IIASA’s mission is to provide insight and guidance to policymakers worldwide by finding solutions to global and universal problems through applied systems analysis in order to improve human and social wellbeing and to protect the environment.

As of January 2013, 20 countries were members of IIASA through their National Member Organizations. The members of IIASA’s Governing Council were:

- Dr. Andrew Johnson, Australia
- Professor Dr. Gerhard Glätzel, Austria
- Professor Carlos Nobre, Brazil
- Professor Dr. Jie Wang, P.R. China
- Professor Maged Moustafa Al-Sherbiny, Egypt
- Professor Dr. Mats Gyllenberg, Finland
- Professor Dr. Peter Lemke, Germany (Chair)
- Dr. Kirit Parikh, India
- Professor Dr. Kunto Maryono Mangkusubroto, Indonesia
- Dr. Kazu Takemoto, Japan
- Professor Seung Jong Lee, Republic of Korea
- Dr. Ahmad Tajuddin Ali, Malaysia
- Professor Dr. Jos Engelen, Netherlands
- Dr. Kirsten Broch Mathisen, Norway (Vice-Chair)
- Dr. Adil Najam, Pakistan
- Academician Professor Alexei Gvishiani, Russian Federation
- Dr. Dorsamy (Gansen) Pillay, South Africa
- Professor Anna Ledin, Sweden
- Academician Professor Anatoly Zagorodny, Ukraine
- Professor Donald Saari, United States of America (Vice-Chair)
IIASA Mission 2
Strategy 2011-2020 4
From the Chair & Director 5
IIASA Conference 2012 6
International Scope 10
IIASA Research Areas
  Energy and Climate Change 12
  Food and Water 16
  Poverty and Equity 20
Education and Training 24
Young Scientists Summer Program 24
Scholarships and Awards 25
Postdocs 26
Training Workshops 27
Scientific Publications 28
Research Programs 30
Financials 34
IIASA’s new research strategy, which began implementation in 2011, addresses the challenges of today’s increasingly globalized world where fundamental shifts are taking place in economic and political power, resulting in growing global environmental problems and potentially explosive social conflict.

IIASA’s strategic aim is to apply advanced systems analysis to identify solutions to the tensions that exist between the developmental aspirations of billions of people, many of whom suffer chronic poverty, and the equally pressing need to safeguard the natural world on which the whole of humanity depends.

Over the next decade, IIASA will be focusing its research expertise on three major global problem areas:

- Energy & Climate Change
- Food & Water
- Poverty & Equity

Supporting these activities will be research into the drivers of global transformation, development of more advanced systems analysis methodologies, ongoing efforts to maximize the impact of the Institute’s research on policy, and extensive education and training. IIASA aims to deliver truly integrative analyses that provide insights into the issues at the intersection of these global problem areas.
The IIASA 40th Anniversary Conference was a metaphor for the research of IIASA itself in 2012—energetic, challenging, exciting, and innovative. Speakers and delegates reflected on the salient role played by the Institute in the evolution of systems analysis; they also debated the pathways available through integrated research for resolving the multiply connected problems of our era.

As mandated by the 2011-2020 Strategic Plan, IIASA scientists report increasing integration within and between IIASA’s three global research areas. An outstanding instance is the collaboration of four IIASA programs on the Shared Socioeconomic Pathways that, with the 2011 Representative Concentration Pathways, will underpin the Intergovernmental Panel on Climate Change’s 5th Assessment Report and its future research.

IIASA leadership in energy research was prominent in 2012, with the publication and launch of the Global Energy Assessment, a six-year collaborative effort by 300 scientific experts from around the world working under IIASA leadership to produce the most comprehensive and complete study into the futures of energy systems transitions, energy supply, and modern energy access.

Another IIASA flagship project, a partnership between IIASA, UNESCO, World Water Council, International Water Association, and the Korean Government, was announced in November. “Water Futures and Solutions: World Water Scenarios” will support decision makers facing the urgent challenges to sustainable and equitable water use across all economic and environmental sectors.

Growing IIASA membership indicates that the Institute’s research directions hit the mark. Indonesia, then Australia, joined in 2012, bringing National Member Organizations (NMOs) to 20; further new members will be announced in 2013. Addressing issues affecting the South, including the tropics, is vital for global sustainability. IIASA welcomes its southern NMOs’ contributions, particularly the hosting by the South African NMO of the first-ever Young Scientists Summer Program (YSSP) outside Laxenburg at the University of the Free State in Bloemfontein.

We are deeply indebted to our NMOs for their financial, scientific, and diplomatic support. We acknowledge the extraordinary research contribution and encouragement of more than 300 IIASA collaborating institutions worldwide, and express gratitude to our international partners and funders from, among others, the United Nations and the European Community. We thank the Austrian Government for its sustained support. Our 40th anniversary conference took place under the privileged patronage of Federal President H.E. Heinz Fischer. IIASA enjoyed constructive interactions with Dr. Karlheinz Töchterle, Federal Minister for Science and Research, and his staff. We also thank the Foreign Ministry for its diplomatic support in Austria and through its missions in NMO countries.

In 2012 IIASA entered two new exciting partnerships. With the Austrian Academy of Sciences, it initiated a series of public lectures by the world’s leading academics on issues related to IIASA research. The Vienna Philharmonic Orchestra also became a goodwill ambassador for IIASA’s work in Austria and around the world.

Finally, we extend special thanks to our scientists whose determination and dedication has helped build IIASA into the great international research institution that it is today.
IIASA’s 40th Anniversary Conference, “Worlds within Reach—From Science to Policy,” took place from 24–26 October 2012 at the Hofburg Congress Center, Vienna, and at IIASA, Laxenburg, Austria. During the conference, delegates thoroughly examined and discussed the many sustainability and development challenges imposed by current global transformations, as well as options for resolving them. The conference was attended by 781 delegates from IIASA National Member Organization (NMO) countries and partner organizations around the world.

The purpose of IIASA conferences, as laid down in the Institute’s Charter, is to facilitate a two-way exchange of information between IIASA and its scientific constituency. Past conferences have laid the basis of the fruitful working relationships of today. With the possibilities for outreach extended by the new media, the 2012 conference was probably the most successful ever in opening up IIASA’s work to the rest of the scientific world and in developing contacts for future scientific collaborations. The title of the conference “Worlds within Reach—From Science to Policy,” ensured a lively debate on science and policy across a wide spectrum of cross-cutting issues.

IIASA was privileged to welcome guests from some of the world’s leading academic and supranational institutions, including three Nobel Prize winners, to speak on their areas of expertise. Many of those attending have strong bonds to the Institute dating back many years. Researchers from all IIASA programs presented their major research themes and accomplishments to IIASA NMOs, colleagues, partners, funders, and a wider public. The conference generated much media interest through its dedicated Web site, media outreach, and press conference. In addition, conference participants were invited to interact with each other using social media, with lively discussions taking place on Facebook and Twitter. The conference was also accessible to those who could not attend, with live streaming of all sessions, and YouTube videos of presentations uploaded within 24 hours. As of 18 April 2013 conference videos on YouTube had been viewed 9,708 times.

Detailed outputs from the conference are being published in a general overview of conference presentations by conference rapporteurs, entitled “Voices,” and in a scientific synthesis by Jill Jäger. Two special journal editions and a prospective on research issues for the future will complete the scientific reporting, and the newest conference insights are already being considered within IIASA’s main research themes.
Communication in its many dimensions emerged as a major conference theme at the 2012 conference. Many delegates attributed the scientific pathways they themselves had pursued either to the direct influence of IIASA on them as young scientists and/or research scholars, or to the pervasive cross-fertilization between systems analytical approaches and their own disciplines. The common language of systems analysis, learned by young scientists through the YSSP Program and by scholars working at IIASA, has helped many fields to flourish and proliferate. Throughout the sessions, it became clear that IIASA’s integrated systems analytical approach is an excellent vehicle for producing science for sustainability because of its inherent focus on practical applications. However, caveats were expressed: the “blue sky” thinking of theoretical science was still a necessary adjunct to systems analysis; many models could be differently structured for improved decision support; and a full understanding of the advanced systems analytical principles, as practiced at IIASA, is needed to optimize model outcomes.

Nexus areas

Nexus areas, a term used to denote the areas falling between disciplines that can be most effectively studied using systems analysis, came into sharp focus at the conference. The nexus between water and energy, for example, was examined in recent IIASA research published in Nature Climate Change. With the increasing programmatic integration at IIASA, nexus areas offer interdisciplinary researchers a fertile ground for new study, where they can find fresh insights and innovative ways forward. The integrated approach at IIASA has led to large-scale integrated models and the creation of analytical tools capable of looking at the synergies and trade-offs available when multiple sectoral problems are tackled simultaneously. A major example of this research by IIASA and its partners is that showing the co-benefits of simultaneously addressing energy, mitigation of greenhouse gas emissions, and air pollution control, as fully illustrated in IIASA’s Global Energy Assessment.

Communication in its many dimensions emerged as a major conference theme, not only how scientists communicate with policymakers—the title theme of the conference—but also the communication between scientists and the general public. Delegates noted that many scientific messages are not reaching the public, and that distrust of science is a major obstacle to overcome. Many delegates called for a greater focus on communicating science with the public, and for more research on effective communication strategies.

Delegates presented examples of successful communication with policymakers, leading to an uptake by the latter of scientific advice. Sometimes this success is a matter of timing, for example, with the adoption of IIASA’s Regional Acidification INformation and Simulation (RAINS) model to advise negotiations on the Convention on Long-range Transboundary Air Pollution.

