Aggregation (weighting, distance to target, monetization)

There are 2 different approaches: midpoint and endpoint. In the first one environmental relevance is generally presented in the form of qualitative relationship in the endpoint approaches there is no need to deal separately with environmental relevance of the category indicators.

Method decision depends on: Who do you want to communicate with? Internal decision-making, external (marketing) or research. What do you want to communicate? Focus specific impact or overall holistic approach. What are the guidelines? Long term vs. short term; positive vs. negative effects

Uncertain: choice of the methods, system boundaries (what to include?).

Summation by Maheshi Danthurebandara and Filippo Corsini.

Sustainable Design Strategies and Product Development Process

Tuesday, June 28. Afternoon Lecture.

Example of product comparison: „Mars 2 Pac“ vs. „Eat Natural“ bars. - Which one is more sustainable? If one looks at the manufacture‘s mission statement, it‘s easy to tell one includes sustainability as their priority, the other one doesn‘t.

Good design should be design that is a. transparent, b. support consumers, c.build trust and socially responsible and last but not least: design for sustainable change.

The difference between goal and strategies: the transition from „idea“ to „solution: policy formation -> idea finding -> strict development -> realisation.

The difference between requirement and specifications: requirement indicates problem to be solved whereas specifications direct solutions. Requirement/problem to be solved is the most important to allow innovative ideas.

THE ECO-DESIGN STRATEGY WHEEL

7 check lists of sustainable design

1. Innovation: e.g. Strellson.com, Rent-a-ski.
2. Low Impact Material: e.g. Building w/ Audi 100 car windows, NL.
3. Optimized Function: nature forms function e.g. Bone Chair, Gecko Tape.
4. Optimized Manufacture: minimize production waste, minimize human/eco toxicity.
5. Efficient Distribution: e.g. modern sailboats (concepts) BMW Oracle Rid Wing 2009.
6. Low Impact Use: e.g. pneumatic seat cushion, Lantal, CH; Bike-Tec.
7. Optimized Product Life Time: short time (e.g. coffee spoon) vs. long time (e.g. overhead conveyor sorter).

Summation by Nicky Chang and Rafael Laurenti.

An De Schryver
Postdoctoral Research Associate
ETH Zurich, Switzerland.

An De Schryver works as a post-doc researcher for ecological systems design at ETH Zurich. After completing her master's in Environmental Biology in 2004 at the Free University of Brussels she began work as a Life Cycle Assessment consultant. She has worked on several European Union projects. Her research field encompasses life cycle assessment of products and impact assessment development. In 2008 she started a PhD at the Radboud Univeristy of Nijmegen in the field of Life Cycle Impact Assessment, more specifically on value choices in human health modeling. In 2010 she finished her PhD and started to work as a postdoc at ETH Zurich to analyse the wood value chain and its improvement potentials from an environmental point of view.

Ernst-Jan van Hattum
Industrial Designer and Owner
XStern, Zurich, Switzerland.

Between 1997 and 2008, Mr van Hattum served as Chairman of the O2 Global Network Foundation on Sustainable Design. After earning his MSc in Industrial Design Engineering in 1989 from the Technical University of Delft, Mr van Hattum worked as an R&D Manager and Industrial Designer for Promech Sorting Systems BV, a producer of sorting systems for clothing, books, CDs and other products. In 1989, he began applying Ecodesign principles to his work and designed a low-energy, 95% recyclable sorting system that was selected as best practice example of Dutch Ecodesign. Through his privately owned business XStern (www.XStern.com) he now offers services in Design and Innovation for Sustainability and organizes practical workshops with a whole-systems approach.

Bernhard Werhli during the Great Pacific Garbage Patch Talk.

The Great Pacific Garbage Patch
Wednesday, June 29, Evening Talk.

The current plastic production today is 250 million tons per year. If all the plastic produced was compressed and filled in cargo trains, it would require a train with a length six times the circumference of earth. Moreover, the plastic production has grown at an exponential rate of 9% per year. At this rate, the amounts of plastic will double every 8-9 years.

It is a known fact that plastic is non-biodegradable and hence a serious cause of concern. Nonetheless, plastic has become an indispensible part of our daily lives and 8% of the oil is used for plastic production. But 33% of all plastic produced is used for unnecessary applications such as single-use food packaging which can also be done using less harmful materials such as paper bags.

A large amount of plastic has entered the oceans, either through ships or being carried by the wind. This has resulted in the formation of the garbage patches in the sea comprising of plastic, distributed in the oceans by the currents, which has concentrated in areas with relatively low currents. The biggest of such patches is located in the Pacific Ocean and is estimated to be approximately twice the size of Texas (i.e. approx. 1.4 million km2). If you had a carpet of that size and could vacuum 1 m2 per second, it would take you 44'393 years to clean it.

PROBLEMS / IMPACTS

The growth in plastic production is a major cause of concern because plastic does not decompose. Since it is non-biodegradable, plastic waste management is a difficult task. It has been found that the concentration of plastic debris in the oceans is increasing in parallel to its production. The floating pieces of plastic affect the marine wildlife adversely. 250 species of marine birds and animals have been found to have traces of plastic in them in addition to the problem of animals getting entangled. Floating pieces of plastic also support alien invasion as many new species of organisms start growing on these plastic pieces and are transported by ocean currents to otherwise unreachable areas. This implies that these exotic species can settle in new habitats and threaten the existence of the local species. Moreover, the plastic pieces which have been floating in the oceans for a long period of time get fragmented and the resulting small particles of plastic get integrated into the tissues of mussels. Additionally, the issue of plastic sinking to deeper areas of the oceans is important. However, very little knowledge about the amounts or processes involved exists.

