Research collaborations between IIASA and Germany have been highly productive throughout IIASA history. Since 2010, this cooperation has involved over 70 German organizations and led to over 1,200 joint scientific publications and wide-ranging policy advice delivered via organizations such as the German Advisory Council on Global Change (WBGU). Joint studies focus on the complex global systems that affect Germany, its economy, and its people. Research topics include transformation paths to a sustainable energy system, the impact of demographic change in Germany and optimizing strategies to reduce greenhouse gas emissions. These activities are complemented by scientific exchange with over 1000 researchers visiting Germany from IIASA and over 760 researchers, advisors and diplomats visiting IIASA from Germany. Beyond continuing these research collaborations, there is significant opportunity to grow the relationship between IIASA and the German scholarly community, through joint research projects, scientific exchange and collaborative capacity building activities. Opportunities for such activities will be facilitated through the forthcoming IIASA strategic plan 2021-2030 and new IIASA membership strategy, which the Association for the Advancement of IIASA are helping to shape via their role on the IIASA governing council. This IIASA Info Sheet provides a summary of this expanding relationship since 2010.

### Highlights of Interactions Between IIASA and Germany (since 2010)

<table>
<thead>
<tr>
<th>National Member Organization</th>
<th>Association for the Advancement of IIASA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Membership start date</td>
<td>Founding membership since 1972 as Max Planck Society for the Advancement of Sciences, Federal Republic of Germany (1972-1983); Academy of Sciences of the German Democratic Republic (1972 to 1990; and German Association for the Advancement of IIASA (1984 to present but affiliate member 1998 to 2002)</td>
</tr>
<tr>
<td>Selected key research partners</td>
<td>74 German organizations have collaborated with IIASA including: Friedrich Schiller University Jena, German Aerospace Center, Johann Heinrich von Thünen Institute, Karlsruhe Institute of Technology, Leibniz Institute for Freshwater Ecology and Inland Fisheries, Max Planck Institutes (various), Potsdam Institute for Climate Impact Research, Universities of Bonn, Freiburg, and Hamburg</td>
</tr>
<tr>
<td>Areas of research collaboration</td>
<td>Supporting Germany’s changing energy landscape, Tackling climate change, Projecting demographic change in Germany, The carbon cycle, farmland, and forests, Increasing climate and disaster resilience, Advancing the methods of systems analysis, Analyzing global and European water challenges</td>
</tr>
<tr>
<td>Capacity building</td>
<td>30 doctoral students from Germany or funded by the German NMO have participated in IIASA Young Scientists Summer Program and its Southern African version</td>
</tr>
<tr>
<td>Publication output</td>
<td>over 1,200 publications have resulted from IIASA-German collaborations</td>
</tr>
<tr>
<td>Scientific exchange</td>
<td>Over 760 researchers, advisors, and diplomats from Germany have visited IIASA, while IIASA scientists have visited Germany over 1,012 times</td>
</tr>
</tbody>
</table>
Activities with Member Countries: Germany

IIASA Info Sheet 2019/12

The electronic version of this document is available at www.iiasa.ac.at/germany

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ZVR 524808900

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IIASA Info Sheets provide succinct summaries of IIASA activities. They do not necessarily reflect the views of IIASA staff, visitors, or National Member Organizations.

This Info Sheet summarizes IIASA recent interactions with the Germany. It includes highlights with links to further information but is not meant to be a comprehensive report on all interactions.

Feedback and updates are encouraged and should be sent to the External Relations Department.
IIASA National Member Organization in Germany

The Association for the Advancement of IIASA is the National Member Organization (NMO) representing German membership of IIASA. When IIASA was established in 1972, both East and West Germany were founding members through the Academy of Sciences of the German Democratic Republic and the Max Planck Society for the Advancement of Sciences respectively. Today, Germany’s Federal Ministry of Education and Research (BMBF) funds the NMO and the IIASA annual membership fee.

Professor Dr. Helga Weisz, Head of the FutureLab Social Metabolism & Impacts at Potsdam Institute for Climate Impact Research (PIK) and Professor of Industrial Ecology and Climate Change at Humboldt University of Berlin, is the IIASA Council Member for Germany, as well as being a member of the Council Executive Committee and Chair of the Council Membership Committee.

The IIASA Council consists of one representative of each of the IIASA National Member Organizations and is responsible for setting the overall strategic direction of the Institute as well as governing IIASA.

Professor Dr. Hermann Lotze-Campen, Head of Research, Department Climate Resilience, Potsdam Institute of Climate Impact Research (PIK) is the NMO Secretary for Germany.

An Executive Advisory Board advises the German NMO and its members (as of December 2019) reflect the main IIASA research fields:

Professor. Dr. Thomas Bruckner, Institute for Infrastructure and Resources Management, University of Leipzig

Professor Dr. Sabine Fuss, Mercator Research Institute on Global Commons and Climate Change (MCC)

Professor Dr. Hermann Held, Chair Sustainability & Global Change, University Hamburg

Professor Dr. Kai Hufendiek, Director, Institute of Energy Economics and Rational Use of Energy (IER) University Stuttgart

Professor Dr. Claudia Kemfert, Head of Department Energy, Transportation and Environment, German Institute for Economic Research (DIW)

Dr. Wilhelm Kuckshinrichs, Institute of Energy and Climate Research, Systems Analysis and Technology Evaluation (IEK-STE) Research Center Jülich

Professor Dr. Peter Lemke, Devision Coastal Ecology & Climate Sciences, Alfred Wegener Institute for Polar and Marine Research (AWI)

Professor Dr. Ortwin Renn, Managing Scientific Director, Institute for Advanced Sustainability Studies (IASS)

Professor Dr. Rüdiger Schaldach, Head of Research Group Global and Regional Dynamic Land, Center for Environmental Systems Research (CESR) University Kassel
Research Partners in Germany

IIASA works with research funders, academic institutions, policymakers and individual researchers in Germany. The following list includes the names of the organizations or the individual’s affiliated institutions that have all recently collaborated with IIASA.

