ALLIANCE FOR GLOBAL SUSTAINABILITY

ENERGY PATHWAYS FLAGSHIP PROGRAM

The Alliance for Global Sustainability is an international partnership of four leading science and technology universities:

Massachusetts Institute of Technology (Cambridge, MA,USA),
Swiss Federal Institute of Technology Zurich (Zürich, Switzerland),
The University of Tokyo (Tokyo, Japan), and
Chalmers University of Technology (Göteborg, Sweden).

Created in 1997, the alliance today brings together hundreds of university scientists, engineers, and social scientists to address the complex issues that lie at the intersection of environmental, economic and social goals.

Funds and expertise have come from individuals, foundations, governments, major corporations and the universities themselves. Members of the International Advisory Board provide significant funds annually for our activities.

The issues around global sustainability – energy efficiency, clean water, fresh air, and sufficient food for an expanding population – are among the most challenging problems on earth today. With strengths in science, technology and the social sciences, the partner universities together commit substantial academic and research resources to meet these challenges through three goals:

Research Improving scientific understanding of global environmental challenges, by creating new knowledge through research that both transcends traditional disciplinary, institutional and geographical boundaries, and crosses the academic/industrial divide.

Outreach Development of technology and policy tools to help societies reconcile ecological and economic concerns, by taking a step beyond normal academic dissemination of results to facilitate implementation.

Education Education of a new generation of leaders, for all sectors of society, committed and with the knowledge and skills required to meet the challenges of sustainable development.

Since the first set of sponsored projects was launched in 1997 with support by the Avina Foundation, we have worked with farsighted leaders from global businesses and industries, governments and NGOs worldwide, to provide innovative and practical solutions to real and urgent environmental problems around the world.

ALLIANCE FOR GLOBAL SUSTAINABILITY

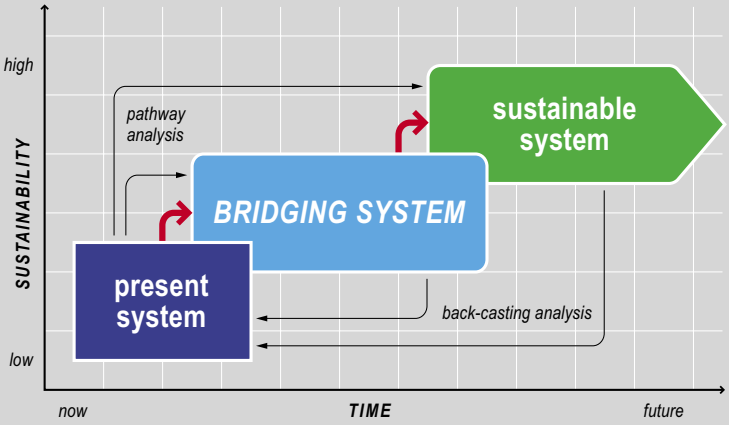
MANAGING GLOBAL UNCERTAINTY THROUGH NEAR TERM PATHWAY ANALYSIS

The overall aim of the *energy pathways flagship program* is to study and evaluate pathways towards a sustainable energy system under uncertainty. Starting from the present system the desirable (sustainable) future is unknown and therefore "bridging technologies/systems" must be implemented on a large scale before a sustainable future might be reached.

We want to develop a capability to handle the uncertainty by combining a pathway analysis – starting from the present system – with a backcasting analysis from visions of future systems and thereby identify possibilities and risks with the bridging system. This includes minimizing the risk of lock-in effects from bridging technologies.

Stakeholders will be asked to collaborate in identifying and assessing near term technologies leading to appropriate, sustainable energy systems for different regions of the world.

Policy makers will be supported and assisted in seeking good choices. A set of currently and soon-to-be-available technologies and strategies can substantially reduce CO_2 emissions, immediately, but we need to identify those options that are robust and select those that should be encouraged.