CONCLUSION

It was concluded that the great pacific garbage patch cannot be cleaned up since most of whatever is in the oceans today will remain there until eaten. However, it is possible for us to prevent further contamination of the oceans by plastic debris. This can be achieved by creating public awareness on the seriousness of the situation. For this reason scientific bodies should work in collaboration with policy makers to assess the impact of our actions on the planet. Many governmental and non-governmental organizations (NGO) have taken initiatives such as organizing beach clean-ups and advertising through the internet and other media to spread awareness about plastic.

ACTION: WHAT TO DO ABOUT IT?

The only effective way is to address the problem at the source, i.e. reducing plastic production and especially prevent the disposal of plastic in the sea. The most important step should be to create awareness among individuals and encourage them to minimize their plastic consumption. In order to achieve this we need to follow the many Rs of reduce, reuse, recycle, rethink, rediscover and redesign.

Summation by Rubina Singh and Christian Marti.

Bernhard Wehrli
Professor of Aquatic Chemistry
Eawag, Dübendorf, Switzerland.

Bernhard Wehrli is professor of Aquatic Chemistry at ETH Zurich and is affiliated with Eawag, the Swiss Federal Institute for Aquatic Science and Technology. His interdisciplinary research group is analyzing biogeochemical cycles in rivers and lakes with the goal to improve the sustainable management of water resources.

Françoise Krattinger
Research Associate
ZHdK, Zurich, Switzerland.

Françoise Krattinger studied cultural anthropology and art history at Zurich University and majored in architecture at ETH Zurich. Since 2007, she has been a research associate at the Museum für Gestaltung Zürich and at the Master of Arts Education, Curating and Museum Education since 2009. She is the Co-Curator of the Plastic Garbage Project. Exhibition: 04.07. – 02.09.2012.

The Role of Thermal Processes in Energy and Materials Flow Management

Wednesday, June 29. Morning Lecture.

There are several possibilities how to handle waste. Most of the countries simply landfill it. Switzerland which forbid landfilling in the year 2000 and other countries in Europe like Germany burn the waste not recycled. This lecture showed what the current situation is, how the technology works in detail and what the benefits of this technology are. As mentioned before, most of the countries landfill their waste. A question which comes up is how much energy is stored in the lanfills of Europe? We did the math and figured out that if you burn all the waste with the available Swiss technology, it would only produce 2 % of the EU's energy need. In addition, we compared the global warming potential of the two variants. We figured out by calculation that landfilled waste emits more of the greenhouse gas CH_4 (which is 21 time more effective in global warming than CO_2) and therefore the thermal processing is more climate friendly - even it produces more CO_2 per year.

The Technology

With a nice cigar burning experiment, the lecturer showed us that burning the waste directly is not the best thermal process. Indeed, to achieve a clear and controlled thermal process, the waste first gets pyrolyzed and then the resulting gas gets burned.

The end-products of waste incineration are flue gas, flying ash and bottom ash. The flying ash is captured in further processes with respect to particulate matter, heavy metals and oxides (sulfur and nitrogen). Finally, all the produced ashes get landfilled.

Cement producers are responsible for about 5 % of the CO_2 emissions in Switzerland. They try to reduce their energy cost by burning waste instead of valuable fuel. The advantage of this technology is that the produced ashes go into the cement. In other words, you get only useful products out of the incineration. But the problem with this solution is that once the heavy metals in the waste are absorbed by the cement, it is impossible to extract them later from the concrete (i.e. resource issue).

Benefits

The main benefit of thermal treatment is the reduction of trash volumes and the energy production during the thermal process (heating value). The ashes have earth crust like concentrations (i.e. inert or ore) and are therefore much less a problem for the environment than untreated waste can be. In the near future, it will get interesting to extract the heavy metals like zinc and copper from the ash because of the increasing market prices. Putting energy to extract materials cannot be the wrong way because the planet is open for energy but the material is a limited resource.

Christian Ludwig during his experiment.

Conclusion

Indeed, you can extract a lot of the raw materials from the thermal processing products. Would it make sense to send all the trash to the incinerator rather than separate the materials (recycling) beforehand? It is like with coffee and cream. Once you have mixed it, it is difficult to separate them. Separate collection and recycling besides incineration makes therefore sense. In other words, thermal processing is only one part of waste handling and not the holy grail!

Summation by Severin Olloz and Grégoire Meylan.

Christian Ludwig
Professor of Chemistry
PSI Villingen /
EPFL Lausanne, Switzerland.

Christian Ludwig earned his master's and PhD in Chemistry at the University of Berne. His post-doctoral years were spent at the Department of Land, Air, and Water Resources (LAWR), UC Davis, CA (1994-1995) and at Eawag (1995-1997). Since 1997 he has worked at the Paul Scherrer Institute (PSI) where he established his own research group in 2000 at the Laboratory for Energy and Materials Cycles. In 2005 he was appointed adjunct professor at the Swiss Federal Institute of Technology Lausanne (EPFL) in the field of Solid Waste Treatment. Today, his group belongs to the Bioenergy and Catalysis Laboratory at PSI and his professorship is hosted at the Environmental Engineering Institute of EPFL.

Waste Management in Developing Countries
Wednesday, June 29. Morning Lecture.

