

Annual Report 2005

Annual Report 2005

Alliance for Global
Sustainability (AGS)

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An International Partnership

Swiss Federal Institute of Technology (ETH Zürich)
Massachusetts Institute of Technology
The University of Tokyo
Chalmers University of Technology

The mission of the AGS is to effect a paradigm shift in structures and policies and to provide a solid foundation for sustainable development through the application of world class research and education in science, technology, and the social sciences.

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Introduction

2005 was an important year for the Alliance for Global Sustainability – one characterized by the culmination and celebration of 10 years of collaboration. 2005 also marked a turning point for the AGS—an end to the first phase in our experiment in multi-disciplinary and multi-geographical research and the beginning of a new phase, which will consolidate our resources and focus them on the transition to sustainable energy sources and technologies. In 2005, the AGS launched its first flagship research and education program, Pathways to a Sustainable Energy Future. In 2006, AGS will consider a second flagship program on food and water.

Since its inception, the AGS has invested heavily in research on sustainable energy. Of the 84 projects supported by the AGS since 1997, 28 have been aimed specifically at energy and climate change issues. These projects range from filling data gaps to enhance our understanding of global climate conditions and effects of current industrial and consumption patterns in developed and developing countries alike, to the development of methodologies for incorporating multiple views for robust solution identification and assessment, to the development of policy frameworks for decision makers in government and industry.

There is no shortage of calls for research required to develop energy supplies that will reduce human impact on the climate 50 to 100 years from now. While supporting advanced research, the AGS has chosen to move forward on the basis of currently available methodologies and tools to produce technological options with the potential to stabilize or reduce carbon emissions substantially while more advanced research continues.

To this end, the AGS has made important strides in 2005 with the support and advice of the International Advisory Board members and other collaborators from industry, government, and the public. Stakeholder dialogues have proven invaluable in framing the questions for the energy flagship program to address. Sponsor support has made the effort possible. The continued support and commitment of the AGS partner institutions and their presidents have allowed us to focus our joint strengths on building a program that can make a significant impact.

This year the AGS saw three university presidents who, over the years have supported and engaged and challenged the AGS to make a difference, step down from their respective positions: Charles M. Vest (MIT), Takeshi Sasaki (UT), and Olaf Kübler (ETH Zürich). The AGS is grateful for their commitment to the mission of the AGS. The AGS now welcomes three new presidents: Susan Hockfield (MIT), Hiroshi Komiyama (UT), and Ernst Hafen (ETH Zürich).



*Charles M. Vest
Massachusetts
Institute of
Technology*



*Takeshi Sasaki
The University
of Tokyo*



*Olaf Kübler
Swiss Federal
Institute of
Technology*

The Annual Report for 2005 summarizes the year's progress as well as its challenges and opportunities for the future. Among the milestones reported in 2005, the report highlights the following:

The launch of a large-scale research and education initiative focused on "Near-term Pathways to a Sustainable Energy Future"

Significant progress in two of the case studies that make up the energy flagship program

A successful Annual Meeting hosted by MIT reflecting on 10 years of collaboration and focusing on a new large-scale research initiative on energy

The 5th AGS Technical Meeting hosted this year by Chalmers University and focusing on critical barriers to a sustainable energy future, and particularly on the European Pathways project of the energy flagship program

Publication of two new books in the AGS book series, "Science and Technology: Tools for Sustainable Development"

The first Youth Encounter on Sustainability (YES) Latin America successfully delivered by ETH at the campuses of INCAE Business School and the Center for Agroforestry, Research and Education in Costa Rica

The second UT-AIT Intensive Program on Sustainability (IPOS) successfully run in Thailand by UT in partnership with the Asian Institute of Technology

Establishment of fellowships for undergraduates in sustainability at MIT

These achievements would not have been possible without support and guidance of the AGS International Advisory Board members.

Report from the AGS Governing Board Chair (2005)



Ernst Hafen
*Swiss Federal Institute
of Technology*



Susan Hockfield
*Massachusetts Institute
of Technology*



Hiroshi Komiyama
The University of Tokyo



Jan-Eric Sundgren
*Chalmers University
of Technology*

Susan Hockfield photo by Rick Friedman

Jan-Eric Sundgren **President, Chalmers University of Technology**

I have been pleased to serve as Chairman of the AGS Governing Board in 2005, a year characterized by significant progress in its new strategy and an exciting and timely focus on energy. During the year, the AGS has made good strides in its first flagship research, education, and outreach program on sustainable energy pathways, particularly in building regional studies on European electricity systems and on sustainable mobility. In conjunction with the flagship programs, the AGS is also initiating an exciting new education program that draws on the complementary strengths of the AGS partner universities. Now, taking what it has learned from activities in 2005, the AGS is poised to move forward on another flagship program on food and water.

At the March 2005 International Advisory Board (IAB) meeting in Boston, board members had the opportunity to learn about and offer advice on the first AGS flagship program on "Energy Pathways." I have personally tracked progress on Energy Pathways and am pleased to report the research is developing robustly and on schedule. Researchers have worked closely with stakeholders to identify and frame the key questions to be answered by the Pathways project. These questions will guide the methodology and focus for the research in 2006.

The AGS Coordinators have also been working hard on a proposal for a new flagship on food and water, "Secure Ecosystems." It is increasingly evident that critical issues of sustainable food and water require an understanding of the interface between ecosystem services, society, and technology. This initiative, led by the University of Tokyo, will examine development paths for ecosystem services, including a social and technical system study by Chalmers-MIT-ETH and a risks and security focus for Tokyo. The proposal seeks to establish a unique AGS program with the potential for global impact.

On the education front, the AGS Education Team has begun an initiative that aims to provide significant outreach. The "Teaching Energy and Climate" initiative will develop and execute four coordinated one-week short courses on energy and climate aimed at different audiences of high importance at each partner's university. The focus will be on awareness building, understanding of energy and climate issues, and identifying actions that can be taken towards reducing energy consumption and reducing our impact on the climate and the environment. I look forward to their report at the 2007 Annual Meeting.

As evidenced by the location of the March 2006 Annual Meeting in Bangkok, the University of Tokyo is leading the way on expanding the AGS through Asia. The Japanese Government has also provided significant funding for the University of Tokyo to lead a priority research initiative with four other Japanese universities. The IR3S program (Integrated Research System for Sustainability Science) is an exciting complement to the AGS. I will have the privilege to participate in the inauguration workshop of the IR3S program in Tokyo in beginning of February, 2006.

Not surprisingly, I have been very involved in AGS developments at Chalmers and I am pleased to announce that we are in close discussions with UPC-Barcelona. UPC-Barcelona has a long ongoing commitment to educational aspects for sustainable development and will bring much valuable knowledge to the AGS. Similarly, MIT is collaborating with Cambridge University (UK) on energy security – research that will complement the energy pathway projects.

The new strategy of AGS has had a very good start during 2005. I would like to thank the IAB, the AGS university presidents, and the Coordinators for their dedication and commitment.

*Jan-Eric Sundgren
President, Chalmers University of Technology
Chairman, AGS Governing Board (2005)*

Research

The AGS research paradigm includes a multi-disciplinary, multi-geographical approach. To date, AGS has supported 79 projects through an investment of 16 million USD. Approximately 250 faculty and more than 400 students have contributed to AGS research activities in the areas of energy and climate, mobility, water, urban systems, and cleaner technologies. Through the active involvement of industry and government partners, academic research is addressing issues of sustainability through action as well as through knowledge development.

In its first large-scale integrated research, education, and outreach program, the AGS is focusing on energy systems and strategies for the early and mid-21st century. As the world progresses in the next few decades toward future low- or no-carbon energy sources, uses, and, infrastructures, robust transitional measures will be required. Immediate carbon reduction, regional appropriateness, and potential for integration into future transitions are key to successful near-term technologies.

To identify optimal near-term energy systems, each AGS university draws on the resources of its own regional network to extend the reach of its research. In addition, AGS is committed to partnership with universities and other partners in the developing world and is actively seeking projects in the South. As an expanding global consortium, the AGS is uniquely situated to provide objective, independent analyses of energy system options for decades to come.

Traditional AGS Projects

Spectroscopic Approach Towards Local and Global Management of the Earth's Atmosphere: Innovation Leading to Implementation

Work on the AGS supported research project "Spectroscopic Approach towards Local and Global Management of the Earth's Atmosphere: Innovations Leading to Implementation" (AGS Project Nr. 2230) has continued in the collaborating investigators' laboratories on an individual basis with remaining available funds. At MIT, work was completed on adapting the IntraCavity Laser Absorption Spectroscopy (ICLAS) system for kinetics measurement on trace species in a discharge flow tube (Kinetics using IntraCavity Absorption Spectroscopy, "KICAS"). The KICAS system was used to re-measure the rate of reaction between atomic hydrogen and NO in helium carrier gas. These results have been reported in the Journal of Physical Chemistry (Vol. B109, pp. 8358 -- 8362, 2005).

The graduate student (Philip Sheehy) who carried out the work using ICLAS for kinetics measurements also participated in an atmospheric modeling study on atmospheric HO_x (HO_x = OH, HO₂) chemistry in collaboration with the group of Prof. Mario Molina. The objective of this work is to develop a comprehensive understanding of HO_x chemistry in the urban atmosphere of Mexico City. Using a multi-faceted approach that combines the extensive field data collected in the MCMA project (partially funded by AGS) and a uniquely tailored box model, the goal is to improve the understanding of the oxidative capacity of the urban atmosphere, with Mexico City as a case study. Dr. Sheehy is currently on a post-doctoral appointment in Molina's group (working out of UC San Diego) carrying out further measurements of trace species in the MCMA atmosphere using the Differential Optical Absorption Spectroscopy technique. 25% of this appointment is being supported by AGS project funds.

A complete Final Report has been submitted, of which a Summary appeared in the AGS Annual Report for 2004.