One of the issues identified in communicating with policymakers is a disconnect in terms of the time horizon for decision making. Policymakers base their decisions on more than just scientific information, and are tied to election cycles which can run on up to six-year cycles. Meanwhile, science and, to a large extent business, focus on the medium to long term in their work. Nongovernmental organizations (NGOs) were also referred to as a vital conduit for communicating scientific needs and insights to policymakers, as they frequently worked at the grass roots and counted activism as an important part of their functions.
The low standard of science education was lamented by several speakers, as was the brain drain of promising science graduates moving from developing countries to richer countries to pursue education and employment. In part this is because of a lack of modern in-country science facilities. If, for instance, African scientists could remain in their own countries to study and work, more appropriate and more sustainable approaches and policies could be developed for Africa, instead of the current reliance on policies imported from outside. Better science-educated citizens across all countries would create a more knowledgeable electorate. In particular, delegates emphasized that better education of women and girls was crucial to political process and to development.

There was a sense of urgency at the conference about the need to move to a sustainable lifestyle. Some of the planetary boundaries enfolding the “safe” areas for humans and the environment had already been breached. Land and water resources are dwindling, the burgeoning world population is predicted to reach 10 billion by 2100, and climate change is rapidly outpacing efforts to mitigate the problem. Climate change mitigation needs to begin in earnest, and stringent measures to mitigate air pollution and greenhouse gases must be implemented in a timely fashion, which is not yet happening. Hence, many speakers emphasized the need for adaptation. Research shows that many of the impacts of climate change, such as increased frequency or intensity of natural disasters, will disproportionately affect the poorest of Earth’s inhabitants. In every country and at every level of society, a transformation is required in the way we live.
toward a green economy

Conference participants heard that although there was still no visible consensus for a new paradigm of sustainability for the whole of humanity, the transformation had, in fact, already begun. For example, Denmark intends to become the first country in the world to be free of fossil fuels by 2050. Among IIASA NMO countries, the Republic of Korea has found that investing in the green economy successfully pulled the country out of the downturn caused by the 2008 financial crisis. China has also invested in green growth and, through collaboration with IIASA, agricultural and climate change programs. The United States is offering prizes for the best sustainability inventions and projects. The Energiewende in Germany, one of the world’s most industrialized countries, is also moving fast. After the disaster at the Fukushima nuclear plant, Japan, while not abandoning nuclear altogether, is now leaning toward a greater share of renewables in its planned energy supply mix.

sustainability & ethics

Ethics needs to be part of the transformation to sustainability, according to many conference speakers. Currently, however, we are far from approaching equity in our societies, and unethical practices are prevalent. Vested interests should have no role in dictating policy. It is unacceptable that a billion people live on less than two dollars a day, while the gap is widening between those with soaring incomes and those unable to buy or grow enough food to nourish themselves. These challenges to society and the environment need to be addressed more urgently by policymakers, just as decisions on problems like climate change need to move more quickly. A bottom- or middle-up approach by citizens—either as individuals, NGOs, businesses, or local communities—is needed as a policy leverage, and can be bolstered by improved science education and communication. Encouraging reduction in consumption can improve quality of life and well-being.
In 2012 some 278 researchers from around the world worked at IIASA, frequently in partnership with other international institutions. Over 100 projects can be under way at IIASA at any given time, from fully fledged global collaborations to small country-scale projects. The Young Scientists Summer Program and Postdoctoral Program constantly renew IIASA’s international network from the ground up.

Global collaborators supply important data that address local challenges and feed into global assessments. IIASA’s international expertise, such as climate change negotiations, is helping smaller countries participate on an equitable basis in the wider international community. Moreover, unconstrained by national self-interest, IIASA is able to look for solutions to global problems that are appropriate for the greatest number of people.

There follows a selective overview of IIASA’s work, much of which is cross-continental and global.

**global**
- IIASA, UNESCO, the World Water Council, the International Water Association, and the Korean Government announced a global water initiative.
- Collaboration with UNIDO and GEF led to the launch of energy related interactive policy tools and reports in a series of regional workshops in Armenia, India, and West Africa.
- Research findings from the GEA have been instrumental in defining objectives for the UN Secretary-General’s Initiative on Sustainable Energy for All (SE4All).
- The GAINS model estimated evolution of global emissions of NOx from transport and of black carbon from the domestic sector between 2005 and 2030.

**americas**
- Modeling by IIASA shows that US biofuel policies will not reduce GHG emissions from fossil fuel combustion over 2010—2030.
- The AndesPlus project—part of the GEF-funded “Adaptation to the Impact of Rapid Glacier Retreat in the Tropical Andes” involving Bolivia, Ecuador, and Peru—used IIASA’s operational model cluster.
- In collaboration with the Wharton Business School, University of Pennsylvania, IIASA researchers developed a new methodology to assess the economic efficiency of disaster risk reduction efforts.
- IIASA and the University of British Columbia (UBC), Canada, developed the first theoretical model demonstrating that selective mating alone promotes the long-term coexistence of species.
IIASA collaborated with eight institutes of the Russian Academy of Sciences on the socioeconomic development of Russia and Ukraine in a European context.

Researchers contributed to “Regional Environmental Changes in Siberia and their Global Consequences” devoted to studying the current state and future dynamics of Siberian land cover.

Reports on agricultural bioenergy potential, including crop residues, livestock manure, and dedicated energy crops grown on surplus land, were used to assess the market for commercial use of biomass for heat and power generation in Belarus, Bulgaria, Romania, Turkey, and Ukraine.

IIASA improved forest fire modeling in Europe by developing a model that allowed for more accurate reproduction of the observed relationships between burned area, climate, and above-ground biomass.

IIASA co-hosted a workshop in India which reviewed how to adapt rural livelihoods to enable vulnerable communities to cope with the impending impacts of climate change.

The National Natural Science Foundation of China–IIASA collaboration project submitted six policy briefs and reports to the State Council, China Meteorological Administration, and Shanghai Municipal Government.

Analyses with the GAINS model show that a global decarbonization strategy could reduce the loss of life expectancy in Asia by about half from respiratory problems caused by fine particulate matter.

IIASA, IEA, the Indonesian REDD+ Task Force, and the Indonesian National Committee for IIASA organized a side-event at COP18 in Doha to focus on the role of forests, bioenergy, and carbon capture technologies in mitigating climate change by removing carbon from the atmosphere.

IIASA launched a South African version of its Young Scientists Summer Program (YSSP) in collaboration with the National Research Foundation, its South African NMO.

Using Google Earth, initiatives were undertaken to collect verified land cover data in Ethiopia and the Central African Republic.

Through the FarmSupport project, IIASA is working with the Zentralanstalt für Meteorologie und Geodynamik (ZAMG) to develop an Internet and mobile phone application to provide up-to-date weather forecasts to farmers in Africa.

The MESSAGE model was applied to energy–climate scenarios for sub-Saharan Africa, a region strongly affected by capital scarcity in the energy sector.

The Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia’s national science agency, became IIASA’s 20th National Member Organization in 2012 and began collaborations across a variety of fields.

The Geo-Wiki Team, in collaboration with the Terrestrial Ecosystem Research Network (TERN) AusCover facility, is developing an Australian Geo-Wiki Branch that will allow people to review land-cover maps created by AusCover and its partners.
High policy proactiveness and international collaborations characterized the direction of the three IIASA programs connected with Energy & Climate Change Research: Energy (ENE), Mitigation of Air Pollution and Greenhouses Gases (MAG), and Transitions to New Technologies (TNT). ENE, in collaboration with Ecosystems Services Management (ESM) and World Population Program (POP), began working on the socioeconomic and technical analysis of energy, land-use, and ecosystem changes for the new Socioeconomic Pathways for the IPCC’s 5th Assessment Report and beyond. According to ENE leader, Keywan Riahi, this collaboration is the initial step toward an integrated approach to climate policy analysis at IIASA.

Already transforming the global energy policy dialog is the Global Energy Assessment (GEA) which ENE and TNT helped to finalize and publish and which was launched in June 2012 at the Rio+20 conference.

Other high-profile events in 2012 included contributions to the launch of the new UN initiative Sustainable Energy For All (SE4All), and a high-level Germany Advisory Council on Climate Change (WBGU) policy forum in Berlin, opened by Chancellor Angela Merkel, at which IIASA Deputy Director Nebojsa Nakicenovic delivered a keynote speech.

As the “Centre for Integrated Assessment Modelling” of the Convention on Long-range Transboundary Air Pollution (LRTAP), the Mitigation of Air Pollution and Greenhouse Gases Program (MAG) provided extensive policy analyses to the negotiations on a revised Gothenburg “multi-pollutant/multi-effect” Protocol signed in 2012. Further, having declared 2013 “Year of the Air,” the Commission of the European Union in 2012 chose IIASA’s GAINS model as the central analytical tool for all quantitative cost-effectiveness analyses to underpin proposals for a full revision of its air pollution legislation.

Following are five representative stories covering the work of the Energy & Climate Change Global Problem Area in 2012.
IIASA’s Energy Program (ENE) research focused in 2012 on how near-term policies affect the attainment of long-term climate objectives, for instance, the 2°C global temperature recognized as the cut-off point for preventing dangerous anthropogenic interference with the climate system.