Christian introduced us to Eawag, the Swiss Federal institute of aquatic science and technology, and its research department Sandec, aiming for better solutions in drinking water supply, solid waste management and sanitation solutions in developing countries. He then explained the waste hierarchy and introduced us to the 3R-concept: Reduce, Reuse, Recycle.

WHY A PRIORITY IN DEVELOPING COUNTRIES

Problems concerning municipal solid waste (MSW) normally arise where the density of people is high. Therefore, the rapid growth of population and especially the urbanization are increasing the problem of municipal solid waste management. The largest growth takes place in cities with less than 0.5 million inhabitants. While in 1950 there were 2.6 billion people, whereof 29% were living in urban areas, in 2030 60% of a population of 7.29 billion will be living in an urban environment. Therefore, applying integrated solid waste management should focus on smaller cities, using as well the possibility to replicate approved systems in as much places as possible.

INTEGRATED SWM

The integrated solid waste management (SWM) includes 4 layers. On the first level we face the system processes including waste generators, storage systems, collection and disposal systems. Within these system elements the collection of recyclables, scavenging, recyclables treatment and processing and reuse take place.

Furthermore, integrated SWM includes all influencing actors and influenced stakeholders. Integrated solid waste management includes planning, management, operation and maintenance and monitoring processes. ISWM also takes into account the interactions with the environment.

An inadequate coverage of the population, operational inefficiencies, unregulated recycling and the lacking treatment or safe disposal are the main challenges faced in SWM. The impacts of those challenges include public health threats and environmental health threats.

CHARACTERISTICS OF SOLID WASTE

Waste amounts vary between the developing and developed countries. Generally the waste generation in developing countries is about 1/5 compared to the US. The problem is therefore not waste minimization, but the challenge of waste growth with future economic growth. However, besides having different amounts, the characterisation of waste differs significantly, too. Due to higher water and organic content the density of waste is significantly higher (up to 500 kg/m^3) compared to 100-170 kg/m^3 in industrialized countries. Waste compression in order to increase truckload is therefore not really feasible in developing countries.

TECHNICAL ASPECTS

Primary collection: Due to missing infrastructure and space in informal housing areas, a manual collection from the household takes place. There are different means of transport, reaching from a mesh cart to sort out sand and water to hand buckets. In some cases, a first separation is performed in the same step.
Secondary collection: From the collection point to the treatment facility the secondary collection takes place, for example using a hook container. The design of the container allows emptying of handcarts and buckets. However, a misplaced container leads to waste in the environment and a non-working operation and maintenance. This example shows the importance of including human factors in the planning of waste management systems.

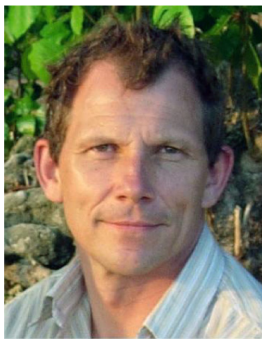
CHALLENGES AND CHANCES

In developing countries the solid waste management is to a significant fraction carried out by the informal sector. The informal sector lacks systematic control and is not legally registered; therefore SWM becomes a challenge for governments. The local infrastructure is often not capable of accessing the houses in areas with narrow roads, which makes the collection hard. In these cases citizens have to carry their waste to collection points. The traffic situation represents another problem, since often only one lane is available and the collecting trucks are stuck in traffic jams. Since the waste consists of more moisture and more organic components, compactor trucks are inefficient and cannot be used in the conventional way. Missing economic incentives are reasons for the population not to separate their waste and to choose the disposal in the landscape. Furthermore the lack of separation leads to a mixture of various waste kinds. For example

biomass is contaminated with plastics and vice versa. Due to the high content of organic and water and the removal of materials with a high calorific value by waste pickers, the incineration plants are sometimes not able to process the remaining waste. In developing countries the population lacks a personal social responsibility towards the environment.

But on the other hand there are also chances for SWM in developing countries. Locals have developed techniques to recycle cardboard. In Manila, plastic recycling is done through labour intensive separation. Additionally, glass recycling takes place. Even used truck tires are reused as containers and stationary plant buckets. Currently a new approach towards pig feeding is tested: The larvae of black flies are a protein source that can be used in the meat production of developing countries. These approaches rise the hope that suitable solutions to SWM for developing countries can be found even though the goal of an efficient solution seems still far away.

Summation by Melanie Haupt and Klaus Fuchs.



Christian Zurbrügg
Researcher
Eawag, Dübendorf, Switzerland.

Christian Zurbrügg is a senior researcher on water, sanitation and solid waste for developing countries and heads the Department of Water and Sanitation in Developing Countries at Eawag (Swiss Federal Institute of Aquatic Science and Technology). His research interests focus on the urban environment in cities of the developing world, especially the challenges of solid waste management, environmental sanitation and water supply. Beyond the technical elements of this field his interests include the economic, institutional and social issues surrounding sustainable solutions for improving urban populations' health and wellbeing through improved environmental services and infrastructure. His research experience is based on projects in a multitude of low and middle income countries in the Asian, African and Latin American regions.

The Swiss Students during the Cultural Night.

Cradle to Cradle

Wednesday, June 29. Afternoon workshop.

The EPEA folks neglected to introduce the Cradle to Cradle concept, perhaps holding an erroneous assumption that we would have been familiar with the book. This summary therefore first introduces the model of C2C, followed by an overview of the lecture itself. We recommend also reading the book. It is short, non-technical, and very inspirational.