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Improving Sustainability in Heavy-Polluting Sectors in China: A Regional Analysis in Shanxi and Liaoning Provinces

Submitted by:
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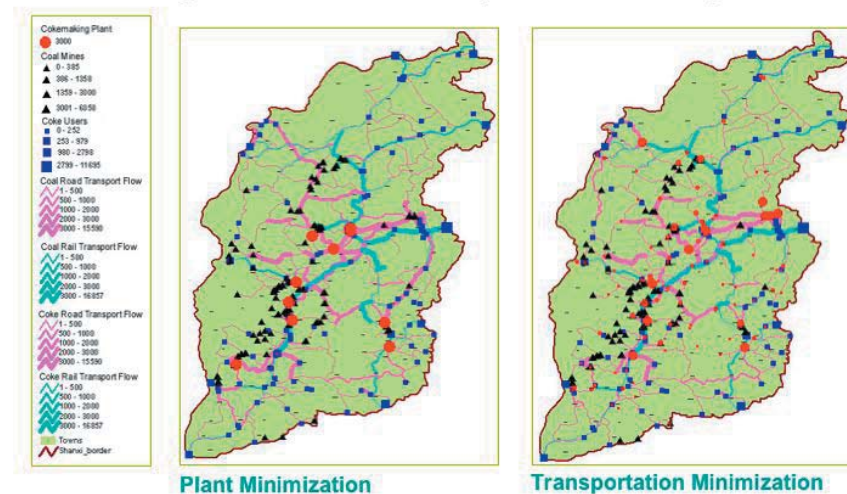
Since 1997, the AGS China cokemaking team has been examining the rapidly changing relationships among technology, energy, the environment, and health (TEEH) in one of China's most energy-intensive and highly polluting industries - cokemaking. The team has developed analytical tools and methods that can be used to examine TEEH issues in almost any industry in any country. Their findings tell a fascinating story that not only teaches us how we can begin to analyze unfamiliar industries through the TEEH lens, but also reveals the often unexpected consequences of industrial management and technology decisions.



The team recently published their findings, "The Technology-Energy-Environment-Health (TEEH) Chain in China: A Case Study of Cokemaking." Coke is unusual in that it is at the same time both unglamorous and important. As a result, key industrial changes occurring in China with far-reaching global economic and environmental impacts often go unnoticed. The book is a major step in closing the knowledge gap of those impacts.

The team is composed of specialists from the following disciplines: chemical engineering, economics, physics and planning. In addition, six graduate students are currently supported fully or partially by the AGS, UNIDO and supplementary funds from the six universities.

Regional Level Spatial Analysis



Source: Kraines, Yang, and Polenske, Chapter 6

Plant location scenarios

Platinum Group Elements from Automobile Catalysts to Global Dispersion

Approximately 500 million vehicles worldwide are equipped with exhaust catalysts. Automobile catalysts use platinum, palladium, and rhodium as main active components and a small amount of these metals is released into the environment. As the number of catalysts is expected to increase in coming years with their introduction in developing countries, a team of scientists working in the framework of an AGS-funded project has now provided evidence for a widespread dispersion of platinum group elements (PGE) emitted by automobile catalysts. Although additional data are needed to refine flux estimates, the study indicates that emission of PGE from automobile catalysts has been underestimated and is on the order of 10-20, 20-50 and 2-4 metric tons per year for platinum, palladium, and rhodium, respectively.

During the past year, the team has also provided the first estimates of PGE concentration in urban air in the USA. The study performed in Boston revealed the occurrence of elevated concentrations of these metals. Similar results were also found for Mexico City. The results for Mexico City show that PGE concentrations increased from 1994 to 2003, but significantly higher concentrations were found for 1993 when catalysts were first mandated in Mexico. These high results are believed to be the result of poor fuel quality (especially the use of leaded gasoline) and car maintenance, and show that the current introduction of catalysts in developing countries need to be accompanied with adequate policy and infrastructures.



High volume PM10 impactor

Selected publications:

S. Rauch, H.F. Hemond, G.M. Morrison, C. Barbante, M. Owari, B. Peucker-Ehrenbrink and U. Wass, Importance of automobile catalyst emissions for the regional and global platinum group element fluxes. *Environmental Science & Technology* 2005, 39, 8156-8162.

S. Rauch, H.F. Hemond, B. Peucker-Ehrenbrink, K. Ek and G.M. Morrison, Platinum group element concentrations and osmium isotopic composition in airborne particles from Boston, Massachusetts. *Environmental Science & Technology* 2005, 39, 9464-9470.

S. Rauch, H.F. Hemond and B. Peucker-Ehrenbrink, Source characterisation of platinum group element deposition in an ombrotrophic peat bog. *Journal of Environmental Monitoring* 2004, 6, 335-343.

C. Barbante, M. Schwikowski, T. Doring, H.W. Gaggeler, U. Schotterer, L. Tobler, K. Van De Velde, C. Ferrari, G. Cozzi, A. Turetta, K. Rosman, M. Bolshov, G. Capodaglio, P. Cescon, C. Boutron, Historical record of European emissions of heavy metals to the atmosphere since the 1650s from Alpine snow/ice cores drilled near Monte Rosa. *Environmental Science & Technology* 2004, 38, 4085-4090.

S. Rauch, H.F. Hemond and B. Peucker-Ehrenbrink, Recent changes in platinum group element concentrations and the isotopic composition of osmium in sediments from an urban lake. *Environmental Science & Technology* 2004, 38, 396-402.

C. Barbante, C. Boutron, C. Morel, C. Ferrari, J.-L. Jaffrezo, G. Cozzi, V. Gaspari, P. Cescon, Seasonal variations in heavy metals in central Greenland snow deposited from 1991 to 1995. *Journal of Environmental Monitoring* 2003, 5, 328 – 335.

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G. Morrison, Civil
& Environmental
Engineering, Chalmers
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U. Wass, Volvo
Technology AB, Sweden

Research Partnerships for Sustainable Development

Bridges to Sustainable Energy Futures: An International Research Partnership to Study Social and Political Aspects of Carbon Capture and Storage Technologies

Principal Investigators:

F. Johnsson, Chalmers University of Technology

H. Herzog, Massachusetts Institute of Technology

Y. Fujii, The University of Tokyo

D. Reiner, University of Cambridge

K. Itaoka, Mizuho Research and Information Institute

T. Suzuki, CRIEPE

The overall goal of the research partnership is to identify, study, and address non-technical barriers to the introduction of carbon capture and storage from fossil-fuelled energy production, and to provide guidance to decision makers. Capture and storage of CO₂ offers the possibility of a significant and relatively quick response to climate change at a reasonable cost. Successful commercialization of capture and storage could therefore provide a transition to a future in which energy production from non-fossil energy sources can grow over time.

Survey Design: For the case of climate change and energy technologies, researchers explored whether and how these differences might emerge. Researchers conducted public opinion surveys in the USA, UK, Sweden, and Japan as part of a larger project on social and political implications of carbon dioxide capture and storage (CCS) technologies. Respondents were asked to describe their awareness of various energy technologies and were tested on their basic understanding of the relationship between energy generation technologies and carbon dioxide emissions. Emphasis was put on posing the same questions across all four surveys, although translation and national context led to some inevitable differences.

Survey Results: Assessing public understanding of the linkage between carbon dioxide and energy production is critical if one believes that there is even a loose correlation between basic understanding, the strength of public support, and policy actions. There was a clear appreciation in all countries (>70% of the public in each survey) that coal-burning power plants and cars increased CO₂ levels and

that wind turbines either had “no impact” or reduced CO₂ levels. In spite of the low recognition for the term “carbon sequestration,” there was also a similar degree of understanding that planting trees decreased CO₂. By contrast, although over 20% of electricity generation in each country came from nuclear power, 31% in Sweden and over 60% in the other three nations either believed that nuclear power led to an increase in atmospheric CO₂ concentrations or did not know the answer.

Current Activities: To complement the public polling studies, an NGO/industry polling study has been designed and executed. In short, the poll asks key NGO/industry leaders about General Background on Climate Change and Carbon Capture and Storage their attitudes toward CCS, and the approach to CCS by the respondent’s organization.

Survey of Public Attitudes				
	US	UK	Sweden	Japan
Survey distribution	Knowledge Networks	YouGov	Statistics Sweden	Mizuho Inst. & NAIST
Research partner	MIT	Cambridge	Chalmers	Mizuho Inst.
Methodology	Internet	Internet	Written	Written
# of responses	1,205	1,056	742	1,006
Response rate	70%	40%	49%	64%
Date of survey	Oct 2003	Sept 2004	Dec 2004	Dec 2003
Questions	20 multiple choice	20 multiple choice	20 multiple choice	5 written + 66 multiple Choice

Howard J Herzog, MIT Laboratory for Energy and the Environment

The polling is in the form of a questionnaire, and will be followed up by interviews. The results from the public polling and the NGO/industry studies will be reported in scientific papers. The aim is also to communicate the results to various decision-makers.

Publications: D.M. Reiner, T.E. Curry, M.A. de Figueiredo, H.J. Herzog, S.D. Ansolabehere, K. Itaoka, F. Johnsson, M. Odenberger, “American Exceptionalism? Similarities and Differences in National Attitudes Towards Energy Policy and Global Warming,” accepted by Environmental Science & Technology (2006).

Competitive Advantage, Regulation and the Environment (CARE)

The CARE project examines the effects of environmental, health, and safety policies on private competitive advantage. Joint research teams are assessing how statutes, regulations, models, and test procedures that serve public environmental interests can increase the value of advanced proprietary technologies, and product development and production methods, and condition marketing, acquisitions, and governmental affairs strategies. Specific activities and awards include:

General CARE studies: Thomas Bernauer (ETH), Kenneth Oye (MIT), and Thomas Sattler (ETH) presented an overview of their work on environmental, health and safety regulation and trade at the American Political Science Association Meetings in Washington DC (September 2005). In addition, Kenneth Oye presented CARE overviews at conferences organized by the Centre for International Business and Management of the Judge School of Business at Cambridge University (July 2005) and by the Finnish Environment Ministry's PROACT program (November 2005).

Sector Specific Issues

Vehicles and Fuels: Christine Ng (MIT Engineering Systems Division) is finishing a dissertation on diesel LDV and HDV vehicles and fuels, with analysis of regulations and corporate strategies in Europe, Japan and the United States. An earlier report by Ng on her work won the award for best student presentation the consortium meeting of national and international science and technology (S&T) policy programs. Kenneth Oye was invited to present CARE findings on vehicles and fuels to TOTAL of France (November 2005).

Consumer electronics: Ladina Caduff (ETH) completed her doctoral dissertation on environmental regulation and E-waste, with an emphasis on effects on competitive advantage, and published several articles on her results. Dr. Caduff will be continuing her work on these issues on a postdoctoral fellowship with the political economy faculty at the London School of Economics.

Pulp and Paper: James Foster (MIT), Mikael Hildane (SYKE Finland), and Per Mickvitz (SYKE Finland) completed papers on European and American environmental regulation and innovation in pulp and paper. They presented their intermediate findings at the Finnish Environment Ministry's PROACT program (November 2005) and are continuing their research into 2006.