Above: Conceptual model of the move from a non-sustainable energy system (e.g. carbon intensive) to a sustainable energy system (decarbonised). The *energy pathways flagship program* will study options and pathways leading through the bridging system.

Near-term pathways to a sustainable energy future

At present 85 % of all commercial energy consumed comes from fossil fuels. New renewable energy sources will not make a major impact for several decades. Meanwhile the CO_2 releases related to fossil fuels are changing global climate systems and even the most optimistic projections foresee a worsening of this problem as energy demands increase.

There is a need for research that takes on these problems now and provides realistic solutions in terms of technology, policy and economy.

The energy flagship program *near-term pathways to a sustainable energy future* will identify – and communicate to decision makers – robust transitional systems or energy pathways that bridge today's energy technologies, infrastructures, and markets, to future sustainable systems.

The program will initially be based on four large regional studies; 1. Pathways to a Sustainable European Energy System, 2. Expanding energy systems in East Asia, 3. Mobility in the Americas, and 4. Clean energy for Indian development.

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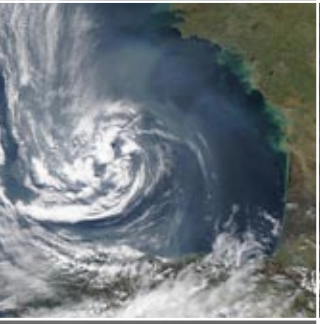
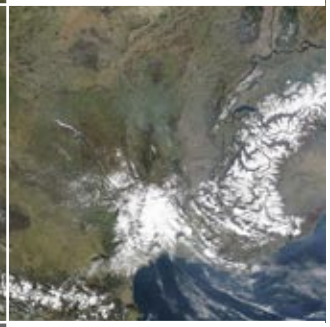
ENERGY PATHWAYS FLAGSHIP PROGRAM

Near-term pathways to a sustainable energy future

Pollution and smoke get caught up in a swirl of clouds off the coasts of Spain (bottom left), France (center), the United Kingdom (top center), and Ireland (under cloud at top left) in this image from March 22, 2003. The smoke and pollution appear as a greyish haze concentrated west of France.





Jan-Eric Sundgren, professor of physics, and president of Chalmers.

Image of Europe's city lights at night. The brightest areas of the Earth are the most urbanised, but not necessarily the most populated.

EUROPEAN STUDY

Lead

Chalmers University of Technology

I. *Europe study:*

Pathways to a sustainable European energy system

The European pathways study has the overall aim to evaluate and propose robust pathways towards a sustainable energy system with respect to technical, economic and social issues. The focus will be 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 will follow how this can be developed into the future under a range of environmental, economic and infrastructure constraints.

The proposed study is a response to the need for a large and long-term research study on European energy pathways, which can produce results of significant interest for decision makers. Consequently, the study is designed so that it can develop over time while maintaining a clear focus – a focus which should be developed in co-operation between the research community and industry.

An important basis for the study will come from a dialogue with a broad representation of the energy industry and governmental boards. Stakeholders for this study are the European utility industry and other energy related industries, the European Commission, EU-member state governments and their energy related boards, oil and gas companies.

The study has the ambition to cover all relevant aspects of the stationary energy system and is divided into several different work areas.

2. *East Asia study:*

Expanding energy systems in East Asia

The East Asian pathways study aims to evaluate the present status and future trends of significantly developing East Asian regions and propose robust pathways towards a sustainable energy system.

The challenge of the study is to understand rapid growth in energy demands in this region and especially China. This effort will build upon the *Tokyo Half Project* in which the research target was to demonstrate the technological transformation required to reduce Tokyo's greenhouse gas emissions by half from 1990.