- Agency for Renewable Resources (FNR – Fachagentur Nachwachsende Rohstoffe)
- Alfred Wegener Institute for Polar and Marine Research
- Association for the Advancement of IIASA (Vereinigung zur Förderung des Internationalen Instituts für Angewandte Systemanalyse)
- Berlin Institute for Population and Development (Berlin-Institut für Bevölkerung und Entwicklung)
- Carl von Ossietzky University of Oldenburg (Carl von Ossietzky Universität Oldenburg)
- Centre for European Economic Research (ZEW – Zentrum für Europäische Wirtschaftsforschung)
- Climate Analytics
- Climate Service Center (CSC)
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
- Ecologic Institute (Ökologisches Institut)
- European Centre for Agricultural, Regional and Environmental Policy Research (EuroCARE)
- FastOpt
- Federal Environment Agency (UBA – Umweltbundesamt)
- Federal Institute for Geosciences and Natural Resources (BGR - Bundesanstalt für Geowissenschaften und Rohstoffe)
- Federal Ministry for Economic Cooperation and Development (BMZ - Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung)
- Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB – Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit)
- Federal Ministry of Education and Research (BMBF - Bundesministerium für Bildung und Forschung)
- Forschungszentrum Jülich
- Fraunhofer Institute for Systems and Innovation (Fraunhofer ISI – Fraunhofer Institut für System und Innovationsforschung)
- French-German Institute for Environmental Research (DFIU – Deutsch-Französisches Institut für Umweltforschung)
- Friedrich Schiller University Jena (Friedrich-Schiller-Universität Jena)
- German Advisory Council on Global Change (WBGU - Wissenschaftliche Beirat der Bundesregierung Globale Umweltveränderungen)
- German Aerospace Center (DLR – Deutsches Zentrum für Luft- und Raumfahrt)
- German Centre of Gerontology (DZA – Deutsches Zentrum für Altersfragen)
- German Committee for Disaster Reduction (DKKV – Deutsches Komitee Katastrophenvorsorge)
- German Development Institute (DIE – Deutsches Institut für Entwicklungspolitik)
- Germanwatch
- Global Climate Forum (GCF)
- Goethe University Frankfurt (Goethe-Universität)
- Hamburg Institute of International Economics (HWWI)
- Helmholtz-Zentrum Geesthacht – Centre for Materials and Coastal Research (HZG - Helmholtz Zentrum Geesthacht – Zentrum für Material- und Küstenforschung)
- Helmholtz Centre for Environmental Research (UFZ - Helmholtz-Zentrum für Umweltforschung)
- Helmholtz Centre Potsdam - German Research Centre for Geosciences ( GEZ - Helmholtz-Zentrum Potsdam - Deutsches GeoForschungsZentrum)
| Institute for Advanced Sustainability Studies (IASS) |
| Institute for Social-Ecological Research (ISOE – Institut für sozial-ökologische Forschung) |
| International Institute for Sustainability Analysis and Strategy (IIINAS – Internationales Institut für Nachhaltigkeitsanalysen und -strategien) |
| Jacobs University |
| Johann Heinrich von Thünen Institute, Federal Research Institute for Rural Areas, Forestry, and Fisheries (Johann Heinrich von Thünen-Institut, Bundesforschungsinstitut für Ländliche Räume, Wald und Fischerei) |
| Karlsruhe Institute of Technology (KIT – Karlsruher Institut für Technologie) |
| Leibniz Centre for Agricultural Landscape Research |
| Leibniz Institute for Freshwater Ecology and Inland Fisheries (IGB) |
| Leibniz Universität Hannover |
| Max Planck Institute for Biogeochemistry (Max-Planck-Institut für Biogeochemie) |
| Max Planck Institute for Chemistry (Max-Planck-Institut für Chemie) |
| Max Planck Institute for Demographic Research (MPIDR - Max-Planck-Institut für demografische Forschung) |
| Max Planck Institute for Meteorology (MPI-M – Max-Planck-Institut für Meteorologie) |
| Max Planck Institute for the Physics of Complex Systems (Max-Planck-Institut für Physik komplexer Systeme) |
| Max Planck Society (Max-Planck-Gesellschaft) |
| Mercator Research Institute on Global Commons and Climate Change (MCC) |
| Munich Climate Change Insurance Initiative (MCII) |
| Potsdam Institute for Climate Impact Research (PIK – Potsdam-Institut für Klimafolgenforschung) |
| Renewable Grid Initiative, Berlin |
| RWTH Aachen University |
| SYNCOM |
| TU Dortmund University (Technische Universität Dortmund) |
| Thünen Institute of Climate-Smart Agriculture (Thünen Institut für Agrarklimaschutz) |
| University of Bamberg (Otto-Friedrich-Universität Bamberg) |
| University of Bonn (Universität Bonn) |
| University of Duisburg-Essen (Universität Duisburg-Essen) |
| University of Freiburg (Albert-Ludwigs-Universität Freiburg) |
| University of the German Federal Armed Forces, Munich (Universität der Bundeswehr München) |
| University of Hamburg (Universität Hamburg) |
| University of Heidelberg (Universität Heidelberg) |
| University of Kassel (Universität Kassel) |
| University of Kiel (CAU – Christian-Albrechts-Universität zu Kiel) |
| University of Konstanz (Universität Konstanz) |
| University of Leipzig (Universität Leipzig) |
| University of Potsdam (Universität Potsdam) |
| University of Stuttgart (Universität Stuttgart) |
| University of Würzburg (Universität Würzburg) |
| Weihenstephan-Triesdorf University of Applied Sciences (Hochschule Weihenstephan-Triesdorf) |
| WIP – Renewable Energies |
| Wuppertal Institute for Climate, Environment and Energy (Wuppertal Institut für Klima, Umwelt, Energie) |
Recent Research Collaborations

Supporting Germany’s changing energy landscape

Germany has adopted a policy of energy transformation (Energiewende) to shift from nuclear and fossil fuels to renewable energy with nationally agreed targets of increasing renewable energy’s share of the country’s energy use to 60% by 2050 among other energy objectives. Achieving these goals requires a thorough understanding of the complex global energy system and its multiple connections with Germany’s economy, environment, and society. Integrated, international assessments are one of the few research approaches that has the breadth and depth to explore such complex problems across multiple sectors, regions, and timeframes. IIASA has developed substantial expertise in international energy assessments ever since the Institute’s researchers carried out the first comprehensive, truly global assessment of energy issues (1973 – 1981).