Food: Thomas Bernauer (ETH) *Genes, Trade, and Regulation: The Seeds of Conflict in Food Biotechnology* won the 2005 Don K. Price Award as the best book on Science, Technology, and Environment at the American Political Science Association. Kenneth Oye, Mark di Figuerido, and Larry McCray (MIT), Ladina Caduff (ETH), and Hideaki Shiroyama (University of Tokyo) conducted research on European, Japanese and US policies on BSE.

Chemicals: Stefanie Engels (ETH) is conducting doctoral research on regulation and competitive advantage in the chemicals sector. Engels will spend six months at MIT in the fall of 2006 for additional training and research in conjunction with the MIT group.

Principal Investigators:

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F. Norrgren and N. Adler, Chalmers University of Technology and Stockholm School of Economics

T. Bernauer, Swiss Federal Institute of Technology (ETH)

C. Pitelis, University of Cambridge

H. Katahira, The University of Tokyo



*Thomas Bernauer, ETHZ
2005 Don K. Price Award*

New Materials for Sustainable Development

Principal Investigators:

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University of Technology

R. Zuest, Swiss Federal
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Y. Baba, The University
of Tokyo

The aim of the project is to develop an integrated assessment of the potential for emerging materials to contribute to sustainable patterns of resource use. Researchers accomplish this by conducting case studies where assessments of cost, technical and environmental performance, and to some extent, social aspects are combined. Specifically, approaches based on life cycle assessment (LCA) are being used for the environmental assessment and process based cost modeling (PBCM) for the cost assessment. Research efforts have focused on two main projects: a material manufacturing case study on polymers made from biomass and a material recovery case study involving end-of-life electronics.

Polymer production from biomass: Polymers may be produced from biomass via a number of different routes. These may either start with biochemical processes such as fermentation, resulting in products such as poly-lactic acid, or they may start with thermo-chemical processes such as gasification, in which case the final products may be conventional polymers such as polyethylene. In this project we have chosen to focus on the thermo-chemical route.

The main objective of this study has been to examine how biomass conversion to polymers based on primary gasification can be configured to have financial and environmental attractiveness. A summary report of the work produced this year analyzes recent studies to evaluate the performance, both environmentally and economically, of biomass/waste-to-polymer processes that are currently available or in the pilot/research phase and that are likely to appear in the next few decades. Only routes that could supply significant proportion of the polymer market are investigated. The report then outlines environmental results from LCA studies and economic analyses from PBCM studies.

The environmental analysis compared energy consumption and greenhouse gas (GHG) emissions of producing high density polyethylene (HDPE) from biomass with the production of a variety of polymers from traditional feedstocks. The results of the analysis are summarized in Figure 1, which clearly indicate that the biomass-to-polymer route is an attractive processing alternative from an environmental standpoint because of its low energy consumption and GHG emissions.

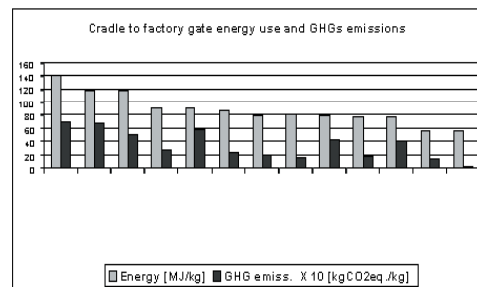


Figure 1. Cradle to gate energy and greenhouse gas emissions for biomass-to-polymer and other routes

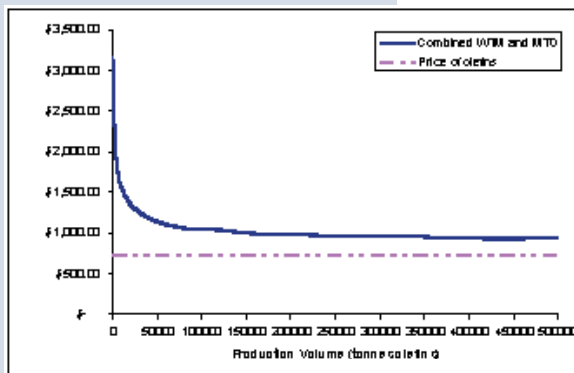


Figure 2. Olefin product cost versus olefin production volume for the waste to olefins process

The economic analyses were conducted by creating two cost models: one for the waste/biomass-to-methanol production process and another for the methanol-to-olefin production process. The studies concluded that it is difficult for the biomass-to-methanol process to be competitive at any production volume, primarily because of the cost of the feedstock. However, the methanol-to-olefin process is extremely competitive if it uses the market price for methanol (produced from traditional feedstocks). The combination of results from the two models indicated that the technologies were not quite competitive with olefins produced from traditional methods. The sensitivity of this combined production cost to production volume compared with a baseline olefin cost is depicted in Figure 2. The main cost-driver in this process is the biomass-to-methanol step; further sensitivity analyses elucidate the conditions under which the entire process would be more competitive.

End-of-life material recovery from electronics: Electronic components are quickly becoming one of the fastest growing streams of waste. This research examines the material recovery system for end-of-life (EOL) electronics because a sustainability analysis of society's technological infrastructure must include an assessment of methods for recovering material from these devices. The project seeks to understand the economic and environmental performance of the existing recycling infrastructure, its alternatives, and the policies that could affect it.

An initial case study of recycling cathode ray tubes (CRT) from monitors and televisions was chosen because of the concerns surrounding this material due to the lead content in the glass and the difficulties recyclers have had in processing the glass. This case study examined the economic consequences of different processing decisions involving EOL CRTs. The alternatives under consideration are depicted in Figure 3. If the monitors or televisions are shredded, the glass cullet is highly aggregated and must be used in a smelter as flux. However, if the monitor/television is disassembled, the glass cullet can be sent to a smelter or to a glass-to-glass (GtG) processor who can use the glass as a feedstock to make new CRTs. In addition, the recycler can choose different levels to which the product should be dismantled before transporting the glass to its final destination. Each of these decisions has different cost and revenue implications.

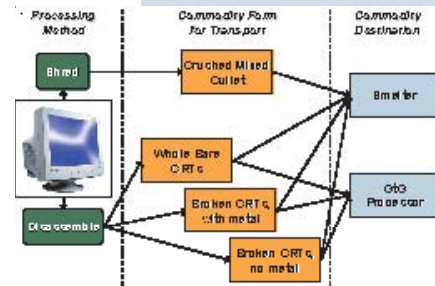


Figure 3. Recycling alternatives for CRT glass from Monitors/TVs for a first tier processor

An economic model was developed that calculates three components of the total cost associated with recovering glass from a CRT: transportation, material, and processing. The transportation costs are dependent on the form of the commodity shipped (whole bare CRTs will fill a truck by volume, whereas broken CRTs will fill a truck by weight) and the transportation distance. The material costs as calculated in the model are dependent on the type of monitor processed (and its material content) and the rates that smelters and GtG processors charge for CRT-derived glass; the latter depend on the form of the glass. Processing costs include labor, allocated capital – equipment and facility, overhead and maintenance expenses associated with, when applicable, breaking or crushing the CRT and separating the metal. Breaking costs are applicable to both of the broken commodity forms and the metal separation costs are applicable only to the broken without metal commodity form.

The results show that although there are higher costs associated with further processing (i.e., breaking the CRTs and removing the metal), this leads to lower transport costs (more material fits on the trucks) and lower material costs (the price charged by smelters and GtG processors is less for broken CRTs is less it is for whole CRTs). It is also clear that for this scenario in which the smelter and GtG processor are equidistance from a processor, the GtG processor is the lower-cost alternative. Of course, this scenario will rarely occur in reality and thus, extensive sensitivity analyses are performed to determine the conditions (based on processing, transportation, and material costs) that would lead one to choose to send glass to a smelter or a GtG processor.

The results of this work show that the proximity of recovery destination is a large driver in the economic and the environmental impacts of dismantler processing decisions. Nevertheless, from an economic perspective, the closer alternative is not always attractive because of changes in material and processing costs. Economic analyses also indicate that it is generally advantageous for the recycler to spend resources to dismantle the CRT for maximum material revenue. The ultimate objective of this research is to provide stakeholders in the EOL electronics recycling system with information and tools that will allow them to make data-driven decisions. Future work will involve analyses of other processing decisions, particularly those related to the recovery of plastics. An economically-sustainable material recovery system for EOL electronics will eventually lead to more sustainable patterns of resource use.

Near-Term Energy Pathways Flagship Research, Outreach, & Education Program

Flagship Director:

S. Connors,
Massachusetts Institute
of Technology

At the March 2005 Annual Meeting at MIT, the AGS inaugurated the “Near-Term Pathways to a Sustainable Energy Future” Flagship Program. The energy initiative builds on the model of past regionally focused AGS projects such as the Tokyo Half Project, the China Energy Technology Program, and the Mexico City Air Quality Program.

Principal Investigators:

F. Johnsson, Chalmers
University of Technology

Research: Prominent in the design of “The Energy Flagship” is a focus on how various portfolios of energy technology and policy options will influence the evolution of energy systems through time (e.g. pathways). Since energy infrastructures change slowly, near-term actions—while having small impact in early years—may have substantial influence over the long-term as changes multiply over time. Similarly, overemphasis on prospective long-term technological solutions (pervasive hydrogen and large-scale fusion for example) overlooks the compounded benefits of multiple, smaller-scale, near-term, often decentralized options.

K. Hanaki, The
University of Tokyo

A. Wokaun, Paul
Scherrer Institut

Learning from past efforts, each flagship research project will focus on one or more energy “themes” or sectors and exercises that focus on a specific geographic region. Energy themes include:

J. Heywood,
Massachusetts Institute
of Technology

- Sustainable Mobility
- Future Fuels and Feedstocks
- Clean Electricity Supplies
- Efficient-Smart Utilization

Regional projects will look at a variety of industrialized, emerging, and developing regions/nations. Two regional-sectoral projects are underway, with several more under development. Chalmers is leading the “**Pathways to Sustainable European Energy Systems**” project with an initial focus on stationary energy supply and demand in the European Union. This project builds upon their ongoing work in mapping fuel supply networks, as well as large emitters of greenhouse gases and potential sinks (carbon capture and storage).

