

2018–19

Outlook

Liquid assets
‘Blue economy’
needed for
thriving ocean –
Prince Albert II
of Monaco

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**Next 10
years critical**
Dr Joeri Rogelj,
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Ones to watch
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projects at Imperial
to look out for
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Foreword

The Grantham Institute's education, research, engagement and advocacy mission is hugely important for the world today and for future generations. I thank our donors, friends, and the Institute staff and students for making this great work possible.

In this Outlook you will read about the Institute's contributions to global debates through leading research and briefing papers, which reach broad audiences through our news stories and media coverage. Highlights include contributions from PhD student Joss Lyons-White, who describes the challenges of delivering deforestation-free palm oil, and Professor Martin Siegert, who has set out the impact that our choices will have on Antarctica and the Southern Ocean.

The Institute is building on strong research foundations and informing policy by engaging audiences, from local communities to global leaders. The unmissable Grantham Annual Lecture is indicative of the Institute's standing as a platform for leaders in climate and the environment. This year we enjoyed inspirational and motivating speeches by former United States Vice President Mr Al Gore and His Serene Highness Prince Albert II of Monaco.

Supported by world-class lecturers, our students excel in entrepreneurship, public outreach and leadership in informing policy. I was pleased to present a President's Award for Excellence in Education to Dr Mirabelle Muûls, a joint Grantham Institute and Business School lecturer, for her exceptional work to develop our unique Master's in Climate Change, Management & Finance from an idea, into a successful and ever-developing programme.

We are also expanding the Grantham Institute's exceptional education provision with open online learning modules in finance, energy and engagement with policy making, as part of Imperial's learning and teaching strategy.

Finally, I wanted to express my gratitude to Professors Joanna Haigh and Geoff Maitland, with colleagues in the Grantham Institute, for leading the Greening Imperial initiative, helping the College to make a difference with its actions on climate and environment. This initiative has already engaged hundreds of staff and students to help integrate environmental sustainability into all aspects of Imperial's operations. ■



*Professor Alice P. Gast
is President of Imperial
College London*

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INTRODUCTION FROM THE CO-DIRECTORS

PROFESSOR JOANNA HAIGH CBE
FRS AND PROFESSOR MARTIN
SIEGERT FRSE

*Co-Directors of the Grantham
Institute – Climate Change and
the Environment*

It is gratifying to reflect on not just a year, but a decade of work by the Grantham Institute, and the impact we have achieved through research, training and innovation, engaging and informing businesspeople and policy makers, and demonstrating meaningful leadership on many levels.

From the outset of our tenth anniversary celebrations in September 2017, our events prompted discussion on what climate action will mean for all of us over the coming decade, whilst taking inspiration from past successes. Climate change is already altering the natural world and, recognising this, we have published a new briefing, *Adaptation of freshwater species to climate change*, which lays bare the challenges our environment faces, and its potential to adapt. Meanwhile, our latest Grantham Research Fellow, Kathryn Brown, Head of Adaptation at the Committee on Climate Change (CCC), has been developing ways to harness civic planning processes to maximise the benefit of parks and waterways to the environment and local communities.

*“Climate change is already
changing the natural world.”*

The past decade has seen plummeting costs and increased confidence in some low-carbon technologies, particularly solar panels and wind turbines that generate clean, cheap power. However, progress in other

sectors has been less encouraging. In May we highlighted solutions for cutting emissions from the aviation industry, as demand for international travel continues to grow, and held an in-depth debate between industry and policy experts and environmental campaigners about the role for biofuels in this sector.

It is one of our goals to reach new audiences with evidence-based information about climate change and the environment. One new initiative, the Grantham Art Prize, aims to connect with people in a personal and meaningful manner about environmental challenges, and encourage new alliances outside the scientific community. You can read more about how this is progressing on our website.

We have also launched the ‘Clean Power Hub’ programme, an open online learning platform designed for people working

in the power sector looking to move towards cleaner energy (read more on p20).

