

Imperial College
London

outlook 2013



Grantham Institute for Climate Change

An institute of Imperial College London

FROM THE RECTOR

Foreword

SINCE ITS ESTABLISHMENT IN 2007 the Grantham Institute for Climate Change has become an integral part of Imperial College London, catalysing exciting research, developing new talent, and linking that research to decision makers in government and business.

Working with researchers across the College, the Institute has been instrumental in facilitating and nurturing cross-disciplinary programmes. One such programme has brought together researchers from the Maths, Physics, and Earth Science and Engineering departments to understand the interactions between the oceans and the atmosphere. This is fundamental research, but the insights it will give into extreme weather events such as cyclones and the processes that govern both natural variability and change in the climate system will be vital to our projections of, and responses to, climate change.

Through the Institute's formal association with its sister institute at the London School of Economics and the Divecha Centre at the Indian Institute of Science, Bangalore, it is able to complement the world-class science and engineering expertise at the College with that available at these institutions. These and other partnerships allow the Institute to build on its translation of leading edge research, delivering focused policy-relevant evidence to inform decision makers in government and business. I was pleased to be able to participate in the Institute's joint workshop with the Divecha Centre in Bangalore last January when the Chief Secretary of the Karnataka State Government gave a hugely impressive keynote setting out the five major development challenges facing the state, including, of course, the related issues of climate change, water, food and energy.

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The UK government-funded programme on “Avoiding Dangerous Climate Change” (AVOID) led by the UK Met Office Hadley Centre is another example. Completed earlier this year, the Institute led the College's involvement in the AVOID programme alongside colleagues from the Walker Institute and Tyndall Centre, all working together to inform Government decision making on the science and potential responses to climate change.

The Institute's strong international reputation has facilitated involvement in other international initiatives such as the joint UK-India research programme, led by researchers from Imperial and IISc Bangalore, looking at water resource exploitation in the Ganges basin and how this interacts with the regional climate.

The Institute also continues to develop its links with business and industry in the UK and overseas. Increasing numbers of businesses are realising that they need to develop sustainability strategies in order to face the future challenges that climate change will bring. The Grantham Institute provides the climate science context and technical research expertise needed to help businesses understand and explore their future strategic landscape and options.

Over the coming years the Grantham Institute will strengthen these links even further and will continue to build on its excellent work addressing climate change and related challenges and opportunities.

Sir Keith O'Nions

President and Rector, Imperial College London



Sir Keith O'Nions, President & Rector, Imperial College London, Dr John P. Holdren, Assistant for Science and Technology to President Obama, and Professor Sir Brian Hoskins, Director of the Grantham Institute for Climate Change.

Low-carbon future

GOVERNMENTS AND BUSINESSES AROUND THE WORLD are becoming increasingly aware that climate change requires new approaches to industry and the economy. The Grantham Institute works with them to identify low-carbon technologies that are profitable as well as technically feasible. As a professor of engineering at Imperial College I collaborate closely with the Grantham in this area.

Our work with government is often concerned with the viability of certain technologies. When might they come on stream? At what cost? And what needs to be done to make them happen? We can help government to make better informed choices by providing the information required. One example is a road map for the implementation of carbon capture and storage, the technology of sequestering carbon dioxide deep inside the Earth instead of releasing it to the atmosphere, which we drew up for the UK Department of Energy and Climate Change.

Energy efficiency

As well as government, we also work closely with large energy businesses. They are interested in new energy systems that both reduce costs and improve environmental performance, for example the possible use of hydrogen as a fuel. When you burn hydrogen, no carbon dioxide is released. But you need a low-carbon or zero-carbon way to produce it, perhaps by burning natural gas with carbon capture, or by using electricity from wind power.

It is even possible to create energy systems that absorb carbon dioxide from the atmosphere rather than emitting it. One approach is to use biofuel crops, which consume carbon dioxide as they grow, in a process that captures the carbon dioxide emitted as they burn. Another possibility is to turn the leftover carbon from biofuels into “biochar”, a solid form of carbon that can be added to poor soils to improve their productivity.

My colleagues and I reviewed these ‘negative emissions technologies’ in a Grantham Briefing Paper published in September 2012.



Commercial challenge

The problem of climate change is so big that we will need every approach to solving it, including nuclear power, biomass, renewables and carbon capture, as well as smarter buildings and vehicles. The Institute’s role is to help businesses and governments to do this effectively. Carbon capture and storage is a good example. All the pieces needed for it to succeed already exist, but it will cost money to join them up. We need the UK Government to support the demonstration projects which allow its full potential to be shown.

Everyone knows that we need these technologies but the international negotiations on implementing them seem to have stalled. That is why it is important for us to develop approaches that reduce emissions and also save money, so they are attractive commercially as well as environmentally.