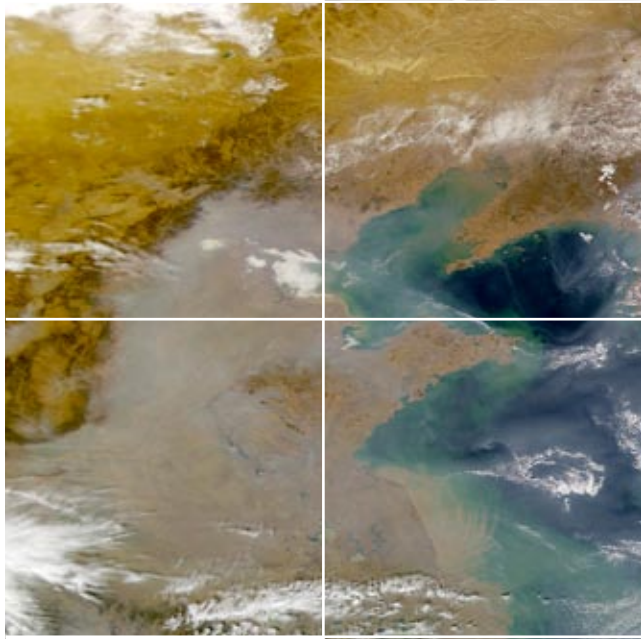
The study will be conducted in collaboration with the member universities, East Asian universities and institutions, NGOs and various stakeholders. It will be initiated with three key studies and should be extended widely to tackle various energy issues:

Infrastructures for sustainable energy supply. The purpose of the study is to obtain insights into the optimal future configuration and operation of East Asian energy infrastructures in the long run and the potential roles of emerging energy related new technologies.

Megacities. Change of urban area, urban structure and transportation system and environmental loading in Beijing, Dalian and Xian will be analyzed. Further, the dynamics of urban development, possibility of mitigation, material consumption and emission of CO_2 will be studied.

Sustainable building. A research network of the four member universities and nine East Asian universities including Tsinghua University, Tongji University in Shanghai, Asian Institute of Technology in Thailand has been constructed. The study focuses on the development of new technologies, case studies in the network, planning symposiums, education and seminars.

Takeshi Sasaki, professor of law and politics, president of The University of Tokyo