For the EU AMPERE project, ENE led a multi-model comparison effort, with 10 international teams developing over 300 scenarios. A major finding was that under current climate agreements higher-than-optimal greenhouse gas emissions will occur to 2030 which must be compensated for by much deeper emission reductions for the rest of the century. Less aggressive actions in the near term would increase the risk that stringent long-term targets become unattainable, of larger longer-term mitigation costs, and of eventual reliance on technologies, like biomass with carbon capture and storage, that offer substantial negative emissions.

A detailed paper published by ENE scholars in *Nature Climate Change* showed how different GHG emissions levels in 2020 would impact the feasibility of achieving the 2°C target. Targeting 2020 emission levels of 41–47 billion tons of CO₂ equivalent (Gt CO₂eq/yr−1) would allow 2°C to be achieved under a wide range of assumptions and help to hedge against the risks of long-term uncertainties caused by potential technological failures and adverse socio-political developments. A higher emission range of 41–55 Gt CO₂eq/yr−1 could still meet the 2°C target, but only using key energy technologies and under efficiency measures to limit growth in energy demand.

ENE’s work has important implications for future international climate negotiations and the Durban Action Plan, which seeks to establish effective post-2015 GHG emissions targets.

Work on technology scaling (i.e., the patterns and dynamics of growth of technologies both at unitary and industrial scales) formed an important part of the research of the Transition to New Technologies (TNT) Program. In 2012 a series of additional historical and contemporary case studies ranging from energy end-use technologies, such as household appliances, steam engines, transportation technologies, to ICT, including cell phones, and environmental add-on technologies, were performed. These confirmed the earlier established robust positive relationship between scale (market size) and scaling duration (diffusion time). The studies added further to the Program’s unique expertise on historical technology transitions to which new research is being added on measuring the output of the service sector, a characteristically difficult task given the sector’s use of rapidly changing technologies.

A first scenario validation paper was also published online in November 2012, which both summarizes both the technology scaling methodology and applies it to a range of climate mitigation scenarios from two major integrated assessment models by IIASA and the Potsdam Institute for Climate Change (PIK). The main finding is that generally the scenarios are quite conservative with respect to their technology capacity growth.

The TNT scaling analysis, and the methods developed jointly with ENE for scenario validation, have also been adopted in a large international scenario comparison project, the EU AMPERE Project. This focused on the role of near-term goals and technology options for climate stabilization and the impact of regional policies under delayed global cooperation.
The Energy Program (ENE) played a leading role in the development of the Shared Socioeconomic Pathways (SSPs) which, with the Representative Concentration Pathways (RCPs) on climate change, form the climate change research community’s new research framework for the Integrated Assessment (IA) and Impacts, Adaptation, and Vulnerability (IAV) modeling communities. ENE, with several major institutions, was involved in both designing the parallel RCP/SSP process and providing scientific input to it. Importantly, the socioeconomic and technical analyses of energy, land-use, and ecosystem changes by ENE, the Ecosystem Services and Management (ESM) Program, and the World Population Program (POP) were critical first steps in the integration of research on the human dimensions of global change and climate policy analysis at IIASA. This required formal soft-linkages being made between ESM’s GLOBIOM model and ENE’s MESSAGE model which are fundamental to IIASA’s SSP scenario development process.

Progress on the SSPs was rapid in 2012. A series of papers were submitted to a Special Issue of Climatic Change summarizing efforts in establishing the SSP concepts for joint mitigation and IAV analysis. Nebojsa Nakicenovic is co-editor and Keywan Riahi co-author of five of these papers. ENE also led the scientific community review of quantitative SSP projections in 2012. Initial quantifications of SSP drivers for population and economic projections were developed by the POP Program for review by the scientific community, particularly the IAV community research for the IPCC 5th Assessment Report. A second SSP Special Issue on IAM scenarios in Global Environmental Change, co-edited by Keywan Riahi, was established in 2012.
To strengthen quantification of the co-benefits of air pollutant and greenhouse gas mitigation measures, the Mitigation of Air Pollution and Greenhouse Gases Program (MAG) improved its assessment methods of the health impacts of air pollution along several lines. MAG made a major contribution to the international assessment of the Global Burden of Disease, a comparative assessment of all human health-related risk factors, organized by the World Health Organization and Harvard University, involving more than 100 scientific institutions. Its findings, published in *The Lancet* in early 2013, highlight indoor pollution as the fourth most important factor for premature mortality, and outdoor pollution as the eighth.

MAG contributed to the global assessment on exposure to fine particulate matter and ozone, integrating results from chemical transport modeling and remote sensing. Results were published in *Environmental Science and Technology*. The journal named the paper as the best science paper of 2012.

MAG researchers published global estimates of the co-benefits for human health from reduced air pollution from mitigation measures targeted at long-lived greenhouse gases, showing that a global decarbonization strategy could significantly reduce the loss of life expectancy from fine particulate matter, for example, by about a half in Asia, and save nearly 20,000 premature deaths per year. A global mitigation scheme would save about 250 billion €/year in air pollution control costs due to lower combustion of fossil fuels, a finding that mirrors MAG’s research findings for the Global Energy Assessment.

The revised Gothenburg “multi-pollutant/multi-effect” Protocol to the Convention on Long-range Transboundary Air Pollution (LRTAP), for which IIASA’s Mitigation of Air Pollution and Greenhouse Gases Program (MAG) is “Centre for Integrated Assessment Modelling,” was signed in April 2012. In October IIASA hosted the first meeting of LRTAP’s Task Force on Hemispheric Transport. GAINS will be used to explore potential win–win solutions to address the inter-continental transport of air pollutants, especially ground-level ozone and its precursor emissions in the northern hemisphere.

In 2012 implementation of the 16 “win–win” measures identified by GAINS to improve human health and crop yields and reduce the rate of temperature increase was promoted by the newly formed “Climate and Clean Air Coalition” (CCAC) for which Markus Amann was appointed Science Advisory Panel member. Through a range of air pollution scenarios up to 2050 MAG found that governance, including compliance with already agreed emission control legislation, emerges as a key determinant of future environmental quality. For instance, future emissions of nitrogen oxides (NOx) could vary by up to a factor of four, depending on whether emission control measures that are commercially available today are fully implemented.

An essential component of these win–win measures involves the mitigation of methane (CH4) emissions. In 2012 MAG published a first comprehensive assessment of global CH4 emission trends, mitigation potentials, and costs showing that known technical interventions could reduce emissions by almost 50%, of which about 80% could be achieved at a marginal cost of less than 20 €/ton CO2 eq.
Collaborating with international partners to boost the amount and quality of data available on ecosystems research was a research highlight of the Ecosystems Research and Management Program (ESM) in 2012. Several new branches were added to Geo-Wiki: regional, urban, biomass, human impact, and agriculture. This opened up the vast potential of citizen science, not only to validate and quantify the results of Earth observation and the Global Earth Observation System of Systems (GEOSS), but ultimately to feed into the ESM integrated model cluster. Mobile technology is also helping establishing two-way communication of weather and crop-growing and fertilization information between IIASA and African farmers. ESM hosted the first meeting of the UN REDD–PAC project (Reducing Emissions from Deforestation and Degradation + Policy Assessment Center), which aims to develop technical know-how and capacity in designing efficient, effective, and environmentally relevant REDD+ strategies and land use policies to curb the deforestation and forest degradation that is responsible for almost 20% of greenhouse gas emissions.

Improved agricultural and water resources are central to development and poverty alleviation. Yet decision makers face many challenges to ensuring their sustainable and equitable use. A major development of 2012 was the launch of a new flagship initiative by IIASA and partners to develop realistic future water scenarios that decision makers can use to identify and prioritize robust options to meet these challenges. The Evolution and Ecology Program (EEP) continued to study the integrated assessment of fishery systems and evolutionarily sustainable consumption, as well as extending research into the equitable governance of common goods. Work also continued on next-generation dynamic global vegetation models, which are instrumental for assessing climate impacts.

Following are five representative stories covering the work of the Food & Water Global Problem Area in 2012.
Optimum management of global water resources is one of the greatest challenges of the 21st century. IIASA in 2012 undertook an initiative, together with partners, UNESCO, the World Water Council, and the Korean Government, to develop a new generation of integrated water scenarios consistent with other global scenarios, for instance, on energy, climate change, and population. The initiative built on the early results of UNESCO’s World Water Scenarios, released in March 2012.

The water sector cannot be managed alone or locally, as it cross-cuts scales and sectors. According to IIASA Director and Chief Executive Officer, Pavel Kabat, in an interview in Nature Climate Change in January 2013, “The only way to manage water resources effectively is to take an integrated view.” As water management is risk-based, scientists need to ask how risk and probability may change, given the large uncertainties in data, scenarios, and the models themselves.

The scenarios were developed by decision makers in water resource management and related sectors and disciplines, public- and private-sector experts, and stakeholders from different geopolitical and social settings. These groups created qualitative scenarios which, with stakeholders’ feedback, data experts and scientists are transforming into realistic quantitative output of potential futures. Over the next five years, these scenarios, augmented with associated methodologies, data sets, information exchange networks, and impact calculators, will provide decision makers with practical and useful tools for setting goals and identifying robust options for action on water.

When free-riders invade a society of cooperators, this causes a tragedy of the commons, like overfishing, pollution of the atmosphere, and overuse of communal water supplies. Research by the Evolution and Ecology Program (EEP) on addressing these problems was published in the 2012 Early Edition of the Proceedings of the National Academy of Sciences.