IIASA led the Global Energy Assessment (GEA), until 2012, in which a new global energy policy agenda is defined—one that transforms the way society thinks about, uses, and delivers energy. GEA involved over 500 specialists from a range of disciplines, industry groups, and policy areas, to identify pathways and policies to facilitate equitable and sustainable energy services for all. Germany was a significant contributor to the GEA with Manfred Konukiewitz of the German Federal Ministry for Economic Cooperation and Development and John Schellnhuber, former Director of the Potsdam Institute for Climate Impact Research (PIK) serving on GEA governing Council. Over 50 German researchers authored or reviewed the assessment and one German organization (Deutsche Gesellschaft für Internationale Zusammenarbeit) sponsored the GEA.

Findings relevant to Germany were outlined at the German launch of the GEA by IIASA at the Federal Ministry for the Environment in Berlin in 2012. Areas of particular interest were the analysis of the major energy challenges, the evaluation of the energy resources and technological options available to build a sustainable energy system, and the policies and investments needed to make these future systems a reality.

Outcomes from the GEA also included the adoption of GEA’s findings as the three key objectives of the United Nation’s Sustainable Energy For All (SE4ALL) initiative on energy access, energy efficiency, and renewable energy.

Other German-IIASA collaborations have explored the roles that technology, risk, and the environment can play in energy transitions:

- Researchers from the IIASA Energy Program and PIK collaborated with international banks to assess the financial implications of deep decarbonization strategies. The IIASA and PIK team contributed to the methodology and development and provided detailed scenario data from both the IIASA MESSAGEis-GLOBIOM integrated assessment model and the PIK REMIND-MAgPIE model, developing factor pathways for individual economic sectors in different world regions. The findings were published in *Nature Energy* 3 in 2018.
- With PIK and Stanford University’s Energy Modeling Forum (EMF), IIASA coordinated a major research project combining 18 different global energy-economy models to explore the role of technology for achieving ambitious climate targets.
- IIASA risk experts have collaborated with a range of German researchers at PIK, the Renewable Grid Initiative, and University of Hamburg on the opportunities and risks of using concentrated solar power from North Africa to fuel Europe, and the barriers to expanding EU electricity grids.
- The German Aerospace Center (DLR) and IIASA partnered on the EU-funded EnerGEO project to assess the current and future impact of energy use on the environment by linking environmental observation systems with the processes involved in exploiting energy resources which was completed in 2013.
Research collaborations to tackle climate change

Achieving Germany’s goal of reducing greenhouse gas emissions by 80–95% by 2050 will require adopting and implementing the most effective and efficient strategies. The holistic approach of systems analysis can help identify strategies that reap multiple benefits across sectors and regions, as well as avoid policies that lead to negative side effects in remotely connected activities. Numerous joint studies between IIASA and German researchers have adopted this approach through the use of integrated assessment models and have been exploring how to tackle climate change from multiple angles.

The IIASA integrated assessment model, GAINS, identifies smart mixes of measures to simultaneously cut air pollution and greenhouse gas emissions in the most cost-effective way. It has been applied successfully to many international environmental negotiations. Experts from the Federal Environment Agency have visited IIASA to learn more about GAINS and how it guides EU policy. Other German-IIASA collaborations using GAINS include:

- IIASA led a consortium of organizations including the University of Bonn as part of the EU-funded EC4MACS project, to develop a toolbox of well-established modelling tools to enable policy makers to explore the synergies and interactions between climate change, air quality and other policy objectives including EU energy, transport and agricultural policies. The research has informed the revision of the EU’s Thematic Strategy on Air Pollution and was completed in 2013.
- Germany is a party to the Convention on Long-Range Transboundary Air Pollution—one of the first international environmental treaties that has helped Europe slash air pollution. At the centre of the treaty is the IIASA GAINS model, and the Convention, through its Network for Integrated Assessment Modeling (NIAM), has encouraged parties to collaborate with IIASA and develop their own national integrated assessment models as a means to enhance national activities to cut air pollutants. The French-German Institute for Environmental Research (DFIU-IFARE) is part of NIAM and has collaborated with the GAINS team to establish a German integrated assessment model to analyze measures to tackle air pollution.
- German researchers from the Institute for Advanced Sustainability Studies and the University of Leipzig collaborated with the IIASA GAINS modeling team to identify measures to curb the release of short-lived climate pollutants on the EU-funded project ECLIPSE which was completed in 2014. An earlier holistic analysis of the short-lived climate pollutants by the GAINS team and international partners had shown the multiple benefits of reducing these pollutants for near-term climate change, food and energy security, the environment and public health.
- IIASA and German researchers used GAINS to improve the understanding of emissions from agriculture, including with the University of Bonn on projections of these emissions, and with the Thünen Institute of Climate-Smart Agriculture on the potentials for reducing such emissions.
- The EU-funded ECLAIRE project with the Forschungszentrum Jülich, Karlsruhe Institute of Technology, the University of Bonn, and IIASA, is researching the effects of climate change on Europe’s ecosystems was completed in 2015.
- IIASA worked with the Max Planck Institutes for Meteorology and for Chemistry on the EU-funded PEGASOS between 2011 and 2014 to enhance the understanding of the interactions of climate and atmospheric chemistry in the past, present and future.

Other collaborations in applying integrated assessment models have used IIASA MESSAGE (Model for Energy Supply Strategy Alternatives and their General Environmental Impact) model which aids medium- to long-term energy system planning, energy policy analysis, and scenario development. These include:

- Joint studies with PIK on: (1) the co-benefits of climate policy for air pollution, energy security and economic growth as part of the EU-funded LIMITS project; (2) mitigation pathways and associated costs as part of the EU-funded AMPERE project, along with researchers from the University of Stuttgart and Climate Analytics, both were completed in 2014; and (3) the analysis of costs and impacts of mitigation policies in order to trigger the development of a new generation of Integrated Assessment Models as part of the EU-funded ADVANCE project which was completed in 2016 and included the DLR as a project partner.
DLR also partnered with IIASA to generate a permanent monitoring system of key factors relevant to the development of the air transport sector ranging from passenger data to greenhouse gas emissions to population change as part of the EU-funded MONITOR project which finished in 2011.

As authors of the IPCC Working Group III Fifth Assessment Report, IIASA researchers worked with researchers at Ecofys, Centre for European Economic Research (ZEW), Mercator Research Institute on Global Commons and Climate Change (MCC), PIK, University of Leipzig, Wuppertal Institute for Climate, Environment and Energy.