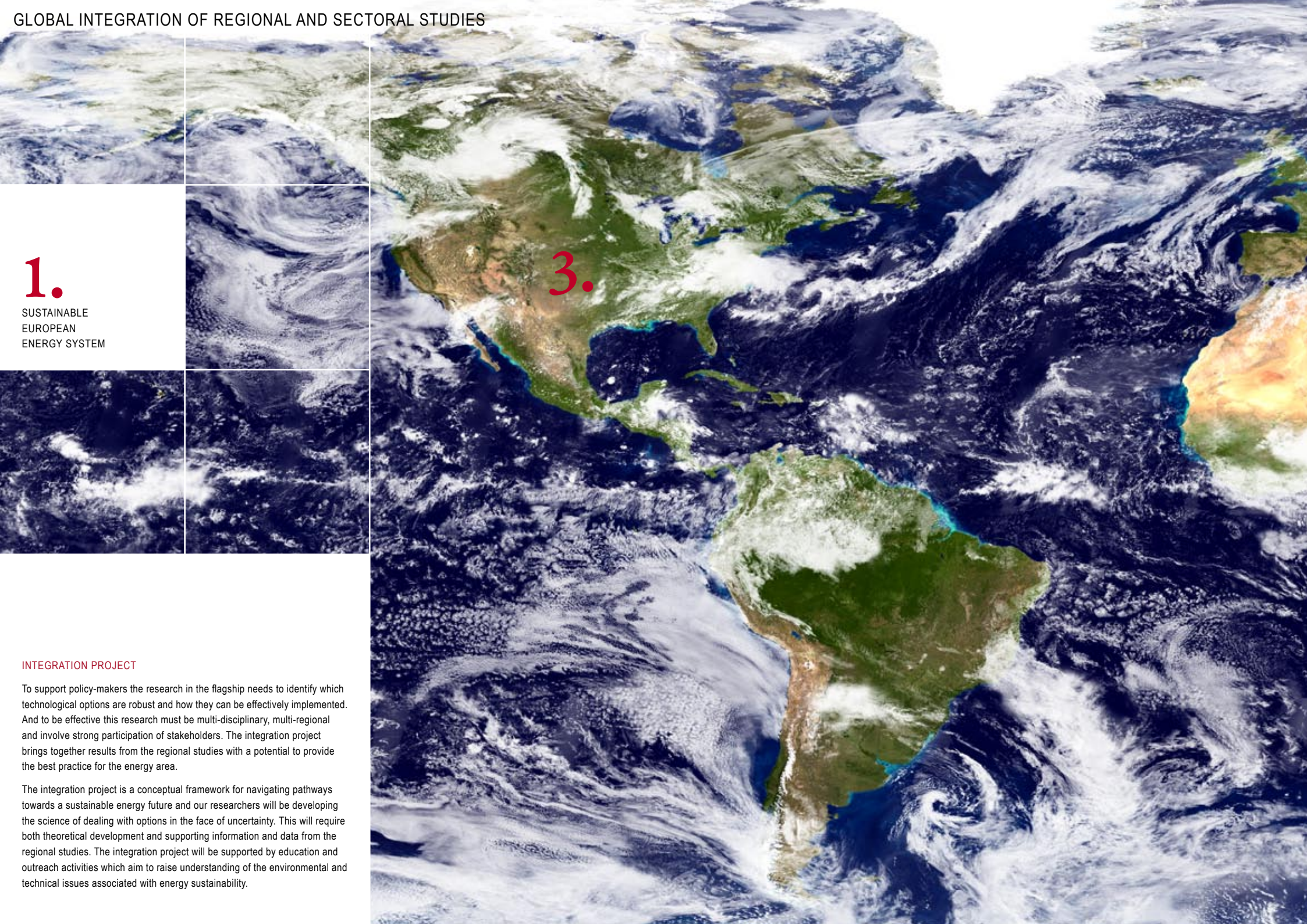


On January 11, 2002, a thick shroud of haze lingers over China, turning the sky an opaque grey and almost completely blotting out details of the land surface. Beijing, China's capital city, is situated under what appears to the densest portion of the aerosol pollution.

Hiroshi Komiyama, professor of engineering, vice-president of The University of Tokyo

EAST ASIAN STUDY

Lead
The University of Tokyo



1.

