





International Institute for Applied Systems Analysis www.iiasa.ac.at

IIASA Mission

IIASA's mission is to conduct international and interdisciplinary scientific studies to provide timely and relevant information and options, addressing critical issues of global environmental, economic and social change, for the benefit of the public, the scientific community, and national and international institutions.

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Schloss Laxenburg, Austria—seat of IIASA

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From the Chairman and the Director

The task of an Annual Report is to look at the year gone by and to review its experiences and achievements. Yet, in many respects, 2006 marked the beginning of a new era for IIASA, as we welcomed new members, India and Pakistan, and started a five-year Research Plan that will take the Institute through to the end of 2010.

The accession of India and Pakistan, represented by the Technology Information, Forecasting and Assessment Council (TIFAC) and the Pakistan Academy of Sciences, respectively, brings our membership to 18 countries in a year when there has been a resurgence of interest among countries in the benefits of joining IIASA. Such advantages, of course, are always a two-way street. There will be enormous synergy between the analytical strengths of IIASA scientists and the insights of Indian and Pakistani scientists regarding local realities and needs on the ground. And the membership of these two countries, their influence and involvement, will place IIASA in an even stronger position in terms of providing policymakers with scientifically credible and important analyses of global change.

As Dr. R. Chidambaram, Principal Scientific Adviser to the Government of India, said at a recent conference: "The insights of the Indian scientific community and the stakeholders with their valuable hands-on experience, wedded with IIASA's analytical and modeling capabilities would help India in making the right technology choices and gain a better global vision of issues. I see a lot of potential in this linkage. Any international collaboration is sustainable only if it is mutually beneficial and I am sure IIASA would also benefit from its interactions with Indian institutions through TIFAC."

The latest five-year Research Plan began in 2006 and focuses on research directions that are clearly informed by strategic policy questions. As the Research Plan unfolds, we can see that IIASA's existing interdisciplinary structures are being utilized more than ever to develop a complementary focus on global challenges. Not only is there increased interaction among programs, but new models and methodologies are being used to foster greater cooperation and innovation across activities.

A new Energy Program began in March 2006. Its aim is a better understanding of the nature of alternative future energy transitions, their implications for human well-being and the environment, and how they might be shaped and directed by current and future decision makers. A new exploratory project on Health and Global Change was established in 2006 and will initially focus on pandemic influenza. There are a number of links and synergies within existing IIASA research programs to health-related issues and the new program will broaden the Institute's scope in this important area. Because of the growing complexity of IIASA's work and the models needed to encompass it, the new Integrated Modeling Environment Special Project was mandated, at the beginning of 2006, to provide advanced modeling support to IIASA programs through the development of new tools and methodologies. All these initiatives, and more, are bringing added value to research at IIASA and to our partners worldwide.

This is not purely "an insider view." Since 2004 IIASA's strengths have been highlighted in a series of external reviews of the quality of the science performed at the Institute, the productivity, vitality, and feasibility of our programs, and the relevance of our research in terms of its scientific and socioeconomic impact. In 2007 IIASA completes the series of evaluations, which means that, over the last three years, external reviewers have independently evaluated all IIASA research within its three core themes: Energy and Technology, Environment and Natural Resources, and



SIMON LEVIN, CHAIRMAN

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Population and Society. IIASA is already building on the reviewers' useful observations and recommendations to maintain the Institute's position, in the words of one evaluation report, as "an international leader in global environmental research."

This year also saw a number of new and wider concepts coming to fruition. One of these was the Global Energy Assessment, a major multi-year and multi-stakeholder initiative seeking to find integrated solutions to existing and emerging energy challenges. Issues such as the need to sustain affordable, available energy services as a precursor to healthy economic growth; the requirement for continued, secure supplies of energy; and the need to address climate change mitigation in a timely fashion. Produced by independent scientific and technical experts, subject to rigorous reviews, and independent of partisan interference, the assessment will not be afraid to challenge conventional thinking on energy.

An important milestone in research on long-term energy system transitions in 2006 was the completion of a series of papers on the results of the modeling work on long-term greenhouse gas emissions and stabilization scenarios performed within IIASA's Greenhouse Gas Initiative, whose work reaches across nine IIASA programs. These papers were contributed to the special issue of the *International Journal of Technological Forecasting and Social Change*.



LEEN HORDIJK, DIRECTOR

The IIASA Energy Day in June 2006, which gave a broad overview of recent and ongoing research activities at IIASA, was a great success, prompting such enthusiastic feedback from participants that we will hold an IIASA Water Day in June 2007. Many of IIASA's Programs conduct water-related research. These include a study of how to transfer Europe's current river basin management systems to more adaptive regimes, an investigation into future global water cycles and related water resources, and research on the impact of climate change on irrigation.

In October 2006 a new project of the World Population Program was inaugurated: Human Capital and Economic Growth. The project will perform a comprehensive assessment of the empirical macro-level returns to education since 1970 for 120 countries, providing educational attainment by age, sex, and five-year age groups.

The year 2006 also saw the end of the project, Environmentally Compatible Energy Strategies, which, after years of successfully maintaining IIASA's leading position in developing and disseminating long-term global energy–economic–environmental scenarios, was succeeded by the new Energy Program. The independent, interdisciplinary, collaborative program, Radiation Safety of the Biosphere, also came to a close in 2006. It was formed in 1995 to assess the world radiation legacy after the end of the Cold War.

From programs to people. IIASA Director Leen Hordijk received an honorary doctorate from the Ukraine Academy of Sciences. Kurt Komarek, Austrian member of the IIASA Council and Chairman of the Finance Committee, was awarded the *Ehrenzeichen für Wissenschaft und Kunst*, the highest award Austria bestows in the arts and sciences. Arkady Kryazhimskiy, leader of IIASA's Dynamic Systems Program, was elected member of the Russian Academy of Sciences. IIASA's Risk and Vulnerability Program leader Joanne Linnerooth-Bayer was appointed as overseas academic commissioner for the newly established Academy of Disaster Reduction and Emergency Management of China. Nebojsa Nakicenovic, leader of both IIASA's Energy and Transitions to

New Technologies Programs, was appointed to chair the Board of the Future Energy Fund of OMV, the leading oil and gas group in Central Europe. Mathematician and IIASA scientist Karl Sigmund was named Austrian of the Year (category research) by the Austrian newspaper *Die Presse*. The distinction conferred on these IIASA scientists is a source of great pride to the Institute.

In 2006 Joanne Linnerooth-Bayer's 15 successful years as Dean of IIASA's Young Scientists Summer Program came to an end. We know we speak on behalf of many hundreds of young scientists when we express to her the thanks of everyone who has passed through or been involved with this spectacularly successful program. One of the jewels in IIASA's crown, YSSP has proved to be a fertile pool of scientific talent for IIASA.

Finally, 2006 was a year of discussions and preparations for the IIASA Conference, Global Development: Science and Policies for the Future, to be held in November 2007 at the Hofburg Imperial Palace in Vienna to mark the thirty-fifth anniversary of the founding of IIASA. At the end of a busy and successful 2006, in which renewal and regeneration played a leading role, the Conference theme seems to us to be entirely in keeping with IIASA's determination to play an active role in shaping the crucial decisions that will need to be made in the years to come.

Decades of Achievements

For 35 years IIASA has conducted policy-oriented research into problems that are too large or too complex to be solved by a single country. Problems like climate change that have a global reach and can be resolved only by international agreement. Or energy security or population aging, which are national issues with international ramifications for every country.

Four characteristics underpin IIASA's success: the Institute's scientific excellence, the relevance of its research for policymakers, its interdisciplinary approach and its independence from both government and country. This combination of qualities makes IIASA a truly international and unique research institute.

The following pages show how IIASA has continued to achieve these characteristics by highlighting examples of the Institute's accomplishments in 2006. But first, for readers who are new to IIASA, we put 2006 into context by presenting a few of IIASA's major accomplishments since it was founded in 1972.

Introductions to our research programs, scientists, finances, and other activities, including the Young Scientists Summer Program, then follow. More detailed information can always be found on our Web site: www.iiasa.ac.at



ENERGY IN A FINITE WORLE

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1972

At the height of the Cold War, 12 nations from the East and West meet in London to sign the charter establishing IIASA in its neutral setting of Austria.

1974

George Dantzig, winner of the US National Medal of Science, is joined at IIASA by Nobel Prize laureates Tjalling Koopmans (USA) and Leonid Kantorovich (USSR) to expand IIASA's study of advanced systems science and methodology.

1975

A new research field, Adaptive Ecosystem Policy and Management, is founded at IIASA based on results of a study relating forest conditions to pest propagation that has implications for forest management policy throughout North America and Scandinavia.

1976

IIASA scientists warn the world about the dangers of climate change and suggest pioneering solutions such as capturing and storing carbon. IIASA was one of only two institutions worldwide that by the mid-1970s already had an established research program on climate change and policy.

1977

The first Young Scientists Summer Program is a huge success and IIASA attracts over 1,300 talented young scientists during the next 28 years to spend a summer working with scholars from other nations and disciplines. Many go on to take senior posts in academia, business, and government.

1980

A chance remark to a colleague brings unexpected results. James Vaupel, a US demographer, mentions a scientific problem to Soviet mathematician Anatoli Yashin. "I think I can help," Yashin replies. They go on to develop more reliable projections of population aging in developed countries.

1981

IIASA publishes the first comprehensive, truly global assessments of energy issues resulting in the internationally acclaimed report: *Energy in a Finite World*.

1982

An IIASA research team of chemists, biologists, mathematicians, engineers, hydrologists, economists, computer specialists, and managers complete a study on eutrophication and management of Lake Balaton, central Europe's largest lake. Its findings influence water policy in Italy, Japan, USA, and the USSR.

1983

Groundbreaking research by an IIASA scholar will provide the intellectual underpinnings for the US Department of Justice's antitrust case against Microsoft. The findings pioneered the modern approach to increasing returns which showed how powerful firms could exploit the peculiar nature of high-tech markets to the disadvantage of opponents who offer better products.









IPCC/EIS-IIASA INTERNATIONAL WORKSHOP ON ENERGY-RELATED GREENHOUSE

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1986

IIASA scholars publish *Sustainable Development of the Biosphere*, which is quickly accepted by the science community as the core scientific text on sustainable development.

1988

In response to mounting tensions regarding global food issues, IIASA creates an unprecedented computer model that links national agricultural models. Named the Basic Linked System, it becomes a practical tool to determine the effectiveness of policies to eliminate hunger and the impacts of agricultural trade liberalization.

1989

IIASA's scientific model of Europe's acid rain problem is officially adopted by the 28 countries of the Geneva Convention on Transboundary Air Pollution as the main technical support for renegotiation of the treaty. This is the first time that all parties to a major international treaty accept a single scientific model.

1991

IIASA researchers complete the first consistent continent-wide assessment of forest resources in Europe and the European regions of the former Soviet Union, revealing alarming consequences of air pollution for European forests.

1994

IIASA's Regional Acidification Information and Simulation (RAINS) model underpine the agreement of 33 European governments to reduce the damaging emissions of sulfur dioxide.