Generations of thinkers and researchers on governance have sought ways of protecting the “common wealth” from self-interested groups by penalizing free-riding in ways ranging from pure peer-punishment through to institutionalized punishment. According to the EEP research, most economic experiments and theoretical studies dealing with peer-punishment have drawbacks. If, for instance, cooperators do not contribute to the sanctions, they are effectively engaging in second-order free-riding which, in turn, raises the issue of second-order punishment.

To address second-order free-riding, EEP constructed a model examining the dynamics of rewarding and punishing in both a compulsory and an optional public good game. In the model, adherence is voluntary, but those wanting to join the game must pay an entrance fee and agree to be sanctioned by a higher authority. Second-order free-riding is not an option, nor is asocial punishment targeted against cooperators.

The situation addressed in the model has both fundamental and widespread usage, as in settlers hiring sheriffs to deter villains. This principle is applicable at the international level, say, to “enforce” climate change governance and also at a less regulated level, in small-scale societies, to permit the sustainable use of common grazing and fishing grounds or the construction and maintenance of irrigation systems.
Following a study by IIASA's Ecosystems Services and Management (ESM) researchers and international partners on the impacts of incentives to reduce emissions from deforestation on global species extinctions, the United Nations' Framework Convention on Climate Change (UNFCCC) in February 2012 approved the creation of a system of financial incentives to reduce carbon emissions from deforestation and forest degradation (REDD) as part of the next climate agreement. For the study, published in Nature Climate Change in February 2012, the team used an advanced global land-use model cluster and comprehensive biodiversity data to predict the impacts of deforestation on biodiversity. To indicate the scale of the problems of deforestation, one of the four analyses carried out suggested that by 2100 current deforestation rates will eliminate more than 36,000 plants and animals that occur only in “biodiversity hotspots.” Financial incentives for conserving forests that value their carbon at US$25 per ton of CO₂ could avoid between 84% and 94% of these extinctions, while preventing 4.3 billion tonnes of CO₂ emissions annually by 2020.

ESM Program Leader, Michael Obersteiner, though praising current progress in REDD negotiations under the UNFCCC, emphasized that the international community must dedicate additional resources and ultimately a substantial fraction of climate mitigation efforts to REDD if it is to effectively deliver climate and biodiversity benefits. Even with high levels of carbon payments, the researchers found that there would be extinctions in highly threatened regions like the Atlantic rainforests or the Andes, meaning that other conservation measures would continue to be necessary.
In a globalized world with its complex supply chains and trade relations, consumption patterns in one country can cause land use changes far away. When the European Union (EU) imports palm oil—an important ingredient in cooking, soaps, washing powder, and other hygiene and personal care products—that demand may be contributing to environmental deterioration in, for instance, Indonesia and Malaysia.

The EU is a major importer of food and non-food commodities from third countries including countries with significant deforestation rates. The EU DG-Environment project, “The impact of EU consumption of food and non-food imports on deforestation,” analyzed the impacts on past deforestation of EU consumption, both primary products and processed or manufactured goods, and is proposing policies to reduce the impacts of EU consumption on other regions.

IIASA’s key contribution to the project was on systems analysis of the EU consumption links concerning deforestation, with a focus on the land-intensive agriculture and forestry sector commodities. For this purpose, the LANDFLOW model developed at IIASA was extended in 2011 and applied in 2012 to track deforested land embodied in trade and final use of agricultural and forestry products.

The LANDFLOW analysis has generated a large time-series database, recording for each country’s physical quantities, land areas, and deforested land content that are embodied in agricultural products and associated “virtual” land flows between major trading blocks of the world.
Poverty, the ultimate inequity, cross-cuts every sector. Much of IIASA’s work in 2012 related to direct measures to improve energy access for 1.4 billion people in developing countries. In some developing regions, a switch to clean energy sources could save a million lives a year.

Land and water resources are dwindling. The poor frequently have no voice and few resources with which to combat inequities like land-grabbing—the commercial exploitation of common goods like forests and land on which people depend for food and livelihoods. IIASA scientists joined with international collaborators in 2012 to accumulate validated land-use data, currently lacking for large areas of the world, by tapping the tremendous resources of social networking. The data gained will be used both to demonstrate where farmers’ rights are being infringed and to provide soil, weather, water, crop, and fertilizer data for areas prone to the many adverse effects of climate change.

The Risk, Policy and Vulnerability (RPV) scientists contributed to the IPCC report, “Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation” (SREX), which considered the character and severity of impacts from climate extremes together with the exposure and vulnerability of people and economic assets.

Equity is strongly related to sustainability. IIASA has been conducting research in conjunction with stakeholders and society “on the ground” to seek optimal solutions to persistent problems. Cooperation is also needed among nations to institute appropriate governance leading to shared responsibility for natural resources and equitable distribution of Earth’s commodities.

Following are six representative stories covering the work of the Poverty & Equity Global Problem Area in 2012.
Disasters trap poor and non-poor in poverty in many developing countries. With Indian partners, the Risk, Policy and Vulnerability Program (RPV) carried out a large empirical cross-country assessment of 2,000 respondents on the opportunities and challenges of micro-insurance for meeting the costs of natural disasters in the South Asia region. The research was conducted to better understand the benefits and impacts of micro-insurance.

The IIASA survey results showed a willingness on the part of poor farmers and households to pay for disaster micro-insurance programs. The findings also show that insured households were more likely to be better prepared for disasters than households without insurance. For instance, insured families reinforced their homes to help them withstand future shocks. Yet, interestingly, this empirical study did not find significant improvements in individual welfare—measured through levels of savings and debt over the last few years—for households with insurance compared to those without.

Access to finance and insurance are among the major support options in the toolbox of disaster risk management. Although micro-insurance products are now reaching a million poor households and farmers globally, the cost of premiums is often substantial.

Many households and farmers in the developing countries are below the poverty line, highly indebted, and forced to use limited and difficult coping mechanisms after disasters. As the cost of disaster micro-insurance is often substantial, there is a need to look at how to support and cross-subsidize premiums to balance efficiency with equity.

In 2012 IIASA’s World Population Program (POP) worked with the Energy Program (ENE) to provide core population data for the five new Socioeconomic Pathways (SSPs), being used by the global Integrated Assessment (IA) and Impacts, Adaptation, and Vulnerability (IAV) modeling communities for a new generation of scenarios on socioeconomic and related issues. With the Representative Concentration Pathways (RCPs), published in 2011 to integrate climate modeling efforts, the SSPs will form a research framework for the IPCC 5th Assessment Report and beyond.

POP is the only group of demographers conducting population projections for all countries of the world based on age, gender, and six levels of education. The previous generation of scenarios considered only total population size plus GDP. Interdisciplinary working at IIASA has enabled POP to study how changes in society, economy, and the natural environment feed back into the human population to influence education and human capital formation, health and mortality, migratory patterns, and reproductive behavior.

The SSPs have also benefited from major new expert-argument-based population projections by IIASA together with the Vienna Institute of Demography and Oxford University. The medium scenario of these projections, which were developed to more accurately assess the uncertainty surrounding population projections, was set to be identical with SSP2. This reflects a “middle of the road” narrative about future trends and is considered the most likely in terms of future fertility, mortality, migration, and education trends.

These internally consistent quantitative and qualitative population data from IIASA and its partners will enhance scientific understanding of interactions between the human and natural environments.
A study by postdoctoral fellow Tatsuya Sasaki of IIASA’s Evolution and Ecology Program (EEP), published in *Proceedings of the Royal Society B: Biological Sciences*, is the first to connect social exclusion with benefits for punishers. The research, conducted in 2012, and based on evolutionary game theory (EGT), could help design intervention strategies to enable future increases in cooperation for the benefit of groups or humankind at large.

Previous studies in EGT focused mainly on punishments being more costly for the punisher. Sasaki’s analysis, which compared costly punishment with social exclusion, showed that social exclusion is easier to maintain than costly punishment. In nature many groups, from reef fish to chimpanzees—and also humans—exclude free riders. The research helps explain how social exclusion arose in evolution, and how it promotes cooperation among groups by (i) increasing the excluder’s net payoff by decreasing the number of beneficiaries; and (ii) making individuals more likely to cooperate to ensure their share of group rewards.

A laboratory experiment with respect to coastal fisheries management, a key area of EEP research, found that the possibility of ostracism can decrease overfishing in a common-pool resource setting by young fishers in a fishing community. Field research also observed that a profit-sharing local fishing group, in which mutual monitoring and peer pressure are common, works efficiently.

Two speakers at IIASA’s 2012 Conference—Professor Karl Sigmund of EEP and Vienna University and Professor William Nordhaus of Yale University—showed how EGT might promote greater international cooperation on issues such as emission reductions.

For the Global Energy Assessment (GEA), launched in 2012, ENE and TNT researchers used a systems perspective to explore the specific energy challenges and opportunities of increasing urbanization and provide a better understanding of urban energy use.

Several hundred million urban dwellers in low- and middle-income nations lack access to electricity and cannot afford cleaner, safer fuels. New GEA findings show that while wealthier (OECD) cities generally have lower direct per capita energy use than their national averages, in most developing-country cities, it is higher. Moreover, many poor people live in informal settlements which also lack other basic energy-based services such as water, sanitation, and transport. With rapid migration rates and urban population growth continuing, the ability to provide affordable, secure, and clean energy will become increasingly critical for the successful operation of cities and the well-being of their inhabitants.