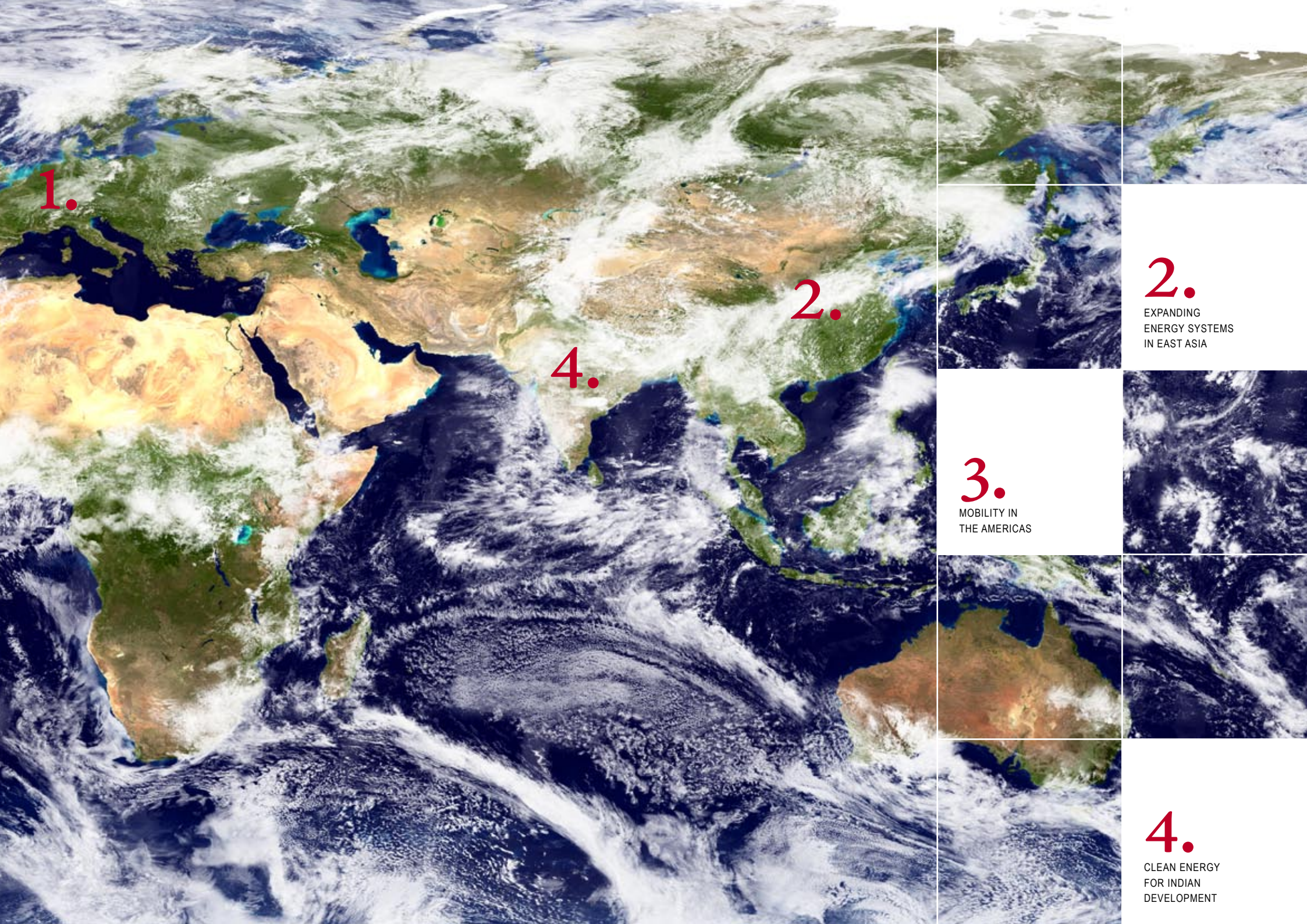
SUSTAINABLE
EUROPEAN
ENERGY SYSTEM

3.

INTEGRATION PROJECT

To support policy-makers the research in the flagship needs to identify which technological options are robust and how they can be effectively implemented. And to be effective this research must be multi-disciplinary, multi-regional and involve strong participation of stakeholders. The integration project brings together results from the regional studies with a potential to provide the best practice for the energy area.

The integration project is a conceptual framework for navigating pathways towards a sustainable energy future and our researchers will be developing the science of dealing with options in the face of uncertainty. This will require both theoretical development and supporting information and data from the regional studies. The integration project will be supported by education and outreach activities which aim to raise understanding of the environmental and technical issues associated with energy sustainability.



2.

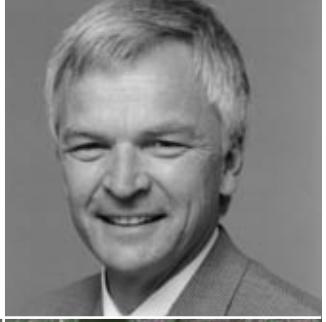
EXPANDING
ENERGY SYSTEMS
IN EAST ASIA

3.

MOBILITY IN
THE AMERICAS

4.

CLEAN ENERGY
FOR INDIAN
DEVELOPMENT



Olaf Kübler, professor of image sciences, president of the Swiss Federal Institute of Technology Zurich..

Maintaining the level of personal mobility while reducing CO_2 emission in the short term is a serious concern in the world's great cities, such as New York City.

Susan Hockfield, professor of neuroscience, and president of MIT.

AMERICA STUDY

Lead
Massachusetts Institute of Technology
and Swiss Federal Institute
of Technology Zurich

3. *America study:* Mobility in the Americas

It is anticipated that personal and goods transport will continue to grow and this will increase demands for better personal access to mobility. This is important for economic and social development but leads to a number of negative aspects.