1995

Five IIASA scientists are chosen to be leading authors of the second Intergovernmental Panel on Climate Change's assessment report. Since then, eleven IIASA scholars have played leading roles in the IPCC's third and fourth assessment reports, which provide the world with the most scientifically advanced, comprehensive, and rigorous analysis of the state of climate change.

1995

Funded by the World Bank and the Asian Development Bank, the RAINS model is extended to facilitate the analysis of sulfur dioxide pollution in Asia and is presented to energy planners and government officials in 18 Southeast Asian nations.











1996

A second edition of the IIASA book *The Future Population of the World: What Can We Assume Today?* is published. It includes the first-ever completed probabilistic population scenarios (predicting world population will probably never double again) and new findings on population aging.

1998

The World Energy Council partners with IIASA in a unique study on Global Energy Perspectives. It analyzes how current and near-term energy decisions will have long-lasting implications throughout the twenty-first century. The five-year study presents its findings at the World Energy Congresses in 1995 and 1998, and publishes its results in a book with Cambridge University Press in 1998.

2000

IIASA scientists and models play a leading role in preparing the most comprehensive and sophisticated scenarios of greenhouse gas emissions for the twenty-first century. The work is published as the *Special Report on Emissions Scenarios* by the Intergovernmental Panel on Climate Change and Cambridge University Press in 2000.



2001

IIASA demographers are first to forecast in a *Nature* article that the world population will peak in the twenty-first century and then begin to decline.

2002

IIASA scientists complete the most comprehensive study of Russian forests and land resources ever undertaken. Results are presented to President Putin of Russia.

2002

The United Nations commissions IIASA scientists to analyze the likely impact of climate change on agriculture to 2080. The influential report was published at the World Summit on Sustainable Development in Johannesburg. It highlighted the need to focus on extending the mitigation scope of the Kyoto Protocol and put the issue of adaptation to climate change on the global agenda of international negotiations.

2003

The importance of using technical experts in multilateral negotiations is highlighted by IIASA scientists as a strategy to achieve more effective negotiated outcomes.

2004

IIASA scientists reveal that undesirable genetic changes are taking place in fish stocks as a result of commercial exploitation. Documenting these evolutionary changes might have provided a valuable early warning signal for the collapse of a fish stock such as the northern cod in the early 1990s.

2005

Disaster aid is often too little and too late. It also discourages governments and individuals from taking advantage of the high returns on preventive action. Scholars from IIASA's Risk, Modeling and Society Program identified in a *Science* article several innovative approaches to free recipient countries from relying on unpredictable post-disaster assistance.

Cutting-Edge Research

High-quality science underpins IIASA research. In 2006 IIASA's scientific standing continued to be far greater than the size of the Institute might suggest.

MORE COST-EFFECTIVE POLLUTION CONTROL Air pollution and greenhouse gases are often generated by the same sources and interact in the atmosphere through complex chemical reactions. Policies to simultaneously reduce emissions of both air pollutants and greenhouse gases are thus the most cost-effective approach to improving air quality and addressing climate change. IIASA's scientists have reformulated the widely used Regional Acidification Information and Simulation (RAINS) model to consider simultaneous constraints on air quality and greenhouse gas emissions. The new model, Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS), is already being used to assess pollution in Europe and is being developed for use in Asia.

CHANGING FISH IIASA's Evolution and Ecology Program is recognized for its innovative focus on researching how commercial fishing changes not only the abundance of fish but also their genetic composition. Restricting commercial fishing to removing only the largersized fish from the seas has been proposed as a viable policy for reducing damage to fish stocks. However, recent IIASA research reveals that the evolutionary consequences of size-selective fishing can cause severe changes in the demographic properties of exploited stocks, causing them to mature earlier and at a smaller size today than a few decades ago. Such trends may have other adverse implications, as larger females produce more offspring per unit of body weight than smaller ones and there is a positive correlation between a female's size and the guality of her offspring.

DEALING WITH UNCERTAINTIES What are the best responses to climate change, given the likelihood that it will be too late to act against it if we wait until we have all the facts? To shed light on the uncertainties inherent in climate change, the Greenhouse Gas Initiative (GGI) carried out a comprehensive integrated assessment study. Key findings of 22 authors were published in a 280-page Special Issue of



Technological Forecasting and Social Change, covering a wide range of methodology aspects as well as policy insights from scenario analyses. The study explores costs and timing of climate change response strategies, adaptation needs, and regional and spatial aspects of the key anthropogenic driving forces. One robust finding is that, if low targets for climate stabilization are to be met, then almost all world regions would need to mitigate by the mid-century.

LEARNING IN CLIMATE CHANGE

Climate change involves a cascade of uncertainty from human activity to its ultimate impacts. Should we wait to learn more before acting, or should we act now to avoid possible irreversible effects? Answers depend, in part, on how fast we might learn.



Oil/Gas

40%

60%

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80%

EUROPEAN (EU15) POPULATION WITH MULTIPLE IDENTITIE





EUROPEAN IDENTITY ON THE RISE Identity is often seen as a necessary precondition for the stability and legitimacy of a political system. Research carried out by the World Population Program and published in the journal *Science* (20 October) shows that the younger generations of Europeans have a strong sense of European identity in addition to their own national identity. According to the IIASA research, although the trend is increasing, significant differences still exist among countries. On average, in 2030, people in the 30–44 age group with a sense of European identity will outnumber those with strictly national identities by over three to one (see chart).

STRATEGIES OF THE ENERGY-POOR IN INDIA There have been more efforts to research energy at the national level but fewer to analyze it from the micro perspective of individual households. IIASA's Population and Climate Change Program is helping to fill this gap by analyzing energy-use patterns in Indian households. Findings reveal that income, as well as education and sex of the head of the household, strongly determine the household's fuel choices, with poorer households using the more inefficient and environmentally unfriendly fuels, such as firewood. For cleaner fuels to be adopted in India, not only will direct fuel rebates/subsidies be needed, but also cheap loans/credit to encourage poorer households to invest in the relatively expensive but more environmentally friendly liquefied petroleum gas stoves and cylinders.

MODELING TECHNOLOGICAL CHANGE IIASA's Transitions to New Technologies Program has developed a stylized model of the dynamics of technology choice under uncertainty, increasing returns as well as environmental surprise. The program also models the increasing complexity of technological systems, in particular, the intricate issue of technological interrelatedness and interdependence. A novel feature of this model is that the simulations treat technologies as "agents" that can merge into new combinations. Such simulation models reveal what constrains the possible rates of change of large, complex technological systems and that need to be considered in policy choices, for example, for climate change mitigation.

MONITORING GREENHOUSE GAS EMISSIONS As it is impossible for a country to measure its entire greenhouse gas emissions, countries provide their "best estimates" of emissions. These estimates, though fraught with uncertainties, have financial implications. For example, a country that has reduced its emissions well below the level needed to achieve its commitments to the Kyoto Protocol in 2010 is able to sell the emissions it has saved to other countries. IIASA's Forestry Program monitors the emissions estimates from the EU25 member states and—uniquely—is able to factor in the scientific uncertainties associated with each country's estimates. The research shows the most credible low-risk sellers of emissions to be Estonia, Hungary, Latvia, Lithuania, and Poland.

THE NEGOTIATOR'S FIELDBOOK The key to successful negotiation is not only doing the right thing, but doing it at the right time. In his contribution to *The Negotiator's Fieldbook*—the most comprehensive reference manual for experienced negotiators—a scholar from the Processes of International Negotiation Network advises on the optimal timing of negotiation. Negotiators need to recognize the "ripeness" of a conflict or problem, such as a mutually hurting stalemate, that will push parties into considering the desirability of opening negotiations. If the time is not ripe, parties and third parties can work toward ripeness; if those efforts do not work, they can at least position themselves strategically to negotiate effectively when ripeness appears.



CLUMSY SOLUTIONS FOR A COMPLEX WORLD In a path-breaking book, IIASA's Risk and Vulnerability Program collaborated with an international, interdisciplinary research team to analyze why well-intended attempts to improve human society sometimes derail. *Clumsy Solutions for a Complex World* takes its cue from the idea that our endlessly changing and complex social world consists of ceaseless interactions among contradictory ways of organizing and perceiving social relations: individualism, egalitarianism, hierarchy, and fatalism. Whenever one of these perspectives is excluded from the decision-making process, governance failure often ensues. The book identifies a number of issues that were successfully resolved by creatively combining the four approaches, and also details the failures that occurred when one or more were excluded.

DEVELOPMENT OF PRIMARY ENERGY

Top chart depicts baseline scenarios without climate policy (straight lines); bottom chart depicts long-term greenhouse gas stabilization scenarios with climate policy (dashed lines). Among many findings in a Special Issue of Technological Forecasting & Social Change, the charts show that achieving stabilization requires fundamental structural changes of the energy system towards less carbon-intensive fuels and technologies.

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Policy-Relevant Research

IIASA applies its research to the real world problems faced by governments. As countries' destinies become increasingly interwoven and interdependent, IIASA is providing solutions that are helping all governments make better-informed and more cost-effective policy decisions.

IRRIGATION WATER AND CLIMATE CHANGE Water is a key driver of agricultural production. Today, some 70 percent of man's 3800 km³ annual freshwater withdrawals is used for irrigation. Research by IIASA's Land Use Change and Agriculture Program shows that climate change will increase global irrigation water requirements by 20 percent by 2080—some 400 km³ a year. About 65 percent of the increase will be due to higher crop water demands and the remainder will result from longer crop calendars under warmer climates. Importantly, the research showed that climate mitigation would reduce such negative impacts significantly by about 250 km³ compared to an unmitigated climate, resulting in global water savings of about US\$10 billion annually (see charts).

MAJOR ASSESSMENT OF CLIMATE CHANGE One IIASA scientist has been appointed as a coordinating lead author and seven IIASA scientists as lead authors for the Intergovernmental Panel on Climate Change's Fourth Assessment Report. Due out in 2007, the Report will be the most comprehensive scientific assessment of climate change ever made. Other IIASA researchers have contributed research, written parts of chapters, and served as expert reviewers.

INTERIM TARGETS: GUIDEPOSTS TO REACHING LONG-TERM CLIMATE CHANGE GOALS As climate change takes place over decades, centuries, and even millennia, international climate change policy demands a long-term perspective. Long-term goals, however, are particularly vulnerable to uncertainty, reducing the prospects of a binding political agreement among many countries being reached on a single long-term target. IIASA's Population and Climate Change Program suggests that international climate change policy would be strengthened by the adoption of targets for atmospheric concentrations of greenhouse gases 25–50 years in the future, in addition to near- and long-term targets. Interim targets would help constrain rates of climate change and also provide a means of keeping open the option of achieving a range of long-term goals while uncertainty (and political disagreement) over the appropriate goal is resolved.

THE ECONOMICS OF CLIMATE CHANGE The acclaimed Stern Report, the most comprehensive review ever carried out on the economics of climate change, was published by the United Kingdom government in October and has been exceptionally influential. Sir Nicholas Stern, the former World Bank chief economist who headed the team of economists working on the Report, commented on IIASA's work that was included in his report, saying: "Thank you IIASA for your invaluable help during the preparation of my review of the Economics of Climate Change. I value IIASA's work highly and know it is taken seriously at the highest levels of government in nations around the world."