Cradle to Cradle (C2C) is a design concept based on a very simple idea: "waste equals food." C2C, which was first presented to the world by William McDonough and Michael Braungart in their 2002 book Cradle to Cradle: Remaking the Way We Make Things, advocates product design focusing on closed-loop nutrient cycling and the avoidance of toxic substances. McDonough and Braungart introduce a distinction between the "biosphere," in which natural nutrient cycles such as the carbon cycle and nitrogen cycle operate, and the "technosphere," in which "technical nutrients" like synthetic polymers and metals can be redesigned to cycle as well, maintaining quality. C2C is in essence a reaction to the first industrial revolution, with its steady entropic march of all materials to a low quality grave in the biosphere, irrespective of their appropriateness to biological metabolism. The conventional design paradigm of cradle to grave ignores both the often detrimental end of life effects of the materials to the natural world and the rapidly increasing scarcity of high-value technical nutrients. C2C introduces the concept of "upcycling" as the proper objective of technical nutrient recycling systems, which currently just postpone the inevitable degradation of our useful materials in the environment. For instance, recycled plastic bottles rarely are turned back into plastic bottles, but rather turned into low value, low quality plastic lumber or filler materials from which high value polymers will never be recovered. Upcycling is a process of recycling a material into a product with higher value than its antecedent.

LECTURE

EPEA is working with industries in Switzerland, Germany, and the Netherlands to champion the C2C approach and help realize the dual vision of a circular materials economy and upcycling. Dr. Michael Braungart founded the Environmental Protection Encouragement Agency (EPEA) after his previous career at Greenpeace as a way to work with industry to solve their environmental problems, rather than just scolding them while suggesting no productive alternatives. EPEA Switzerland is an offshoot of the home office in Hamburg focused on business development because of its location at the heart of industrial Europe. They describe their core competencies as being 1) material assessment, 2) material alternatives research, 3) industrial materials streams, 4) network management, 5) supply chain management, and 6) serving as a knowledge trustee. These core competencies have been selected to address their role in engineering and product design consulting for their clients as well as their objective in redefining industry.

C2C and Sustainability

EPEA views C2C as an extension of what is generally considered by businesses to be sustainable practices. In addition to the three "Ps" of sustainable business— people, profit, and planet (referring to social, economic, and ecological sustainability, respectively)—C2C adds a fourth "P": pleasure. This refers both to its role in decreasing the environmental impact of consumption by ensuring material cycles and eliminating ecological toxins as well as the "pleasure" that comes from high quality products and materials that are safe, clean, and even environmentally productive. Kälin highlighted four environmental themes for the future: 1) water contamination, 2) toxic sewage sludge, 3) soil erosion, and 4) nutrient downcycling. C2C is designed to address these four issues.

C2C Process

The C2C process is at its core a system of materials characterization. EPEA has developed a ranking system of A-B-C-X, which describes the toxicity of the substances to human and environmental health. There is also an allowance for unknown materials. In this way C2C is actually more uncompromising than other sustainability evaluation methods because it has an increasingly stringent list of no-go materials that must be avoided to achieve the C2C certification. Their certification ranges from Basic to Platinum, with most products in the lower two categories and Platinum effectively impossible to achieve, as it demands 100% renewable energy in manufacturing. EPEA and its American partner, the McDonough Braungart Design Chemistry (MBDC) have teamed up with the State of California and other stakeholders to develop a third party certification body called the Green Products Innovation Institute (GPII). This is a positive step in the public knowledge and acceptance of C2C, which has been criticized in the past for keeping its certifications in-house. GPII promises to retain the authenticity of the certificate and robustness of firm engagement while increasing the number of certified products on the market. EPEA has broken new ground in sustainability evaluation with its Blueprint Netherlands, which aims to apply the principles of C2C design to the entire country of the Netherlands.

C2C and LCA
C2C uses life cycle assessment in their evaluation but make two important distinctions. First, their analytical scope is one of product design and development, and as such refers to the technique as "life cycle development," or LCD. Second, they claim their materials characterization techniques fill in the gaps of life cycle inventories, or the "2%" of materials that conventional LCA's ignore.

WORKSHOP

The objective of the workshop was to come up with a product that fits into the criteria of Cradle to Cradle according to the 15-step reference model that was provided at the start of the workshop: Defining purpose of the product, Determining metabolism: biological or technical, Defining closed loop scenarios, Defining areas of innovation (chances and risks), Developing product criteria and product purposes, Setting priorities of the criteria, ABC-X categorization of the ingredients, Development of the positive list, Phase Out Plan X (Red) substances, Implementation of product design, Implementation processes production and supply chain, Strategy implementation of closing the loop scenarios, Development marketing statement (certification yes/no), Influences on consumer behaviors, After sales service after product launch.

Presentations
The first group presented on an edible packaging for chocolate, the second group presented on a washing machine with replaceable components and the third group presented the traditional musical instrument of Switzerland - the Alphorn.
Considering the cradle to cradle implementation on washing machines, the summer school participants discussed the potential of constant product refurbishment: In the case of washing machines a service is sold rather than the product (leasing). This would encourage faster product development and improvement. If products or components are of value as resource for follow-up products they can be replaced more frequently i order to correspont to state of the art techology. In terms of sustainability this means decreasing operation energy demand over time due to new technology. Since operation energy demand exceeds production energy demand in case of washing machines this might decrease the LCA of „washing" on a bigger time scale, shifting focus from product LCA to service LCA.