Professor Nilay Shah
Department of Chemical Engineering

“ The problem of climate change is so big that we will need every approach to solving it, including nuclear power, biomass, renewables, and carbon capture, as well as smarter buildings and vehicles.”

A year in the life of the Grantham Institute

MAY

Advising government

Professor Sir Robert Watson, Chief Scientific Advisor to DEFRA, visited the Institute to join in a roundtable discussion with Grantham researchers on DEFRA's climate change programme and the contribution the Grantham Institute could make to it.



JUNE

Climate challenge

Brian Hoskins and Grantham PhD Student, Alistair McVicar, contributed an article on 'The Climate Challenge' to the Green-Alliance/RSPB publication entitled 'Rio+20: Where it should lead'. The publication included views from government, business, NGOs, economics, science and the youth movement on what was needed at the Rio+20 Earth Summit to help embed sustainable development and stability into the decision making of governments, businesses and civil society.



JULY

Industrial impact

Mirabelle Muuls contributed to a report published by DECC on the impact of the first two phases of the EU Emissions Trading System on the industrial sector,

which was well received by both academics and policy makers. Mirabelle also presented her research results on the EU ETS permits allocation mechanisms at the National Bureau for Economic Research Summer Institute in the US.

2012

NOVEMBER

Forum for the Future

The inaugural London Climate Forum was hosted at Imperial College, with the aim of inspiring the next generation of climate innovators across the spectrums of business, government, academia, media and campaigning. Professor Sir Brian Hoskins participated in a panel discussion on the current state of climate change and sustainability.

DECEMBER

Balancing costs

The Grantham Annual Lecture for 2012 was delivered by Dr John P Holdren, Assistant to the President Obama for Science and Technology and Director of the White House Office of Science and Technology Policy. Discussing what action governments should take in the face of uncertainty about the changing climate, Dr Holdren said that the cost of fixing the damage caused by extreme weather events will massively outweigh the cost of doing something about climate change now.



JANUARY

Making research matter

The Institute initiated a joint workshop with the Divecha Centre in Bangalore entitled 'Understanding climate change: working together to meet the challenges'. It explored the challenges faced by communities in India and beyond, discussed the contribution that research universities could make to tackling these issues, and focused on two key areas, namely solar power and low-carbon resilient cities.

AUGUST

Environmental crisis

'Climate Change in a Finite World' was the subject of a talk by Jeremy Grantham, organised by Brian Hoskins, at a workshop hosted by the International Centre for Theoretical Physics in Trieste. The focus of the international workshop was on 'Framing Climate Change Discussions on the Looming Environmental Crisis and Sustainability'.



SEPTEMBER

Low-carbon technologies

Under current policies world energy demand

and emissions are likely to double by 2050. The International Energy Agency's Energy Technologies Perspectives 2012 publication shows how the energy system could be transformed through greater energy efficiency and the integrated use of existing technologies. These findings were discussed at an event hosted by the Grantham Institute, DECC, and the Energy Futures Lab at Imperial.

OCTOBER

Negative emissions

'Negative Emissions Technologies' and their costs were the subject of the Institute's 8th Briefing Paper.



The paper looks at five exemplar negative emissions technologies and addresses the likely energy, economic, environmental and policy implications of the use of the specific technologies.

2013

december

january

february

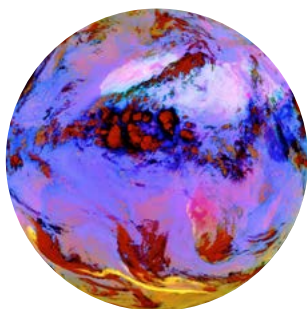
march

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FEBRUARY

Earth observation

Satellite measurements have provided direct observational evidence that recent increases in greenhouse gas concentrations have produced the expected changes to the outgoing energy emitted by the Earth. The latest Grantham Briefing Paper provides an overview of the way measurements from space can provide a basis for the understanding and analysis of climate change.



MARCH

Smart gas

The Grantham Institute together with the Grantham Research Institute on Climate Change and the Environment at LSE launched a joint policy brief on "A dash for 'smart gas'? The future role of natural gas in UK electricity generation" at the House of Commons to the All Party Parliamentary Group on Climate Change.



APRIL

Energy governance

Neil Hirst travelled to Beijing to give presentations on "World Energy Scenarios and Critical Levers for China" and "Global Energy Governance Stalled: Opportunity for China" at the World Energy Council China International Summit. Neil has also written a Grantham Discussion paper on the topic of Global Energy Governance in collaboration with Chatham House.



Climate and variability

THERE IS MORE TO CLIMATE CHANGE THAN GLOBAL WARMING and we are beginning to get a better understanding of the other ways in which our climate system is changing. It is likely to mean more intense weather events, ranging from violent rainstorms to droughts. Paradoxically, there may even be more cold winters in some parts of the world.