MIT and ETH are the lead participants in the “**Before a Transition to Hydrogen Transportation**” research initiative. This study will focus on the coupled dynamics of vehicle technology improvements and the development of alternative fuels, and how improvements in the performance, costs, and availability of these technologies influence the evolution of on-road vehicle fleets, and their impacts on overall fuel consumption and greenhouse gases. The initial focus will be on North American and European light duty vehicle fleets.

Under development are projects in Japan, including an extension of the Tokyo Half Project, plus other prospective projects with partners in China, India, and elsewhere. To support the development projects under the banner “Energy for Development” the AGS has put out an RFP to AGS faculty to identify potential projects and partners. In addition, sessions at the 2006 AGS Annual Meeting in Bangkok will focus directly on the prospective Asian energy projects.

Outreach: Informing the world of current AGS activities, and especially what we have learned, is a key aspect of the Energy Flagship. Like the CETP and Mexico City projects, interaction with stakeholders is an important feature. Stakeholder involvement early in the research ensures that the AGS pursues “policy-relevant research.” The November 2005 AGS Technical Meeting at Chalmers provided an opportunity to engage with European energy industry representatives and others for whom these issues were most important. Projects with a “regional footprint”

not only help ensure quality stakeholder participation, but also provide an avenue for the dissemination of research results that can help policymakers make more informed decisions.

With strong stakeholder involvement, insights and lessons from AGS research are directly communicated to decision makers, and AGS researchers become a resource for stakeholders as they explore options related to Energy Flagship research. In addition to traditional academic knowledge dissemination such as reports, journal articles, etc., the AGS websites will provide higher level (cross-regional, cross-energy theme) insights from the research. On the AGS Energy Flagship website, currently under development, “early insights” will be taken from the past regional projects mentioned above.

The integration of research techniques, common assumptions, and key insights is also important. In parallel with the regional-sectoral projects and outreach activities, a series of “integration projects” will be pursued focused on discovering common and complementary insights to share both among research projects and through various AGS outreach channels. Advanced methods focused on the design, analysis, and evaluation of “pathways” is another aspect of integration research.

Education: While there are many resources (courses, websites, government reports) on specific energy technologies, curricula on energy systems—and especially on the evolution of energy infrastructures—is rare. This educational niche built upon Energy Pathways methods and findings, will be actively pursued. In collaboration with the AGS Education Program, a series of short courses aimed at different educational audiences focused on “Teaching Energy and Climate” have been launched. These courses will be enhanced by the development of case studies arising out of existing and future AGS research activities, as well as the dissemination of research methods and tools developed during the course of AGS energy research.

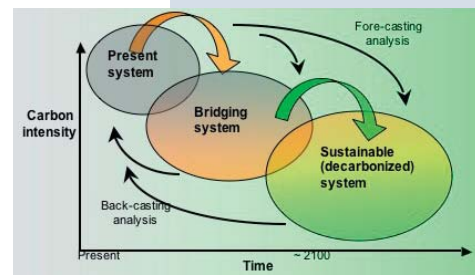
Pathways to Sustainable European Energy Systems

The European pathways project is a 5-year project to evaluate and propose robust pathways towards a sustainable energy system with respect to environmental, technical, economic, and social issues. The focus is on the stationary energy system (power and heat) in the European setting. Evaluations will be based on a detailed description of the present energy system and follow how this can be developed into the future under a range of environmental, economic, and infrastructure constraints. The project is a response to the need for a large and long-term research project on European energy pathways, which can produce independent results to support decision makers in industry and in governmental organizations. Stakeholders for this project are: the European utility industry and other energy related industries, the European Commission, EU-Member State governments and their energy related boards, and oil and gas companies. The overall question to be answered by the project is:

How can pathways to a sustainable energy system be characterized and visualized and what are the consequences of these pathways with respect to the characteristics of the energy system as such (types of technologies, technical and economic barriers) and for society in general (security of supply, competitiveness and required policies)?

Lead AGS University:
Chalmers University of
Technology

Lead Industrial
Collaborator:
Vattenfall AB



This question is addressed on three levels through the application of energy systems analysis (technology assessment and technical-economic analysis); a multi-disciplinary analysis; and an extended multi-disciplinary policy analysis. Pursuant to a dialogue with stakeholders, the above question has been divided into sub-questions such as:

What is the critical timing for decisions to ensure that a pathway to a sustainable energy system can be followed?

What are "key" technologies and systems for the identified "pathways" - including identification of uncertainties and risks for technology lock-in effects?

What requirements and consequences are imposed on the energy system in case of a high penetration of renewables?

What are the consequences of a strong increase in the use of natural gas?

What if efforts to develop CO₂ capture and storage fail?

Where should the biomass be used – in the transportation sector or in the stationary energy system?

Are the deregulated energy markets suitable to facilitate a development towards a sustainable energy system?

Will energy efficiency be achieved through free market forces or regulatory action?

What are the requirements of financing the energy infrastructure for the different pathways identified?

In order to address the sub-questions in an efficient and focused way the project is structured into 10 work packages addressing topics such as description of the energy infrastructure, energy systems modeling, technology assessment of best available and future technologies, and international fuel markets. In planning the project significant efforts have been put into ensuring that the project should not only be strong in research but also in management, communication, and fundraising. Both research and fundraising have been initiated and are progressing well.

Lead AGS Universities:
Massachusetts Institute
of Technology, Paul
Scherrer Institut

Lead Sponsor:
Ford Motor Co.

Before a Transition to Hydrogen Transportation

This project extends the "wells-to-wheels" and fleet dynamics research of John Heywood, Malcolm Weiss (MIT) et al. to look at key metrics of vehicle performance and costs of future light-duty vehicles. The key assumption is that if these vehicles (hybrids, plug-in hybrids, electric, and hydrogen fuel-cell vehicles) do not offer near equivalent drivability, trunk space, and purchase and operating costs, then issues regarding the development of a suitable hydrogen supply infrastructure may be moot. Alexander Wokaun's team at PSI is looking at the issue in a broader context, and is part of a growing network of Swiss academics working on sustainable mobility.

Advanced light duty vehicles are only one of a great many topics that fall under the banner "sustainable mobility." Past AGS projects (Mexico City, DIMSUD), which have led to two AGS series books show that urban form, transportation network investments, and the demand for transport are equally important aspects of the sustainable mobility equation. At MIT, Chris Zegras, who co-edited the AGS book,

“From Understanding to Action”, as well as the WBCSD Mobility 2030 section on transport demand in developing country cities, is interested in pursuing the urban form, the vehicle choice-traffic-emissions topic which bridges the Heywood-Zebras topics.

Personal transportation (both private and public) attracts much of the press regarding sustainable mobility. However, as the Mobility 2001 WBCSD report showed, well over one-third of energy used in transportation is for freight (road, rail, water, air). Ground-based diesel freight, as well as high altitude airfreight and personal transportation contribute to significant atmospheric pollution in addition to greenhouse gas emissions. Furthermore, the vulnerability of developed and developing economies to the quality and cost of freight transport is a very large issue. Research into the performance and risks of local/urban, regional, and international freight networks is a prime topic for the AGS Energy Flagship to pursue.

East Asian Energy Studies

Rapid economic growth, trade, and energy and material consumption patterns of a growing middle class will continue to be a major environmental management challenge for China, Japan, and their neighbors. The University of Tokyo is leading projects to mitigate the future tremendous increase of energy demand in East Asia. Development of infrastructures for sustainable energy supply in East Asia, mega-cities management, and sustainable buildings are the principal research areas. Because of the uneven distribution of energy resources and energy demand, an international electricity network and natural gas pipelines are needed. Potentials for greenhouse emission reduction in Tokyo and other cities will be analyzed using integrated analytical simulation tools. Dynamism in urban and rural development in China is also being studied. Based on the past AGS studies on sustainable buildings, demand and supply side management of energy savings in Asian buildings will be studied.

Lead AGS University:
The University
of Tokyo

Lead Sponsor:
Japanese Ministry
of the Environment

Clean Energy for Development

In addition to the Energy Pathways projects above focused on the AGS' home regions, sustainable energy pathways for developing nations are also of great interest. In late 2005 the AGS issued an RFP to AGS faculty aimed at identifying potential topics and partners for addition Energy Flagship projects.

Leads to be determined
based on responses
to an RFP

Numerous regions, East Asia, South Asia, Africa and Latin America, are of interest. The AGS has a history of collaborative energy related projects in China (CETP, Sustainable Housing, etc.), Latin America (Mexico City, DIMSUD), and elsewhere. The Energy and Resources Institute (TERI) in New Delhi has been a long-time participant in AGS Annual and Technical meetings, as has the Kwame Nkrumah University of Science and Technology in Ghana. These represent just two of many potential partners that the AGS may partner with to address energy topics associated with sustainable mobility, urbanization, affordable and clean energy services for the poor, and rural energy.

The new IR3S partnership with East Asian universities in China, Thailand, and elsewhere, is another opportunity for the AGS to establish quality partnerships leading to focused research in energy pathways for developing and emerging economies.

AGS Focus Center (AFC) Reports

AGS Focus Center at ETH Zürich - ETHsustainability

ETHsustainability has been a center of competence in sustainability at the Swiss Federal Institute of Technology Zürich since 2003. Its purpose is to create, transfer, and implement knowledge to effect change towards viable future living. The center focused its activities in 2005 in three areas -- Dialogue, Services, and Education -- by providing a variety of forums, projects, capacity building, and virtual infrastructures.

Education and life-long learning are fundamental to shifting society towards a more holistic framework of thinking and action. For this reason the activities of the center have a strong focus on education. A summary of the activities in 2005 follows.