Despite some international progress, more must be done. Strong words from the star-studded cast of former Grantham Annual Lecturers, who spoke at our *Ten years to save the future* event in June 2018, have inspired the themes of this issue of Outlook – People, Planet and Technology.

*“Despite some international
progress, more must be done.”*

We hope you enjoy reading about our past year and future plans in this magazine, and about ten years’ of achievement in the commemorative pull-out poster, and that they will inspire you to work with us to tackle the massive challenges currently threatening our climate and environment. ■



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HIGHLIGHTS

The Grantham Institute celebrated ten years as a world-leading authority on climate change and the environment during 2017–18. Here are some of the highlights of the year, showing how we contributed towards our vision for a sustainable, resilient, zero-carbon society.

① Working together on climate change and air quality



In the week that London brought in a ‘toxicity charge’ – or T-charge – on older, more polluting road vehicles, Grantham Institute teamed up with the Royal Meteorological Society and the All-Party Parliamentary Groups on Climate Change and Air Pollution to discuss creative policies that address both air pollution and climate change. “Transparent, independent testing of vehicle emissions is a vital part of the solution,” Imperial’s **Professor Helen ApSimon** told the audience in the Houses of Parliament.



READ MORE
GRANTHAM BRIEFING:
NOVEL POLICY TOOLS TO
ASSESS THE ENVIRONMENTAL
IMPACT OF AIR POLLUTANTS
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② Insurance failing to cover 70 per cent of global warming damage

Imperial delegates to the COP23 climate change negotiations in Bonn, Germany, raised concern that most people are unprotected against the rising risks of climate change, unless governments step in. “Some weather extremes are becoming more frequent,” Grantham Institute Co-Director **Professor Joanna Haigh** (pictured) warned. Speakers at the event emphasised climate risk management as a long-term intervention, requiring commitment to improve communities’ resilience to climate change and their role in avoiding its worse effects.

3 Pushing for change on the climate crisis and its solutions

Former Vice-President of the United States, Al Gore, delivered a spellbinding address at the 2017 Grantham Annual Lecture. Mr Gore (pictured), who featured in the film *An Inconvenient Sequel: Truth to Power*, told the audience “I believe we will solve the climate crisis, but we must act with greater urgency”.

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COMMEMORATIVE
TEN-YEAR PULL-OUT
POSTER



4 ‘Blue economy’ must be a priority to conserve the ocean

“To protect the ocean we need not just words and regulations but the goodwill and energies of all,” stressed the speaker at the tenth Grantham Annual Lecture, **Prince Albert II of Monaco** (pictured meeting our cleantech innovators). His Serene Highness attended a showcase by Imperial entrepreneurs and researchers who are using engineering, materials science and design solutions to ensure that humans continue to benefit from the economic benefits the ocean provides, while eliminating the scourge of plastic and chemical pollution.

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5 Government’s Clean Air strategy launched at Imperial

In May, **Environment Secretary Michael Gove** launched the Government’s Clean Air Strategy at Imperial. He met with academics who are researching ways to monitor and reduce the impact of air pollution, including Grantham Affiliates **Dr Marc Stettler**, a transport emissions modeller, and environment and public health expert **Dr Daniela Fecht**. Mr Gove also met student entrepreneurs who have developed **Pluvo**, a futuristic roadside structure to tackle air pollution while acting as an innovative advertising medium.

6 Science informs City investments

Academic input can complement business expertise in identifying sustainable and climate-friendly investments. The Grantham Institute launched its ‘Science in the City’ scheme in 2017 to create space for City of London businesses to discuss their portfolios with top technical experts from Imperial. Now in its second year, the scheme has visited nine companies – including **Barclays Bank UK Plc**, **Santander UK Plc** and **BlackRock Inc.** – hosting 11 sessions on topics ranging from water management, to disruptive battery technologies and energy storage, to the future of nuclear power.



PEOPLE



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People are at the heart of the Grantham Institute at Imperial College London. It is a vital part of our work to develop leaders of the future.