Grantham researchers in fields from physics to economics are looking at the full range of issues raised by climate change. They are working on everything from its drivers in the Earth's atmosphere and oceans, to its effects on people, business, and key human activities including food production.



Extreme weather

Professor Sir Brian Hoskins, the Director of the Grantham Institute, is one of the world's most influential meteorologists. One aspect of his work focuses on extreme climatic events: floods, droughts, heavy rainfall, and extremes of heat and cold.

He explains that the term "extreme" covers any weather or climate event that is abnormal for a particular region. Even within the UK, rainfall that is normal for the Highlands of Scotland would be extreme in London.

His interest is in finding out why a specific part of the climate system was especially active at a particular time, causing extreme conditions, and in whether the atmosphere's growing concentrations of greenhouse gases are making these events more or less likely.

Professor Hoskins says that no set of climate records is ever long enough for any researcher's tastes. But the evidence is there, he thinks, to show that heatwaves, heavy rain and flooding are getting more common. The 2003 European heatwave, for example, is "off the



range" of 200 years of careful Swiss weather records. In recent times, high-temperature records are twice as likely to be broken as low-temperature ones.

Sometimes the link between climate change and extreme events is comparatively straightforward. Tropical cyclones form over warm areas of the ocean from which they draw their energy. As temperatures rise, the intense cyclones could become even more intense. Other extreme events may be less directly connected to climate change. But Professor Hoskins warns that in general, a warmer atmosphere holds more water, so that a given storm will produce even more rainfall. "Models and events both seem to be showing that there are already more heavy rainfall events," he adds.

Of all the extreme events he studies, Professor Hoskins regards heatwaves and droughts as the most damaging. They cause large numbers of excess deaths, including many thousands in France in 2003, and in Russia in 2010. This means that they also place a big load on medical and social services. Even more seriously, they reduce food production. In 2010, he points out, Russia ceased grain exports because of reduced production caused by a heatwave which also produced destructive wildfires.

“ Climate change is likely to mean more intense weather events, ranging from violent rainstorms to droughts”



Professor Hoskins warns that key food-producing areas could be disrupted by drought, including regions such as Australia, southern Europe, and parts of the United States. “Spain is a major food supplier to the UK,” he points out. “It would affect British food supplies as well as the Spanish economy if drought reduced food production there.”

One key issue for decision makers is whether extreme events are predictable. Professor Hoskins says that in some cases, such as the El Niño/Southern Oscillation, we know enough to “predict floods and droughts in large areas of the globe.” In other areas we know less, but we can still see where climate change is “biasing the dice” in the direction of more abnormal weather.

It is possible to adapt to some of this change, for instance by better water management and the use of salt-tolerant crops. Social systems can also be improved. Professor Hoskins points out that the deaths in France in August 2003 might have been fewer in any other month. August is the time when many in the social care system tend to be on holiday.

He adds that this set of issues is well-suited to the Grantham approach in which disciplines can work together and learn from each other. Professor Hoskins says that there are strong links to atmospheric and ocean scientists, hydrologists, mathematical modellers, medical scientists and business experts at Imperial and meteorologists at Reading University. He is especially excited about getting mathematicians and statisticians to work on existing weather records.

Understanding the climate system

Arnaud Czaja, Reader in Atmospheric Physics, works on the way heat is exchanged between the Earth’s oceans and its atmosphere. He is now making his skills available to everyone by putting simple but effective models of the climate system online (http://www.sp.ph.ic.ac.uk/~aczaja/EP_ClimateModel.html). He says: “The idea is to create something that can be used in teaching, or by scientists and engineers who are not climate experts. Even a simple model of something like heat storage in the oceans can give a good idea of how much warming we might see in future. So people can use them to make their own predictions.”

Dr Czaja’s own research on heat transport in oceans has recently produced some surprises. He and colleagues in Norway have shown for the first time that even in a coarse climate model, it is rare for large volumes of warm surface water to be transported by the Gulf Stream into the Arctic. Instead, he says, “observation and modelling agree” that warm surface waters mostly recirculate in a loop and rarely reach high latitudes. It is important to understand the mechanisms controlling when the bodies of warm water do reach high latitudes because even small amounts of additional heat could have a large impact on Arctic sea ice.

Assessing the risks

Ralf Toumi, Professor of Atmospheric Physics, has also been making climate change modelling more accessible, this time with a specific audience in mind. His OASIS Open Source Catastrophe Model supported by Climate-KIC allows brokers, insurers and reinsurers to gauge their exposure to extreme events such as floods and cyclones.

Professor Toumi explains that OASIS is an open-source model which allows people to use their own data. He says: “There are already models out there which are more of a black box. Ours is an open platform to which users can bring their own or other people’s data. Regulators are beginning to demand this more transparent approach.”