The Educators Seminar on Teaching Sustainability (ESTS): Based on the experience of managing the YES education program, ETHsustainability organized the first Educators Seminar on Teaching Sustainability (ESTS), held in Braunwald Switzerland, from April 30 to May 8. The week-long seminar provided ample opportunity for 17 professors, researchers, and lecturers from colleges and university level, in 11 different countries to share their experiences in introducing sustainability issues into their courses and to identify common challenges. The seminar was guided by faculty from MIT, TU Vienna, ETH Zürich, and included guest speakers from academia, business, and government in Switzerland. <http://www.sustainability.ethz.ch/en/activities/seminar.cfm>



The YES Course Braunwald: The 2005 Youth Encounter on Sustainability (YES) was held on July 7 to 24, 2005, in Braunwald, Switzerland, the sixth consecutive year of the program. Over the course of two weeks, 38 students from 30 countries shared a program of lectures, group discussions, field excursions, cultural showcases and guest speakers with professors from ETH Zürich, MIT, The University of Tokyo, TU Vienna, the Humboldt University Berlin, Chalmers University, and the Central American Institutions, INCAE and CATIE. <http://www.sustainability.ethz.ch/en/activities/braunwald.cfm>

The YES Course Latin America: In September 2005 ETHsustainability collaborated with two institutions based in Costa Rica: the INCAE Business School and the Center for Tropical Agricultural Research and Higher Education (CATIE) to deliver the first Youth Encounter on Sustainability (YES) Latin America. The 27



participants from 17 different countries acquired well-founded knowledge on current development paths and future challenges for Costa Rica and the Latin-American region, in connection to the global state of the world. <http://www.sustainability.ethz.ch/en/activities/costarica.cfm>

The WYF project: In the year 2004 ETHsustainability started an initiative under the title “World YES Forum (WYF), students shaping the future.” This education project promotes an innovative learning approach for young academics so that they can actively contribute to meeting global challenges. These young academics (mostly alumni from the YES courses) researched and discussed three major topics in the context of their world regions: 1) Beyond Agenda 21, 2) Sustainability Leadership, and 3) Corporate Social Responsibility and Climate Change (CSR-CC). The work was carried out in 7 regions, namely Latin America, Asia, Europe, Africa, North America-Canada-Australia and New Zealand, Japan, and Palestine. During the WYF project these 7 regional groups and the international team working on CSR-CC delivered results and refined their findings at their local seminars (in 8 different countries, including Colombia, India, Kenya, USA, Japan, Slovakia, Palestine, and Switzerland). At the final meeting in Switzerland in August of 2005 the results were shared among the regional groups, and fruitful discussions on their ideas on strategies and visions towards moving societies in the direction of sustainable development were held. <http://www.wyf.ethz.ch>



YES Braunwald

The “Tokyo Colloquium” Education and Sustainability - Capacity Building for the 21st Century Vision and Experiences from Switzerland and Japan:

In the context of the World YES Forum project and with the support from ETH Zürich, Presence Switzerland and The Swiss Department of Foreign Affairs, ETHsustainability brought prominent Swiss and Japanese speakers to various sessions at three Japanese universities in June of 2005. This dialogue with the audience on the global issue to increase awareness on sustainability by building future education capacity helped further the themes of United Nations “Decade on Education for Sustainable Development” and the Aichi World Expo “Nature’s Wisdom.” <http://www.wyf.ethz.ch/content.cfm?uNav=531&uLang=1>



YES Latin America

The “Sustainability Leaders and Pioneers” series: Relevant personalities working in sustainable development discussed the challenges and visions for the future of the economy, politics, and society in open fora with the public. This initiative was carried out in 2005 in Switzerland in partnership with ETHsustainability, novatlantis, the Center for Corporate Responsibility and Sustainability at the University of Zürich, and the Sustainability Forum.



YES Braunwald

The “ExperienceGroup Sustainability” (Erfarungsgruppe Nachhaltigkeit):

An initiative of ETHsustainability and the Swiss Institute for Systems Engineering, the “Experience Group Sustainability” continued to bring in 2005 experts of the ETH Zürich together with technicians and managers from companies to discuss and exchange experiences in the development of innovative and sustainable products and services.



EcoDesign Workshop

Integration of Sustainability at the ETH: ETHsustainability was approached by the Rector and the School Board of the ETH Zürich in 2005 to develop a strategy for widely incorporating sustainability in all areas of ETH curricula and activities. A proposal elaborated by ETHsustainability on “the integration of sustainability in all areas of teaching/research of the ETH Zurich” is currently under evaluation.

Diverse activities: ETHsustainability began work on new projects, such as a high school level education program on the topic of “Energy, Climate change, Risks and Opportunities.” Another initiative concerns alternative medicine and is based on an exchange with Tibetan experts.

Support: In 2005 ETHsustainability continued to support the work of “project 21” (the sustainability student organization at the ETH Zürich), “myclimate” and “seed-sustainability”.

<http://www.sustainability.ethz.ch/en/cooperation/cooperation.cfm>



YES Braunwald

AGS Focus Center at the Massachusetts Institute of Technology

AT MIT, the Laboratory for Energy and the Environment oversees the AGS activities and administration. AGS activities at MIT focus heavily on student support and fellowships, in addition to support for energy-related research.

AGS Annual Meeting: MIT hosted the 2005 Annual Meeting on 20-23 March. The meeting, entitled “Near-Term Pathways to a Sustainable Energy Future,” launched the new Energy Flagship Program and celebrated 10 years of collaboration. Approximately 275 representatives from academia, industry, government, and non-government organizations participated.



Photo by Heratch

Martin Fellows



Photo by Heratch

Martin Fellows



Photo by Heratch

Martin Fellows Induction dinner



Staff photo

Environmental Fellows' Retreat at WHOI

Energy Flagship research: LFEE continued financial support for the research project “Before a Transition to Hydrogen Transportation,” which seeks to identify the key questions that need to be answered before beginning the transition to a hydrogen economy in the USA. John Heywood, Sun Jae Professor, Mechanical Engineering and Director of the MIT Sloan Autolab, is Principal Investigator for the project, which forms the basis for the sustainable mobility component of the Energy Flagship Program.

Cyprus Institute: LFEE co-organized the workshop entitled “Climate Change and Energy Pathways for the Mediterranean” with the Cyprus Research and Educational Foundation (CREF) in Cyprus, 21-22 June. AGS and LFEE are collaborating with CREF on the creation of the Cyprus Institute, a scientific and technological research and education institute in Cyprus.

Martin Fellowships: LFEE awarded 30 fellowships to graduate students researching complex problems of environment or sustainability. The fellowships are part of the Martin Family Fellows for Sustainability, established in 1996 through support from the Martin Family Foundation. <http://lfee.mit.edu/metadot/index.pl?id=2448&isa=Category&op=show>

Kabcenell Fellowships: MIT awarded three fellowships to graduate students researching alternative energy technologies. The Kabcenell Future Energy Fellowship was created in June 2001 with a generous contribution from MIT alumni, Dirk and Charlene Kabcenell.

YES participation: LFEE sponsored the participation of an MIT student in the Youth Encounter on Sustainability (YES), Braunwald, Switzerland and at YES-Latin America.

IPoS participation: LFEE supported the participation of two students in the UT-AIT Intensive Program on Sustainability (IPoS) in Bangkok, Thailand.

WSC-SD Annual Meeting: LFEE provided partial support for the World Student Community Annual Meeting held at MIT in March.

Seminar: In May, LFEE sponsored a seminar by James Gustave “Gus” Speth, Dean of the Yale School of Forestry and Environmental Studies and former chair of the U.S. Council on Environmental Quality, who spoke on the current state of environmental sustainability and proposed strategies for developing a U.S. response to climate change.

Environmental Fellows retreat: LFEE hosted a retreat on “Research in Wind Resource Development” for MIT environmental fellows at the Woods Hole Oceanographic Institution (WHOI) in October.

The AGS is a very important international and multidisciplinary program for UT. More than 100 faculty members of various fields have been involved. AGS activities at UT broadly cover the three-fold mission of the AGS: research, education, and outreach. Based on the activity of the AGS at UT, the collaborative research organization, Integrated Research System for Sustainability Science (IR3S), began in 2005. IR3S represents UT's attempt at structural reforms in forming network-type research bases in collaboration with highly competent participating universities and research institutes in sustainability-related fields in Japan.

AGS-related activities at UT in 2005 include:

Research: UT-AGS provided financial support for 19 full research projects and 12 seed projects. As a local research activity of UT, research projects focusing on interdisciplinary and international approaches and society for sustainable development are supported annually.

The Global Sustainability Symposium: This AGS-related Symposium was held at UT's Hongo campus on July 13, 2005 to introduce AGS activities to more than 100 participants from Japanese industry in order to explore the interest of potential supporters.

IPOS: UT and the Asian Institute of Technology (AIT) jointly conducted the Intensive Program on Sustainability (IPOS) as a second-year program for students from Japan and other Asian nations focusing on food and energy in Thailand on June 28-July 9, 2005. Nine students from UT participated in the meeting, which was organized and supported by UT-AGS, UT and AIT.

COP 11: UT-AGS supported 3 students participating in COP 11 held in Montreal, Canada on November 28-December 9, 2005.

UT Student Community: UT-AGS supported the activity of 4 working groups in the UT-Student Committee (UT-SC): OASIS (English discussion of global Sustainability), Climate Change, Water, and Sustainability Education.

WSC-SD: UT-AGS has decided to support 8 students participating in the WSC-SD Annual Meeting to be held at ETH on March 27-April 1, 2006.

AGS Focus Center at Chalmers University of Technology

In 2005, the activities of Chalmers AGS were focused on initiating the European Flagship Program, Pathways, and supporting education and outreach. AGS related activities at Chalmers cover the three-fold mission of the AGS: research, education, and outreach.

Research: Chalmers continued financial support for the research project Development of International Research Information in order to make the Swedish Research for Global Sustainability Reachable, Interesting and Reinforced. Bodil Vesterlund, Director of Information at Chalmers, is the principal investigator. This project aims to stimulate communication synergy between industry, political organizations, and society.

YES participation: Chalmers-AGS supported student participation in the Youth Encounter on Sustainability (YES) 2005 in Braunwald, Switzerland.

IPoS participation: Chalmers-AGS provided support for student participation in the UT-AIT Intensive Program on Sustainability (IPoS) - an AGS Asia educational activity.

CSS: Chalmers-AGS supported Chalmers Student Community (CSS) activities.

AGS Annual Meeting participation: Chalmers-AGS supported Chalmers student attendance at the AGS Annual Meeting 2005 at MIT in Cambridge, Massachusetts, USA.

GISD: Chalmers launched a web-based course with MIT and Monterrey Tech Mexico (GISD).

Aichi World Expo: Researchers participated in the Seminar "Find the Nordic Way" at the Aichi World Expo and at a similar event at the Embassy of Sweden in Tokyo. Presentations from Denmark, Finland, Iceland, Norway, and Sweden dealt with the Nordic approach to sustainability, a concept imbued with the Nordic spirit. AGS Chalmers was invited by the Swedish Institute to take part in the seminars.

AGS Technical Meeting 2005: Chalmers hosted the AGS Technical Meeting 2005, 7-8 November 2005 on "Critical Barriers to a Sustainable Energy Future" with approximately 80 participants from the four AGS member schools, Nordic universities and institutions, students, and industries participating.