We do this through the traditional university channels: undergraduate and postgraduate education, including our Natural Environment Research Council (NERC)-funded Doctoral Training Partnership (DTP) on Science and Solutions for a Changing Planet, and Master’s in Climate Change, Management & Finance that is jointly taught with Imperial College Business School. We have now extended to teaching early-career researchers how to shape and share their work effectively for audiences beyond the academic community. We are also experimenting with the use of online

learning for impact (see Training, pages 20–21), and are inspiring a future generation of scientists through our public engagement activities for all ages.

In parallel, we explore the human dimension of environmental issues, looking at how climate change, and actions to tackle climate change, can cause conflict between peoples. Our research dives into the costs of air pollution to human health, considers the consequences of using mosquito nets for fishing and highlights the benefits of cooperation in tackling climate change.

Our vision for a sustainable, resilient, low-carbon society looks towards a healthy, prosperous and fair existence for all people. ■

DR AMIERA SAWAS

PROFILE



Researcher in the Climate Change and Risk Programme at Stockholm International Peace Research Institute

Dr Amiera Sawas studies the impact of climate change on the risk of conflict around the world. She recently carried out a major review at the Grantham Institute to bring together existing research on this topic. She says: “I spoke to over 70 stakeholders around the world about their perspectives and experiences of the issue, and I asked what the knowledge gaps were.”

Results of the review were published in a Grantham briefing paper and launched at a special event with the UK Foreign and Commonwealth Office’s Special Representative for Climate Change, Nick Bridge. The review found that climate change can exacerbate security threats and that responses

to climate change – including adaptation, mitigation and low-carbon development – may also trigger insecurity. However, it also suggested that low-carbon developments can promote peacebuilding if they take account of local contexts and power dynamics.

Dr Sawas adds: “We found that one of the key areas of concern was understanding the threats and opportunities for peace and security with low-carbon development, particularly in developing states and those affected by conflict.”

Building on the review, Dr Sawas has gone on to research low-carbon mega-projects in Pakistan. She is now working for the Stockholm International Peace Research Institute, Sweden, providing evidence to various policy forums and conducting research on low-carbon development and security in the borderlands between Kenya and Ethiopia. ■

DEVELOPING COUNTRIES FACE RISING PAYMENTS DUE TO CLIMATE CHANGE

A new study from Imperial College Business School found that climate risks are increasing the cost of capital for developing countries, with some countries having already endured an additional \$40 billion in interest payments on government debt over the past decade.

The researchers estimate that these extra costs are set to rise to between \$146 billion and \$168 billion over the next decade, which could exacerbate the economic challenges already faced by poorer countries around the world.

However, the study also showed that investments in climate resilience could help. **Dr Charles Donovan**, Director of the Centre for Climate Finance and Investment at Imperial,

said: “Investments in climate adaptation can not only reduce social, ecological and economic harm, but can buffer against fiscal impairments. But to be effective, these investments need to be made now.” ■



MINI SCIENTISTS GROWN IN LAB AT IMPERIAL FESTIVAL

Children under 12 years at the 2018 Imperial Festival donned lab-coats, goggles and latex gloves to become climate-conquering scientists. They learned how to use the weight of elements to find information hidden within materials and ran their own experiments to make elements of different weights. The activity, supported by the Grantham Institute and the Department of Earth Science & Engineering, was designed to communicate about research that takes place in the Mass Spectrometry and Isotope Geochemistry (MAGIC) laboratory at Imperial.

Rachel Bertram, a research postgraduate and member of the Science and Solutions for a Changing Planet DTP, who led the activity, said, “In the lab, one application is the study of materials from Antarctica that were

deposited at the bottom of the ocean millions of years ago. The distribution of different elements in these samples unlocks vital information about the climate at that time. Understanding this information can help us predict what our future climate will be like.” ■



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EARLY-CAREER RESEARCHERS LEARN TO MAKE A DIFFERENCE

Early-career researchers learned how to influence policy through their research in a new course run by the Grantham Institute at Imperial and the University of Sheffield's Grantham Centre for Sustainable Futures, and funded by the Natural Environment Research Council. 'Research making a difference' was a brand new training programme for 15 participants from five top UK universities.