Conclusions & Feedback
Products influence consumer behavior. Business systems determine whether the cradle-to-cradle practice could really be practiced or remain as a conceptual idea.
The cradle-to-cradle approach focuses on retaining quality of the material, therefore requiring collaboration on different groups and services. The product has to sustain itself, yet be able to meet the consumer's demands for a new product which is not 'second-hand'.
Concluding the discussion on the exercise outcome, the cradle to cradle ideology follows very fine targets. However, the low definition level of the invented products showed the limits of the method to be applied on common industrial products.

Summation by Jonathan S. Krones and Stefano Castelanelli, Gege Wang, Christina Chin and Pascal Hendrickx.

Albin Kälin
CEO
EPEA, Switzerland.

Albin Kälin developed the world's first Cradle to Cradle® products, the Climatex® lines of fabrics. In 2005 he was appointed CEO of the scientific consultancy EPEA in Hamburg, Germany. At the end of 2009, Albin founded EPEA Switzerland. As CEO he is currently pursuing his passion, to help the Cradle to Cradle® concept spread by successfully implementing projects in all industries globally, using his core expertise in the textile industry.

Andreas Schlaepfer
Project Parnter
EPEA, Switzerland.

Andreas founded Schlaepfer Associates in 2010. The company delivers innovative services with a focus on sustainability in the building and construction sector. As a member of the network of EPEA Switzerland he also represents the Cradle to Cradle® concept in these areas.

Walter Eschenmoser
Management Consultant
EPEA, Switzerland.

Walter Eschenmoser works as a consultant on strategy, marketing and business development. His main focus is the building material industry. For more information about Cradle to Cradle®, feel free to browse the EPEA website, epeaswitzerland.com.

Picture by Catherine Lippuner.

Caio Bosso, Christina Chin, Rubina Singh and Liane Honda during the Biomimicry Workshop.

Biomimicry
Thursday, June 30. All Day Workshop and Lectures.

As humans, we have invented a lot throughout our brief existence on planet earth, but still nature is the master! During a timespan of over 90 000 times the human existence of this planet, nature has created its own unique system, filled with unique innovations, that still today, we can not fully understand.

Biomimicry opens up our eye´s to be inspired and learn from the world that surrounds us. Not only by being inspired by the beautiful structures of nature in design (biomorphism), but also when it comes to her unmatched functionality.

Throughout history, humanity hase always been inspired by nature, but it is first now we have the technologies to analyze the true uniqueness of nature´s sometimes incredible design.

Biomimicry can be used in many ways! As inspiration for innovation, design or as a system in a whole. i.e. nature always makes sure to find symbioses in a system, structures that support each other, generative clusters. This has inspired several of businesses into finding symbioses of their own, as in Denmark, where different waste-water and power-plants are supporting each other to minimize energy usage. 1+1=3!

In order to tackle our emerging global challenges we can also learn about resource efficiency from nature.

– In nature, resources are scarse and design cheap! This has lead to some extraordinary innovations throughout evolution.

Connecting that to our reality today, when we are starting to realize that our planet´s resources are not unlimited, but our population keeps on growing. One of our biggest challenge might be to figure out how we can keep on growing without devastating our planet. We are creating monstrous hybrids that are impossible to recycle, but nature can teach us about an alternative way, one which have proven successful for billion of years.

At one point, we will also be forced to create “cheap” design. By activating our unused human resources, and a little help form nature, we might be able to do it. Or as Michael put it:

– Our biggest resource is un-utilized human resources! Biomimicry opens up our eye´s to an incredible world filled with innovation still unmatched by humanity! By working alongside with nature, we can create products and systems that serves our planet instead of working against it.

BIOMIMICRY AND CRADLE TO CRADLE
“Less bad is not the same as good”.

The idea of a good design based on sustainable principles is to change linear models for cycles, and specially taking care for the reduction of toxins, create a more effective product and take responsibility for its complete life cycle and the future uses after being wasted.

Nature uses few elements from the periodic table, in a very wise way. Nature knows how to deal with the use of elements based on carbon, hydrogen, oxygen and others,

and has developed systems that deal with the creation of structures, system interaction and what we have called "waste". In contrast in the human applications they have used all the elements of the periodic table. We have used elements that we don't have any idea how to manage. We are not able to see how nature has managed those elements because they have remained unused.

The designs should be inspired from nature and at the same time use the cradle to cradle principle in order to close the loops, and avoiding the use of toxic and hazardous materials that are present in todays artifacts.

To create vibrant colors, nature has used very wise methods, one of them, is the case of the butterflies, which instead of having pigments to have different colors they use refracting structures to refract light and create the colorful effects that we perceive. In the designs instead of using fossil fuel based colors for the surfaces of artifacts, this strategy could be used, i.e. by creating nanostructures. Another example is the use of very toxic adhesives that can be replaced by a technique developed by the geckos, which have very hairy fingers that can stick to almost any surface. Learning from this designers and engineers can develop adhesives inspired on this concept.

Another example is Biorock - created in the sea, where with a small amount of electricity it is possible create a rock structure in a natural way.

Using rapid manufacturing you can reduce the use of materials. One case is the cellulose as waste product from the algae biofuel process. It can be used to create building structures in a very effective way. Another example was presented for the development of an aircraft: using PET bottles as a structure material instead of carbon fiber, which is a very unsustainable material. Using the structures created by nature the team developed a very resistant, light and efficient structure.