New GEA estimates suggest that future energy sustainability challenges in cities will need to focus on demand management including, for example, more energy-efficient buildings, the structuring of urban form and density to be conducive to energy-efficient housing, and the provision of energy-efficient and eco-friendly public transport.

TNT and ENE researchers found that the largest policy leverages, namely, systemic approaches and policy integration, are also the most difficult to use because cities typically have policy fragmentation, weak institutional capacity, and uncoordinated, dispersed decision. This “urban governance paradox” makes integrated urban planning and coordinated energy, transport, and other infrastructural policy approaches more difficult to design and even more difficult to implement.
Ecosystems Services and Management (ESM) steadily expanded its crowd-sourcing-based Geo-Wiki Project in 2012, launching a new beta-hybrid geo-wiki.org to improve the accuracy of the latest IIASA/IFPRI global cropland map. ESM aims to enlist the help of local experts working on food and agricultural-related topics to upgrade the map data.

Accurate cropland information is needed to monitor crops and populations affected by droughts; make longer-term food security assessments for a growing global population; and model competition for land under increasing pressures from the food, feed, and biofuel sectors.

In 2012 ESM gathered data through participating in a “hackathon” effort in October, based on Geo-Wiki and organized by USAID, to validate cropland in Ethiopia. Ethiopia is a target for land-grabbing in developing countries by companies, governments, and individuals for purposes such as biofuel production. This can lead to displacement of the local population, affecting food security and local livelihoods. To halt this practice, a better estimate of true land availability is needed—ironically, a map does exist, but is unavailable.

The first results for the Ethiopia “Hack for Hunger,” which were later extended by IIASA, resulted in more than 77,500 pixels being validated. This has resulted in a large open-source database on settlements and cultivated areas which can be used to raise awareness of land-grabbing by cross-referencing where this practice is occurring on land where people are living and farming.

Another hackathon was organized in October for the Central African Republic where the two best cropland maps disagree almost completely on cropland location, and useful information is thus poor.

Researchers from IIASA’s Risk, Policy and Vulnerability Program (RPV) in 2012 led the EU Responses Project’s water and agricultural research, conducting a case study on Poland’s Upper Warta River Basin. Climate projections suggest significant increases in future risk of flood hazards and drought losses across the European Union (EU). Many stakeholders recognize the need for new reservoirs (“gray” infrastructure) in the Warta region, but suggest supplementing these with on-farm water retention (“green”) strategies, especially those that promote climate change mitigation.

The Upper Warta study drew on RPV’s previous experience of stakeholder consultations. It compares the water-retention effectiveness of the region’s Wielowies-Klasztorna reservoir with three on-farm measures: ponds, shelter belts, and conservation tillage. It includes a baseline assessment of current European, Polish, and local policies, a vulnerability analysis examining the effects on water and agriculture of policies that cut carbon emissions, and an appraisal of options for future policies.

RPV showed significant economic advantages for storing water in the Wielowies Klasztorna reservoir rather than in on-farm ponds, although these could be economically viable as fish farms and facilitate migration of natural species. The cost advantage of the reservoir, however, lessens when compared to shelter belts, and disappears altogether when compared to conservation tillage, which not only reduces runoff, but also lowers labor and machinery costs.

The advantage may be further reduced or eliminated if climate change mitigation, as well as other unquantified costs, like restricting fish migration, and co-benefits, like contributions to biodiversity and erosion control, are accounted for.
Through its Young Scientists Summer Program (YSSP) and Postdoctoral Research Program, IIASA is passing on to successive generations of young scientists the theory and practice of systems analysis. Used at IIASA since its foundation in 1972, systems analysis is helping practitioners gain fresh insights into complex systemic problems, thus spurring research to higher levels.

In 2012 the Young Scientists Summer Program welcomed 49 advanced graduate students from 24 countries to work on their research projects within IIASA’s programs, and be part of one of the Institute’s most acclaimed programs. For the first time, the YSSP hosted participants from New Zealand, Cambodia, and Ghana. Since the beginning of the YSSP in 1977 some 1,670 participants have benefited from the opportunity of collaborating with IIASA’s scholars and enhancing their own perspectives and career opportunities. Many have achieved high positions in science, business, and government, while others have returned to IIASA as research scholars or continued to work as close collaborators in the Institute’s research network.

Also in 2012, IIASA joined with its South African NMO, the National Research Foundation, to launch the first regional expansion of the YSSP. Hosted by the University of Free State in Bloemfontein in South Africa, the Southern African Young Scientists Summer Program (SA-YSSP) ran from December 2012 through February 2013. Nineteen SA-YSSP fellows from southern Africa and around the world participated in the program, taking part in 11 projects representing 7 different IIASA programs. Twelve senior scientists from IIASA and the IIASA network partnered with 11 South African scientists, each from a different South African research institution, to provide research supervision for the systems analysis-based research projects.
In 2012 funding was offered once again through IIASA’s Annual Fund and the Petr Aven Fellowship. Additionally, the newly established Nathan Keyfitz Fellowship funded one young researcher to participate in the YSSP within the World Population (POP) Program.

An Annual Fund scholarship was awarded to Mr. Pheakkdey Nguon from Cambodia, who worked with the Ecosystems Services and Management (ESM) Program to develop a conceptual framework for the UN REDD+ (Reducing Emissions from Deforestation and Forest Degradation) initiatives that would facilitate production of socio-ecological knowledge on the drivers of deforestation and forest degradation.

Ms. Lan Hoang of Vietnam won the Petr Aven Fellowship for research conducted within the Risk, Policy and Vulnerability (RPV) Program regarding the robustness and resilience in water resources planning focusing on water availability in North Sussex, United Kingdom.

The Nathan Keyfitz Fellowship went to Mr. Sam Hyun Yoo from the United States. He is a PhD student in the School of Social and Family Dynamics, Center for Population Dynamics at Arizona State University with research interests in fertility in developed countries.

The Peccei Award and the Mikhalevich Award are given annually for outstanding work by participants in IIASA’s Young Scientists Summer Program. They provide financial support for the winners to return to IIASA for an additional three-month period of research. The Peccei Award is given to outstanding young scientists in recognition of their understanding of global problems, while the Mikhalevich Award is presented to scientists who are solving research questions with mathematical tools.

Pin Pin Oh, from the Department of Chemical and Environmental Engineering at the University of Nottingham’s Malaysia Campus, and Karol Opara, from the Systems Research Institute of the Polish Academy of Sciences, won IIASA’s Mikhalevich Award for their joint study entitled “Kinetic and Thermodynamic Modelling of Biodiesel Reaction.”

The 2012 Peccei Award was given to Stefan Schreier of the Institute of Environmental Physics (IUP) at the University of Bremen, Germany, for his paper on “Estimates of Forest Fire NOx emissions in Russia between 1998 and 2010.”
Every year a number of postdoctoral scholarships are available from different funding sources on topics for research related to IIASA’s scientific agenda. In 2012 the following postdoctoral fellows were working at IIASA:

**Dr. Xiaojie Chen** (EEP, China) used evolutionary game theory and adaptive dynamics to assess evolutionary dynamics in biological and social systems, especially the emergence and stability of cooperation in social networks.

**Dr. Nicklas Forsell** (ESM, Sweden) researched the use of optimization models to analyze the links between forest, agricultural, and energy planning.

**Dr. Christina Kaiser** (EEP, Austria) focused on a soil carbon and nitrogen cycling model that is based on competitive and synergistic interactions between soil microbes belonging to different microbial functional groups in a spatially structured system.

**Dr. Wei Liu** (RPV, China) carried out research into integrated adaptive management of complex socio-ecological systems, with a geographical focus on China.

**Dr. Eva-Maria Nordström** (ESM, Sweden) worked on scenario analysis for the forest sector conducting global and local analysis, with a focus on Scandinavia and Sweden. She is the focal point of ESM collaboration with the Future Forests Program of the Swedish University of Agricultural Sciences (SLU).

**Dr. Narasimha Rao** (ENE, USA) researched the relationship between electricity access, income distribution, and greenhouse gas (GHG) emissions in India, focusing on policy implementation and governance influences.

**Dr. Tatsuya Sasaki** (EEP, Japan) carried out research on the co-evolution of cooperation and volunteering in public goods games.

**Dr. Anna Scolobig** (RPV, Italy) researched stakeholder process for choosing appropriate sets of risk prevention measures and institutional frameworks for adaption and mitigation in a multi-hazard environment.
Workshops are an important element of outreach and training by IIASA, allowing new tools and methodologies to be transferred to scientists working in areas covered by IIASA research around the world. A few of 2012’s many workshops are highlighted here.

- The “Land Use Vision” Workshop, Rio de Janeiro organized by Brazil’s Center for Strategic Studies and Management (CGEE), together with Brazil’s National Institute for Space Research (INPE) and IIASA developed plans for a study on sustainable land use in a greenhouse gas emissions constrained world. Brazil, an important biomass producer-and food-exporting country, will be the first case study.

- Ecosystem services and management (ESM) researchers participated in the CGIAR Climate Change, Agriculture, and Food Security Program (CCAFS) workshops focused on developing plausible scenarios of Eastern African food security for stakeholder groups and policymakers using IIASA’s GLOBIOM model. CGIAR is a global partnership uniting organizations engaged in research for a food secure future.