Participants learned how to collate evidence from a range of sources and disciplines to inform debates on specific issues; how different styles

of analysis and presentation formats can be used to meaningfully communicate with non-academic audiences; and how to engage with parliamentary select committees.

Grantham Institute Director of Policy and Translation, **Alyssa Gilbert**, who organised the course, said, "I was delighted to see the level of engagement between the researchers and the stakeholders, who make use of scientific evidence in their daily work. During each session, the room was buzzing with conversation and peppered with numerous 'aha' moments!" ■

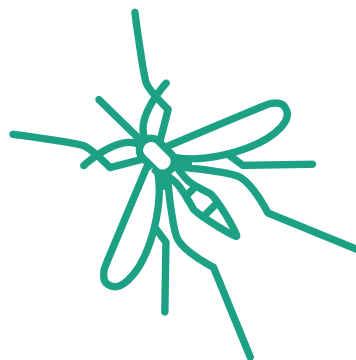
FISHING WITH MOSQUITO NETS THREATENS HUMANS AND NATURE

In efforts to combat malaria, mosquito nets are widely distributed in developing countries. However, anecdotal evidence suggests they are often wrongly-used for fishing. The tightly laced mosquito nets trap younger fish, which reduces the future number of breeding adults and can disadvantage communities that rely on fish as a major food source.

A team of researchers has assessed the global extent of this problem for the first time, finding that the practice occurs across most of the world's tropical latitudes, and affects a broad range of marine and freshwater habitats.

Lead author **Rebecca Short**, a research postgraduate and part of the Science and Solutions for a Changing Planet DTP, said in an

Imperial media release: "We are wholly supportive of the efforts of the healthcare community to tackle this disease, which is so damaging to many people's lives, but there needs to be further research into the potential impacts of this unintended environmental consequence." ■



Ones to watch

1

A new tool developed at Imperial can help reveal the health and social care costs associated with increasing air pollution to policy makers, and provide impetus to act. The research revealed the estimated costs in England are already £157 million, and could rise to £18.7 billion by 2030. **Dr Daniela Fecht**, the principal investigator, said, "Air pollution will put further strain on the already overstretched health care system in the future if no immediate action is taken."

2

Following United States President Donald Trump's announcement to withdraw from the Paris Agreement, Imperial researchers modelled the approaches that US factions could take to mitigate climate change. Despite the Administration's arguments, the study found a collaborative approach, where states trade electricity and share emissions targets, would significantly benefit both the environment and economy. **Dr Gonzalo Guillén Gosálbez** explained that in the future this model could "spur co-operation at the international level, eventually leading to win-win scenarios."

3

Imperial researchers **James Alden** and **Paul Baranowski** and alumnus **Gabriel Brueckner** have designed a pioneering low-cost weather station to help small-holder farmers in tropical countries like Uganda in east Africa, where coffee growing is big business. Their creation, 'Climate-Edge', can be placed among crops to monitor factors such as temperature and humidity. This information will help the farmers to boost crop quality in the face of climate change.



PLANET

Researchers at Imperial College London continue to find out new and astonishing information about our planet every day. These discoveries inspire us at the Grantham Institute to protect our unique planet and all its diverse inhabitants. We have different roles in these projects, sometimes instigating new research, or promoting our students' work. We also encourage experts to comment on topical new developments and aid the understanding of climate change through the media.

This year, our research hit the headlines with evidence about plants and animals responding

to a changing climate. Top researchers have provided new perspectives on persistent holes in the ozone layer and stark visions for the future of Antarctica, and our students have been striving for truly sustainable biofuels.

We are delighted to welcome four new Grantham Lecturers, to help further understand and protect our planet. Climate scientist **Dr Paulo Ceppi** aims to determine how much global warming is caused by increasing carbon dioxide concentrations. He joins Drs Andreas Kafizas (p15), Yves Plancherel (below) and Joeri Rogelj (p18). ■

DR YVES PLANCHEREL

PROFILE


*Grantham Lecturer
in Climate Change
and the Environment*

Dr Yves Plancherel joined the Grantham Institute in July from the University of Oxford. A specialist in the global lifecycle of metals, he is studying the impact of metal pollutants on the environment.