Transformations towards a sustainable future

IIASA researchers, have been working with a number of international partners, including PIK and the German Development Institute (DIE) on the World in 2050 (TWI2050) initiative, which has been established to provide scientific foundations for the 2030 Agenda. It is based on the voluntary and collaborative effort of more than 60 authors from about 20 institutions, and some 100 independent experts from academia, business, government, intergovernmental and non-governmental organizations from all the regions of the world, who met three times at IIASA to develop pathways toward achieving the Sustainable Development Goals (SDGs).

Two reports have currently been published. Transformations to Achieve the Sustainable Development Goals in 2018, which was presented at the United Nations Science, Technology and Innovation Forums and the United Nations High-level Political Forums and also at a high level meeting focusing on governance organized by the DIE in Bonn, Germany. The second report, The Digital Revolution and Sustainable Development: Opportunities and Challenges was published in 2019.

IIASA researchers also contributed to a major report from the Germany Advisory Council on Global Change (WBGU), which examined the trend of urbanization and its implications for sustainability. They analyzed the infrastructure and metabolic needs and patterns of cities globally. The research was published in report Humanity on the Move: Unlocking the Power of Transformative Cities in 2016.

Selected publications resulting from IIASA-German collaborations

IIASA work is underpinned by high-quality science, which is regularly published in high impact publications. A selection of current publications is presented here and full list can be found in appendix 4:

**Linking Climate and Development Policies – Leveraging International Networks and Knowledge Sharing (CD-LINKS) project**

IIASA is coordinating the Linking Climate and Development Policies – Leveraging International Networks and Knowledge Sharing (CD-LINKS) project. In collaboration with the Potsdam Institute for Climate Impact Research, and other partners, the project explores national and global transformation strategies for climate change and their linkages to a range of sustainable development objectives.

**CD-LINKS** aims to:

- Develop the next generation of globally consistent national low-carbon pathways.
- Establish a research network and capacity building platform to enable knowledge-exchange between European institutions and other key players within the G20. New funding is currently enhancing and expanding the network.

**Projecting demographic change in Germany**

IIASA demographers study and project the changing composition of population for all countries of the world. They produce one of the few independent alternatives to the demographic projections of the UN Population Division. As a testament to the quality of IIASA demography, the IPCC in 2011 adopted IIASA population projections as its source data in all modeling for the Fifth Assessment Report; and UNESCO has adopted IIASA’s demographic methods as part of its literacy forecasting.

The Institute’s interdisciplinary setting has encouraged its demographers to research beyond the traditional boundaries of demography and to explore how changes in society, economy, and the natural environment influence the health and mortality, migratory patterns, and reproductive behavior of human society.

An example of this broader approach has been the development of research methods to project population by level of education. This equips researchers with the tools to explore the implications of different education policies on a country’s future fertility, life expectancy, migration, and population level as well as economic growth and ability to adapt to climate change. In 2014 IIASA published the first projections of educational attainment by age and sex for 195 countries with Oxford University Press. Findings for Germany show how different policies over the next few decades could lead to the country’s 2010 population of 82.3 million remaining close to 82 million by 2060 or falling to around 60 million.

IIASA was established in 1972 to use scientific cooperation to build bridges across the Cold War divide and research growing global problems on a truly international scale. Today the soft power of science diplomacy continues to help IIASA member countries through using scientific cooperation to improve international relations, and through international teams jointly researching controversial issues to find consensus such as through integrative assessments of the future for the Arctic or of the economic integration of Eurasia.

In addition, IIASA also maintains its original bridge-building objective through attracting member countries that represent a range of geo-political interests (see full list of members: Back page). For instance, both Russia and the US are members; as are Brazil, China, India, and South Africa. Several key factors also unite all IIASA member countries: their interest in systems analysis, scientific and academic infrastructure, economic stability and the geopolitical role in future global transitions. With this in mind, IIASA negotiated membership with Iran and Israel.
Other population studies research aging:

- A recent study showed how new measures of aging, combined with United Nation’s (UN) population projections indicate that population aging is likely to end before 2100 in China, Germany and the USA. The study combines new measures with UN probabilistic population projections, producing a new set of age structure projections, showing that population aging will peak in Germany by the year 2040. The findings were published in the journal *PLoS ONE* in 2017.
- An analysis with the Max Planck Institute for Demographic Research explored the advantages of demographic change leading to fewer, older people who were smarter and healthier.
- A study researched aging based not on people’s chronological age but on remaining life expectancy, people’s health and cognitive function among other measures for Germany, Japan, Russia, and the US.
- Research with Otto Friedrich University examined the relationships between cognitive performance, social participation and behavioral risks, taking into account age and educational attainment.
- Collaborations between IIASA and Jacobs University include: (1) findings that older people were perceived as more competent in countries in which more older people participated in paid or volunteer work, independent of life expectancy and the average education, gender makeup, and average cognitive abilities of the older population; and (2) an investigation into changing cognitive abilities among people over 50.

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Many of today’s most pressing challenges do not stop at international borders. IIASA research areas such as climate change, water scarcity, and poverty are affected by multiple factors across the globe. In turn these global problems have impacts on nations, regions, and continents. Finding long-lasting solutions to these challenges requires scientific expertise that is free from the interests of a single nation. IIASA National Member Organizations recognize this need and that their investment in IIASA is a contribution to a global public good. And the benefit of this contribution is paid back to global researchers, policymakers, and citizens in multiple ways as the following examples show:

1. **IIASA supports the climate change research community by hosting the Representative Concentration Pathways (RCP) database.** The database provides data on greenhouse gas emissions for four different future scenarios that underpin the analysis of thousands of climate change researchers. IIASA also calculated the data for one of the scenarios, all of which have been developed for the world’s most comprehensive analysis of climate change—the IPCC’s (Intergovernmental Panel on Climate Change) Fifth Assessment Report.