LEARNING FROM BIOLOGICAL SYSTEMS

In man-made systems it is not uncommon to see various industries working in close proximity to allow for waste flows from one to be used as inputs in another - this is knows as industrial symbiosis. Biological systems on the other hand, take this concept a step further and create closed loops in which nothing is wasted. In this sense all 'waste' streams are actually considered opportunities and are nutrients for another process.

It is also worth noting the generalized differences between man-made and biological systems: simple disconnected and mono-functional vs complex, interconnect and symbiotic, linear and wasteful vs closed loop, resistant to change vs adapted to constant change, long term toxins that accumulate in the environment vs no long term toxins, centralised and mono-cultural vs distributed and diverse, fossil fuel dependent vs running on current solar income, engineered to maximize one goal vs optimizing the whole system, and lastly, extractive vs additive.

Case Study: Eco-Rainforest Project

A client project proposal to transform a landfill site into a botanical visitor attraction in northern England. The proposal was based on a principle in which natural systems operate in closed loops where waste from one organism becomes a nutrient to another. Housed in the walls of the greenhouse would be biodigestors (think big composters) that would harvest carbon-neutral heat from the decomposition process of biodegradeable waste that would be redirected from the neighbouring landfill. Additionally, this scheme would generate huge revenues through the landfill tax system by diverting this compostable waste.

Case Study: Cardboard to Caviar Project

The Carboard to Caviar project was originally conceived to re-use cardboard box waste, which was then shredded and used as bedding for horses. Over the years it was been expanded to include a variety of things; worm production, fish farming and caviar production, vegetable growing and a waste bread fed maggot farm, just to name a few. It also employs people who are frequently marginalized and have trouble finding work - drug addicts, war veterans and the disabled.

SOLAR ECONOMY

The world is running into a big energy problem as the way we are treating the energy resources today is far away from a sustainable energy resource management. With the discovery of the value of oil mankind went away from innovative thinking, because there was no need for it any more. However to solve this enormous energy problem we will be facing, we have to transform our oil economy into a solar economy. The book "Sustainable Energy without hot air" addresses these issues and presents various solutions. It is not beyond the range of what we have already achieved, it is just a matter of will to make this change happening. Biomimicry has a different way of treating the problem, instead of maximizing individual technologies; it tries to optimize a system as a whole. Nature takes all its energy from the sun, so why shouldn't we do the same?

Case Study: Sahara Forest Project

The Sahara Forest Project is a flagship project regarding Biomimicry. To look for solutions in any environment, one has to study how nature does it already, creating biomimetic solutions. The Sahara Forest Project integrates a waste range of biomimetic approaches on one project. It is this combination, treating the system as a whole, which

makes of it a well-studied Biomimicry project.

Details about the project can be found on the above-mentioned web page. In a few words, the aim of the project is to use the humidity of the sea breeze to grow food in well-designed greenhouses. Further, electricity can be produced by a concentrated solar power tower system placed in the wind and dust shadow of the greenhouses. This way three goals are reached:

- Grow CO_2-free food
- Produce abundant energy
- Recover desert

This goes beyond sustainability; it is RECOVERY of the desertic area.

LESSONS LEARNED

Max's statement

For long, humanity's indigenous populations have lived with respect for and in a big grade symbioses with nature whiles our moderns societies have relied on exploding our nature to benefit only us. Sustainability is precisely what have let these ancient tribes live on, keeping the environment healthy has been key to the survival for these local communities. If mistreated, nature would turn its back and the community would have to move on to a new location. What has happened in our modern world is that we have not, in our big-scale society, been as dependent on our local environment. This lack of immediate feedback has left us ignorant to the consequence of our actions. And here we are... Has humanity finally become humble under nature? Can we really learn from nature? We, humans, who are so superior to all?! I think biomimicry might be the tool to communicate to the world that sustainability is neither hard nor boring! At the same time biomimicry can tech us about our planet, and how it works, in a way that might even attract a urban architect kiddo! In combination to methodologies such as C2C, the world might just become a little bit more aware, and at the same time do business!

Carolina's statement

The sustainable challenges that we have experienced can be faced looking at nature, but not only imitating the amazing designs, instead of how nature has achieved and adapted according with the needs, the requirements, the provided resources and other actors that can involve in it. Nature has solved very complex issues using as less resources as possible in a very fast and effective way where all the waste created is being part of the system itself or another system. In order to face the sustainable challenges we can use this powerful concept, be inspired by nature is a good way to start moving our society towards sustainability. Biomimicry is a very inspiring concept that can be applied in many fields. As we experienced (in the game), it was very interesting to see how nature tries to adapt and tries to find a balance, even smallest changes can influence the system entirely, that is why the natural systems are flexible and easy to be changed and adapted, according to the new circumstances and requirements of the system.

Mark's statement

Michael Palwyn said a lot of interesting things, but the one that really stuck with me was 'one of the biggest wastes of resources is the under utilized human resources, especially amongst typically marginalized groups'. The concept of considering human capital in this manner had never occurred to me, and the more I contemplate it, the more I realize that it definitely is a huge waste of a valuable resource.

Rafael's statement

For me Biomimicry goes beyond the concept of C2C, not only to think in a closed loop, but integrating the ecosystem in the loop. It's not only about saving resources, but we have to rethink our processes, and smartly combine existing technologies to find solutions for whole systems.

Summation by Carolina Villamil, Max Parknäs, Mark Simmons and Rafael Schmitt.

Michael Pawlyn
Director, Exploration Architecture. London, UK.