- A Bioenergy with Carbon Capture and Storage (BECCS) workshop in Jakarta, attended by a large number of stakeholders and the respective government units, led creation of a BECCS task force with advisors from IIASA and the International Energy Agency.

- MAG, together with the International Nitrogen Initiative, organized a workshop to review the key assumptions of the currently available nitrogen scenarios for the 21st century and discuss the factors that could lead to different developments (breakpoints and options for policy interventions). Participants at the meeting agreed to include future nitrogen scenarios, in addition to greenhouse gases, in the development of the “Shared Socio-economic Pathways” (SSP) that are currently being developed as an input to future climate calculations for the IPCC.

- IIASA researchers in the Water Program organized a series of AEZ technology transfer workshops of the GAEZ v3.0 modeling framework and supporting climate, soil, terrain, and land-cover databases for on-site use at the headquarters of the UN Food and Agriculture Organization (FAO). The aim was to enhance FAO staff capacities in agro-ecological zoning and to facilitate application of the GAEZ modeling framework/software in FAO’s project work and studies.
IIASA’s work is underpinned by high-quality science. In 2012 IIASA scientists published 193 articles in peer-reviewed journals and held editorships in almost 100 academic journals. IIASA’s research was cited in over 5700 journal articles in 2012—more than in any previous year.

**HIGHLY PUBLISHED & CITED**

In 2012 IIASA had its most successful year to date in terms of scientific publishing. The Institute’s researchers published 193 journal articles recognized by the independent database of peer-reviewed literature, SCOPUS (accessed March 2013). Citations of IIASA articles have also continued to increase significantly.

**76 h-INDEX** This h-index measures the productivity and impact of the 2020 journal articles by IIASA authors in the SCOPUS database of peer-reviewed literature. Of these journal articles, 76 articles have been cited more than 76 times.

**99 EDITORSHIPS** Numerous IIASA scientists have been appointed to editorships for peer-reviewed academic journals. In 2012 IIASA researchers held editorships in almost 100 journals ranging from Climatic Change to Ecological Modelling to Asian Population Studies.


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The take-it-or-leave-it option allows small penalties to overcome social dilemmas

Institutions charged with safeguarding public goods should combine optional participation in social contracts with penalties for freeloaders. The study of cooperation in groups shows how voluntary accession to such contracts greatly reduces institutional costs needed for achieving full cooperation.

**Authors** Sasaki T, Brännström Å, Dieckmann U, Sigmund K

**Journal** PNAS 109(4) (24 January)

Variation in cognitive functioning as a refined approach to comparing aging across countries

To date, most comparisons of the burden of aging across countries have focused on measures of how old people are such as the old-age dependency ratio. The researchers argue that an alternative approach that measures cognitive functioning at older ages would offer a valuable new perspective.

**Authors** Skirbekk V, Loichinger E, Weber D

**Journal** PNAS 109(3) (17 January)

Statistical detection of systematic election irregularities

The researchers develop a parametric model to identify election irregularities.

**Authors** Klimk P, Yegorov Y, Hanel R, Thurner S

**Journal** PNAS 109(41) (9 October)
Sexual selection enables long-term coexistence despite ecological equivalence

The research is the first to demonstrate that selective mating alone enables the long-term coexistence of species, given that the choosy mating behavior of females bears a cost and resources are not distributed evenly over space. This finding challenges the long-held belief that ecological differentiation is a prerequisite for maintaining biodiversity.

Authors M’Gonigle LK, Mazzucco R, Otto SP, Dieckmann U
Journal Nature 484(7395) (26 April)

Marginalization of end-use technologies in energy innovation for climate protection

The article shows that twice as much effort is being spent on developing energy supply technologies—such as new power stations—than is spent on improving the ways energy is used. The research shows that efficient end-use technologies have the potential to contribute large emission reductions and provide higher social returns on investment—so the imbalance in spending must be redressed to mitigate climate change.

Authors Wilson C, Grubler A, Gallagher KS, Nemet GF
Journal Nature Climate Change 2(11) (November)

Vulnerability of US and European electricity supply to climate change

The study highlights the vulnerability of US and European electricity supply to climate change. The research projects disruption to thermoelectric power generating capacity due to higher water temperatures and reduced river flows in Europe and the United States. Thermoelectric power plants directly depend on the availability and temperature of water resources for cooling.

Authors Van Vliet MTH, Yearsley JR, Ludwig F, Vögele S, Lettenmaier DP, Kabat P
Journal Nature Climate Change 2(9) (September)

Impacts of incentives to reduce emissions from deforestation on global species extinctions

The researchers show that while the current rate of deforestation threatens to cause massive species extinctions worldwide, prompt implementation of an effective carbon payment system to avoid deforestation could reduce extinctions by more than three-quarters.

Authors Strassburg BBN, Rodrigues ASL, Gusti M, Balmford A, Fritz S, Obersteiner M, Kerry Turner R, Brooks TM
Journal Nature Climate Change 2(5) (May)
IIASA’s work is centered overall on three global problem areas: Energy and Climate Change; Food and Water; and Poverty and Equity. Research also covers three important drivers of the global transformations taking place in our world: population growth and migration; technological change; and economic development. Research at IIASA is based on advanced systems analysis which uses an integrated, interdisciplinary approach based on mathematical models and analytical techniques to investigate complex systems. As a result, IIASA’s individual programs conduct research across the problem areas, with some programs more focused on one or two research areas and some being highly cross-cutting.

**IIASA Annual Report 2012**

**Research Programs**

**Applied Systems Analysis (ASA)**
ASA remains at the core of IIASA’s research. The ASA Program uses mathematical models and analytical techniques to investigate complex systems, with the focus on an integrated, interdisciplinary approach. It thereby aims to achieve a cutting edge in systems analysis and provide a substantial basis for tying together systems methods and applied research on global change. ASA’s core themes include Assessment of Dynamical Systems; Systemic Risks and Robust Solutions; and Integrated Modeling and Decision Support.

**Research Scholars**
- Arkady Kryazhimskiy, Russia (Program Leader)
- Elena Rovenskaya, Russia (Deputy Program Leader)
- Sergey Aseev, Russia
- Thomas Brudermann, Austria
- Alexey Davydov, Russia
- Yasunori Endo, Japan (Guest)
- Brian Fath, USA
- Janusz Granat, Poland
- Leena Ilmola-Sheppard, Finland
- Masakazu Katsumoto, Japan (Guest)
- Andrey Krasovskiy, Russia
- Marek Makowski, Poland
- Tapio Palokangas, Finland
- Hongtao Ren, China
- Gerald Silverberg, USA (Guest)
- Alexander Tarasyey, Russia
- Stefan Thurner, Austria
- Chihiro Watanabe, Japan (Guest)
- Yuriy Vermoliev, Ukraine

**Research Assistants**
- Alena Puchkova, Russia
- Nikita Strekovskiy, Russia
- Ying Zhang, China (Guest)

**YSSP Participants**
- Morag Ayers, New Zealand
- Shaoping Chen, China
- Seyed Kharraz, Iran
- Dmytro Movchan, Ukraine
- Pin Pin Oh, Malaysia
- Karol Opara, Poland
- Anton Platov, Russia
- Hiroshi Shiraki, Japan
- Yadong Yu, China

**Administrative Support**
- Angela Dowds, United Kingdom

**Evolution and Ecology (EEP)**
EEP analyzes and forecasts how ecological and evolutionary dynamics shape populations, communities, and ecosystems. The quintessential systems science, ecology deals holistically with complex challenges to adaptive systems, such as nonlinear feed-backs, non-equilibrium dynamics, discontinuities and break points, collective phenomena, systemic transitions, behavioral dynamics, and multi-level and multi-scale interactions among processes and agents. Studies of adaptation and evolution, which account for the ubiquitous capacity of agents to alter their features and interactions in response to environmental change, complement this approach.

**Research Scholars**
- Ulf Dieckmann, Germany (Program Leader)
- Nils Brännström, Sweden
- Mikko Heino, Finland
- Hiroshi Ito, Japan
- Adam Kun, Hungary
- Cesare Marchetti, Italy (Guest)
- Rupert Mazzucco, Austria
- Johan Metz, Netherlands
- Kalle Parvinen, Finland
- Sergio Rinaldi, Italy
- Akira Sasaki, Japan
- Tatsuya Sasaki, Japan
- Karl Sigmund, Austria

**Postdoctoral Scholars**
- Xiaojie Chen, China
- Christina Kaiser, Austria

**Research Assistants**
- Gergely Boza, Hungary
- Chihio Kaito, Japan
- Tuyen Nguyen, Vietnam (Guest)
- Alena Puchkova, Russia
- Lai Zhang, China (Guest)

**YSSP Participants**
- Sarah Evens, USA
- Harald Ficker, Austria
- Taiki Fuji, Japan
- Jounghun Lee, Republic of Korea
- Kyong Nah, Republic of Korea
- Victoria Veshchinskaya, Russia

**Administrative Support**
- Darina Zlatanova, Bulgaria
ECOSYSTEMS SERVICES AND MANAGEMENT  ESM provides integrated impact assessment of ecosystem management options for policy processes. Research combines spatially detailed modeling of land use options and ecosystem services in diverse social and environmental conditions and accounts for physical and financial flows across multiple scales.

Earth Observation Tools are used by ESM as a repository of the newest verified information on the extent, condition, vitality, and dynamics of ecosystems and related landscapes. Novel social networking processes are also being tapped to acquire verified data from volunteers on the ground.