2. **IIASA research provides scientific guidance to the Convention on Long-range Transboundary Air Pollution of the United Nations Economic Commission for Europe.** This international environmental treaty between 33 countries has slashed air pollution in Europe, improving people’s health and countries’ crop production. IIASA GAINS model guided negotiators and policymakers as they worked on the treaty to identify the most cost-effective approach to cleaning Europe’s air. The negotiators chose the GAINS model not only because of its accuracy and usability but also because it had been developed by an international team with funding from multiple countries, which assured them that the model was nationally unbiased.
The carbon cycle, farmland, and forests

IIASA works with a range of German research institutions to explore different aspects of the global carbon cycle in order to reduce the huge scientific uncertainties surrounding how the natural world both releases and absorbs greenhouse gases, which in turn will improve climate change predictions. Collaborations range from remote sensing to forest management to biofuels and include:

- A combined study with the Helmholtz-Centre for Environmental Research (UFZ), Germany and other partners based on the findings of the Unlocking Forest Finance project which ran from 2013-2018, showed how ‘blended finance’ could help transitions to sustainable landscapes. Particularly, how models that combine funding from commercial, public and philanthropic sources could contribute to financing sustainable landscapes. The findings were published in the journal *Ecosystems Services* in 2019.

- Studies with Friedrich Schiller University Jena harnessed the power of satellite imagery to remotely observe different elements of the carbon cycle and then develop and test different techniques to process this wealth of information into inventories that researchers can use to monitor the release and uptake of greenhouse gas emissions. Work included an assessment of Northern Eurasian forests in the EU-funded ZAPAS. IIASA also worked with the Max Planck Institute for Biogeochemistry, FastOpt, and the University of Hamburg to develop an operational global integrated carbon observation and analysis system as part of the EU-funded GEOCarbon project. Both projects ran from 2011-2014.

- The IIASA global land use model GLOBIOM and its global forestry model G4M support multiple research projects that have improved our understanding of how Europe’s forests and farmland—and people’s management of them—release and absorb greenhouse gases. Other collaborations use the models to analyze how climate change and associated government policies impact Europe’s agricultural and forestry sectors, which account for some 50% of Europe’s land surface. Projects and partners include:
  - The EU-funded GHG Europe project with Johann Heinrich von Thünen Institute, Max Planck Institute for Biogeochemistry, Weihenstephan-Triesdorf University of Applied Sciences, University of Heidelberg, and PIK.
  - The European Centre for Agricultural, Regional and Environmental Policy Research (EuroCARE) on the EU-funded EUCLIMIT project between 2011-2014.
  - The EU-funded CC-TAME project with EuroCARE and the Max Planck Institute for Meteorology which ran until 2011.
  - Helmholtz Centre for Environmental Research - Centre for Materials and Coastal Research (HZG), Global Climate Forum, and PIK on the EU-funded IMPACT2C project which ran between 2011 and 2015.

- The impact of extreme weather events on the carbon cycle is the focus of the EU-funded CARBO-Extreme project, which is coordinated by the Max Planck Institute for Biogeochemistry and the Max Planck Institute for Meteorology, and included IIASA, Leibniz University Hannover, and PIK as project partners. Together they improved the understanding of how extreme weather events impact the Earth’s ability to absorb carbon; the project was completed in 2015.

IIASA researchers also explore land-use sector policies to address climate change, including biofuels and REDD (Reducing Emissions from Deforestation and forest Degradation):

- Funded by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), IIASA and international partners developed technical know-how and capacity in designing efficient, effective and environmentally relevant policy strategies for REDD.

- Mercator Research Institute on Global Commons and Climate Change (MCC), IIASA, and other partners are analyzing incentives to protect global forests in the future via REDD schemes.
The EU-funded S2Biom project developed research tools and a roadmap for Europe to make more efficient use of the continent’s biomass resources. German partners included: Agency for Renewable Resources (FNR), International Institute for Sustainability Analysis and Strategy, SYNCOM, the University of Freiburg, and WIP – Renewable Energies. The project ran from 2013-2016.

Other research has developed new indicators: (1) for land-use as part of a project funded by Germany’s Environmental Agency and (2) for sustainable development as part of the EU-funded IN-STREAM project with the Centre for European Economic Research, the Ecologic Institute, and the University of Stuttgart until 2011.

IIASA collaborates with PIK on pioneering studies to conduct multiple model assessments of the impacts of climate change (ISI-MIP) and of agricultural production (AgMIP). By carrying out comprehensive and rigorous model inter-comparisons, researchers find more robust findings and improve the underlying models. The results were published in a 2013 special issue of PNAS.

IIASA Models, Tools, and Data

Through intense data gathering, computer modeling, and other advanced research methods, IIASA provides a country’s researchers and their policymakers with the essential numbers and tools to select the most effective policies. For example:

- Transport is one of the key contributors to past and future climate change. Historical emissions from transportation contributed to about 9% of temperature change in 2000, and this share may increase to 20% by 2100. IIASA research analyzed the climate impact of Germans travelling nationally and internationally. The analysis found the total climate impact is determined almost entirely by car (~46%) and air travel (~45%), with smaller contributions from public transportation. The wealthiest top 10% of the German population is responsible for almost 20% of the total climate impact of travel, but two-thirds of climate impact comes from the broad middle classes. The study also showed that the few long trips (longer than 100 km, by any means of transport) stand for more than half of the total climate impact with one long-distance holiday return trip having the same impact as more than two months of regular urban travel. The research concluded that a combination of different behavioral changes, efficiency improvements and transport policies will be needed to mitigate emissions from travel. (Source: Aamaas B, Borken-Kleefeld J, Peters GP (2013). The climate impact of travel behavior: A German case study with illustrative mitigation options. Environmental Science & Policy 33:273-282)

Many of the research projects summarized in this Info Sheet draw on analyses from IIASA’s models, tools, and data, including:

- Reducing air pollutants and greenhouse gas emissions simultaneously (GAINS model).
- Planning a sustainable energy system (MESSAGE model, Global Energy Assessment Scenario Database).
- Reducing energy poverty (Energy Access Interactive Tool [ENACT]).
- Improving food security through identifying yield gaps (GAEZ model) and assessing competition for land use between agriculture, bioenergy, and forestry (GLOBIOM model).
- Financial disaster risk management (CATSIM model).
- Projecting future population (Demographic multistate modeling).
Activities with Countries: Germany

Increasing climate and disaster resilience

Joint research has assessed ways to improve proactive climate and disaster risk management through helping countries and sectors prepare for natural disasters, providing management tools for those working in disaster prevention and emergency preparation roles, and identifying effective ways to adapt to anticipated changes from climate change.