AVOIDING DANGEROUS CLIMATE CHANGE Temperatures are expected to continue to rise and extreme events are likely to become more frequent with climate change. But how much climate change can we take and how can we avoid levels that are considered dangerous? These questions were explored in a new book, *Avoiding Dangerous Climate Change*, co-edited by IIASA's Nebojsa Nakicenovic and published in 2006. With a foreword by Prime Minister Tony Blair, the research has been influential at the highest levels of the United Kingdom government and also provided input to the IPCC's Fourth Assessment Report.



AGRICULTURAL WATER WITHDRAWALS Impacts of climate change (top) and effects of mitigation (bottom). Positive values indicate additional annual costs; negative values correspond to benefits of mitigation (i.e., reduced irrigation costs with respect to the unmitigated case). The figures compare results using two general circulation models (global climate models): Hadley (green curve) and CSIRO (red curve).



REDUCING GREENHOUSE GASES The Integrated Sink Enhancement Assessment (INSEA), a consortium of 14 research teams, coordinated by IIASA's Forestry Program, was completed at the end of 2006. With the role of agriculture and forests as contributors to climate change mitigation gaining increasing international attention, the INSEA results will provide a valuable resource for policymakers. Among INSEA's many findings are: the benefits of introducing reduced and minimum tillage systems to sequester soil organic carbon; the potential for biomass use to produce energy; identification of the biomass demands for competitive methanol production and power plants; and promoting afforestation and discouraging deforestation as a significant contribution to the global portfolio of efficient climate change mitigation policies.

REDUCING THE VULNERABILITY OF THE CARIBBEAN TO HURRICANES Financing rescue, recovery, and rebuilding in the wake of natural disasters can bankrupt developing countries, leaving most to rely on unpredictable post-disaster aid. IIASA's Risk and Vulnerability Program has developed a catastrophe simulation model, CATSIM, which, by showing the respective costs and consequences of financing alternatives for important indicators, for example, economic growth or debt, can help policymakers develop public financing strategies for disaster risk. In 2006 the Program's scientists used the model to help policymakers from 18 Caribbean countries prepare for the 2006–2007 hurricane season.

A DOWNWARD SPIRAL OF LOWER FERTILITY IN EUROPE The European Commission published a strategy in October on how Europe should deal with its massive population aging and turn challenges into opportunities. New research from IIASA's demographers played a crucial role in informing that policy by highlighting that fertility may continue to fall in countries that already have very low fertility. Three factors could push the birth rate further downward. Low fertility means fewer potential mothers in the future resulting in fewer births. The ideal family size for younger cohorts is falling, as they see their parents and their peers having smaller and smaller families. Low expectations of future income, together with high aspirations for consumption, are also likely to discourage young cohorts from having larger families.

EUROPEANS COULD LIVE LONGER Work carried out by scientists of IIASA's Atmospheric Pollution and Economic Development Program is helping to increase statistical life expectancy in Europe by an average of three months by 2020. The potential for such life-prolonging benefits came after the European Parliament and Council of Ministers adopted the European Commission's (EC) Thematic Strategy on Air Pollution in 2006. The RAINS model developed by IIASA provided the scientific basis for the EC's ambitious strategy and for the Parliament's analysis of the strategy's costs and benefits. IIASA researchers are now preparing for the practical implementation of the strategy by working with EU member states, as well as Belarus, Norway, Russia, Switzerland, and Ukraine, to determine national emission ceilings for 2020.

THE CASPIAN DIALOG In 2006 members of IIASA's Processes of International Negotiation Network organized the Caspian Dialog in Istanbul among the five Caspian littoral states—Azerbaijan, the Islamic Republic of Iran, Kazakhstan, the Russian Federation, and Turkmenistan—at which several IIASA scientists gave presentations. The Dialog's purpose was to enable the Caspian states to talk informally and off the record about non-contentious issues of common concern that they do not usually discuss, such as water and air pollution, fisheries, and energy.

PANDEMIC INFLUENZA In 2006 IIASA launched an exploratory research project, Health and Global Change, whose first initiative was to analyze the economic and social aspects of and responses to pandemic influenza. Early investigations suggest that the world's toolkit in the event of an established influenza pandemic is frighteningly ineffective. However, measures to reduce the world's vulnerability could be in place within five to ten years. These include putting more resources into the public health systems of low-income countries, speeding up world production of vaccines, and improving epidemiological surveillance.

Interdisciplinary Research

IIASA's research topics, such as climate change, energy security, and air pollution, are well beyond the work of a single academic discipline, which is why IIASA builds interdisciplinary teams of researchers and harvests the innovative research that results.



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GLOBAL ENERGY ASSESSMENT In-depth knowledge and an integrated analysis of the economic, social, technological, and environmental aspects of the world's energy challenges is crucial to helping governments and business make the best long-term decisions regarding energy. A major challenge is to secure a global supply of affordable energy, while minimizing environmental damage from energy production and use. The Global Energy Assessment was launched in January 2007 with the appointment of Ged Davis and Jose Goldemberg as Co-presidents. As an integral component of IIASA's Energy Program, GEA will build on Program leader, Nebojsa Nakicenovic's track record of success in international energy assessments. In 2006 Professor Nakicenovic was lead author for the United Nations Sigma Xi Expert Group Assessment on Climate Change and Sustainable Development, the InterAcademy of Sciences Council's study on Transitions to Sustainable Energy, and the International Gas Union's study on Sustainable Development and the Role of Gas.

CLIMATE CHANGE: DON'T WAIT TO ACT The view that we should postpone actions on climate change until we know more about it continues to be influential. However, an interdisciplinary group of climate scientists, economists, demographers, and energy analysts, who came together at an IIASA conference, rejected this view. The prospect of learning more about how the climate might change, said the group, does not support the postponement of emission reductions today. Among other things, the conference, organized by IIASA's Population and Climate Change Program, examined better-informed simulations of how learning affects the optimal timing of emission reductions, analyzed how new information could affect the prospects for reaching political agreements, and explored how learning could lead us astray rather than closer to the truth.

FOOD AND AGRICULTURE IN 2080 Mathematicians, engineers, economists, ecologists, physicists, and agronomists from IIASA have joined their expertise to assess the impacts of climate change on agriculture over the twenty-first century. Using multidisciplinary methodology and models, IIASA's Land Use Change and Agriculture Program shows that, compared to unmitigated climate change, mitigation of climate change would have significant positive effects on agriculture. Specifically, global economic costs of climate change impacts on agriculture, though relatively small in absolute amounts, would reduce by roughly 75–100 percent as a result of mitigation; the number of additional people at risk of malnutrition due to climate change would fall by 80–95 percent. However, there would be significant geographic and temporal differences, with some countries benefiting or suffering more than others.

INVESTING FOR ECONOMIC GROWTH How much should a country invest in its economy in order to maximize its long-term economic growth? This complex research question was answered by a first year Russian Ph.D. candidate participating in IIASA's Young Scientists Summer Program. During summer 2006, the young mathematician collaborated with one of IIASA's leading scholars—an industrial ecologist 40 years his senior. The result was a simulated optimal growth trajectory for the United States. The graph (above right) shows the capital-per-worker growth trajectories for the United States: real (blue) and simulated (green). The simulated trajectory is the optimal one, constructed through the use of the infinite-horizon Pontryagin maximum principle. A good fit is seen in the period 1901–1990, while a misfit appears during the World War II period, thus showing the strong forecasting capacity of the model.



CLIMATE CHANGE AND AGRICULTURE Geographical databases of the distribution of the world's irrigated areas provide a valuable input to IIASA's agricultural scenario projections. The sophisticated models enable researchers to assess the impacts of climate change on agriculture and water use over the twenty-first century. Source: GMIA ver. 4, FAO/University of Frankfurt, 2007. CAPITAL-PER-WORKER GROWTH TRAJECTORY FOR THE UNITED STATES



SELECTED LECTURES Unlike many universities

Unlike many universities, IIASA does not divide the world into academic disciplines, which is one reason why audiences are eager to hear lectures by IIASA researchers.

MARKUS AMANN "Links between climate, air pollution, and energy policies. Findings from the GAINS (Greenhouse Gas and Air Pollution Interactions and Synergies) model" at the Conference on Air Pollution and Greenhouse Gas Emission Projections for 2020, Brussels, Belgium, 29 September.

JOHN CASTI "The decline and fall of globalization" at the Annual Meeting of European Futurists, Lucerne, Switzerland, 22 November.

ERIN DUNLOP "The propensity for marine reserves to slow evolutionary effects of fishing" at the Annual Science Conference of the International Council for the Exploration of the Sea, Maastricht, the Netherlands, 19–23 September.

YURI ERMOLIEV "Using non-parametric estimation for decisions under uncertainty" at a special scientific session of the Glushkov Institute of Cybernetics, Ukrainian Academy of Sciences, Kiev, Ukraine, 4–6 September.

ARNULF GRÜBLER "A historical perspective on global energy transitions" at the Resources for the Future Workshop on Modeling the Oil Transition, Washington DC, USA, 20–21 April.

WOLFGANG LUTZ "The policy experience in Austria and Bulgaria." Keynote speech at the International Seminar on Low Fertility and Policy Options in the Russian Federation, Can We Influence Fertility?, in Moscow, Russian Federation, 14–15 September.

PAUL MEERTS, VICTOR KREMENYUK "International negotiation processes" at the NATO Defence College, Rome, Italy, 21 September.

NEBOJSA NAKICENOVIC "Integrated assessment of climate change, its driving forces and response strategies" at the Tokyo Electric Power Company, Tokyo, Japan, 20 October.

STEN NILSSON "Population, urbanization, and the Chinese forest sector" at the Beijing Forum, Beijing, China, 27–29 October.

ANDREW NOYMER "Influenza and tuberculosis: Lessons from 1918 for the next flu pandemic" at the American Thoracic Society International Conference, San Diego, USA, 19–24 May.

BRIAN O'NEILL "Climate change: Should we wait to learn more before acting?" at the EuroScience Open Forum 2006, Munich, Germany, 15–19 July.

ANTHONY PATT "Applying climate information to decision-making in Africa" at the 12th Conference of the Parties to the United Nations Framework Convention on Climate Change, Nairobi, Kenya, 6–17 November.

KEYWAN RIAHI "Future energy transitions and greenhouse gas emissions" at the IIASA–ECLAC workshop on Global Change, Sustainable Development, and Vulnerability of Latin American and the Caribbean to Human-Induced Environmental Hazards, Santiago, Chile, 22–24 November.

MAHENDRA SHAH "Dimensions of diversity, humanity, nature, and sustainable development" at the Pakistan Government College University, Lahore, Pakistan, 24 April.

but it can also explain social and technological change. At IIASA, ecologists, geneticists, physicists, and mathematicians join forces to predict evolutionary changes based on demography and interaction of species. Known as adaptive dynamics theory, this approach, which was developed in the biological context, is now being experimentally applied at IIASA to explore new angles for research in the field of the social sciences and economics. For example, one of the traits of technological change is the increasing complexity of products. The 1885 Rover safety bicycle consisted of about 500 parts, a modern car has as many as 30,000 components, and a Boeing 747 has roughly 3.5 million. IIASA's initial investigations suggest that product complexity can be understood as a trait of a suitable adaptive dynamics model. In particular, the "evolutionary branching" of traits predicted by adaptive dynamics theory helps to explain the coexistence and diversity of products. These perspectives lead to a better understanding of the economic conditions that imply increasing complexity and of their consequences for technological change and economic development.