OASIS is now at a prototype stage. Its importance became apparent after severe flooding in Thailand in 2010 and 2011, with the realisation that there was no flood model for Thailand. Professor Toumi says that there is a growing need for OASIS. “We are not sure whether there are more extreme events, but it does seem that the ones we have are getting more severe.”





Tackling a global challenge

“This is a critically important time for international efforts to address the risks of climate change,” says Dr Simon Buckle, Director for Climate Policy at the Grantham Institute. “Since the major international climate conference in Copenhagen in 2009, we have seen many countries commit to national mitigation actions and collectively, within the UN process, governments have now agreed a timetable to adopt a global climate agreement by 2015 to come into effect in 2020. India and China have taken on carbon intensity targets and China is trialling a carbon trading scheme. Yet global carbon dioxide emissions from fossil fuel continue to grow at around three per cent per year, the European Emissions Trading Scheme is in disarray and political resolve to tackle climate risks in some parts of the world is shaky, to say the least.”

“Achieving the systems’ transformations needed to bring about high levels of mitigation is a long-term challenge, but one we cannot put off until tomorrow. Our success depends on the development and deployment now of a portfolio of low-carbon technologies and systems at a cost that does not undermine economic prosperity and growth, particularly in the developing world. Just as crucial in motivating action will be the realisation that the potential future impacts of climate change on economies and societies – possibly even the viability of some countries – are sufficiently serious to warrant ambitious, coordinated action,” he continues.

“This underlines the importance of the Institute’s work on the technologies and systems that could underpin a low-carbon transition over the coming decades, as well as understanding the nature of the likely impacts we will face.”



Making mitigation feasible

The Institute’s programme on “Making Mitigation Feasible” aims to address some of the most important technological, economic and political challenges involved in making the transition to a low-carbon world on a climatically-relevant timescale: that is, by 2050.

Working with leading scientists, engineers and economists at Imperial, the Institute’s programme comprises three different strands. The first is an assessment of the mitigation potential of key low-carbon technologies and the innovations required for them to be adopted at scale, with an initial focus on solar PV, carbon capture and storage (CCS) and energy storage and distribution. The second is on mitigation and energy efficiency in industry. The third takes a systems approach to low-carbon developmental pathways, using modelling to understand transitions, and policy analysis and evaluation to inform decision makers.



Low-carbon technologies

The Institute’s solar work aims to explore the potential for different solar technologies in various economic, geographic and technical environments. It sets out to assess the impact that improvements in the solar technology, the design of the energy system – involving energy storage or electricity grid – and energy policy would have on the deployment of solar power and the related carbon emissions.

One exciting example of this work is a study of the mitigation potential of solar PV in the context of rural electrification in India. The modelling framework developed at Imperial combines cost, performance and life cycle emissions analysis for four different photovoltaic technologies used in stand-alone systems for rural electrification. It found that off-grid solar PV offers large emissions savings compared with diesel generation and electric grid extension, and that it should become cost-competitive within two years in remote locations.

Energy efficiency in industry

THE SECOND STRAND OF THE INSTITUTE'S MITIGATION WORK is on industrial mitigation and energy efficiency, a major neglected area of research and policy. It is a problem because a large fraction of emissions due to industrial processes cannot easily or cheaply be decarbonised through the use of low-carbon electricity. The Institute's programme aims to assess the mitigation potential and costs of decarbonising different industrial processes, investigate the technical feasibility and challenges of applying carbon capture and storage to these processes, and provide an analysis and evaluation of policies to incentivise the uptake of these new technologies.

The work so far has concentrated on three main projects. In September 2012, Dr Tamaryn Napp presented a paper - Is UK policy making industries more energy efficient? - to the European Council for an Energy Efficient Economy. Working with Ajay Gambhir, Research Fellow for mitigation policy, Tamaryn has also been making industrial site visits and interviewing managers to investigate the barriers and drivers for the uptake of energy-efficiency technologies. The initial findings were presented to the Non-Ferrous Alliance in March 2013.

In the first quarter of 2013, Dr Paul Fennell, Ajay and Tamaryn carried out a systematic literature review for the Department of Energy and Climate Change, on the potential for decarbonising heat in UK industry. The review covered the potential for decarbonisation, the different technologies that could contribute, and the costs of these technologies. It also laid out the barriers to and drivers for the uptake of the technologies, including the effect of specific policies.



Low-carbon pathways

Meeting the sorts of mitigation targets thought necessary to limit climate risks will require systemic changes in the way we produce and use energy. There is no "one size fits all" low-carbon pathway, so each country's pathway will depend on its level of economic development, the availability of natural and fossil resources, as well as its policy and environmental context.

Such a transition will have major implications for long-term investments in generating technologies and infrastructure, such as electricity grids and gas, heating, and carbon dioxide transport networks. We aim to understand the complex interplay of these different factors through existing and new modelling approaches. An example of this work is the study that Ajay led, in partnership with UCL's Energy Institute, of potential mitigation pathways for India to 2050, which suggests that it would be feasible to achieve an emissions pathway consistent with a target to limit global warming to 2°C at a cost of some 1-2 per cent of GDP annually.