- Recent IIASA research looked at the governance factors that contribute to the success of nature-based solutions beyond their cost-effectiveness and technical viability by identifying the key governance enablers and (co)benefits of nature-based solution success stories based on three case studies: Nocera Inferiore (Italy), Munich (Germany), and Wolong (China). The work formed part of the formed part of the PHUSICOS Innovation Action project funded by the EU Horizon 2020 research and innovation program with the findings published by IIASA in 2019.

- Improving disaster risk management via the development of the IIASA CATSIM model, which has helped countries, including Madagascar and Mexico, to prepare public finances to fund rescue, recovery and re-building in case of major natural disaster. CATSIM was used in the EU-funded MEDIATION project which involved IIASA and nine research partners including the Global Climate Forum (GCF) and PIK. The project ran from 2011-2015.

- Decision support tools include: (1) landslide risk management tools as part of the EU-funded Safelands project which included the Max Planck Society as a research partner and ran until 2012; (2) multiple hazard management tools from an analysis with the German Committee for Disaster Reduction (DKKV), Helmholtz Centre Potsdam, and Karlsruhe Institute of Technology; (3) new multi-sector partnerships to reduce or redistribute risk as part of the EU-funded ENHANCE project and including German partners HZG and Potsdam University which ran from 2012-2016.

- A collaboration with the Technical University Dortmund and other partners helped to model the anticipated changes in natural disaster patterns in Europe in order to assist emergency preparedness officials and to train young scientists in the risk management skills needed to respond to future disasters. The joint study is an EU-funded project, CHANGES, ran from 2011-2014.

- Other climate change adaptation studies include: (1) developing methods to appraise different climate change adaptation actions, including the management of extreme weather events, as part of the EU-funded ECONADAPT project with Ecologic Institute and PIK among other partners, which ran from 2013-2016; (2) an analysis of economic instruments to incentivize adaptation to climate change with the Hamburg Institute of International Economics; and (3) assessing the biophysical impacts and socio-economic risks associated with a global temperature increase of 2°C for Europe and the most vulnerable regions of the world with the Climate Service Center, Hamburg as part of the EU-funded IMPACT2C project, which ran from 2011-2015.

Basic research: Advancing the methods of systems analysis

Advancing the methods of systems analysis ensures system analysts, both at IIASA and elsewhere, are equipped with the latest research tools. IIASA has recently worked with German organizations in a range of collaborations to advance data quality and research methods, these include:

- Accurate data underpins all studies. Over the past 5 years as part of the Geo-Wiki project, IIASA and partners including the University of Freiburg have been leading a team of citizen scientists to improve maps of different land uses by examining satellite data to identify exactly how people use the land. The rise of citizen scientists provides potential to radically improve the accuracy of maps and subsequently the quality of the research and policy recommendations that are based on mapping data.

- Researchers from IIASA and the Federal Institute for Geosciences and Natural Resources (BLR) are also collaborated on the ICT COST Action TD1202 project to explore and enhance the role that citizen scientists play in mapping.
One question the research teams always get is whether the analysis from laypeople is as good as that from experts. In other words, can they rely on non-experts to provide accurate data analysis? Together with a researcher from the University of Freiburg, IIASA researchers showed in the journal *PLOS ONE* (2013) that data gathered and analyzed by non-experts can rival the quality of data from experts.

- IIASA brought its expertise in modeling complex systems including characteristics such as thresholds, feedback loops, avalanche effects, and irreversibility, to the EU-funded project, COMPLEX, which included the Max Planck Institute for Meteorology. The researchers developed a suite of modeling tools and decision-support systems to inform national and supra-national policy and support communities across Europe working to make the transition to a low-carbon economy. The project ran from 2012-2016.

- IIASA’s mathematicians also work with researchers from the University of the German Federal Armed Forces and the University of Duisburg-Essen on economic and environmental modeling; with RWTH Aachen University on multiple criteria analysis; and with the University of Kiel on using different indicators as a means to understand long-term ecosystem dynamics.

### Analyzing global and European water challenges

Progress toward meeting global water challenges has not been enough. For example, 770 million people lack access to improved sources of drinking water, and 35 million die prematurely each year from water-related diseases. In 2013, IIASA launched a flagship initiative, Water Futures and Solutions, to conduct an integrated analysis of global water challenges and solutions of which the Center for Environmental Systems Research (CESR) at the University of Kassel are a contributor. Other collaborations in this are include:

- The Supporting risk assessment and adaptation at multiple spatial scales: CO-development of Methods to utilize uncertain multi-model based Information on freshwater-related hazards of Climate Change (CO-MICC) project began in 2018, in collaboration with IIASA researchers and several German partners, including the Goethe-University Frankfurt (GU) and PIK. The project aims to co-develop methods for providing and utilizing MME data on freshwater-related hazards for risk and adaptation assessments at various spatial scales and to provide these data at a web portal in a suitable way, in order to increase availability and applicability of information for different types of end-users, with a focus on how to address uncertainties.

- IIASA water experts are worked with the Center for Environmental Systems Research at the University of Kassel to contribute to UNEP’s World Water Quality Assessment and identify problem areas of freshwater quality and evaluate policies to address water pollution. The report was published in 2016.

- IIASA water experts joined hydrologists, climate change specialists, and agricultural scholars among other disciplines to contributed to the EU-funded WATCH project to assess the vulnerability of global water resources. German partners in the project were the Max Planck Institute for Meteorology, PIK, and the Universities of Frankfurt and of Kassel, which was completed in 2011.
Capacity Building

Young Scientists Summer Program

The Young Scientists Summer Program (YSSP) develops the research skills and networks of talented PhD students. Program participants conduct independent research within the Institute’s research programs under the guidance of IIASA scientific staff. Since the start of the YSSP in 1977, 120 students from Germany have taken part in the program. Funding is provided through IIASA-German National Member Organization unless otherwise stated. The following 30 young researchers from Germany or undertaking a PhD in Germany have participated in this program since 2010:

YSSP ’19

Nepomuk Dunz (Vienna University of Economics and Business (WU)) studied the opportunities and risks of development banks to close the climate finance gap by extending a North-South Stock-Flow Consistent model, and calibrating it to Austria and the Western Balkans, with international trade and financial capital flows.