EVOLUTION AND TECHNOLOGICAL CHANGE Evolution shapes the biosphere,

CLIMATE CHANGE: THE ROLE OF CHINA IIASA's Greenhouse Gas Initiative began collaborating with the Chinese Energy Research Institute (ERI) to study the development of the future energy system and associated greenhouse gas (GHG) emissions in China. Engineers, economists, and energy experts from IIASA are working with ERI researchers to establish the initial phase of the study and have successfully implemented the methodological basis for examining issues of energy taxation, local air quality, and GHGs within the Chinese energy system. This project is expected to last until the end of 2007 and to provide valuable insights into the dynamics of how emissions will evolve in developing countries, the policies that can influence such developments, and their impacts on the energy system and the economy as a whole.

TEN BILLION COMBINATIONS OR MORE IIASA's new Integrated Modeling Environment Project supports IIASA's interdisciplinary teams by developing methods and tools to model complex problems. IIASA's models are growing fast, both in complexity and size, as they represent increasingly complex real world problems. However, neither general purpose modeling tools nor standard use of database management systems are efficient at handling data structures with over ten billion possible combinations of indices values. The Project has researched data structures that can handle such complex and large models effectively and will use these to implement new structured modeling technology prototypes.

International Research

Today, countries are increasingly affected by events outside of their borders. As an independent organization, free from the constraints of national self-interest, IIASA is able to identify the most appropriate local solutions to global issues. And by fostering international teams of researchers, IIASA uses science to help build bridges between countries over frequently contentious global problems.



In 2006 IIASA's researchers came from 36 countries, indicated on the map. The chart above shows the percentage of researchers that came from each continent, and the bullet points provide a flavor of the many research activities of IIASA.

THE AMERICAS

- Fisheries-induced evolution in Atlantic cod off the coast of Newfoundland
- Optimal investment for long-term economic growth in the United States
- Non-contributory pensions in Bolivia
- Regional groundwater flow system in the Basin of Mexico

GLOBAL

- Global Energy Assessment
- Negotiating with terrorists
- Disaster insurance for the poorThe effects of human capital on
- economic growth Global emission scenarios of air
- Global emission scenarios of air pollutants
- International governance of forests
- Reducing climate change impacts on agriculture
- Policy and social science aspects of pandemic influenza
- Energy investments and financing
- Technology for development and climate protection
- Integrated modelling methods and tools
- Long-term energy–climate scenarios

EUROPE

- Vulnerability and adaptation to weather extremes in Europe
- Consequences of population aging and other demographic
- challenges facing Europe
- Greenhouse gas accounting in Siberia
- Biofuels roadmap for Europe

ASIA

- Reducing vulnerability to natural disaster in Nepal, Pakistan, and India
- Reducing greenhouse gas emissions and air pollution in China and India
- Optimal investment for innovation in Japan's automotive industry
- China and India and the global forest sector

AFRICA AND OCEANIA

- Insurance schemes to make
 Malawian farmers more resilient to droughts
- The usefulness of seasonal climate forecasts to farmers in Zimbabwe
- Population and human capital growth in Egypt
- The influence of climate change on South African wine industry

INTERNATIONAL NETWORKS

- IIASA scientists are members of Working Groups II (Impacts, Adaptation and Vulnerability) and III (Mitigation) of the Intergovernmental Panel on Climate Change's Fourth Assessment Report.
- IIASA's Processes of International Negotiations (PIN) steering committee unites seven leading negotiation researchers and a network of 4,000 researchers and practitioners.
- IIASA leads the Consortium for Modelling of Air Pollution and Climate Strategies and so combines seven integrated assessment modeling teams from across the European Union.
- IIASA heads the Fisheries-induced Evolution project which comprises 18 different national teams of researchers to explore European and North American fish populations.

INTERNATIONAL CONFERENCES

- "Population and Development in Asia: Critical issues for sustainable future" conference hosted by the Asian MetaCentre for Population and Sustainable Development Analysis (IIASA is a founding member), Phuket, Thailand, 20–22 March.
- "Globalization as Evolutionary Process" conference hosted by IIASA, Laxenburg, Austria, 5–8 April.
- "Learning and Climate Change" conference hosted by IIASA, Laxenburg, Austria, 10–11 April.
- "IIASA Energy Day" conference hosted by IIASA, Laxenburg, Austria, 12 June.
- "Sustainable Harvesting of Natural Resources: New Insights from Evolutionary Ecology and Community Dynamics" session co-organized by IIASA at the Annual Conference of the Japanese Society for Mathematical Biology, Kyushu University, Fukuoka, Japan, 18 September.

Environment and Natural Resources

"Science and technology in the 21st century should be used to develop man's understanding of which changes in climate, pollution, and industrial activity will not change the state of the biosphere and will not cause it to evolve into a new, irrecoverable form."

— Marchuk, G.I., 1992, Current and future global challenges. In: *Science and Sustainability: Selected Papers on IIASA's 20th Anniversary*. IIASA, Laxenburg, Austria, pp. 8–9 (excerpts).

EVOLUTION AND ECOLOGY PROGRAM (EEP)

It was a decisive year for EEP in terms of expanding its international research agenda on the evolutionary implications of modern fisheries. In 2006 EEP was chosen as coordinator of the international, interdisciplinary "Fisheries-induced Evolution" (FinE) research consortium, comprising 18 different national teams. The appointment was based on EEP's past and present work on fisheries-induced evolution, which currently includes coordination of the European Commission–funded program, "Fisheries-induced Adaptive Changes in Exploited Stocks" (FishACE). EEP also began researching the repercussions of fisheries-induced evolution for the collapse and recovery of exploited marine stocks as part of a new four-year European Union project aimed at rebuilding exploited fish stocks. A research partnership with a German fisheries institute to develop models to investigate the evolutionary consequences of freshwater angling also began during the year.

EEP undertook two new collaborations with IIASA programs, PIN and DYN, as well as helping convene nine international meetings, including four FishACE workshops. Throughout 2006 EEP work continued on Volumes 6 and 7 of the "Cambridge Studies in Adaptive Dynamics" book series which fosters the dissemination of methodological advances and innovative scientific perspectives developed at IIASA.

Research progressed on the evolution of cooperation which strives to unravel the conditions required for engendering unselfish behavior in groups of unrelated agents. EEP also contributed to work on developing new insights into the evolutionary formation of biodiversity through speciation and opened up a new avenue of IIASA research by studying the evolutionary dynamics of ecological food webs and communities.

www.iiasa.ac.at/Research/EEP

FORESTRY (FOR)

In 2006 FOR finalized the IIASA-coordinated "Integrated Sink Assessment" (INSEA) project, designed to develop analytical tools to assess the economic and environmental efforts of enhanced greenhouse gas (GHG) sinks and abatement measures on agricultural and forest lands for the 25 European Union member states. Results were reported to the Directors-General of Research, Agriculture, and Environment in Brussels.

FOR also carried out substantial work on the issue of bioenergy and climate change, with a number of studies on capture and storage of greenhouse gases in pulp and paper mills. With its long involvement in earth observations, GHGs, and climate change, FOR was awarded a three-year European Union–funded project, "Global Earth Observation—Benefit Estimation: Now, Next and Emerging" (GEO–BENE) to develop methodological and analytical tools to assess the economic, social, and environmental benefits of improved information from global Earth observation systems.

In 2006 there were major efforts in methodological and modeling development, and work was also carried out to improve databases for 550 million hectares of West and East Siberia for full greenhouse gas accounting, important to upcoming post-Kyoto negotiations. Studies on the impacts of emerging economies on the global forest sector in China and India continued. FOR is developing scenarios with Beijing University on population growth, educational development, and migration for China. FOR was heavily involved in contributing to international policy and governance issues in 2006, giving over 60 keynote addresses or invited papers on these topics.

www.iiasa.ac.at/Research/FOR





CARBON PRICES AND AIR POLLUTION Carbon prices will lower air pollutant emissions $(SO_2, NO_3, and PM2.5)$ as well as CO_2 emissions for the EU25 for 2020. The chart compares the effects for carbon prices ranging from $\notin 0$ to $\notin 90$. Analysis with recent data prepared for the revision of the EU emission ceilings directive.

ATMOSPHERIC POLLUTION AND ECONOMIC DEVELOPMENT (APD)

In 2006 APD's work centered mainly on the policy applications of the "Regional Air Pollution Information and Simulation" (RAINS) model and its extension, the new "Greenhouse Gas and Air Pollution Interactions and Synergies" (GAINS) model with its perspective on simultaneous improvements of air pollution and greenhouse gases, including their economic aspects.

The Program started its new five-year research plan in 2006 with an enhanced focus on these economic issues. Both models are now being used in consultations on establishing national European Union emissions ceilings for 2020. APD also won an European Commission contract to collaborate with other European institutions to prepare a validated toolbox of scientific models for the 2010–2011 air pollution and climate strategy policy rounds, using GAINS as the common assessment framework.

Linkages of atmospheric pollution across different spatial and temporal scales is another APD research question. In 2006 APD explored the possible range of global emissions and transport of air pollutants to 2030 and their implications for global, hemispheric, regional/continental, and background pollution levels.

Regarding the economic aspects, focus was on the development of an optimization module for the GAINS model. APD's new "measure-based" approach allows a systematic and unbiased analysis of measures yielding multiple environmental and economic benefits.

The first step toward making GAINS an open model system freely accessible on the Internet was taken by APD in 2006 with the establishment of the European Consortium for Modelling of Air Pollution and Climate Strategies (EC4MACS). APD also collaborated with the Chinese Energy Research Institute (Beijing) and The Energy and Resource Institute (TERI), Delhi, to implement the GAINS model for China and India. GAINS-Asia is available on the Internet.

www.iiasa.ac.at/Research/APD

LAND USE CHANGE AND AGRICULTURE (LUC)

Two global studies were completed in 2006 by LUC. Results of the study, "Reducing Climate Change Impacts on Agriculture: Global and Regional Effects of Mitigation, 2000–2080," suggest mitigation would reduce the costs of climate change impacts on agriculture by 75–100% and the number of additional people at risk of malnutrition due to climate change by 80–95%. Moreover, "Climate Change Impacts on Irrigation Water Requirements: Effects of Mitigation, 1990–2080," showed mitigation reducing climate change impacts on agricultural water use by about 40% and annual savings of roughly US\$10 billion.

Successful project proposals in 2006 included SCENES (Water Scenarios for Europe and for Neighbouring States) and WATCH (WATer and global CHange). LUC also joined a world-class consortium to prepare a successful proposal for a policy study on "Chinese Agricultural Transition: Trade, Social and Environmental Impacts," investigating agriculture in relation to the environment.

Collaboration with distinguished partners focused on China, Europe, and Ukraine. LUC scientists submitted a final project report on the EU-funded project, "Modeling Opportunities and Limits for Restructuring Europe towards Sustainability" (MOSUS), which concluded that a well-designed mix of policies can result in a win–win situation for both the economy and the environment. Building on continuing collaboration with Ukrainian scientists, complementary projects on an Ukraine agro-ecological model, climate change and carbon in managed land, and on flood modeling and risk reduction were carried out.