Research Scholars  Michael Obersteiner, Austria (Program Leader) • Florian Kraxner, Austria (Deputy Program Leader) • Franziska Albrecht, Germany • Kento Kar, Japan (Guest) • Juraj Balkovic, Slovakia • Geraldine Boqueho,* France • Hannes Böttcher, Germany • Gaspard Dumollard, France • Lars Eriksson,* Sweden (Guest) • Tatiana Ermoljeva, Austria • Stefan Frank, Austria • Karl Franklin, Sweden • Steffen Fritz, Germany • Sabine Fuß, Germany • Petra Glabatsch, Austria • Alejandro Gonzalez del Valle Albare, Spain • Christian Götz, Germany • Mykola Gust,* Ukraine • Sarah Hall,* Sweden (Guest) • Petr Havlík, Czech Republic • Matthais Jonas, Germany • Mathias Karner, Austria • Nikolay Khabarov, Russia • Dong Hyun Kim, Republic of Korea • Georg Kindermann,* Austria • Andrey Krasovskiy, Russia • Pekka Lauri, Finland • David Leclere, France • Sylvain Leduc, France • Junguo Liu,* China • Andreis Lunnan, Norway (Guest) • Ian McCallum,* Canada • Elena Moltchanova, Finland • Aline Mosnier, France • Sten Nilsson,* Sweden (Guest) • Amanda Palazzo, USA • Christoph Perger,* Austria • Sylvia Prieler, Austria • Felician Rydzak,* Poland • Carl Salk, USA • Linda See,* United Kingdom • Dmitry Shchepaschenko, Russia • Anatoly Shvidenko, Russia • Rastislav Skalsky,* Slovakia • Alexey Smirnov, Russia • Liangxiang Sun,* United Kingdom • Elisabeth Suwandschieff, Austria • Jana Szolgayova* Slovakia • Elena Tarnavsky,* Bulgaria • Eva Tothne Hizsnik,* Hungary • Hugo Valin, France • Marijn van der Velde, Netherlands • Harri van Velthuizen,* Netherlands • Harri van Velthuizen,* Netherlands • Franz Wei, Austria • Larry Willmore, Canada (Guest) • Yoshiki Yamagata, Japan (Guest)

Postdoctoral Scholars  Paul Forsell, Sweden • Nils Lindroos, Sweden (Guest) • Ingrid Nordström, Sweden (Guest)

Research Assistants  Abel Marcarini, Brazil (Guest) • Yurii Myklush, Ukraine (Guest) • Ornra Saen-Tun, Thailand (Guest) • Brian Shaw, Ireland (Guest) • Geza Toth,* Hungary (Guest) • Honglin Zhong, China

YSSP Participants  Olha Danylo, Ukraine • Emma Jonson, Sweden • Dilip Khatiwada, Nepal • Alexander Laletin, Russia • Pheak Nguon, Cambodia • Katalin Petz, Hungary • Bishnu Poudel, Nepal • Yaw Sasu-Boakye, Ghana • Stefan Schreier, Austria • Xiaopeng Song, China • Yuanyuan Zhao, China

Administrative Support  Cynthia Festin, USA • Elisabeth Preihs, Canada

*Part-time affiliation
IIASA's World Population Program (POP) addresses the human core of global change. It studies the changing number of human beings on this planet with a specific focus on the changing composition of the population by age, gender, level of education, place of residence, and other important human characteristics. POP tries to comprehensively assess the social, economic, and environmental drivers of such changes as well as their implications for long-term sustainable development.

POP has a strong strategic alliance with the Vienna Institute of Demography of the Austrian Academy of Sciences and the Vienna University of Economics and Business in the form of the Wittgenstein Centre for Demography and Global Human Capital.

**Research Scholars**
- Wolfgang Lutz, Austria (Program Leader)
- Guy Abel, United Kingdom
- Bilal Barakat, Germany
- Valeria Bordone, Italy
- William Butz, USA
- Jesus Crespo Cuaresma, Spain
- Neil Cummins, Ireland
- Regina Fuchs, Austria
- Alessandra Garbero, Italy
- Anne Goujon, France
- Clarissa Guimarães Rodrigues, Brazil
- Samir K.C., Nepal
- Harold Lentzner, USA
- Elke Loichinger, Germany
- Raya Muttarak, Thailand
- Elsa Pamuk, USA
- Michaela Potancokova, Slovakia
- Isolde Prommer, Austria
- Warren Sanderson, USA
- Serguei Scherbov, Netherlands
- Jose Siri, USA
- Vegard Skirbekk, Norway (Project Leader)
- Marcin Stonawski, Poland
- Muhammad Wazir, Pakistan

**Research Assistants**
- Jeevana K.C., Nepal
- Andreas Sattra, Austria
- Erich Stiessnig, Austria
- Daniela Weber, Austria

**YSSP Participants**
- Collin Payne, USA
- Angan Sengupta, India
- Sam Yoo, Republic of Korea

**Administrative Support**
- Stefanie Andruchowitz, Austria
- Ekaterina Smirnova, Netherlands
- Suchitra Subramanian, India
RISK, POLICY AND VULNERABILITY  RPV combines quantitative methods for modeling and analyzing systems with a suite of quantitative and qualitative approaches to policy analysis. Its objectives are to contribute both to decreasing the risk and vulnerability of economic, ecological, and social systems to stresses imposed by global change and to policies designed to cope with global change. RPV particularly emphasizes reducing the vulnerability of the poor.

RPV informally comprises three working group: Disasters and Development; Decisions and Governance; and Water and Resilience.

Research Scholars  Joanne Bayer, USA (Program Leader) • Michael Beck,* United Kingdom (Guest) • Jason Blackstock,* Canada (Guest) • Kerstin Damerau,* Germany (Guest) • Anna Dubel,* Poland • Susanne Hanger, Austria • Stefan Hochrainer-Stigler, Austria • Nikolay Khabarov, Russia • Nadejda Komendatova-Amann,* Austria • Karl Lilliestam,* Sweden • Piotr Magnuszewski,* Poland • Ziga Malek, Slovenia • Reinhard Mechler,* Germany • Janosch Ondraczek, Germany (Guest) • Anthony Patt, USA • Stefan Pfenninger, Switzerland • Georg Pflug,* Austria • Armon Rezai,* Austria (Guest) • Carl Salk, USA (Guest) • Dagmar Schröter,* Germany • Anna Scloboig, Italy • Jan Sendzimir, USA • Upasna Sharma,* India (Guest) • Teresa Sprague, USA (Guest) • Joanna Stefanska,* Poland • Michael Thompson,* United Kingdom • Anna Timonina,* Russia • Giacomo Trombi, Italy (Guest) • Keith Williges, USA • Masoud Yazdanpanah, Iran (Guest)

Postdoctoral Scholar  Wei Liu, China

YSSP Participants  Sebastian Busch, Germany • Ngoc Hoang, Vietnam • Syed Naqi, Pakistan • Danielle Nel, South Africa • Tobias Nielsen, Denmark • Anubhav Pattanayak, India

Administrative Support  Jennifer Carvill,* United Kingdom • Jun Watabe, Japan

WATER  The Water Program and the Flagship Initiative on Water Futures and Solutions: World Water Scenarios aim to provide a set of robust strategies, policies, technologies and solution options to inform decision making in the face of growing water scarcity and increasing uncertainty.

Research Scholars  William Cosgrove,* Canada (Scenario Leader) • Molly Convery,* USA • Günther Fischer • Piotr Magnuszewski,* Poland • David Wilberg, USA • Paul Yillia, Sierra Leone

Research Assistants  Long Hoang Phi, Vietnam • Somayeh Shadkam Torbati, Iran

YSSP Participants  Firdos Khan, Pakistan • Zhuoran Liang, China • Debra Perrone, USA

Administrative Support  Deirdre Zeller,* Ireland

COUNCIL AND EXTERNAL RELATIONS  Gui-Yang Cao, China • Margaret Collins, USA • Chin-Min Lee, Republic of Korea • Björn Stigson, Sweden

TRANSITIONS TO NEW TECHNOLOGIES  TNT’s research aims for an improved empirical understanding of the patterns, drivers, constraints, and impacts of technological change, particularly in the areas key for framing global sustainability conditions, such as climate change. New modeling approaches of technological change with an emphasis on the treatment of technological uncertainty, spatial and actor heterogeneity, and assessments of the potential economic and societal impacts that could result from pervasive diffusion and adoption of new technologies are priority research areas.

Research Scholars  Arnulf Grubler,* Austria (Acting Program Leader) • Morgan Bazilian,* USA • Nuno Da Costa Bento, Portugal • Shobhakar Dhakal,* Nepal (Guest) • Luis Gomez Echeverri,* Austria (Scientific Support) • Peter Kolp,* Austria (Scientific Support) • Tieju Ma,* China • Nebojša Nakicenovic,* Austria • Keywan Riahi, Austria • Charles Wilson,* United Kingdom

Research Assistants  Simon De Stercke, Belgium • Jessica Jewell, USA • Mathis Rogner (Germany)

YSSP Participant  Stephen Healey, Canada

Administrative Support  Patricia Wagner, USA

*Part-time affiliation
IIASA’s main funding came from its National Member Organizations (NMOs) in 20 countries in Africa, the Americas, Asia, Europe, and Oceania. Additional funding came from competitive contracts, grants, and donations from governments, international organizations, academia, business, and individuals. For the period of 2006 through 2012, this additional funding totaled some €50 million. These many diverse income sources enabled IIASA to perform research that is truly independent. IIASA would like to thank all those who have given their financial support in 2012.