Cost-effective mitigation also requires good policies to drive the changes. Here, a major focus for Dr Mirabelle Muûls working with colleagues in the Business School and at the London School of Economics has been on the European Emissions Trading System (ETS) and how this might impact on firm competitiveness and the effectiveness of different mechanisms for addressing potential carbon leakage problems if energy intensive firms move their activity outside the EU.



Solar potential in India

In January, a team from the Institute visited the Divecha Centre in Bangalore, to meet representatives from academic and non-governmental organisations, businesses and the public sector. Introduced by Dr Sheela Ramasesha and Professor Jenny Nelson, the meeting explored the technical, environmental, economic and policy issues associated with solar PV in rural communities. As well as basic scientific topics such as the chemistry of organic PV devices, the group discussed their practical experiences in implementing PV in a rural setting: the cost of finance, reliability of components, and regulatory and logistical hurdles.

The Institute continues to apply its expertise in the area of technical and economic assessments of solar PV technologies, and has recently won EPSRC funding to investigate potential innovations in the manufacture of novel PV technologies, with a view to reducing their costs and embedded energy.

“ Meeting the sorts of mitigation targets thought necessary to limit climate risks will require systemic change in the way we produce and use energy.”



Impacts of climate change

CLIMATE VARIABILITY AND CHANGE HAVE THE POTENTIAL to cause significant human suffering and economic impacts and costs. Understanding how these impacts might develop is both a critical research challenge and of huge practical importance.

The Institute has a range of activities in this area, looking at how climate change might impact on ecosystems, how biological (and agricultural) productivity might be affected, changes to the water cycle and associated impacts from flooding, droughts and rising sea levels, as well as the potential for environmental change to affect the incidence and impact of vector-borne diseases.

We are particularly pleased to congratulate Professor Colin Prentice on his new role as AXA Chair in Biosphere and Climate Impacts at Imperial, and look forward to his contributions to our research. Professor Prentice plans to look at the worldwide biological consequences of predicted climate change, particularly for primary production in agriculture, bio-energy and natural ecosystems.

Drinking water

Professor Paolo Vineis, School of Public Health at Imperial, has won a Leverhulme Trust grant to look at the impact of climate change on the salinity of drinking water in Bangladesh in collaboration with Dr Adrian Butler, Reader in Subsurface Hydrology in the Department of Civil and Environmental Engineering, and a number of institutions in Bangladesh.

Salt intake among pregnant women in the coastal area of Dacope is well above the recommended levels, and the rates of hypertension and (pre)eclampsia are considerably higher compared with non-coastal areas. The project has now been extended to estimate the overall impact of salinity on other coastal populations, and to establish the effectiveness and sustainability of potential solutions, like rainwater harvesting.

Adrian, with colleagues in the Department's hydrology group and at the British Geological Survey, has also developed new models of recharge and groundwater behaviour in the chalk aquifer, which provides up to 20 per cent of the UK's water supply. "These are helping key stakeholders, such as the Environment Agency and Thames Water, in managing water resources and environmental impacts," he says.

The models are also helping us understand the susceptibility of the chalk aquifer to surface pollution: in particular, the way nitrates seep into the aquifer. This is important as European directives require the nitrate level in drinking water to be below 50 milligrams per litre.



Ecosystem services

This autumn, Dr Wouter Buytaert, from the Department of Civil and Environmental Engineering at Imperial, will be starting a project funded by the UK's Ecosystem Services for Poverty Alleviation programme. The research will explore how local people can use tablet computers and smartphones to learn about local ecosystem services and alleviating poverty in four remote and poor mountain regions: the Ethiopian highlands around lake Tana, the Central Tien Shan Mountains of Kyrgyzstan, the Kaligandaki watershed in Northern Nepal, and the Andes of central Peru.

The collected data will be brought together in online platforms, Environmental Virtual Observatories, which will enable marginalised and vulnerable communities that are bypassed by the traditional mechanisms to participate in governing their ecosystem services.

Partnerships with India

The Grantham Institute has close ties with India through our partner Institute, the Divecha Centre in Bangalore. We have collaborated in three broad areas.

The Changing Water Cycle in the Ganges Basin – Researchers from Imperial and the Indian Institute of Science in Bangalore are leading work on the interaction between climate and groundwater use in this heavily-populated and productive region. In the great plains of the USA, the wetlands in sub-Saharan Africa and the Ganges Basin, climate models show there is a strong interaction between the land surface and the atmosphere. The researchers aim to understand the natural system, and how land use has changed, so they can work out how to manage it better.