A new activity for 2006 was the project, "Planning the Roads Ahead for Biofuels" (REFUEL), designed to encourage a greater market penetration of biofuels in Europe. LUC's research concentrated on establishing a spatially detailed land resources database for the EU27, an assessment of biomass production potentials on agricultural land, and quantifying scenarios of agricultural land potentially available for biofuel agro-feedstocks.

www.iiasa.ac.at/Research/LUC







Population and Society

"Population analysis, including the determinants of fertility, mortality, and migration, is becoming an increasingly interdisciplinary area, especially in its relationship to global environmental change. A central question in this context are the effects of possible future population trends in the face of growing ecological constraints and new threats to human life."

— Lutz, W., 1996, Introduction. In: *The Future Population of the World: What Can We Assume Today?* W. Lutz (ed.), Earthscan, London, UK, pp. xvi–xx (excerpts).

WORLD POPULATION (POP)

The only group in the world dedicated to the scientific analysis of global population dynamics, POP during 2006 played a major role in European-level discussions about demographic trends and the consequences of population aging, which now top the European agenda. High-level consultations and keynote speeches by Wolfgang Lutz were augmented by the publication of the first "European Demographic Data Sheet," with a wall chart of demographic indicators, which has been widely disseminated and cited.

The year also saw efforts to reconstruct the population by age and sex and for levels of educational attainment for 120 countries for 1970–2000 using demographic multistate techniques pioneered at IIASA. Results from recent analyses show that, at the macro level, education levels contribute directly to GDP

and, uniquely, that people with higher educational status tend to have significantly lower mortality. A new project, "Human Capital and Economic Growth," was established in 2006 to capitalize on the enormous potential of this new dataset.

An IIASA book, *The New Generations of Europeans*. *Demography and Families in the Enlarged European Union*, summarizing the work of the European Observatory for the Social Situation, Demography and Family, of which Wolfgang Lutz was demographic coordinator, was published by Earthscan in 2006. A contribution to *Science* by Wolfgang Lutz, Sylvia Kritzinger, and Vegard Skirbekk, "The demography of European identity," maning

"The demography of growing European identity," received attention in the highest European policy circles as a welcome positive outlook for future European integration.

www.iiasa.ac.at/Research/POP





The Caspian Sea's rich resources, including oil and natural gas, have given rise to an often contentious debate among the five Caspian littoral states—Azerbaijan, the Islamic Republic of Iran, Kazakhstan, the Russian Federation, and Turkmenistan.



Villagers in Peru cross a bridge to work on nearby fruit farms and access the market. Flooding regularly destroys the bridge as well as nearby farmland. IIASA's RAV Program helps farmers in Peru become more resilient to natural disasters by mainstreaming disaster risk into development planning.





Long-term goals are particularly vulnerable to uncertainty, making the prospects of reaching a binding political agreement on a single long-term target low. Interim targets for, say, 2050 provide the possibility of choosing alternative paths after 2050 to either higher or lower long-term targets, including a possible overshoot path (peak and then decline). The graph is an illustrative example of an interim target for concentrations of greenhouse gases.

PROCESSES OF INTERNATIONAL NEGOTIATION NETWORK (PIN)

The PIN Program had a productive 2006, finalizing three book projects, facilitating the successful Caspian Dialog in Istanbul among the five littoral states of the Caspian Sea (May) in which several IIASA scientists participated, and organizing a workshop, Negotiating with Terrorists (June).

A 2006 highlight was the Caspian Dialog, to which scientists from several IIASA programs contributed and which enabled states that are frequently preoccupied with contentious issues to talk informally about common environmental concerns. Further involvement with other IIASA programs included organization of a workshop on Negotiating with Terrorists in collaboration with DYN, initiation of a Director's Seminar on Systems Analysis, participation in an IIASA workshop on methodology, and supervision of three participants in the Young Scientists Summer Program.

Disseminating information about negotiation to promote specific solutions or international regimes for international governance is a major aim of PIN. Three book projects, *Formal Models, Negotiating Risks*, and *Facilitation of the Climate Talks* are on their way to publication; one on negotiation failures, based on a 2005 workshop, is under preparation; and two new projects, *Negotiating with Terrorists* and *The Handbook of Conflict Resolution* were launched. A well-attended Roadshow in February in Bologna, Italy, hosted by the Johns Hopkins University School of Advanced International Studies, saw both students and scientists attending lectures and seminars on key themes from the Program's work.

www.iiasa.ac.at/Research/PIN

RISK AND VULNERABILITY (RAV)

During 2006 RAV made significant conceptual and methodological advances with the publication of the *Clumsy Solutions for a Complex World*, which will underpin the Policy Assessment Framework of the EU project on Adaptation and Mitigation of Climate Change (ADAM). RAV also contributed a chapter on the IIASA CATastrophe SIMulation (CATSIM) model to a recent UN University book, *Measuring Vulnerability to Natural Hazards*, as well as teaching Caribbean country policymakers at a meeting in Barbados to use CATSIM in preparation for the 2006–2007 hurricane season.

Under a World Bank–funded project, RAV surveyed 4,000 Malawian farmers facing severe drought risks to provide initial insights into how their livelihoods can be made more resilient. It also contributed to the Earthquake Istanbul Project by combining microeconomic analysis with modeling of the potential macroeconomic impacts of a severe earthquake.

A RAV study of the flood-prone River Tisza in Hungary emphasized the importance of taking stakeholders' views into account when designing and implementing science-based processes to reduce the vulnerability of social–economic–ecological systems. The Tisza also figures among three case studies under the EU integrated project, NeWater, which is exploring transition paths to more adaptive future river management regimes.

A successful proposal was submitted to the UK Department for International Development (DFID) to work with partners in India, Nepal, and Pakistan to reduce vulnerability in selected disaster-prone developing countries. The RAV Program also contributed to building the capacity of farmers and others at risk from weather extremes related to the El Niño/Southern Oscillation (ENSO) cycle.

www.iiasa.ac.at/Research/RAV

POPULATION AND CLIMATE CHANGE (PCC)

In 2006 the PCC Program built on steps taken during its first year in its three main projects.

Results of the first stage of a case study of the United States, carried out under the demography, energy, and emissions project and published in *Energy Economics*, showed that in some cases, aging could reduce emissions in the USA by one-third, relative to emissions expected if aging were ignored. Case studies of China and India also focused on the implications of an aging population and urbanization for energy use and subsequent GHG emissions. There was collaboration with the International Energy Agency to understand not only the links between non-commercial biomass energy use and major demographic trends but also the social, health, and environmental impacts of traditional reliance on biomass.

The uncertainty and learning project continued to examine the implications of learning (or changes in uncertainty over time) for climate change policy, simulating learning about population growth and the response of the carbon cycle to future emissions. There was also collaboration with Princeton and MIT researchers on a new concept called "negative learning." Preliminary results were published on modeling uncertainty in the effect of climate change on the large-scale ocean overturning circulation.

As climate policy strategies for the interim period are needed that keep long-term options open while uncertainties are reduced through learning, the medium-term strategies project investigated options for strategies over the next 30–50 years that help link potential long-term climate change targets to short-term actions (see graph).

www.iiasa.ac.at/Research/PCC

Energy and Technology

"Given our current understanding of the carbon cycle, CO₂ emitted today will remain in the atmosphere for many decades to come, altering future climate, whose legacy, e.g. in form of thermal expansion of oceans and resulting sea level rise, might even take a millennium to fully unfold. Likewise, given the longevity of infrastructures and the capital stock of our energy system, many decades will pass before initiated policy changes will translate into a noticeable effect on emissions and hence avoidance of 'dangerous interference in the climate system,' which is the stated objective of the UN Framework Convention on Climate Change."

— Riahi K., Grübler A., and Nakicenovic N., 2006, *IIASA Greenhouse Gas Initiative (GGI) Long-term Emissions and Climate Stabilization Scenarios,* IIASA Interim Report IR-06-018, p. 2.

ENERGY (ENE)

The central research goal of the new ENE Program, launched in March 2006, is to provide scientific and strategic analysis to give policymakers a better understanding of the dynamics of future energy transitions, including their consequences for human wellbeing. An important research milestone for ENE was the completion of five papers reporting on the results of the modeling work on long-term GHG emissions and stabilization scenarios performed within IIASA's Greenhouse Gas Initiative for the special issue of the *International Journal of Technological Forecasting and Social Change*, guest-edited by Nebojsa Nakicenovic and Keywan Riahi.

Three additional international assessments were either completed or published in 2006, with Professor Nakicenovic as lead author, notably, the policy-oriented "Sustainable Development and the Role of Gas," which he presented at the 2006 World Gas Conference. Professor Nakicenovic also contributed to the completion of the new Global Energy Outlook of the International Energy Agency and the Stern Report.

Several ENE scientists are taking part in a three-year World Bank initiative to identify investment opportunities that combine environmental and social perspectives, a core area for future ENE research.

Research activities were complemented by coordination activities to facilitate the launch in January 2007 of the Global Energy Assessment, which identifies the state of knowledge and key strategic gaps needing to be addressed to support long-term energy decision making. ENE scientists continued to expand their networking activities in various international forums, workshops, and conferences, as well as organizing two important in-house events, the IIASA Energy Day in June and a training course in using the global energy scenario model, MESSAGE, in October.

The strong embedding of ENE's energy modeling work in international scenario assessment activities was illustrated by the appointment of Nebojsa Nakicenovic as a member of the Working Group III of the Intergovernmental Panel on Climate Change Task Group on New Emission Scenarios for the next (Fifth) Assessment Report.

www.iiasa.ac.at/Research/ENE





ENERGY INVESTMENTS Energy system investments for alternative baseline energy transitions (left-hand panels) compared to additional investment needs for achieving climate stabilization (right-hand panels). Upper panels give costs for the short-term (2000-2030) and lower panels for the long-term (2000–2100). The figure illustrates the importance of up-front investments into advanced technologies over the short term (B1: upper left panels) for achieving substantial cost savings in the long term (lower left panels). The right panels indicate the additional investments that are necessary for achieving a climate policy corresponding to a 670 ppm CO, equivalent concentration target in 2100. Climate mitigation investments depend critically on the baseline development path and are substantially lower in the high-efficiency scenario B1. Another important result is that climate mitigation involves substantial reductions in investment needs in certain sectors like extraction of fossil fuels in favor of climate-friendly alternatives.



TRANSITIONS TO NEW TECHNOLOGIES (TNT)

There was important progress in 2006 in all TNT's research areas. This was communicated through peer-reviewed publications, including two books, 20 journal articles and book chapters, and the successful completion of draft chapters in several major international scientific assessments to be published in 2007.

Nebojsa Nakicenovic is Coordinating Lead Author of Chapter 3, Working Group III, IPCC Fourth Assessment Report, Arnulf Grübler is Lead Author of Chapter 2, and Keywan Riahi is Lead Author of Chapter 3 and the Synthesis Report.