Stefanie Klose (University of Freiburg) researched the relevance of in-use stocks and flows, vintage tracking and waste treatment for climate change mitigation pathways. As an important step towards the integration of the IAM and IE perspectives on society’s biophysical basis help to provide more profound political advice.

Jakob Knauf (University of Siegen) researched determining the technological co-dependence of energy technologies on related infrastructures for different building types from a private investment perspective.

Business can benefit from science through the analysis and knowledge it provides. In turn, science can benefit from business through its experience on the ground and in implementation. IIASA also recognizes that closer collaboration between business and its researchers can increase the impact of the Institute’s work. Not surprisingly, IIASA is seeing a growing number of contracts with commercial partners, including:

- The global insurer, Zurich Insurance Group, began working with IIASA in 2013 to identify and address research gaps on flood resilience and community based disaster risk reduction, demonstrate the benefits of pre-event risk reduction over post-event disaster relief and to improve public dialogue around disaster resilience.
- The German carmaker, Daimler AG, has collaborated with IIASA researchers to assess biofuel potential from marginal and degraded lands in India and Brazil.
- The Brazilian energy company, Petrolero Brasileiro, was one of nineteen sponsors of IIASA’s Global Energy Assessment.
- The research institute of the Japanese carmaker, Toyota, has an ongoing collaboration with IIASA to research measures to reduce ozone emissions in Asia.
- The multinational consumer goods company, Unilever, funded IIASA’s agricultural experts from 2008-10 to analyze yields and land suitability of key agricultural crops under a changing climate.

Other interactions with business include researching with German organizations, 50Hertz and TenneT how to expand the European electricity grid to integrate a growing share of electricity from renewable sources as part of the EU-funded BESTGRID project (2013-15). In addition, IIASA is exploring ways that it can work more closely with multinational corporations, including Anglo-Dutch corporations Unilever and Shell, particularly through input to the development of their global sustainable business plans.
Fabian Stenzel (Potsdam Institute for Climate Impact Research (PIK)) analyzed how strict compliance to the regional planetary boundary of freshwater by respecting environmental flow requirements would influence water stress. Simulations were performed with the dynamic global vegetation model LPJmL.

Julian Joseph (Wirtschaftsuniversität Wien) studied agricultural productivity and foreign direct investment (FDI) in land in Sub-Saharan Africa.

YSSP’18

Davit Stepanyan (Humboldt University of Berlin (HU Berlin)) Applied Gaussian Quadratures in the Global Biosphere Management Model (GLOBIOM) as an efficient approach for uncertainty analysis.

YSSP’17

Karl-Kien Cao (German Aerospace Center, Institute of Engineering Thermodynamics) incorporated power exchange limitations into energy system models to define spatial aggregations while maintaining information regarding limited electricity transmission capabilities.

Tobias Sieg (University of Potsdam) Assessed the costs and the duration of business interruptions after flood events in Germany to provide valuable insights into the vulnerability of societies to floods to help enhance adaptation strategies for the future.

YSSP ’16

Clara Orthofer (Technical University of Munich) studied scenarios for the development of South Africa’s power system under the influence of the United Nations Framework Convention on Climate Change (UNFCCC) Paris agreement.

YSSP’15

Oludunsin Arodudu (Leibniz Centre for Agricultural Landscape Research) conducted a spatio-temporal analysis of life-cycle assessment indicators within a sustainability assessment framework for assessing agro-bioenergy land use.

Erasmus Zu Ermgassen (University of Cambridge), a German national, studied the influence of property size on sustainable agricultural intensification in Mato Grosso, Brazil.

Franziska Gaupp (University of Oxford), a German national, investigated globally correlated drought events in six major food-producing areas and their overall influence on agricultural production.

Yolanda Cristina Lopez Maldonado (Ludwig-Maximilians-University) used material-flow analysis to identify the human drivers affecting groundwater system of Yucatan, Mexico.

Mehdi Ghodrati Shojaei (Alfred Wegener Institute for Polar and Marine Research) used biological trait analysis to explore the ecological functioning of species living in or on the seabed and to compare functional diversity across different species. (Funded by IIASA)

Johanna Wehkamp (Mercator Research Institute on Global Commons and Climate Change) explored if weak institutions drive deforestation by identifying relevant governance indicators for global forest modeling.

YSSP ’14

Thi Luu (Kiel University) will use various modeling approaches to research the interrelations between the financial sector and the macro-economy.

YSSP ’13

Veronika Bertram Hümmer (Humboldt University) researched how Mongolian nomadic households cope with and reduce the risks caused by dry summers and harsh winters—something that is expected to increase with climate change.

Juliana Gil (University of Hohenheim) explored how anti-deforestation measures and high grain prices may lead to livestock farming intensification in Mato Grosso, Brazil.

Prajal Pradhan (Potsdam Institute for Climate Impact Research) studied the pathways to increase crop yields including what anthropogenic inputs will be needed and what environmental stresses will be caused by increasing this agricultural productivity.
YSSP ’12

Christoph Bertram (Potsdam Institute for Climate Impact Research) modeled how energy demand and emissions in the industry sector may evolve under different technology, energy supply, resource, and emission price assumptions.

Sebastian Busch (Vienna University of Technology), a German national, developed a regulatory framework to facilitate cooperation among European states on the generation and transmission of renewable energy.

Stefan Schreier (University of Bremen) estimated nitrogen emissions from wild fires in northern Eurasia for 2001 to 2010 (Funded by Austrian NMO).

YSSP ’11

Hans-Christian Gils (German Aerospace Center) assessed the potential for combined heat and power production in Europe and its effect on emissions of air pollutants and greenhouse gases.

Michael Hüttner (Max-Planck Institute for Biogeochemistry) modeled deforestation drivers in Papua New Guinea in order to research options for the spatial and temporal distribution of economic incentives in a scheme to reduce emissions from deforestation and degradation (REDD).

Lucia Maria Seebach (University of Copenhagen), a German national, improved the mapping of forest resources (biomass and biodiversity) by evaluating the influence of input data quality on the uncertainty of forest resource model outputs.

YSSP ’10

Goran Mihelcic (University of the Federal Armed Forces, Munich) studied decision support tools to help in the management and protection of critical infrastructure in the event of an extreme event.

Markus Tum (German Aerospace Center) improved estimates of carbon fixation by agricultural, forest or grassland vegetation with two different modeling approaches for a range of case studies including selected farms, single fields, and defined forest and grassland areas.