Solar technologies – Atmospheric and materials scientists at the Institute are working with researchers at the IISc in Bangalore to measure and model the performance of photovoltaic solar concentrator systems in the Indian climate. This is important because most models of solar output are based on measurements of clear, still desert skies of the US, whereas the atmosphere of India is full of moisture and aerosols and is far from static – all of which lead to different performance characteristics.

Understanding the behaviour of the South Asian monsoon – The monsoon, which provides some 80 per cent of all India's rainfall, is a major determinant of agricultural output, and is affected – in different ways – by human carbon dioxide emissions and by atmospheric aerosols. How it behaves in a changing climate is an area of major uncertainty for a substantial proportion of the world's population.

As well as these research links, we have also enjoyed discussions with a range of Indian decision makers, in Delhi, Bangalore and London. A delegation of Indian Members of Parliament interested in climate change visited the Institute in May 2013 for discussions with the Director.



Disease transmission

Dr Paul Parham, who was a Research Fellow at the Grantham Institute and is now an Honorary Lecturer in the School of Public Health and Research Fellow in Mathematical Modelling at Bangor University, has been researching the impact of environmental change on the dynamics of vector-borne diseases such as malaria, dengue and schistosomiasis. As the climate changes, the incidence of the vectors that cause these diseases may also change. The programme aims to assess the use of seasonal climate data to develop early-warning systems.

If we are to have a better understanding of the implications for mitigation, adaptation and control, it will be vital to understand, quantify and improve our knowledge of disease transmission, climate modelling and the interaction between the two.

“ The monsoon, which provides some 80 per cent of all India's rainfall, is a major determinant of agricultural output, and is affected – in different ways – by human carbon dioxide emissions and by atmospheric aerosols.”

Informing decision makers

IN LINE WITH ITS REMIT TO TRANSLATE RESEARCH into real-world impact, the Institute has continued to work to inform decision makers in government and business, both in the UK and internationally, in a number of ways.

We are very happy to welcome John Ashton, who was the Foreign Secretary's special envoy on climate change, and joined the Institute in April. Widely known as a leading climate diplomat, John Ashton is now a commentator on the politics of climate change.

"Communication has broken down between science and politics – what we know and what we do," says Ashton. "Messages get blocked or wilfully distorted. Unless we fix this, from both sides, we will make bad decisions about climate change and many other problems. I think science has not risen to this challenge.

"The taxpayer pays for science, so there's a contract. That contract now needs renewing. Science must not only generate knowledge but should do more to ensure that it is reflected in the choices societies make: to stand up as it were for reality-based politics.

"The Grantham Institute can make a big contribution to this and I'm delighted now to have a chance to be part of that effort."

“ Power generation is by far the cheapest area where we can make reductions in greenhouse gas emissions. We have more alternatives for generating electricity than we have for transport or heating.”



Informing UK gas strategy

Neil Hirst, Senior Policy Fellow for Energy and Mitigation (and former Director of Technology at the International Energy Agency), recently collaborated with colleagues at the Grantham Research Institute at LSE to produce a joint briefing on UK gas policy.

"Our most important message to Government is that the UK does need more capacity for gas-fired electricity generation, but we shouldn't overdo it because we must sharply reduce our carbon emissions," says Neil. "Shale gas is important, but we certainly can't rely on it to solve our energy problems. We should be cautious about the amount that might be produced in the UK, over what period, and what effect shale gas will have on world energy prices. We say that we shouldn't build too many gas stations.

"Power generation is by far the cheapest area where we can make reductions in greenhouse gas emissions. We have more alternatives for generating electricity than we have for transport or heating. So if we exceed our targets for emissions from generation, we'll have far fewer options and they'll cost more."

Engaging with UK policy

The most direct way in which the Institute has worked to inform Government policy is the four-year, UK Government-funded AVOID programme, which held its final symposium in February 2013 at the Royal Society. The AVOID science team, led by Dr Jason Lowe of the Met Office Hadley Centre and comprising Professor Nigel Arnell from the Walker Institute for Climate System Research at the University of Reading, Dr Rachel Warren from the University of East Anglia (Tyndall Centre) and Dr Simon Buckle

from the Grantham Institute, all gave presentations on the major results from the programme. These presentations were followed by the keynote speech by the Secretary of State for Energy and Climate Change, Ed Davey.

Within the AVOID programme, the Institute led two particularly important pieces of work looking at the 2050 potential mitigation pathways for both China and India consistent with international efforts to limit average global warming to 2°C. Emissions from China and India can no longer

be ignored in international climate agreements and these pieces of work have been important inputs to that process, as well as leading to direct discussions with academics and policy makers from those countries.



Global energy governance

We continue to work with the UK and other government officials in a variety of fora, and we also act as a venue for important events and discussions related to climate change. One interesting area of work has concerned the international governance of energy, where Neil Hirst has been working with Chinese colleagues on an FCO-funded project to explore options for much needed reform. “The most influential body for international energy cooperation, the International Energy Agency,” says Neil, “does not include the big emerging economies that are the largest part, and the most rapidly-growing sector, of world energy. Climate change is now high on the list and the biggest issues there are about the growth of developing countries.”