TNT members were involved in three major international assessments and contributed to the special issue of the *International Journal of Technological Forecasting and Social Change* (see ENE). All special issue papers and results of the model calculations are available to in-house IIASA researchers through an interactive Web-based Scenario Database, developed within the Greenhouse Gas Initiative, which will be opened to the public in 2007.

British Prime Minister Tony Blair contributed the preface to a highly policy-relevant book, co-edited by Nebojsa Nakicenovic, *Avoiding Dangerous Climate Change*. A conceptual piece on "green engineering" by Arnulf Grübler was published in *Environment*, and a commentary on avoiding the hazards of best-guess climate scenarios (by Arnulf Grübler, Brian O'Neill and Detlef van Vuuren) appeared in *Nature*.



NIGHT-LUMINOSITY MAPS OF THE WORLD The upper map uses night satellite imagery to show nocturnal lighting in 2000. The extent and brightness of nocturnal lighting correlate highly with indicators of socioeconomic activities such as GDP and energy use. The lower map is an illustrative simulation of possible light patterns in 2070.

TNT scientists hosted and contributed to the conference on "Globalization as Evolutionary Process," funded by the Colouste Gulbenkian Foundation, held 6–7 April 2006. The conference was organized jointly with Prof. George Modelski from Washington University and Prof. Tessaleno Devezas from University of Beira Interior. The proceedings are to be published by Routledge in May 2007. Globalization is one of TNT's important research topics, in particular, in the context of alternative scenarios that explore different manifestations of global change, which is at the heart of IIASA's research agenda.

All senior TNT scientists were actively involved in the relaunch of the Energy Program at IIASA, the preparations and presentations at the IIASA Energy Day, and preparations for the 2007 Global Energy Assessment. In-house research on modeling also continued strongly in 2006.

www.iiasa.ac.at/Research/TNT

DYNAMIC SYSTEMS (DYN)

DYN had eight active projects during 2006 and performed two exploratory initiatives. The major achievements of "Methods of Dynamic Optimization in Management Sciences," a special research effort with the Tokyo Institute of Technology, lay in the field of optimal control of long-term dynamical processes related to economic growth.

"Optimal Control of Technological Innovation" analyzed the problem of dynamic optimization of R&D investment under the effect of technology assimilation. The model was tested with data on Japan's automotive industry.

Explaining the optimal behavior of a technology innovator is important for understanding market dynamics. In the project, "Competing Innovators—Models of Equilibrium Behavior," tests with real data showed agreement, in principle, with innovators' optimal decision-making patterns.

"Attainability Domains for Analysis of Models of Economics of Climate Change," with GGI and FOR, aimed to utilize the concept of attainability domains from mathematical control theory to analyze large-scale climate–economy systems. The project, "Downscaling Global GDP and Population Scenarios," focused on optimizing TNT's GGI distributional algorithm. The procedure was implemented in a prototype software package and tested using U.S. data.

The project, "Design of Atmospheric Carbon Emission Paths via Learning," a collaboration with PCC, examined the implications of learning for climate change policy, while "Analysis of Economic Implications of Russia's Participation in the Kyoto Protocol" studied medium-term regional economic development under environmental constraints, concentrating on Russia, a powerful party in the Kyoto Protocol.

"Methods for Coastal Area Management," a collaboration with the University of Venice, focused on elaboration of an economic–ecological model of an offshore mussel farm.

Exploratory projects on "Population and Environment in the Context of Economic Growth" and "Equilibrium Patterns in the Context of Spatial Ecological Interactions" were also carried out.

www.iiasa.ac.at/Research/DYN

Institute-Wide Research and Special Projects

"Problems are becoming more complex, and our expectations that we can deal with them adequately have also risen enormously. No single discipline has a monopoly on providing an adequate understanding of problems that touch on the political, social, and economic fabric of a high technological world. An integrated approach gives us an opportunity to glean wisdom from many domains of knowledge."

— Peter de Jánosi, Director of IIASA (1990–1996). Interview in IIASA's magazine Options, Spring 1996, pp. 6–7.

GREENHOUSE GAS INITIATIVE (GGI)

An inter-program research activity involving nine IIASA programs, GGI continued to develop long-term energy–climate scenarios with multiple greenhouse gases and varying climate stabilization targets, integrating contributions into an overall modeling framework. Key GGI research findings were published in a Special Issue of *Technological Forecasting and Social Change* (see ENE and TNT).

In order to facilitate the dissemination of GGI's research findings in global, long-term, multigas stabilization scenarios covered in the Special Issue, a new Web-based interactive GGI scenario database has been developed and implemented. The database includes consistent datasets for demographic, economic, energy, and environmental indicators of the GGI scenarios. The database is publicly accessible from the IIASA Web site (www.iiasa.ac.at/web-apps/ggi/GgiDb/dsd?Action=htmlpage&page=about) and will thus provide a unique and useful service to the research community worldwide.

GGI strategically developed various components of its rich Integrated Assessment modeling framework. Its DIMA model, used for generating scenarios of terrestrial carbon sink potentials, was reprogrammed and formed the basis for a paper in *Carbon Balance and Management* on the economics of avoided deforestation. The forestry model OSKAR, initiated in 2005, has been parameterized for all important European tree species and its management cost functions have been updated to match different European regions.

Work continued to implement a first version of the Policy Assessment Framework (PAF), and linkage of the global energy assessment model MESSAGE and the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) has been examined for the region "Western Europe" using selected policy scenarios. GGI made further progress in the development and application of the innovative economic growth model SEDIM (Simple Economic Demographic Interaction Model) and collaborated with FOR and DYN on a project on attainability domains for analyzing models of climate change economics. Collaboration was initiated with the Energy Research Institute in China to study the development of future energy system and associated GHG emissions in China.

www.iiasa.ac.at/Research/GGI

WATER ACTIVITIES

Water-related research, a major priority on the international sustainable development agenda, was addressed by a number of IIASA programs in 2006. Some of the work not mentioned elsewhere in this report includes: DYN worked with the University of Venice to develop models and modeling techniques with the ultimate goal of improving coastal zone management. The model will first be applied to the Italian Adriatic coastline. RAV led a stakeholder-driven process to develop and analyze a set of comprehensive scenarios covering the freshwater futures of all of "Greater" Europe and the Mediterranean rim countries up to 2025 as part of the European Commission–funded project, "Water Scenarios for Europe and for Neighbouring States" (SCENES). RAV is also leading a work package in the scientifically challenging NeWater project, which aims to support the transition of typical key elements of current river basin management systems to more adaptive regimes.

LUC is coordinating a work block in the new European Commission–funded project, WATer and global CHange (WATCH), which brings together the hydrological, water resources, and climate communities to investigate current and future global water cycles and related water resources. www.iiasa.ac.at/Research/WA



METHODOLOGY FORUM

The aim of the Methodology Forum is to facilitate cross-program sharing of experiences and problems in methodological issues. In a series of five Forums in 2006, scientists looked at different approaches to scaling methodologies, based on presentations by scholars from inside and outside IIASA.

The economic, environmental, and social data gathered by applied modelers often refer to different time periods and describe geographical areas of vastly differing size. Data frequently need to be reliably scaled up or down to provide a consistent and well-integrated database as a basis for modeling.

www.iiasa.ac.at/Research/MF



ENVIRONMENTALLY COMPATIBLE ENERGY STRATEGIES (ECS)

The ECS Project came to a close in 2006, completing many of its research activities, co-organizing the 2006 International Energy Workshop, and publishing the results of its research.

One of the final ECS projects was "Case Study Comparisons And Development of Energy Models for Integrated Technology Systems" (CASCADE–MINTS), a European energy research project funded by the European Commission 6th Framework Programme. Modeling teams from both inside and outside the European Union used a wide range of existing Energy–Economy–Environment (E3) models to evaluate how different technology options, such as renewables and carbon capture and storage, can affect the global energy system, and their implications for Europe.

The International Energy Workshop "IEW 2006" took place in Cape Town, South Africa, in June. Topics of the sessions and presentations ranged from questions related to global energy supply and climate change through energy issues in Africa and developing countries in other regions of the world to local energy planning. www.iiasa.ac.at/Research/ECS

INTEGRATED MODELING ENVIRONMENT (IME)

The goal of IME, founded in 2006, is to build capacity to meet IIASA's growing needs for integrated modeling support, where commonly known methodology and/or general-purpose modeling tools are inadequate.

One example is the Structured Modeling Technology (SMT) prototype, developed by IME, which provides a Web-based modeling environment supporting interdisciplinary teams during the entire modeling process. In 2006 IME collaborated on refining the SMT prototype to address the new generation of IIASA models with their fast-growing size and complexity.

IME also researched and applied new methods for efficient treatment of endogenous uncertainty and risks. In collaboration with LUC and FOR, IME developed a new concept of discounting that enables long-term spatially explicit robust risk management strategies to be evaluated against potentially catastrophic events. IME worked with LUC on rescaling and non-parametric estimation procedures for spatio-explicit modeling of livestock production systems, taking into account their exposure to risks, resources, and sustainability indicators.

Building on long-term research in the Multi-criteria Model Analysis (MCMA) field, IME leads the activities of multi-criteria analysis within the European Union FP6 Integrated Project, "NEEDS." In 2006 research focused on the requirement analysis of this complex application which is characterized by two challenges: multi-criteria analysis of a large set of alternatives, each characterized by a large number of criteria organized in a hierarchical structure; and an analysis process involving about 1,500 stakeholders from four countries with diverse backgrounds and conflicting interests.

www.iiasa.ac.at/Research/IME

HEALTH AND GLOBAL CHANGE (HGC)

HGC was launched in 2006 with the long-term aim of equipping IIASA to contribute to research and deepen international policy dialog on health, a human dimension of global change, as evidenced by the threats of Severe Acute Respiratory Syndrome (SARS), bio-terrorism, and pandemic influenza. HGC made a strategic start by concentrating its study on pandemic influenza, the goal being to produce research results that will be credible in their own right, while building capacity and setting the stage for further work.

In August an international scoping workshop "Policy and Social Science Aspects of Pandemic Influenza" was held at IIASA. Sessions covered demographic aspects of pandemic mortality/morbidity (mainly social factors in pandemic mortality), policy responses (including public health responses, behavioral changes under pandemic conditions, and impact of control measures), economic impacts (in both developing and developed countries), epidemiological modeling of pandemics, and hybrid (e.g., micro–macro) modeling approaches. The summer work of two YSSPers was presented, and there were also presentations by scientists from the LUC and POP projects. Twelve international researchers, representing inter alia the U.S. National Institutes of Health Fogarty Center, the World Bank, and the United Kingdom Health Protection Agency attended, as did seven IIASA scientists. www.iiasa.ac.at/Research/HGC

Programs for Young Scientists

"The young people we welcome each year as YSSP participants or postdoctoral fellows bring with them new, thought-provoking ideas and ways of looking at the world. IIASA benefits from these influences, and the young people also learn a great deal from our scientists who have often worked in the field for years. Many return later in their lives to work at the Institute, so we do look on these programs as a kind of talent pool for the future."

----Leen Hordijk, Director of IIASA (private interview)

THE YSSP PROGRAM

Forty-nine young scientists from 15 countries took part in IIASA's Young Scientists Summer Program (YSSP) in 2006.