Michael Pawlyn set up Exploration Architecture in 2007 to focus on biomimicry – an emerging discipline offering innovative architectural solutions inspired by nature. From 1997 to 2007 he worked with Grimshaw and was part of the core team that designed the Eden Project. In 2009 he opposed renowned environmental sceptic, Bjorn Lomborg, and more recently delivered a TED talk. He has taught at the Bartlett, AA, and at Schumacher College. His areas of interest include innovative structures and processes inspired by nature, industrial ecology and biomimetic technologies with near-to-mid-term applicability. He is currently working on the ambitious 'Sahara Forest Project' and an RIBA book titled 'Biomimicry in Architecture.'

Picture by Nicky Chang.

During Daniel Freitag's Talk at the Hub, Zurich.

BACK IN ZURICH

MORE TALKS AND WORKSHOPS

During Claude Martin's Talk at Villa Hatt in Zurich.

Being a Sustainability Pioneer

Friday, July 1. Evening Talk.

"Thoughts develop while you're speaking."

Background and Personal Career

- Biology and MSE major at ETH
- Early practice in India
- Ghana: National Park Director
- 1980s joined WWF Switzerland
- 1990s Rio Conference on Environmental Development, end of regulatory, start of market movement
- China practice

Key question to contemplate

"How, as environmental organizations, you can't move environmental agenda at a global scale"

WWF, decided in 1995 as a global target: increase 10% globally protected rain forest, 25,000,000 acres increase in certified forests – achievement in Brazil (policy reinforcement)

Key elements for sustainability in the future:

1. increase in bio-diversity
2. sourcing of material and energy 3.consumption

Closing comment

What can we do as young professionals and students?

"I came out of an era of student movements. At that time, universities are active agents of all social and environmental issues. However in the 1980s, universities became corporated. University is dead. This does not help... One need to move the curriculum with your professors to the direction of sustainability. One also need to recognize the differences between goal and possibility/feasibility. Feasibility includes analysis of the drivers, form strategies etc. At last, one need to understand: do not try to resolve everything at once."

Summation by Nicky Chang and Caio Bosso.

Claude Martin
Former Director General
WWF International.

A Swiss national, Claude Martin was born in Zurich in 1945. In his position of Director General of WWF International, he initiated several new approaches in conservation, as well as international partnerships, for example with the World Bank and business/industry groups. From 1995-2006 Claude Martin has been a member of the China Council for International Cooperation on Environment and Development (CCICED). Since 2006 he is the chairman of the International Sustainability Innovation Council of Switzerland – ISIS, the Chancellor of the International University in Geneva, and a board member of several other environmental organizations. Claude Martin holds a MSc and PhD in zoology from the University of Zurich.

Freitag. Recycled Bags!
Monday, July 11. Evening Talk.

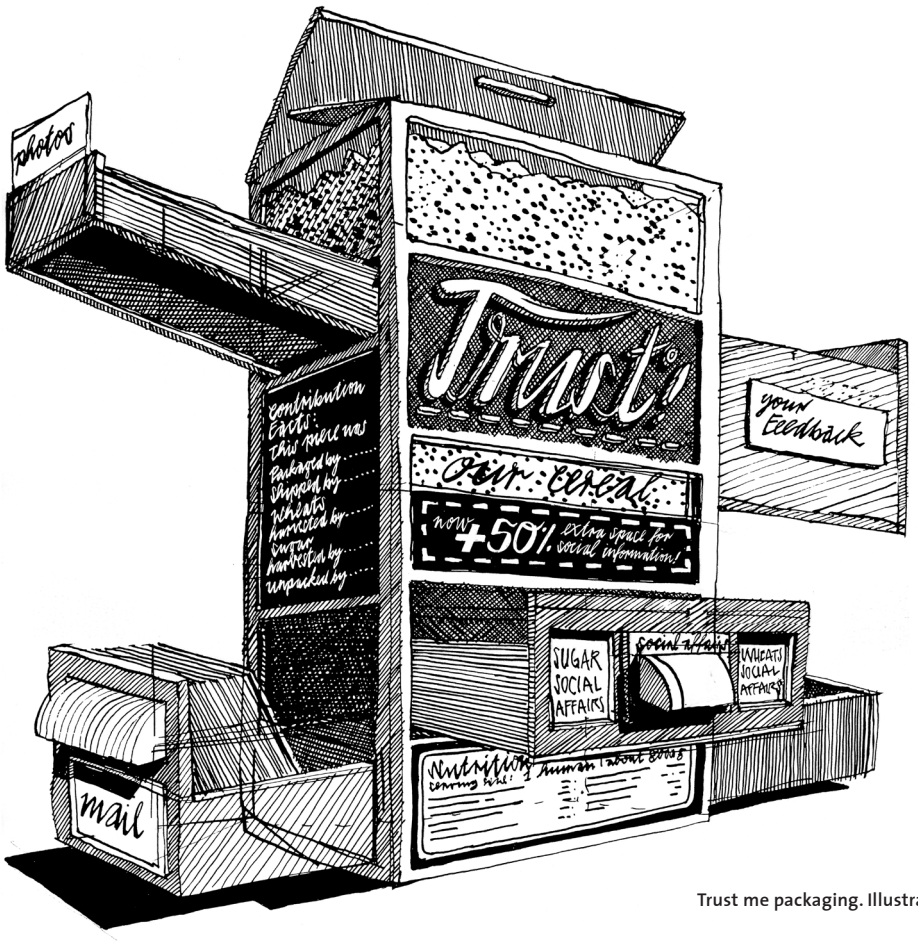
The „Freitag. Recycled Bags!“ was a joint evening talk by the ETH Sustainability and the Climate KIC Summer School which was dealing with entrepreneurship in climate change.