“We need to get the big new players (especially China, but also India, Brazil, Indonesia) round the table to address the stability and efficiency of the energy markets, on which we all depend, and the challenge of clean energy,” says Neil. “Something China is now becoming much more interested in.”

In a speech Neil delivered to the Beijing Energy Club in September 2012, he called for China to share the responsibility for world energy leadership.



“ We need to get the big new players (especially China, but also India, Brazil, Indonesia) round the table to address the stability and efficiency of the energy markets, on which we all depend, and the challenge of clean energy.”



Martin Bolton, Business Development Director of Antaco

Working with business

The Institute has been working with the supermarket chain Sainsbury's to look at the impact of climate change on the production of certain key crops. It has been studying impacts over the next 20-30 years and also up to 2100. This is important because supermarkets have to think 10-20 years ahead when it comes to ensuring security of supply.

Our colleagues in the Climate-KIC (Knowledge Innovation Community) at Imperial and across Europe are working with small businesses and start-ups in the area of climate innovation, providing them with opportunities and practical tools to turn their ideas into commercial success.

The Climate-KIC Venture Competition winner in 2012, Antaco, received €50,000 funding from Climate-KIC to develop a benchscale model of the process of turning biomass to biocoal. Antaco's business development director Martin Bolton says “Climate-KIC is opening doors to industry and research partners. It also gives us clout at the European level”.



The Grantham community

Xavier Gilbert is in the first year of his PhD at the Grantham, working on the possible effects of climate change on crop growth and therefore on food security. His role as student liaison with the Grantham Institute gives him a strong sense of its unique flavour.

There are more than 40 Grantham PhD students distributed across Imperial. Xavier explains that one of his liaison duties is to organise a monthly seminar for students, and the range of subject matter can be surprisingly broad. One recent session was on indigenous knowledge of climate change among people in Micronesia. This knowledge is a powerful resource for understanding and coping with rapid change.

Students also benefit from the Grantham's external links, allowing them to take secondment positions with POST, develop exhibition ideas with the Science Museum and explore other outreach opportunities.

Mirabelle Muûls is further into her academic career than Xavier, and is now a Leverhulme Early Career Trust Fellow at the Grantham Institute.

Dr Muûls has also been awarded a Junior Research Fellowship by Imperial College, which is given to 20 exceptionally promising researchers to work at Imperial. An economist, her research is concerned with the business response to climate change, and to climate change policies such as the EU's Emissions Trading System (ETS).

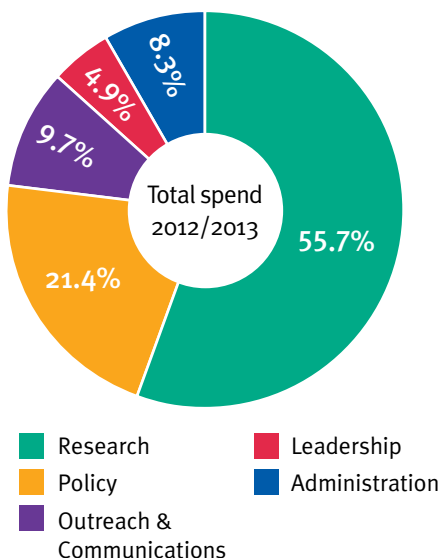
Dr Muûls says that her research has involved structured interviews with 800 companies across Europe, how their behaviour might change in reaction to the system. She has now moved on to a new project to measure the impact of the EU ETS on emissions by firms, and on their innovation, employment and economic performance. She says "by collecting firm-level data in several European countries, we can compare firms before and after the start of the market in 2005, as well as similar firms that are not included in the policy." This research will be crucial in assessing the efficiency of the ETS and in designing its future evolution.

Dr Muûls agrees that her research has gained from the wide range of expertise available at the Grantham, as well as from the links with the Grantham Research Institute at LSE, and with the Imperial College Business School, where some of her co-authors are based.

One example is her current work on the economic effects of extreme climate events, which has benefited from her ability to meet the Institute's experts on climate and weather. She says: "Rather than looking at future models of possible extreme events, we have been examining the effects of such events from the past 10-20 years, using records for individual firms. So we can see the effects of floods, heavy snow, heatwaves and extreme rain on businesses in France and the UK."

Investing in climate change research

In line with the Institute's strategy, 2012-13 saw an increase in spend within our outreach and communications activities.