The Program, established in 1977, lasts from June through August and provides gifted young researchers with an opportunity to research and produce a paper, for possible publication, with a theme related to IIASA's ongoing research on issues of global environmental, economic, and social change. Each young scientist joins an IIASA Program and experiences at first hand the atmosphere of interdisciplinary cooperation in an international setting, which typifies IIASA's work.

YSSP 2006 also challenged participants to experience science and science-related issues "outside the box" of their own research through lectures, seminars, and discussion groups. The Director's Seminar provided the rare opportunity of listening to and interacting with Erhard Busek, an exceptional Austrian and international politician. Another major feature of the 2006 Program was the Philosophy in Science discussion group with eminent speakers who addressed the question of how scientists should think or train their minds in order to create new insights. Three of these lectures provided the basis for IIASA's first podcasts, which have received very encouraging feedback. A full program of sporting and leisure activities was extended to the young scientists during their stay.

The substantive efforts of the summer were varied and of high quality. Among many others, Kiarash Nasserasadi of Iran (RAV) assessed suitable and cost-effective methods of managing or reducing the higher-order economic impacts of earthquakes on oil-related industrial facilities. Marcin Stonawski of Poland (POP) worked on issues of the influence of workforce aging on human capital resources and productivity. Nobuko Mizoguchi of Japan studied the demographic impacts of a possible flu pandemic. Luis Mundaca of Chile (ECS) conducted research on so-called tradeable white certificates (TWC) for energy efficiency improvements, analyzing the effects of implementing a TWC scheme at the European level.

2006 was the last year in which Joanne Linnerooth-Bayer presided as Dean of the YSSP. She reflects on how enormously the world and the YSSPers have changed during her 15 years as Dean. "The intrigue of doing research crossing the iron curtain has given way to the intrigue of interdisciplinary research addressing truly global phenomena," she said.

Netra Chhetri, a 2006 YSSP participant from Nepal summed up the experiences of the whole group when he wrote: "This was one of my most productive summers for a few years now. I went to IIASA with respect and positive attitude, and I am proud that I have come back with more of both." It is, in fact, a measure of the success of YSSP 2006 that a reunion was held in February 2007 at which five YSSPers presented their most recent research since summer 2006 under the title "Recent Progress—Future Opportunities" to all interested IIASA staff. www.iiasa.ac.at/YSSP



YSSP PARTICIPANTS: NAME & NATIONALITY 1 Stephane Alberth, Switzerland 2 Tanya Alfredson, USA 3 Karl Åström, Sweden 4 Dalia Bach, USA 5 Jeffrey Bielicki, USA 6 Per Bodin, Sweden 7 Andriy Bun, Ukraine 8 Katherine Calvin, USA 9 Netra Chhetri, Nepal 10 Alessandro Colombo, Italy 11 Erin Cushing, USA 12 Xiangzheng Deng, China 13 Egon Dumont, Netherlands 14 Daniel Falster, Australia 15 Varvara Fazalova, Russia 16 Shinichiro Fujimori, Japan 17 Sabine Fuss, Germany 18 Michael Gerst, USA 19 Aki Havulinna, Finland 20 Barbara Hermann, Germany 21 Fang Jiang, China 22 Magdalena Kaska, Poland 23 Juha Kiviluoma, Finland 24 Andrey Krasovskiy, Russia 25 Jerome Larosch, Netherlands 26 Shanyu Lei, China 27 Zheng Lu, China 28 Nobuko Mizoguchi, Japan 29 Soleiman Mohammadi Limaei, Iran 30 Yousaf Muhammad, Pakistan 31 Luis Mundaca Toro, Chile 32 Kiarash Nasserasadi, Iran 33 Noora Rintala, Finland 34 Martin Schönhart, Austria 35 Edward Smeets, Netherlands 36 Sebastian Speetjens, Netherlands 37 Marcin Stonawski, Poland 38 Marko Tainio, Finland 39 Davnah Urbach, Switzerland 40 Roman Vasylyshyn, Ukraine 41 Sergey Vdovin, Russia 42 Jennifer Walston, USA 43 Christine Wamsler, Germany 44 Yujie Xu, China 45 Jie Yan, China 46 Viktor Yarovyy, Ukraine 47 Genesis Yengoh, Cameroon 48 Zhiwei Yu, China 49 Lei Zhang, China

LUIS DONALDO COLOSIO FELLOWSHIP



Jaime Carrera Hernandez (IME)—having found out about IIASA's Colosio Fellowship for Mexican pre- or post-doctoral students during YSSP 2004—applied for and won the 2006 award. Currently a Ph.D. candidate and research assistant at McGill University,

Quebec, Canada, he was keen to use the multi-criteria model analysis methods (MCMA) developed at IIASA to analyze water management solutions in the 9,000 km² Basin of Mexico, which encloses Mexico City and its metropolitan area (see figure).

Groundwater accounts for 80 percent of domestic, industrial, and agricultural water supply in the Basin, and demand is outstripping

aquifer recharge, resulting in declining water levels and land subsidence. Mr. Carrera is developing a spatial decision-support system based on a three-dimensional finite difference numerical model of groundwater flow within a GIS framework to optimize the use of groundwater within the Basin. A relational database management system keeps track of the huge amounts of data required by the model.

This is the first regional groundwater flow model designed for the Basin of Mexico. Mr. Carrera will present it to government water agencies in his home country to demonstrate ways of sustainably managing this "hidden water resource."

www.iiasa.ac.at/YSSP/scholar-fellow.html

POSTDOCTORAL PROGRAM

IIASA offers research opportunities to talented individuals to engage in research for one to two years. The candidates are expected to conduct their own research within one of IIASA's research programs or special projects on topics closely related to IIASA's agenda.

The postdoctoral fellowships, funded by IIASA's National Member Organizations in Finland and the Netherlands, as well as the Kempe Foundation in Sweden and as part of projects funded by the European Commission, have proved so successful that in 2006 IIASA decided to fund two applicants from its own resources—Tapas Mishra and Katsumasa Tanaka, who will be working at POP and PCC, respectively.

The postdoctoral awards support the training of researchers who have just received their doctorate, allowing them to gain broader knowledge and experience, make connections, and build a name in research circles. IIASA also benefits from the influx of creative and highly trained scientists with their fresh knowledge and youthful enthusiasm.

The following post-doctoral research fellows worked at or were appointed to IIASA during 2006.

Dr. Åke Brännström (EEP) investigating evolution in ecological food webs and multi-species communities.

Dr. Fredrik Dahl (FOR) is researching how large-scale habitat changes and climate change affect the fauna in the boreal forest.

Dr. Erin Dunlop (EEP) researched eco-genetic models of fishing-induced evolution and aimed to bring an evolutionary perspective to modern fisheries science.

Dr. Katja Enberg (EEP) is working on eco-genetic models of fisheries-induced evolution to elucidate the ecological and evolutionary dimensions of fish stock recovery processes.

Dr. Anna Hörnell-Willebrand (FOR) focuses on wildlife GIS applications and habitat relationships of forest wildlife and harvest management.

Dr. Joakim Lundgren (ENE) is creating scenarios of the future energy demand in northern Sweden to investigate the potential for making the residential and transport sectors fossil-fuel-free.

Dr. Shuichi Matsumura (EEP) is working on spatial modeling of interactions between anglers and fish populations.

Dr. Rupert Mazzucco (EEP) is working on computational models of non-allopatric speciation.

Dr. Tapas Mishra (POP) is studying the consequences of stochastic demographic systems on economic growth and development by exploiting their non-stationary temporal and spatial features.

Dr. Jan-Jaap Poos (EEP) studied the effects of harvesting on evolution in small food webs during six months at IIASA.

Katsumasa Tanaka (PCC) will join IIASA in April 2007 on conclusion of his Ph.D. in Geophysics at the International Max Planck Research School in Hamburg. www.iiasa.ac.at/YSSP/pdoc





POSTDOCTORAL FELLOWS: NAME AND NATIONALITY 1 Åke Brännström, Sweden 2 Fredrik Dahl, Sweden 3 Erin Dunlop, Canada 4 Katja Enberg, Finland 5 Anna Hörnell-Willebrand, Sweden 6 Joakim Lundgren, Sweden 7 Shuichi Matsumura, Japan 8 Rupert Mazzucco, Austria 9 Tapas Mishra, India 10 Jan-Jaap Poos, Netherlands 11 Katsumasa Tanaka, Japan

The IIASA Society supports contact between scientists who have worked

at IIASA and wish to continue to

work together despite living far

apart. In 2006 the number of

alumni continued to grow. The

was well attended with a lively

IIASA Alumni/ae Day on 23 May

discussion following talks by Leen

Hans-Holger Rogner. The importance

of the alumni to IIASA was stressed.

as was the importance of keeping

in touch with IIASA to ensure the

Elections were completed for the

officers, and Hans-Holger Rogner,

who has had a long association with

continuing strength of the Society.

Hordijk, Georg Kindermann, and

IIASA, was elected President. www.iiasa.ac.at/IIASA_Society

New and Returning Researchers

Fifty-two promising and leading researchers joined or returned to IIASA in 2006. Some stayed for as little as a month, while others plan to work at the Institute for several years. They come from 22 countries and have a wide range of disciplinary backgrounds. IIASA's strength stems from the expertise of its researchers, as well as the huge networks of international scientists with whom they interact.

USA 43 Jana Szolgayova, Slovakia 44 Barbara Taborsky, Austria 45 Tommy Tranvik, Norway 46 Luc Verelst, Belgium 47 Benjamin Warr, UK 48 Wie Wei, China 49 Heinz Weisshaupt, Austria

50 Artur Wyrwa, Poland 51 Jia Xing, China 52 Yu Zhao, China



IIASA's Program Leaders

IIASA's fourteen research programs and projects in 2006 were directed by leading international researchers.

ENVIRONMENT & NATURAL RESOURCES



Dr. Markus Amann Austria Atmospheric Pollution & Economic Development (APD)



Dr. Ulf Dieckmann Germany Evolution & Ecology (EEP)



Prof. Sten Nilsson Sweden Forestry (FOR) Deputy Director (IIASA)



Dipl. Ing. Günther Fischer Austria Land Use Change & Agriculture (LUC)

POPULATION & SOCIETY



Dr. Brian O'Neill USA Population & Climate Change (PCC)



Dr. Joanne Linnerooth-Bayer USA Risk & Vulnerability (RAV)

E

Prof. Wolfgang Lutz Austria World Population (POP)



Processes of International Negotiation (PIN) Network Steering Committee

Left to right: Prof. Rudolf Avenhaus (Germany), Prof. Guy Olivier Faure (France), Prof. I. William Zartman (USA), Paul W. Meerts (Netherlands), Ambassador Franz Cede (Austria), Prof. Victor Kremenyuk (Russia), Prof. Gunnar Sjöstedt (Sweden)

In 2006, 184 research scholars, assistants, and postdoctoral scholars worked at IIASA. They came from 36 countries and represent many academic disciplines—41% natural scientists and engineers, 36% social scientists, and 23% mathematicians. Many worked part-time or on short-term contracts. Together, the 184 scientists contributed 91 person-years to IIASA's research—an expansion from 85 person-years in 2005.