This event was not only a good opportunity to listen to the eloquent founder of FREITAG, Daniel Freitag, talking about the companies values and development, but also to meet counterparts from another summer school while exploring the HUB Zurich, a place for entrepreneurs and social innovators, where the event took place.

About the company:
„FREITAG has been manufacturing bags and accessories for women and men since 1993. Our materials are used, having seen service on the road. They are well-travelled truck tarpaulins, unravelled seat belts, bicycle inner tubes beyond repair, recycled airbags. Tough stuff - which makes our products tough, too. As for us, we are Swiss, which means we are acutely quality-conscious. We apply our recycled materials in a totally new way, insisting on superlative design and functionality. Every FREITAG product is made from original tarpaulins of different colours, markings and contours. So every FREITAG product is a one-off. „ from: freitag.ch

Daniel Freitag
Co-Founder
FREITAG, Zurich, Switzerland.

Daniel Freitag and his brother Markus began FREITAG in their apartment in Zurich, hand making messenger bags out of old truck tarpaulins, bicycle inner tubes, air-bags, and seat-belt webbing. He used his background in graphic design and personal desire for a sturdy, functional, and water-repellant bag to inspire his first handmade bags. From the two-brother operation in 1993, FREITAG grew to its present size of 120 employees and world-wide distribution. The company is still based in Zurich.



Trust me packaging. Illustration by Jörg Hülsmann.

Soft Ecologies
Saturday, July 9. All Day Workshop.

During this workshop, the students created design fictions to explore different contexts and new uses in relation to wood furniture, washing machines and food packaging. We use stories to make sense of the world and our relationship to it. Technology driven product development tends to design into a blank space. Instead of focussing on what is technologically possible, we put people first and draw from personal quirks, desires and fears. We introduced story-telling and fictional design to explore possible situations, rituals and investigate unexpected implications.

Trust - Our belief in the truth or reliability of someone or something - lies at the very heart of our relationships, our society and our everyday lives. Much of the time we take it for granted. And yet trust, or the lack of it, is becoming an increasingly prominent issue in public life: politicians say they want to rebuild trust in politics; people look for new ways to trust each other in a world where relationships are easier to start and harder than ever to sustain; and we are no longer sure how much we trust experts on issues like the safety of food or medicine. Especially if products claim sustainable ways of production, it is essential to build trust.

Compared to most industrial food packaging, some tradi- tional forms take a more active role in building trust but also rely on different ways of production and distribution. By nature, a milk churn is a more social object than a tetra pack. It implies going to a local farmer to buy your milk - you will have a conversation and get to know the producer personally.

Explore the relationships between people, a specific food product, producer and distributer and how trust can be established and sustained. What role does packaging play? Go beyond materiality.

Could packaging be designed to care about us?
We have designed a smart packaging that will facilitate trust between the consumer and the product rather than the brands or labels by adapting to the mood, personality and more importantly, the personal needs of the consumer. The packaging can deal with different types of individuals si- multaneously due to the optic properties. The objective of the packaging is to guide the individual at the grocery store by advising on which products to buy based on their per- sonal needs. Doing so, it emphasises the relevant informa- tion an individual requirements. For example, in the eyes of a diabetic person, the sugar content of products will be more prominent than that of a young and healthy teenager.

Project by Rafael Schmitt, Stefano Castelanelli, Nicolas Nägeli, Grégoire Meylan and Tasha Chan.

Gunnar Green
Designer
Berlin, Germany.

Gunnar Green is a designer at TheGreenEyl, which he co-founded. He holds an MA in Design Interactions from the Royal College of Art in London and a Diplom in Visual Communication from the Berlin University of the Arts. Gunnar divides his time between teaching, commissioned and self-initiated work. He currently lectures at the Bauhaus University Weimar and the University of the Arts Bremen.
His work has been exhibited internationally at the Japan Media Arts Festival in Tokyo, Design Museum London, Jewish Museum Berlin, Ars Electronica in Linz and the MoMA, New York, among other places.

Bernhard Hopfengärtner
Designer
Berlin, Germany.

Bernard Hopfengärtner holds an MA in Design Interactions from the Royal College of Art, London and a BFA in Media Art from the Bauhaus-Universität Weimar. Hopfengärtner's work investigates the relationship between science, technology and society, using various media including video, audio, programming, and installation. His work has been exhibited at, amongst others, the Wellcome Trust, London and the Science Gallery, Dublin. Upcoming Exhibitions will be at the MoMA, New York and National Museum of China, Beijing.

Jörg Hülsmann
Illustrator
Berlin, Germany.

Jörg Hülsmann, born 1974, studied illustration in Düsseldorf and Hamburg, Germany. Since 2003 he has worked as a freelance illustrator for book publishers, magazines and newspapers, including S. Fischer, Suhrkamp, Dumont, Büchergilde Gutenberg, Frankfurter Rundschau. He is also developing free book projects. His adaption of Italo Calvinos' „The invisible cities" has been awarded by the German Book Arts Foundation as one of the most beautiful German books and was exhibited internationally. He works in Berlin, where he lives with his wife and two children.

The whole „All Just Rubbish?“ Summer School Group After the Final Presentations.