Cyprus Symposium: Chalmers initiated preparation for the 8th Highway Urban and Environment Symposium, in Nicosia, Cyprus, June 2006. The symposium is a collaboration between AGS Chalmers and the Cyprus Institute.

Energy Flagship outreach: Chalmers-AGS published the Energy Flagship brochure, which provides a brief overview of the regional flagship projects within the four universities and the Energy Pathways Flagship Program. This publication contains an introduction and summary of the flagship program.

Pathways outreach: Chalmers-AGS published quarterly reports and newsletter for the European Energy Flagship – Pathways project.

Education

In addition to AGS-related education activities at the partner schools, the AGS comes together to promote sustainability in education through a number of joint activities during the year.

The 2005 Annual Meeting included the third annual AGS Poster Session and Competition. Researchers from AGS institutions were invited to submit posters documenting their sustainability research and educational projects. This year, researchers from all four AGS institutions submitted 33 competitive posters, three of which were selected as winning posters. Sixteen researchers assisted the Learning Team with expert review and selection.

One winning poster, “Evidence for a widespread dispersion of platinum group elements from automobile catalysts,” was prepared by a coalition from five universities and one industry participant. The entry documented the role of automobile catalysts in the wide dispersal into the environment of otherwise-scarce platinum group elements. A team from the University of Tokyo won with “The sense of forest – sequential video images recorded with the robot camera in the Tokyo University Forest.” This experimental integration of video and audio taken in a forested landscape was designed to evoke diverse perceptions of nature and an awareness critical to the concept of global sustainability. The third winning poster, from a group of MIT researchers, was titled “Microfabricated fuel cell systems: sustainable portable power generation devices?” The methodology proposed would allow identification and design of the optimal fuel cell system for a given application – a task inherently different from designing power generation systems at the macro-scale.



*Atsuko Terazono,
The University of Tokyo*



*Sebastien Rauch,
Chalmers University
of Technology*



*Alexander Mitsos,
Massachusetts Institute
of Technology*

At the Annual Meeting, the AGS Learning Team led participants in the Working Group, “Integrating Communication, Learning, and Research,” in a discussion of the challenges of incorporating key education principles into interdisciplinary research from the earliest stages to completion. The team emphasized that Energy Flagship research groups – with the aid of integrated education and communication specialists – should pre-think the possible educational purposes that could be served by outcomes of their work. In addition, research/education teams should continually consider and discuss potential topics, audiences, methods, and activities in which research findings can be deployed.

AGS Annual Meeting Poster Awards

Photos by Justin Knight

AGS Annual Meeting Education/Integration Workshop

Finalization and Presentation of DRR template

The AGS Annual Meeting also marked the debut of the final product of the two-year Delivering Research Results (DRR) education research project, funded by the AGS and LFEE. Collaboration with web experts and several rounds of testing yielded a template for making AGS research widely accessible and usable for educators at secondary and post-secondary levels. Summaries of research findings (methodological or analytical) are augmented by glossaries of key terms, citations for further information, and web links back to full research reports or other documentation. The template highlights interdisciplinary connections and makes material accessible beyond the specialty area of the source material. The template is currently being adapted for learning components of the Energy Flagship website.

Development of “Teaching Energy and Climate” Proposal

Looking ahead, the AGS Learning Team has proposed an innovative effort for 2006. The “Teaching Energy and Climate” initiative will develop and execute a set of independent but coordinated one-week short courses on energy and climate for diverse audiences of high importance at each partner’s university. Each university will be fully responsible for planning and implementing its one-week course. The short course format is one in which all project partners have implemented successfully for this range of audiences. The focus will be on awareness building, understanding of energy and climate issues, and identifying actions that can be taken towards reducing energy consumption and reducing impact on the climate and the environment. As feasible, the project will also improve sustainable energy knowledge among educators at these levels. The Team will collaborate on the design, comparison, and evaluation of the short courses, with the goal of generating a robust model of how to teach important information to targeted audiences in a short, intensive course. This will be the principal educational activity for the AGS Learning Team during the coming year, and will run from January 2006 through June 2007. A report including recommendations and curriculum materials will be presented at the AGS Annual Meeting in 2007. Additional project deliverables include sets of tested and evaluated instructional materials, and recommendations for replication of this approach to teaching about energy and climate.

UT-AIT Intensive Program on Sustainability (IPoS): An AGS Asian Educational Challenge

“Intensive Program on Sustainability – IPoS,” a challenge under the AGS to develop an Asian regional educational program on sustainability, started in 2004 through the collaboration between The University of Tokyo (UT) and the Asian Institute of Technology (AIT). Sustainability is a key concept for the 21st century leading to development of an environment-friendly society. Understanding of this concept is especially important for rapidly expanding Asian economies. IPoS provides an opportunity for students (especially from Asian nations) to obtain a deeper appreciation for sustainable development in the Asian region.

In this program, participants lodge together for about two weeks, study through experience-based learning that includes workshops, field visits, and lectures, and cultivate friendship across different nationalities and academic backgrounds. A unique part of this program is that it tries to look at Asia as the key region in achieving global sustainability. On one hand, solutions to Asia’s regional problems are an essential requisite for global sustainability. On the other hand, Asian traditions and perspectives should be introduced to other parts of the world and contribute to global sustainability much more. IPoS is a challenge to develop an educational program that enables such goals.

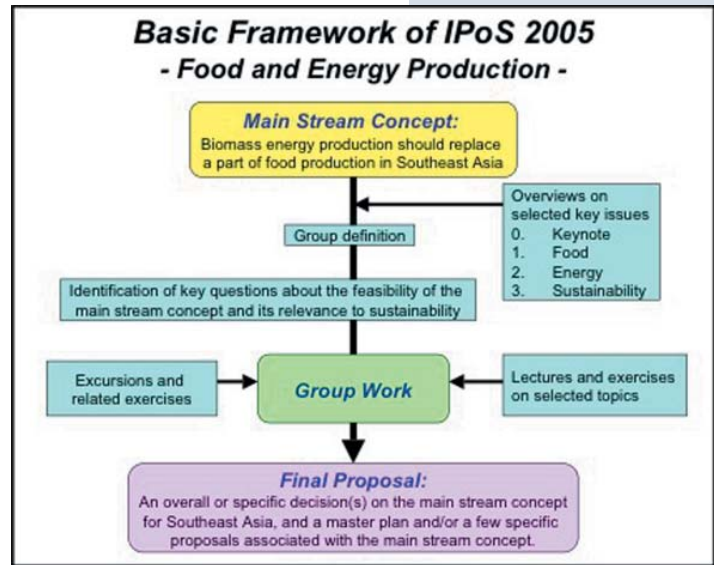
IPoS for the year 2005 was held in Chonburi, Thailand for 12 days (28 June-9 July, 2005). Twenty-four students from UT, AIT, MIT, ETH, and Chalmers attended in the program. The key topic of IPoS 2005 was “Food and Energy” instead of “Food Security,” the title in 2004.

For sustainable development in the Asian region, and also for the global world, it is necessary to satisfy energy demands by developing renewable energy. The key question is whether or not it is possible for Asian farmers to produce energy crops for biomass energy while reserving enough quantities for food. This question raises many sub-questions, not only in technological but also in social, cultural, and economical perspectives.

The principal concept in the above question, namely, “Should Asian farmers replace a part of food production with energy crop production”, was defined as the Main Stream Concept (MSC) throughout the program. Through group work, students were asked to define and focus on a specific aspect of the MSC. In the end, students experienced a process that included identification of issues that should be considered in the context of sustainability; addressing the selected issues in innovative ways of their own design; and proposal of an overall responsible decision.

The program also provided several study modules. Module topics were selected to help students think about relevant aspects of the MSC. The modules were organized independent of the group work, but students were given several opportunities to consider possible connections between the module and the MSC-related group work. A special day-long module was introduced specifically in the IPoS 2005 to discuss the Tsunami issue as Thailand suffered greatly from the 26-12-2004 Tsunami. Finally, by exchanging opinions and discussing relevant issues, group members learned how to develop common understandings integrating different race, language, nationality, and study backgrounds. The program also included many social activities.

This program was organized and supported by AGS-UT AFC, UT and AIT. We will continue to further develop the program to create a model of a of short-term educational effort mainly for graduate students dealing with sustainability.



Student Activities

World Student Community for Sustainable Development (WSC-SD)

<http://www.wscsd.org>

2005 was a busy year for the World Student Community for Sustainable Development. WSC-SD is the international student organization that grew out of AGS activities in 2002. It is the overarching group that binds together 6 student communities largely at the 4 Alliance for Global Sustainability (AGS) partner schools in Göteborg, Zürich, Tokyo, and Cambridge, and at St. Petersburg and Lausanne.

In March 2005, MIT hosted the WSC-SD Annual Meeting, "Beyond Brundtland." The meeting was a tremendous success with participants from more than 20 countries. The students raised support in excess of \$15,000 to help pay for travel for students from developing countries. A dedicated team of five MIT students: Christine Ng, Karim Abdul-Matin, Philip Sheehy, Masahiro Sugiyama, and Chaitra Chandrasekhar



Students at Simmons Dining Hall, MIT

led the planning efforts. Planning for the 2006 annual meeting, "Mind, Knowledge, and Sustainability," is underway. It will be held in Rasa, Switzerland from March 27th to April 1st. http://www.wscsd.org/rubrique.php3?id_rubrique=16

In addition to hosting meetings, the WSC-SD continues to publish a bi-monthly e-journal (<http://www.wscsd.org/ejournal/>). Moreover, several of the WSC-SD student communities have begun publishing campus-wide versions of Studio!Sus, a student guide to sustainability begun by the student community at ETH Zürich.

Student Activities at MIT – Students for Global Sustainability (SfGS)

The year 2005 has been a diverse one for MIT's Students for Global Sustainability Club. The group started off the year by rolling out Studio!Sus: A guide to practical sustainability in Cambridge and at MIT. The 14-page booklet features articles written by SfGS members about everything from green architecture to eco-labeling to worm composting. The students are currently working on distributing the booklet throughout the Institute. http://openwetware.org/wiki/SfGS:_Studio%21Sus

Over the course of the year, SfGS organized a seminar series on sustainable development. In April, SfGS hosted their annual Earth Day celebration, complete with a bike repair workshop, plant give-away, organic food, and local entertainment. In September, SfGS led a volunteer trip to The Food Project (www.thefoodproject.org), a local sustainable urban agriculture NGO. While weeding and sowing cover crops, students learned that local agriculture is important in ensuring urban food supply, teaching leadership skills to local youths, and educating city inhabitants about the importance of fresh produce. They are currently planning a follow-up visit to help plant in the spring.