ENERGY & TECHNOLOGY



Dr. Arkady Kryazhimskiy Russia Dynamic Systems (DYN)



Prof. Nebojsa Nakicenovic Austria Energy (ENE) Transitions to New Technologies (TNT)

SPECIAL PROJECTS



Dr. Leo Schrattenholzer Austria Environmentally Compatible Energy Strategies (ECS)



Dr. Landis MacKellar USA Health & Global Change (HGC)



Dr. Marek Makowski Poland Integrated Modeling Environment (IME)

Mid-Career Researchers

Working on global change and sustainability requires the participation of virtually all scientific disciplines. To enable sound policymaking and implementation, expertise from the research base is vital. The members of IIASA's research community develop innovative tools that are used extensively throughout the scientific and policymaking domains. This spotlight on four IIASA researchers highlights the skills that IIASA brings to studying the major challenges facing our world.





METHANE EMISSIONS The quantities and sources of methane emissions in the European Union. Methane emissions are expected to fall due to current legislation, however, the decreases will not be as large as those technically feasible.

RESERVOIR STORAGE IN CHINA Total cost curves, with and without evaporation. Horizontal axes show yield from storage in billion m³; vertical axes show total cost in billion yuan. The vertical axis crosses the horizontal axis at the estimated yield from current storage levels.

LENA HÖGLUND ISAKSSON (Atmospheric Pollution & Economic Development) Methane is the second most important greenhouse gas, accounting for 17 percent of the contribution of anthropogenic gases to global warming. One of Lena Höglund Isaksson's main tasks at IIASA is to implement methane into the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model. This work allows her to assess current and future emissions of methane from human activities and estimate the available potential for mitigation and its associated costs.

Dr. Höglund Isaksson, who studied Environmental Economics at Göteborg University in Sweden, where she gained her Ph.D., worked as a consultant at the International Atomic Energy Agency, Vienna, before joining IIASA in 2004. Now with two sons, aged six and ten, she finds being able to work a shortened day at IIASA very helpful, family-wise.

Her job satisfaction is enormous. With greenhouse gases other than carbon dioxide coming under increasing focus by policymakers, she is calculating domestic, agricultural and industrial sources of methane using IPCC guidelines and studying possible mitigation methods, such as extended gas recovery from waste and wastewater and reduced leakages from gas pipelines. "GAINS is now being applied for China and India," she says. "My work can be used as a basis for legislation in Europe and Asia. It has real practical value, and that's why it's so inspiring."





MICHAEL OBERSTEINER (Forestry/Greenhouse Gas Initiative) Michael Obersteiner's forebears were among the first sustainable foresters in Austria, clearing land to facilitate the country's fledgling mining industry and replanting trees to maintain timber supply. A fourth-generation forester, he first came to IIASA as a YSSP participant, then returned after extensive forestry studies in the United States, Russia, and Austria that culminated in a Ph.D. from Vienna's University of Agriculture and Forestry.

Once a field researcher in the Siberian wilderness with a passion for treating tree ailments, Dr. Obersteiner is now a self-confessed "number cruncher," carrying out data analysis for a number of high-profile Forestry Program projects at IIASA. The main thrust of his work is the development of analytical tools to assess the social and economic effects of global change and, as he says, "teasing anything of global social or economic significance out of noisy data." Such data include photographs of the Earth's surface taken from space, which he analyzes daily for signs of potential damage to biodiversity from competition over land.

Socioeconomic development and the natural world are tightly interwoven. Dr. Obersteiner's painstaking, quantitative approach to forest sector issues is providing policymakers with the best-possible data on which to base decisions about the future.



SHILPA RAO (Energy/Greenhouse Gas Initiative) Following her degree in engineering, Shilpa Rao's first career move was a six-month apprenticeship at a wind farm near Ahmedabad, India. Restless there, she researched other possibilities and read a book on sustainable energy that changed her life.

The author, Professor P.R. Shukla of the Indian Institute of Management in Ahmedabad, an expert in the energy field, invited Ms Rao to become his research assistant. Thereafter she went on to do her master's degree at Pennsylvania State University in the USA and on completion applied for an IIASA vacancy. Now four years at IIASA and a Ph.D. candidate at the Technical University of Vienna, she works with colleagues on structuring energy models to analyze the dynamics of future energy systems. She has been involved in numerous research efforts including the IIASA in-house Greenhouse Gas Initiative. She has also been a contributing author to the IPCC Fourth Assessment Report. Her research interests include a focus on technological development and environmental impacts.

"Decisions taken now have a large impact on the evolution of energy systems," Ms Rao says. "Through our work at IIASA, we try to understand how we can ensure future development along technologically advanced and environmentally sustainable energy pathways."



DAVID WIBERG (Land Use Change & Agriculture) A childhood spent in the Minocqua area of northern Wisconsin, with its thousands of lakes and hundreds of rivers and streams, had a powerful influence on David Wiberg's career choice. His first impulse was to gain practical experience in the water industry, but while at the University of Colorado he opted for research, gaining a master's degree and Ph.D. in civil engineering with a focus on water resource engineering and management.

Now 10 years at IIASA, Dr. Wiberg collects data to input to hydrologic models to establish water availability and demand, chiefly in the agricultural sector. Major projects include Chinagro—IIASA's multidisciplinary, collaborative project to provide policy decision support for the sustainable adaptation of China's agriculture to globalization, WATCH—a large EU project to study the global water cycle from 1900 to 2100, and SCENES—another large EU project developing stakeholder participation to produce scenarios of water futures in Europe and improve river basin management.

With water a high priority on the international sustainable development agenda, Dr. Wiberg is increasingly involved with other IIASA programs, such as World Population, where analysis of water requirements is essential to the sustainability and quality of human life.

Good data, however, is vital. Countries can reap enormous benefits, says Dr. Wiberg, by making their data freely accessible to scientists.

International Funding for International Research

IIASA's work is funded by prestigious scientific institutions in 18 countries in Africa, the Americas, Asia, and Europe. Known as National Member Organizations (NMOs), the institutions—along with contracts, grants, and donations from government, academia, business, and individuals—ensure IIASA performs independent research because of its many, diverse income sources. IIASA would like to thank all those who have given their financial support.

NMO contributions 59% Grants and contracts 38%	INCOME		
Grants and contracts 38%	NMO contributions	59%	
	Grants and contracts	38%	
Investments and other 3%	Investments and other	3%	

In 2006 IIASA's income was €12.4 million, 59% of which came from National Member Organizations and 38% from contracts, grants, and donations.

OPERATING EXPENDITURE		
Research program	66%	
Infrastructure	21%	
Scientific services	13%	

In 2006 research represented 66% of total expenditure, with 21% spent on infrastructure and only 13% on scientific services.

NEW EXPENDITURE IN 20	06	
Research	76%	
Infrastructure	18%	
Scientific services	6%	

In 2006 IIASA's expenditure rose by €1.6 million, 76% of which was invested in research.

SUMMARY OF FINANCIAL ACTIVITIES

INCOME

NMO contributions Contracts, grants, and donations Other income TOTAL

EXPENDITURE

Research Infrastructure Scientific services TOTAL

Contracts, Grants, and Donations 2006

Alpen-Adria University, Klagenfurt, Vienna, Austria Austrian Development Agency, Vienna, Austria Austrian Exchange Service, Vienna, Austria Austrian National Bank, Anniversary Fund, Vienna, Austria Austrian Research Promotion Agency, Vienna, Austria Austrian Science Fund, Vienna, Austria Federal Ministry for Education, Science and Culture, Vienna, Austria MERIT Consulting and Brokerage, Vienna, Austria Vienna Institute for Demography, Vienna, Austria Vienna Science and Technology Fund, Vienna, Austria The Oil Companies European Organization for Environment, Health, and Safety, Brussels, Belgium University of British Columbia, Vancouver, BC, Canada Center for Clean Air Policy, Prague, Czech Republic International Gas Union, Hoersholm, Denmark Forschungsverbund Berlin e.V., Berlin, Germany Friedrich Schiller University Jena, Jena, Germany Acid Deposition and Oxidant Research Center, Niigata, Japan Global Environmental Forum, Ibaraki, Japan Japan Advanced Institute of Science and Technology, Ishikawa, Japan Kyoto University, Kyoto, Japan Tokyo Electric Power Company, Tokyo, Japan Tokyo Gas Co. Ltd., Tokyo, Japan Toyota Central Research & Development Laboratories, Inc., Aichi, Japan Energy Research Centre of the Netherlands, Petten, Netherlands Institute for Environmental Studies, Vrije Universiteit, Amsterdam, Netherlands Netherlands Environmental Assessment Agency, Bilthoven, Netherlands Centre for Advanced Study at the Norwegian Academy of Science and Letters, Oslo, Norway Norwegian Meteorological Institute, Oslo, Norway Calouste Gulbenkian Foundation of Lisbon, Lisbon, Portugal Russian Academy of Sciences, Moscow, Russia Swiss Agency for the Environment, Forests and Landscape, Bern, Switzerland United Nations Economic Commission for Europe, Geneva, Switzerland AEA Technology Environment, Oxfordshire, United Kingdom Department for Environment, Food and Rural Affairs, London, United Kingdom Department for International Development, London, United Kingdom Unilever UK Central Resources Limited, London, United Kingdom World Energy Council, London, United Kingdom Columbia University, New York, NY, USA Electric Power Research Institute, Palo Alto, CA, USA Institute for Social and Environmental Transition, Boulder, CO, USA International START Secretariat, Washington, DC, USA The Rockefeller University, New York, NY, USA The William and Flora Hewlett Foundation, Menlo Park, CA, USA United States Institute of Peace, Washington, DC, USA Commission of the European Communities, DG Environment, Brussels, Belgium Commission of the European Communities, DG Research, Brussels, Belgium Food and Agriculture Organization of the United Nations, Rome, Italy United Nations Development Programme, UNOPS, New York, NY, USA

2005 (€)
7,287,146
3,746,278
350,866
11,384,290
2005 (€)
<mark>2005 (€)</mark> 6,870,989
2005 (€) 6,870,989 2,340,049
2005 (€) 6,870,989 2,340,049 1,449,050

ABOUT IIASA

IIASA is an international, independent, and interdisciplinary research institution with thirty-five years' experience in researching global change. IIASA is sponsored by its National Member Organizations. On 1 January 2007 these were: **AUSTRIA** The Austrian Academy of Sciences CHINA The National Natural Science Foundation of China **CZECH REPUBLIC** The Academy of Sciences of the Czech Republic EGYPT The Academy of Scientific Research and Technology (ASRT) ESTONIA The Estonian Association for Systems Analysis FINLAND The Finnish Committee for IIASA **GERMANY** The Association for the Advancement of IIASA HUNGARY The Hungarian Committee for Applied Systems Analysis INDIA Technology Information, Forecasting and Assessment Council (TIFAC) JAPAN The Japan Committee for IIASA **NETHERLANDS** The Netherlands Organization for Scientific Research (NWO) **NORWAY** The Research Council of Norway **PAKISTAN** The Pakistan Academy of Sciences **POLAND** The Polish Academy of Sciences **RUSSIAN FEDERATION** The Russian Academy of Sciences SWEDEN The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS) **UKRAINE** The Ukrainian Academy of Sciences UNITED STATES OF AMERICA The National Academy of Sciences (NAS)