Sponsoring Students from the Developing World

The following doctoral students have also been generously sponsored by the IIASA German National Member Organization to participate in the YSSP since 2010:

Ali Seyed Kharazzi (YSSP’12 & from Iran) explored whether and why the sustainability of economic networks tends to be more dependent upon the resiliency or the efficiency of the network.

Tuyen van Nguyen (YSSP’11 & from Vietnam) used an eco-evolutionary model to analyze how certain aquatic organisms respond to external environmental disturbances such as oxygen, temperature, and pollution.

Arame Tall (YSSP ’10 & from Senegal) researched how farmers could use climate and weather forecasts to reduce their vulnerability to hydro-meteorological disasters.
Regional Young Scientists Summer Program

In 2012 IIASA, National Research Foundation (NRF) of South Africa, and the South African Department of Science and Innovation launched the Southern African Young Scientists Summer Program (SA-YSSP)—the first regional YSSP. The program ran for three consecutive years, between November and February in 2012/13, 2013/14 and 2014/15. During this time, 83 doctoral students from 30 countries participated, including 35 students from or studying in South Africa and 14 students from other African nations. In a competitive selection process, three doctoral students who were German or studying in Germany were awarded fellowships to take part in the program:

Noor Jamal (SA-YSSP 2013-14 & University of Flensburg) conducted a techno, economic, and environmental analysis of electrification options in remote and rural areas of South Africa.

Emnet Tadesse Woldegiorgis (SA-YSSP 2013-14 & University of Bayreuth) analyzed regional higher education reform initiatives in Africa.

Verena Helen van Zyl-Bulitta (SA-YSSP 2012-13 & University of Leipzig/University of Stellenbosch) investigated negative externalities of adaptation plans on a conceptual level in the African context through direct engagement with stakeholders in in-depth interviews.
Prospects for Future IIASA-German Activities

This Info Sheet summarizes recent research collaborations between IIASA and Germany (see pages 6 to 14). Significant potential remains to further intensify the IIASA-German relationship through developing a range of new joint activities including:

- **Enhancing German expertise in applying system analysis to national problems:** Developing bespoke German versions of IIASA global models would allow researchers and policymakers to look at complex global problems and their impact on Germany in a holistic and integrated way.

- **Conducting international assessments in areas of German strategic interest:** Germany was a significant contributor to the IIASA Global Energy Assessment which brought together over 500 specialists to transform the way society thinks about, uses, and delivers energy. The new IIASA Strategy for 2021-30 will empower its members to collectively initiate large-scale interdisciplinary projects of high relevance to the regions where its members are located.

- **New partnerships between IIASA and German institutions to win grants from international research funders:** IIASA high-quality research and international research network makes it highly competitive in its applications for international research funds. About half of IIASA income comes from additional funds through contracts, grants and donations. This is growing and has increased by up to 25% from €8.4 million in 2017 to €10.5 million in 2018.

- **Using international scientific cooperation to support diplomacy:** IIASA was established in 1972 to use scientific cooperation to build bridges across the Cold War divide and research growing global problems on a truly international scale. Today the soft power of science diplomacy continues to help IIASA member countries through using scientific cooperation to improve international relations, and through international teams jointly researching controversial issues to find consensus, free from the constraints of national self-interest (see box: Research to support science diplomacy: page 9).

- **Academic training opportunities for young German scientists:** There is significant potential to enhance participation by young German postdoctoral students in IIASA programs to develop international and interdisciplinary research skills (see page 15: Capacity Building).
Several IIASA researchers hold positions at universities and other institutions in Germany. These include, Wolfgang Lutz (member, German Academy of Sciences Leopoldina; foundation board member, Berlin Institute for Population and Development); Nebojsa Nakicenovic (former member, German Advisory Council on Global Change; member, International Advisory Board, Helmholtz Programme on Technology); Yoshihide Wada (Member, International Advisory Board, Helmholtz Horizon 2020 project on Development of a Global Gravity-based Groundwater Product).

IIASA researchers have also made numerous presentations in Germany, a recent selection follows:

- **Florian Kraxner** on “Biomass, Bioenergy, and Negative Emissions” at the IEA Bioenergy Annual Meeting in Berlin in 2019.
- **Fabian Wagner** on “Modeling Environmental Policies and Interventions” at the International Symposium on Integrative Modelling in Sustainability Systems in Kassel in 2018.
- **Thomas Schinko** on “Applying Recent Insights from Climate Risk Management to Kick-Start the Operationalization of the Loss and Damage Mechanism” at the European Consortium for Political Research in Hamburg in 2018.
- **Markus Amann** on “Decision Support Tools Relevant for Controlling the Hemispheric Transport of Air Pollutants” at the joint workshop of the Long-Range Transboundary Air Pollution Task Forces on Integrated Assessment Modelling and the Hemispheric Transport of Air Pollutants in Potsdam in 2016.

Other examples of scientific exchange include:

- 1,211 publications have resulted from IIASA-German collaborations since 2010.
- Since 2010, 30 doctoral students from Germany, studying in Germany or funded by the German NMO have gained international and interdisciplinary research experience from participating in the IIASA Young Scientists Summer Program.
- Over 200 researchers, advisors, and diplomats from Germany have visited IIASA and over 550 Germans have participated in IIASA events since 2010.
- IIASA scientists have visited Germany over 1000 times.

**Appendices**

Summaries detailing the presented information can be requested by contacting the External Relations Department (externalrelations@iiasa.ac.at).
About IIASA

Founded in 1972, the International Institute for Applied Systems Analysis (IIASA) conducts policy-oriented research into problems of a global nature that are too large or too complex to be solved by a single country or academic discipline. IIASA research is across and at the intersection of natural, human, social, knowledge and technology systems to support the development of integrated solutions to global sustainability challenges.

IIASA is at the center of a global research network of around 3,500 scholars and over 830 partner institutions in over 65 countries. It is funded and supported by its National Member Organizations which represent the scholarly community in the following countries:

Austria, Brazil, China, Egypt, Finland, Germany, India (Observer), Indonesia, Iran, Israel, Japan, Mexico, Malaysia (Observer), Norway, Republic of Korea, Russia, South Africa, Sweden, Ukraine, United Kingdom, United States of America, Vietnam.

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