Although toxic emissions are under control in developed countries this is still a major problem in the developing world. Most serious is that transportation provides a major contribution to greenhouse gases.

In the first case study we will identify and examine key questions which need to be answered before introducing the large scale societal use of hydrogen. It is likely that the sustainable energy system of the future will rely on several different energy sources and carriers depending on the local conditions and the time perspective. At present, the wish to reduce oil import and CO_2 emission are key arguments for an introduction of hydrogen.

Our aim will be to examine the first crucial steps in the transition towards hydrogen. In a transportation system based on hydrogen as energy carrier two major parts will be important; a system for producing hydrogen and for distributing it to the vehicles, and one for producing and maintaining the hydrogen vehicles.

In the second case study we will use the experience from an initial study of historical and current mobility conditions in eight world cities. The next step will be to consider the paths toward future mobility in the developing cities of the world. Variables that needed to be examined include population, urban densities, transit supply, congestion, motorization and the speed of change in these variables.

4. *India study:*
Clean energy for Indian development

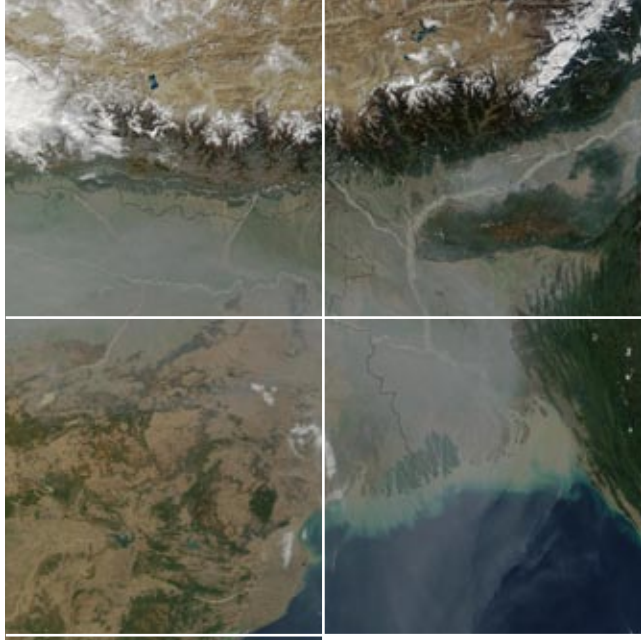
India has set ambitious development goals aimed at improving the quality of life among India's rural populations.

Initial delivery of electric service to India's rural villages is not a "one size fits all" technical solution, especially given the seasonal diversity of energy needs, as well as the availability and quality of candidate renewable energy resources. Nor will the expansion, and potential integration, of those systems over time be a simple task.

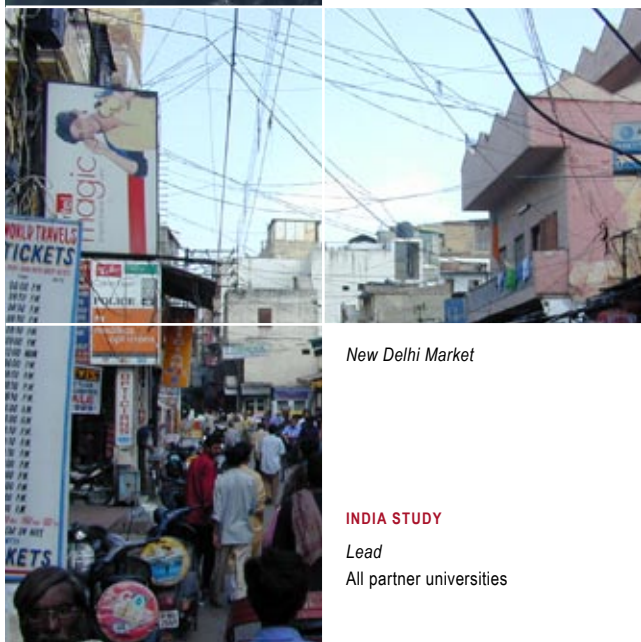
In collaboration with TERI (The Energy and Resources Institute) in New Delhi, we will identify and evaluate pathways towards providing cost-effective, reliable energy services to India's rural populations. The technical and economic feasibility of different systems is highly dependent on a diverse set of design criteria: local energy demands (daily, seasonal); available renewable resources (quantity and quality); location relative to conventional fuel supplies and/or grid power; and also how these factors may vary over time.