One of SfGs' main thrusts in fall 2005 was to foster collaboration among like-minded sustainability/development/energy groups on the MIT campus. SfGS organized a group picnic on Cape Cod in July and a Sustainability Mixer in November, and is helping to organize an Alternative Career Fair and Zero Waste Party, both of which are being held in the spring of 2006.

Chalmers Students for Sustainability (CSS) is one of the member organizations of World Students Community for Sustainable Development (WSCSD). CSS is also a member of the Swedish umbrella organization Swedish Ecodemics, and CSS students collaborate in campaigns and projects with other groups. CSS, which consists of about 25 active members, has been active with regular meetings during the whole year. There has been a general activity at least every second week during the semesters, and working groups and board meetings in between these. The largest engagement was put into the preparations and performance of the workshop at the annual meeting of WSCSD at MIT in Cambridge, Massachusetts.

Student Activities at Chalmers– Chalmers Students for Sustainability (CSS)

Some CSS activities include:

WSC-SD Annual Meeting: Two papers and four posters by CSS members were accepted for the conference, which was held at MIT in Cambridge on 14-17 March. CSS members also organized one of the workshops. Eight CSS members participated in the meeting. Three members also attended the AGS annual meeting that followed.

Study Visits: During the year CSS arranged several study visits to learn about sustainable development in companies. They visited Shell (energy), Sweco (building consulting), Gryaab (water cleaning), and Volvo (cars).

Excursions: CSS arranged wonderful environmental excursions by canoe for members and other students in the beautiful Delsjön lake in July and September.



Canoe excursion

As usual, CSS invited all new Chalmers students to a welcome meeting at Ekocentrum in September.

Projects and campaigns

Fair Trade: During the year, a group of CSS members tried to organize a campaign to promote the Fair Trade label. In May CSS collaborated with other organizations for the arrangement of the World Fair Trade Day.

MyClimate: A visit by Prof. Walter Ernst in November 2004 was the starting point for the CSS climate campaign. The aim has been to collect facts, produce material, and investigate the possibilities of, e.g., influencing Chalmers University's travel policy.

Green Boards: CSS members have set up 'Green Boards' (note boards for environmental information) in the various departments of Chalmers. During the year, they have arranged an organization for management and coordination; designed the boards, printed cloth covers; and put up the first boards.



Three CSS Board Members

Student Activities at UT – UT Student Community

At the University of Tokyo, student initiatives in sustainability are mainly undertaken by the UT Student Community (UTSC). The goals of UTSC activities in 2005 were to:

Bring expertise, discuss, and extend knowledge

Within UTSC, there are three ongoing student working groups (WGs) related to sustainability: the Climate Change Working Group, the Water Working Group; and the Sustainability Education Working Group. These WGs have regular study meetings as basic activities. In addition, one of the WGs held a study tour and others took part in a campus festival, an academic conference, and a meeting. At the end of this year, the members of the Climate Change WG participated in COP11/MOP1 in Montreal, Canada. The Water WG is going to take part in the 4th World Water Forum to be held in Mexico in March, 2007.

Send messages and talk

Meeting for presenting theses, March 26

The students from various fields who have just finished master theses presented their study results in front of other students.

General Assembly, October 27

The theme of the assembly was “What is Sustainability? The roles of students in international scenes”. Students from diverse study backgrounds attended the meeting and took part in active discussions. In addition, the alumni of YES (Youth Encounter on Sustainability) and IPOS (Intensive Program on Sustainability) introduced each program and shared experiences and information.

WSC-SD 4th Annual Meeting, March 16-19

Seventeen students from UTSC presented papers, posters, and workshops at the WSC-SD Annual Meeting at MIT. UTSC members organized 2 of the 4 workshops in collaboration with ETH and MIT Student Communities: “Sustainability at the university” and “Communicating the risks of climate change.” One of the posters from UTSC won the best poster award at the AGS Annual Meeting.

Improve interface between students and society

EXPO project

The 2005 World Exposition, Aichi, Japan was held from March to September. UTSC accepted an offer from the Japanese government-affiliated pavilion “cyber NIPPON-KAN” to make a special web page for presenting EXPO from the viewpoint of students. The EXPO project “GO! GO! Time Machine” was established and 7 students were involved. They visited EXPO several times. Some students surveyed visitor’s attitudes to environmental topics and others met people supporting EXPO. <http://www.nippon-kan.jp/agsutsc/index.php>

Participation in COP11/MOP1

Four members of the Climate Change WG participated in COP11/MOP1. They tried to absorb the sense of international negotiation and to communicate with other global intellectuals from all over the world.

Outreach

Conferences are a major component of the AGS outreach program. Each year the AGS holds an Annual Meeting in the spring and a Technical Meeting in the autumn. The partner institutions alternate hosting the meetings.

In 10 years of growth, the AGS has built extensive capacity for understanding the impacts of energy sources and energy uses on global climate, regional ecology, and local quality of life. At the 2005 Annual Meeting, the AGS launched a major new initiative, "Near-Term Pathways to a Sustainable Energy Future." The goal of the initiative is to identify steps that can be taken now to move the world toward sustainable energy technologies, infrastructures, and markets in the future. One goal of the annual meeting was to identify a set of research questions, educational and outreach activities, and possible collaborations for the new initiative.

A series of panel discussions provided insights into challenges to achieving global sustainability. One key message was that energy-related needs and opportunities vary from place to place and the effectiveness of energy-saving technologies also varies from place to place, depending on such factors as available resources, population density, and patterns of energy use. One analysis investigated potential gains from burning solid waste to make methane for electricity generation. Other examples demonstrated the importance of understanding where current technologies are headed before pursuing and adopting new ones.

The difficulty of forcing changes in energy consumption was a recurring topic. Even when regulations are passed, poor design and implementation can reduce their effectiveness. Getting individuals to change their energy-consuming behavior is difficult, in part because consumer choice is so poorly understood that energy-efficiency measures cannot be designed properly. Understanding consumer behavior is a critical research challenge.

An encouraging note came in the final panel devoted to voluntary actions being taken on climate and energy, such as the more than 80 companies who have voluntarily joined the Chicago Climate Change Exchange, and the Henry P. Kendall Foundation which is providing funds that support conservation and sustainability at the community level, in particular, in the construction of "green" school buildings. While the potential for reducing emissions is limited, such highly visible community activity is intended to raise people's awareness of the sustainability challenge and to mobilize civic communities to take political action.

Annual Meeting

The AGS Annual Meeting was held at MIT on March 20-23 with approximately 275 participants from academia, industry, government, and non-government organizations.



Photos by Justin Knight

The working groups

A central goal of the annual meeting was to design the new Near-Term Pathways initiative and to define effective ways to achieve its combined goals of research, education, and outreach. In a series of working groups, participants from varying fields and backgrounds focused on key energy challenges, for both mobile and fixed-energy applications, facing different regions of the world.



Building on the first day's activities, two workshops on the second day – one focusing on mobility, the other on stationary energy applications – examined needs and challenges common to all the research and outreach activities. Participants considered opportunities for cooperation across regional studies; common and enabling methodologies, models, and core assumptions; key audiences and outreach opportunities for informing policy; and educational opportunities, needs, products, and partners.



At two other concurrent sessions, professional journalists from the US and Sweden briefed participants on how to present their research to the public. Radio, television, and print media each require some similar and some quite different elements to present a compelling and comprehensible story.

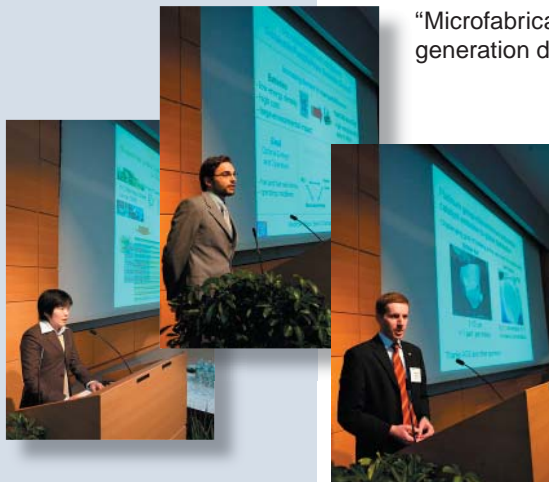
The poster competition

The 2005 Annual Meeting included the third annual AGS Poster Session and Competition. Researchers from AGS institutions were invited to submit posters documenting their sustainability research and educational projects. This year, researchers from all four AGS institutions submitted 33 competitive posters on topics ranging from improved wind-turbine technology to methods of detecting pathogenic viruses to the effects of regulation on industry. Three winning posters were selected.

“Evidence for a widespread dispersion of platinum group elements from automobile catalyts.”

“The sense of forest – sequential video images recorded with the robot camera in the Tokyo University Forest.”

“Microfabricated fuel cell systems: sustainable portable power generation devices?”



Best Poster Awards were handed out by President Jan-Eric Sundgren of Chalmers University

In November 2005, Chalmers hosted the 5th Technical Meeting. The meeting was entitled, "Critical Barriers to a Sustainable Energy Future," and focused heavily on the European Pathways project. Participants on the first day heard from leaders in business and society. They emphasized that reaching a sustainable energy system will be a gradual process and that a global policy framework must be in place to address climate change issues. International and European regulation are both needed to ensure a correct price on emissions on a global and a regional scale. Substantial new investments in research and development must be made in the energy sector, with a focus on technical development and on resource management, in addition to behavior change. Success will also depend on participation and support from local politicians and initiatives.

The afternoon session provided a detailed description of stationary energy systems, including power and heat. The Pathways project, the European studies portion of the Energy Flagship Program, will be based on a detailed description of energy systems, including database analysis, energy systems modeling, technology assessment and analysis of social and political implications of energy futures. The overall questions are how can pathways to a sustainable energy system be characterized and visualized and what are the consequences of these pathways? A prerequisite for the initiative has been close cooperation and dialogue with stakeholders involved in policy making and technology implementation.

The second day included presentations and workshops with a focus on sustainable mobility and on a more general approach to energy systems and sustainable urban development for East Asia. In the parallel sessions focused on energy systems and sustainable development in East Asia, presenters examined the role of academia in research on urban sustainability, international management of recyclable resources in the Asian region, and indoor thermal environment controlling for Eastern Asian countries. In the second parallel session, presenters addressed critical barriers to sustainable mobility, offering their thoughts on transdisciplinary approaches to sustainable transport, sustainable mobility and logistics, and evolving metropolitan structures and their impact on personal mobility. The session also examined technological opportunities and challenges to achieving sustainable mobility.