**summary**

<table>
<thead>
<tr>
<th>INCOME</th>
<th>2012 (€)</th>
<th>2011 (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMO contributions</td>
<td>8,997,521</td>
<td>8,820,176</td>
</tr>
<tr>
<td>Contracts, grants, donations</td>
<td>7,825,242</td>
<td>7,710,043</td>
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<tr>
<td>Other income</td>
<td>134,269</td>
<td>273,661</td>
</tr>
<tr>
<td><strong>SUBTOTAL</strong></td>
<td>16,957,032</td>
<td>16,803,880</td>
</tr>
<tr>
<td>Movements on reserves</td>
<td>903,704</td>
<td>(1,372,865)</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>17,860,736</td>
<td>15,431,015</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPENDITURE</th>
<th>2012 (€)</th>
<th>2011 (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>11,208,697</td>
<td>10,000,779</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>3,985,259</td>
<td>3,375,170</td>
</tr>
<tr>
<td>Scientific services</td>
<td>1,869,324</td>
<td>1,767,615</td>
</tr>
<tr>
<td>Depreciation</td>
<td>329,841</td>
<td>257,301</td>
</tr>
<tr>
<td>Other sundry expenses</td>
<td>467,615</td>
<td>30,150</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>17,860,736</td>
<td>15,431,015</td>
</tr>
</tbody>
</table>

Generous donations to IIASA’s Annual Fund, together with the Petr Aven Fellowship, enabled two young scientists from developing countries to participate in the 2012 Young Scientists Summer Program (YSSP). Additionally, the newly established Nathan Keyfitz Fellowship funded one young researcher to participate in the YSSP within the World Population Program. The IIASA Fund, formerly known as the IIASA Endowment Fund, continued efforts to support the creative exploration of new frontiers in systems analysis research at IIASA. IIASA thanks all the donors named here, as well as to those who wished to remain anonymous, and is grateful for their belief in the goals and mission of this Institute. 

- Jesse H. Ausubel
- Petr Aven
- Sebouh Baghdoyan
- Erica Bickford
- Alfred Blumstein
- Maria Brouwer
- Jacqueline and William Buehring
- Rostyslav Bun
- Lierh Clemens
- Janusz Cofala
- Ellen Edwards
- Tommi Ekholm
- Günter Fettweis
- Kiyotada Hayashi
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- David Horlacher
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- Soshichi Kinoshita
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- Sadaaki Miyamoto
- Augustus Nasmith, Jr.
- Dimitri Philippov
- Gerhard Plasonig
- Edward J. Rising
- Sergiu Robu
- Leon Clement Rousseau
- Feng Shan
- Katsumasa Tanaka
- Michael Ter-Mikaelian
- Nikola Totzey
- Marc Tremblay
- Kiichiro Tsuji
- Vivek Voora
- Alfred Wirth
- Mitsuo Yamada
- Muneta Yokomatsu
EXPENDITURE

Research 63%
Infrastructure 22%
Scientific services 10%
Depreciation 2%
Other sundry expenses 3%

- Austrian Agency for International Cooperation in Education and Research, Vienna, Austria
- Austrian Federal Forests, Purkersdorf, Austria
- Austrian Research Promotion Agency, Vienna, Austria
- Austrian Development Agency—Austrian Development Cooperation (Appear), Vienna, Austria
- Federal Ministry for Transport, Innovation and Technology, Vienna, Austria
- Kommunalkredit Public Consulting GmbH, Vienna, Austria
- United Nations Industrial Development Organization, Vienna, Austria
- Vienna Institute for Demography, Vienna, Austria
- YSSP Annual fund, Austria
- European Commission, DG Clima Action, Brussels, Belgium
- European Commission, DG Environment, Brussels, Belgium
- European Commission, DG Environment, LIFE, Brussels, Belgium
- European Commission, DG Environment/Climate Action, Brussels, Belgium
- European Commission, DG Information Society and Media, Brussels, Belgium
- European Commission, DG Research, Brussels, Belgium
- European Commission, DG Research and Innovation, Brussels, Belgium
- European Commission, European Research Council Executive Agency, Brussels, Belgium
- European Commission, Executive Agency for Competitiveness and Innovation, Brussels, Belgium
- European Commission, Research Executive Agency, Brussels, Belgium
- Vision on Technology—Flemish Institute for Technological Research NV, Mol, Belgium
- Center for Strategic Studies and Management, Brasilia DF, Brazil
- Ministry of Defense of Finland, Helsinki, Finland
- Ministry of Employment and the Economy, Helsinki, Finland
- United Nations University—World Institute for Development Economics Research, Helsinki, Finland
- European Science Foundation, Strasbourg, France
- French National Institute for Industrial Environment and Risks, Verneuil-en-Halatte, France
- International Energy Agency, Paris, France
- Organisation for Economic Co-operation and Development, Paris, France
- The German Society for International Cooperation, Eschborn, Germany
- Federal Minister for the Environment, Nature Conservation and Nuclear Safety, Bonn, Germany
- Forschungsverbund Berlin e.V., Berlin, Germany
- Potsdam Institute for Climate Impact Research, Potsdam, Germany
- The Alfred Wegener Institute for Polar and Marine Research, Potsdam, Germany
- Institute of Communication and Computer Systems, National Technical University of Athens, Greece
- AP EnvEcon, Dublin, Ireland
- Food and Agriculture Organization of the United Nations, Rome, Italy
- Italian Agency for New Technology, Energy and The Environment, Rome, Italy
- Research Institute of Innovative Technology for the Earth, Kyoto, Japan
- Toyota Motor Corporation, Aichi, Japan
- The International Livestock Research Institute, Nairobi, Kenya
- Deltares—Enabling Delta Life, Utrecht, Netherlands
- Wageningen University, Wageningen, Netherlands
- Norwegian Meteorological Institute, Oslo, Norway
- Norwegian University of Science and Technology, Trondheim, Norway
- The Norwegian International Climate Forest and Initiative, Oslo, Norway
- Korea Forest Research Institute, Seoul, Republic of Korea
- Korea Science and Engineering Foundation, Daejeon-City, Republic of Korea
- Science and Technology Policy Institute, Seoul, Republic of Korea
- YSSP Petr Aven fellowship, Moscow, Russia
- Russian Academy of Sciences, Moscow, Russia
- IVL Swedish Environmental Research Institute, Strömshund, Sweden
- Swedish University of Agricultural Sciences, Umeå, Sweden
- The Stockholm Environment Institute, Stockholm, Sweden
- The Swedish Knowledge Centre for Renewable Transportation Fuels, Göteborg, Sweden
- United Nations Economic Commission for Europe, Geneva, Switzerland
- United Nations Population Fund, Geneva, Switzerland
- AMEC Environment and Infrastructure UK LTD, London, United Kingdom
- Department of Energy and Climate Change, London, United Kingdom
- Vivid Economics Limited, London, United Kingdom
- Clean Air Task Force, Boston, MA, USA
- ClimateWorks Foundation, San Francisco, CA, USA
- Electric Power Research Institute, Palo Alto, CA, USA
- Environmental Protection Agency, Washington, DC, USA
- National Science Foundation, Virginia, USA
- Pew Research Center, Washington, DC, USA
- United Nations Development Programme, New York, NY, USA
- United Nations Foundation, Washington, DC, USA
- The World Bank, Washington, DC, USA
IIASA is an international, independent, interdisciplinary research institution with 40 years’ experience in researching global change. IIASA is sponsored by its National Member Organizations. On 1 January 2013 these were:

<table>
<thead>
<tr>
<th>National Member Organization</th>
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</tr>
</thead>
<tbody>
<tr>
<td>AUSTRALIA The Commonwealth Scientific and Industrial Research Organisation (CSIRO)</td>
<td>AUSTRIA The Austrian Academy of Sciences</td>
</tr>
<tr>
<td>BRAZIL Center for Strategic Studies and Management in Science, Technology and Innovation (CGEE)</td>
<td>CHINA The National Natural Science Foundation of China</td>
</tr>
<tr>
<td>EGYPT The Academy of Scientific Research and Technology (ASRT)</td>
<td>FINLAND The Finnish Committee for IIASA</td>
</tr>
<tr>
<td>GERMANY The Association for the Advancement of IIASA</td>
<td>INDIA The Technology Information, Forecasting and Assessment Council (TIFAC)</td>
</tr>
<tr>
<td>INDONESIA The Indonesian National Committee for IIASA</td>
<td>JAPAN The Japan Committee for IIASA</td>
</tr>
<tr>
<td>MALAYSIA Academy of Sciences Malaysia</td>
<td>NETHERLANDS The Netherlands Organization for Scientific Research (NWO)</td>
</tr>
<tr>
<td>NORWAY The Research Council of Norway</td>
<td>PAKISTAN The Pakistan Academy of Sciences</td>
</tr>
<tr>
<td>REPUBLIC OF KOREA National Research Foundation of Korea (NRF)</td>
<td>RUSSIA The Russian Academy of Sciences</td>
</tr>
<tr>
<td>SOUTH AFRICA The National Research Foundation</td>
<td>SWEDEN The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS)</td>
</tr>
<tr>
<td>UKRAINE The Ukrainian Academy of Sciences</td>
<td>UNITED STATES OF AMERICA The National Academy of Sciences</td>
</tr>
</tbody>
</table>