The research will be conducted in collaboration with the recipients and providers of village electricity systems. The output of the study will be a toolkit representing a starting point for local implementers that address key technical, economic, and institutional factors.

The research team can look at systems in technical and economic detail. Interaction with people in the field is essential and only local "implementers" will be able to assess the practical problems associated with installation, maintaining and managing candidate systems. In the long-term this research capability could be extended to underserved urban areas as well.



Air pollution is a severe and persistent problem in India, Pakistan, and Bangladesh. The haze and pollution back up against the mountains and remain for weeks at a time, posing a severe health hazard. The pollution comes from inefficient wood and dung-fueled heating and cooking devices, as well as forest fires and industrial and urban pollution.



New Delhi Market

INDIA STUDY

Lead
All partner universities

LEARNING AND COMMUNICATION

Lead
The AGS Learning Team,
with members from
all partner universities

&. Learning and communication:

Education and information for a sustainable energy future

In order to meet our goals effectively, education and communication at all levels must be an integral part of the overall strategy. Education is arguably the central activity for the partner universities.

The identification of near-term strategies for meeting global energy needs while reducing regional and global environmental threats, such as greenhouse gas emissions, but providing resource equity among developed and developing economies, will provide a rich source of new educational content.

Providing industry with the next generation of highly educated people in this field is, understandably, a high priority for the sponsors of this program. Also *professional workshops* for policymakers and industry managers are an important way of bringing new knowledge.

A new *interactive web site* will provide users with free and open access to current, highly relevant information on sustainable development.

In order to facilitate transfer of information from the research studies to the educational activities, an *education specialist* will be embedded in each of the regional studies.

Annual workshops will provide a forum for discussion on progress and results. The planned workshops will be in Brussels 2006, Beijing or Tokyo 2007, Washington 2008, and in New Delhi, Rio de Janeiro or Johannesburg 2009.

Scientific reporting is an integral part of the activity, both comprehensive reviews and presentations of the research as well as specific scientific publications. A final report will be tailor-made for industry.

Communications will be prepared for a general (rather than specialist) audience, and has a central role in supporting the Integration project.

CHALMERS

ETH

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Massachusetts Institute of Technology

東京大学
THE UNIVERSITY OF TOKYO

FOUR UNIVERSITIES

The Alliance for Global Sustainability is an international partnership of four leading science and technology universities:

CHALMERS Chalmers University of Technology, was founded in 1829 following a donation, and became an independent foundation in 1994. Around 13,100 people work and study at the university. Chalmers offers Ph.D and Licentiate course programmes as well as MScEng, MArch, BScEng, BSc and nautical programmes.

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ETH Swiss Federal Institute of Technology Zurich, is a science and technology university founded in 1855. Here 18,000 people from Switzerland and abroad are currently studying, working or conducting research at one of the university's 15 departments.

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MIT Massachusetts Institute of Technology, a coeducational, privately endowed research university, is dedicated to advancing knowledge and educating students in science, technology, and other areas of scholarship. Founded in 1861, the institute today has more than 900 faculty and 10,000 undergraduate and graduate students in five Schools with thirty-three degree-granting departments, programs, and divisions.

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UT The Univeristy of Tokyo, established in 1877, is the oldest university in Japan. With its 10 faculties, 15 graduate schools, and 11 research institutes (including a Research Center for Advanced Science and Technology), UT is a world-renowned, research oriented university.

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