Congratulations

We would like to congratulate all our students who have completed their studies here, successfully gaining their doctorates and moving on:

Dr Alvin Chan: Contributing to a Grantham Briefing Paper on solar energy

Dr Erik Chavez: Research Assistant at Imperial College London

Dr Maria Dickinson: Has recently had her first baby and will be returning to research soon

Dr Simon Funke: Postdoctoral Researcher in Renewable Energy at Imperial College London

Dr Ute Hausmann: Postdoctoral Researcher at MIT

Dr Anerie Khan: Working at Imperial College London

Dr Poppy Lakeman-Fraser: Analysing environmental surveys for the Open Air Laboratories Initiative

Dr Diane Lawrence: Postdoctoral Researcher at Edinburgh University

Dr Joerg Leib: Management consultant at McKinsey

Dr Paul Lynch: Working in building and environmental physics at Arup

Dr Flora MacTavish: Science communication research analyst at the Grantham Institute

Dr Ana Mijic: Postdoctoral Researcher at Imperial College London

Outreach

GRANTHAM PHD STUDENTS ARE ACTIVE IN INFORMING UK CLIMATE POLICY, and in communicating their knowledge to the public.



POLICY INFLUENCE

Áine Ní Bhreasail, whose PhD in civil engineering is on changes to frozen ground in the Arctic regions, spent time with the House of Commons Select Committee that scrutinises the UK Department of Energy and Climate Change.

This involved sessions on the UK Energy Bill, and on international climate change negotiations. She says: “The Committee starts by gathering written submissions, from stakeholders and the public as well as the department. It then decides what witnesses to call and structures the questions to ask them.” On the energy bill, for example, this involved small independent energy suppliers as well as the big household-name companies.

She says that this work was fast-moving and often meant changing direction in the light of breaking news. It also meant working closely with colleagues, a contrast to the sometimes isolated life of a researcher.

ECOLOGY ROADSHOW

Sarah Pierce is studying possible changes to grassland ecology under conditions of climate change. At the same time, she is bringing ecological insights to unexpected audiences. She is one of the leaders of the “Sex and Bugs and Rock and Roll” stand seen at UK music festivals, one of the centenary activities of the British Ecological Society.

About 1600 people visited her at the Larmer Tree festival in Wiltshire. She says that Whose Poos, a game which involves identifying droppings (replicas, fortunately) from British animals is one favourite draw. Another is to culture swabs from festival-goers’ clothes, astonishing them with the range of bacteria and fungi that appear over a few days.

Sarah has also run a “BioBlitz” at Imperial’s Silwood Park ecology campus, a period of 24 hours for spotting as many species as possible. The public could join in during daylight hours. It revealed everything from bats to newts, as well as a variety of unexpected insects. She says: “It revealed fantastic variety, with about 500 species recorded. My own favourite is the slow worm, a lovely legless lizard.”



SUSTAINABLE BUSINESS

Grantham students joined other students from across Imperial College at a sustainable business event organised by the Grantham Institute in partnership with Unilever and Net Impact, a non-profit organisation that encourages students and professionals to use business skills to promote positive social and environmental change.



A panel of leaders from the world of sustainable business spoke to students about why they see the need to take action in the face of climate change and what steps they are already taking. Students were then given the opportunity to pitch their ideas of the next steps businesses can take in becoming more sustainable.

Following on from the successful pilot at Imperial, Unilever plan to replicate the event at universities worldwide.

Dr Giovanni Rapacciuolo: Postdoctoral Researcher at University of California Berkeley

Dr Luke Reynolds: Postdoctoral Researcher at Imperial College London

Dr Erica Thompson: Postdoctoral Researcher at LSE

Congratulations also go to our students who were awarded prizes in the last year:

Christoph Mazur, was a member of the Imperial team that was awarded 2nd prize for the best business presentation at the Institution of Mechanical Engineer’s Formula Student competition.

Simon Moulds, who won Best Poster Prize for ‘Modelling land cover change in the Upper Ganga basin’ at the BHS Peter Wolf Early Career Hydrologist event

Sian Williams, who won the IOP Environmental Physics group essay prize for her essay entitled “Communicating climate change: should we ‘sell’ environmentally friendly behaviour?”



Grantham Institute for Climate Change

The Grantham Institute was founded with a mandate to drive forward climate change related research, translating this into impacts and communicating our knowledge to help shape decision-making. The Institute is integrating researchers and capabilities from all areas of the College necessary to tackle the challenges of climate change, through which we will work to offer practical scientific and technical knowledge of the highest quality.

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About Imperial College London

As the only UK university to focus entirely on science, technology, engineering, medicine and business, Imperial College London offers a critical mass of international research expertise and a vibrant home for innovation and enterprise. Imperial is committed to making sure that its research improves quality of life and the environment.

Sustained support for Imperial's climate change research is a sound investment in environmental improvement, and in developing the next generation of climate change pioneers, researchers, innovators and entrepreneurs.

Climate change regularly features on Imperial's home page at www.imperial.ac.uk, which is visited by over 1 million people each month.