Technical Meeting 2005

The AGS Technical Meeting was held at Chalmers on November 6 and 7 with approximately 75 participants from academia, industry, government, and non-government organizations .



Cyprus Workshop

On June 21–22, the Alliance for Global Sustainability (AGS) and the Cyprus Research and Educational Foundation (CREF) jointly hosted a workshop entitled Climate Change and Energy Pathways for the Mediterranean. The workshop, held in Cyprus, involved 45 participants, including 16 speakers from 14 countries. Together they explored the implications of climate change for the eastern Mediterranean and the impact of climate-change response on regional economic activity, particularly in the hydrocarbon industry.

One session focused on de-carbonizing the electricity sector through increased use of natural gas as a transition fuel, carbon sequestration, and at carbon-less technologies such as renewables, biofuels, and nuclear power. Another session focused on transportation in a greenhouse-gas-constrained world. Speakers addressed efficiency in oil use and alternatives to oil and examined the transition to hydrogen. The final session looked at implications for the oil and gas industry. The panelists discussed the need for a balanced debate and a more pragmatic agenda.

CREF was created in February 2005 and charged with establishing a new independent research and educational institution, the Cyprus Institute, with a strong scientific and technological orientation. The Cyprus Institute will serve both as a first-class technical research and educational institution and as a convening place for bringing science, technology, and analysis to bear on important public issues in the region. The AGS is collaborating on the initial step toward establishing the Cyprus Institute—the creation of a research center focusing on energy, water resources, and the environment. The meeting in June was the first in a series of workshops that will serve to engage the international community.



AGS Book Series

The AGS Book Series, Science and Technology: Tools for Sustainable Development published two new titles in 2005. This brings to eight the total number of books published in the series since its inception in 2002. The 2005 books are:

Sustainable Energy Consumption and the Public
David Goldblatt

The dissertation content for this book received the silver medal for best thesis at the ETH-Zürich in 2003. The innovative approach to energy studies demonstrates the need to identify distinctive “lifestyle groups” with a view to preparing differentiated policy approaches to influence energy consumption patterns. This work, which was published in early 2005, makes a substantial contribution to the new area of “demand-side” policy initiatives. The book has sold over 200 copies in the United States and Europe.

The Technology, Energy, Environment, Health Chain in China: A Study of the Coke-making Industry
Karen R. Polenske, editor

This important work adds significant new knowledge to understanding energy intensity and related pollution from the use of fossil fuels in township and village enterprises in China. Small and medium sized enterprises represent the fastest growing industrial segment in China. The book is thus both timely and urgently needed. In addition, the book provides a thorough analysis of workers’ personal exposure to pollutants from the coke-making industry and an investigation of household energy consumption. Together, the studies presented in this volume will fill data gaps in universal understanding of the sources and effects of pollution in a major industrial sector in China.

There are also a number of books in the pipeline expected for publication in 2006.

An Energy Analysis of Household Consumption in India
Shonali Pachauri

Based on thesis work carried out under the aegis of the AGS project on household energy consumption at ETH-Zürich, this work provides a unique socio-economic analysis of national and household level energy consumption patterns in India. Covering the period 1983–2000 the methodological approach developed by Dr. Pachauri for the study includes consideration of non-commercial sources of energy as well as the large diversity in energy consumption patterns across households with widely divergent life-styles and levels of well being.

Sustainable Buildings in China: Design and Technology for Residential Buildings
Leon Glicksman and Juintow Lin, editors

This architectural design book will provide a manual for developers, builders, and building managers in China. It includes a review of new technologies and low-cost low polluting applications to support development of sustainable urban housing in China and elsewhere in rapidly developing urban centers.

Public Entrepreneurship Networks: Institutions for Innovation and Sustainability
David Laws, editor

The book explores the policy implications of promoting innovation for meeting the challenges of sustainable development and related policy areas such as climate change. The authors examine the challenges such promotion creates for public, private, and civic actors who want to foster technological innovation as a way to deal with these complex issues. Case studies of success are presented and their implications for practice are analyzed. The authors emphasize that innovation extends all the way down to the user of new technology and they highlight the often-unmet demands for institutional innovation this creates. Recommendations for policy and for action by governmental, non-governmental, and market organizations are included in this practical and forward-looking work.

AGS also anticipates publication of several manuscripts, including two books of proceedings in 2006.

Climate Change and Energy Pathways for the Mediterranean (Cyprus, 2005)
Ernest J. Moniz, editor
(Publication expected March 2006)

Proceedings of the Eighth International Symposium on the Highway and Urban Environment (Cyprus, June 2006)
Greg Morrison and Sebastien Rauch, editors
(Publication expected December 2006)

Mapping Sustainability and Managing Knowledge e-Networking
Nazli Choucri, editor with Toufic Mezher, Farnaz Haghseta, Wallace Baker, Dinsha Mistree, Carlos Ortiz

The results of the study on arsenic poisoning in the Bangladesh water supply, Prof. Watanabe, editor, is also anticipated in 2006

The AGS book series, “Science and Technology: Tools for Sustainable Development” is published by Springer. Dr. Joanne Kauffman is series editor.



Dr. Joanne Kauffman, AGS series editor

Photo by Justin Knight

Investments: Facts and Figures

The expenditures of the AGS can be broken down into Research, Education, Outreach and Administration. Expenditure from the AGS Core Account during 2005 includes administration, support for the Annual and Technical Meetings, and publication costs.

AGS Core Account, direct expenses (USD)	
Administration	135 000
Support for Technical and Annual Meeting	80 000
Flagship Management	95 000
Total	310 000

Reports from AGS Regional Activities

In 2004, the AGS moved towards a more decentralized way of business with greater emphasis on building up the regional activities. While core funds are still allocated for joint activities, such as administration, meetings, education, and outreach, the AGS Focus Centers are primarily charged with promoting research and education activities on the regional level. In 2005, much of the focus was on development of the AGS Energy Flagship Program. Below are the distributions by the AFCs for AGS-related activities.

	ETHZ		MIT		UT		Chalmers	
	USD	%	USD	%	USD	%	USD	%
Administration and overhead	85,000	7.76	155,477	11.16	379,030	43.89	118,250	13.65
Research	0	0	535,772	38.46	312,500	36.19	569,625	65.75
Education	880,000	80.37	551,744	39.60	35,104	4.07	36,002	4.16
Outreach	30,000	2.74	50,157	3.60	36,837	4.27	42,500	4.91
Balancing against the core	100,000	9.13	100,000	7.18	100,00	11.58	100,00	11.04
Total	1,095,000	100	1,393,149	100	863,471	100	866,377	100

Outlook

Looking ahead to 2006, the AGS will hold its Annual Meeting in Bangkok, Thailand on the 19 – 22 March. The University of Tokyo will host the meeting in cooperation with the Asian Institute of Technology (AIT). The meeting will focus broadly on global sustainability and regional diversity. Topics will range from the energy flagship program, to water and food security, to environmental risk and disaster.

The March meeting provides a forum for furthering the collection of Asian energy studies that form one of the case studies of the energy flagship program, in addition to exploring issues for future flagship programs. The meeting will be followed by an IR3S-AIT Joint Symposium on Sustainability Science, held at AIT in Bangkok.

The AGS in 2006 will focus on building the regional studies of the energy flagship program, including exploring potential partners for the regional study on clean energy development for India, China, and Africa. Both the European Energy Pathways and Before a Transition to Hydrogen Transportation projects will be reaching out to leading research colleagues, both regionally and within the AGS, as their research progresses. Research forums, through which outreach to decisionmakers will occur, are also planned. These activities will also help each of the AGS universities advertise and communicate various energy research interests that may not be directly involved in the European Pathways, Before Hydrogen and other AGS Energy Flagship research activities.

The AGS is also developing a proposal for a new flagship on food and water, “Secure Ecoservices.” This initiative of the University of Tokyo looks at development paths for food and water as ecosystem services, with a social and technical system study by Chalmers-MIT-ETH and a risks and security focus for Tokyo. The proposal seeks to establish a unique AGS program aimed at making a global impact. Initial efforts will be on determining the direction of Secure Ecoservices and identifying ways in which the research program can be financed.

The AGS will also strengthen its education and outreach activities in 2006, particularly as they pertain to the energy flagship. The AGS Learning Team will develop and execute a set of independent but coordinated one-week short courses on energy and climate as part of the “Teaching Energy and Climate” initiative. The effort will run from January 2006 through June 2007.

AGS Organization

International Advisory Board (2005)

- Dr. Francis Waldvogel, former President, Swiss Federal Institutes of Technology (ETH) Board (Chairman)
- Dr. Thomas Connelly, Chief Science and Technology Officer, DuPont de Nemours & Co, Ltd
- Dr. Hiroyuki Fujimura, Honorary Chairman of the Board, Ebara Corporation
- Dr. Jay Ihlenfeld, Vice President, Research and Development, 3M
- Mr. Lars G. Josefsson, President and CEO, Vattenfall AB
- Mr. Lars Kann-Rasmussen, Director, VKR Holding A/S
- Dr. Paul C. Killgoar Jr., Director, Environmental, Physical Sciences & Safety R&A Engineering, Ford Motor Co.
- Mr. Masatake Matsuda, Chairman, East Japan Railway Company
- Mr. Nobuya Minami, Advisor, Tokyo Electric Power Company, Inc
- Prof. Jakob Nüesch, Honorary Member, International Committee of the Red Cross
- Mr. Kazuo Ogura, President, the Japan Foundation
- The Hon. President José-Maria Figueres Olsen, former President, Costa Rica
- Mr. Dan Sten Olsson, CEO, Stena AB
- Mr. Motoyuki Ono, Director General, The Japan Society for the Promotion of Science
- Mr. Alexander Schärer, President of the Board, USM U. Schärer Söhne AG
- Dr. Stephan Schmidheiny, President, Avina Foundation
- Mr. Norio Wada, President, Nippon Telegraph and Telephone Corporation (NTT)
- Ms. Margot Wallström, Member of the European Commission
- Prof. Hiroyuki Yoshikawa, President, National Institute of Advanced Industrial Science and Technology
- Dr. Hans-Rudolf Zulliger, President Stiftung Drittes Millenium, Board of Directors, Amazys Ltd

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