While public attention is often focused on reducing global carbon emissions and tackling plastic pollution, shifting to a low-carbon economy and using plastic in a sustainable way isn't the full picture of an environmentally-friendly society. "Carbon emissions weren't considered a problem until we had been burning fossil fuels for about 100 years," says Dr Plancherel. "We need to learn from that lesson and think about the next pollutants."

It is estimated that the demand for some metals will increase up to ten times in the coming decades. "Using so much metal has serious health and environmental implications – from mining, to manufacturing, to recycling (or lack of)," he says. "That's why academic research is so important. We have the freedom to think about long-term, maybe even hypothetical, questions. At the Grantham Institute, there are economists, physicists, biologists and policy experts who can all feed into research, enabling us to tackle the big, not-yet-considered questions."

Dr Plancherel's work takes him to remote parts of the planet (pictured) "Last year, I spent over 2 months at sea, travelling through the Southern Ocean from Tasmania to Antarctica and then Punta Arenas in Chile, as part of a research project," he says. ■



LEAF-SIZE EXPERIMENT TO INFORM ADAPTATION PLANS

From large leaves in tropical rainforests to the needles of trees in the far north, leaf size varies with location. Until now, it was thought to be determined by balancing the plants' needs to avoid overheating and to retain water.

Now, research published in the journal *Science* co-authored by Grantham Affiliate **Professor Colin Prentice**, overturns this idea, finding that resisting frost damage is the main driver.

“The most surprising result was that the maximum size of leaves is

set by the risk of damaging frost at night,” said Professor Prentice.

At night, leaves are cooler than air because they lose heat to the sky. In areas with low night-time temperatures, leaves tend to be smaller because large leaves could suffer from frost damage.

The researchers will use the findings to create more accurate models that governments can use to predict how vegetation will change under climate change, and to plan for adaptation. ■

SCIENTISTS FORESEE FUTURE OF ANTARCTICA

Decisions made in the next decade will determine whether Antarctica suffers dramatic changes that contribute to a metre of global sea level rise, according to research published in *Nature*.

The study assesses the state of Antarctica in 2070 under two future scenarios: firstly, if emissions rise unabated; and secondly, if emissions are significantly reduced. Which scenario plays out depends significantly on choices we make in the next ten years.

“Some of the changes Antarctica will face are already irreversible,

such as the loss of some ice shelves, but there is a lot we can prevent or reverse,” said co-author **Professor Martin Siegert**, Co-Director of the Grantham Institute.

“To avoid the worst impacts, we need strong international cooperation and effective regulation backed by rigorous science. This relies on governments recognising that Antarctica is intimately coupled to the rest of the Earth system – damage there will cause problems everywhere.” ■



WATCH
HOW TO SAVE ANTARCTICA
(AND THE REST OF EARTH TOO)
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CAN PALM OIL EVER BE 'DEFORESTATION-FREE'?

Palm oil is used in thousands of products worldwide, from food to detergents to cosmetics. Its cultivation is a major cause of tropical deforestation, particularly in Malaysia and Indonesia, where palm oil plantations replaced 2.7 million hectares of tropical forest between 1990 and 2005.

Many companies commit to only using 'deforestation-free' palm oil products. However, a study has shown that this label is problematic to guarantee.

"Supply chains are so complex that tracing palm oil back to its source and determining whether it was linked to deforestation or not is very difficult," says lead author **Joss Lyons-White**, research postgraduate on the Science and Solutions for a Changing Planet DTP.

However, simply banning palm oil is unlikely to be the answer. "We need to find ways to ensure commitments can be implemented more effectively," he said.

Lyons-White responded to questions from readers of the news website Reddit in two hour-long 'Ask Me Anything' session in August. ■



HERBIVORES HELP PROTECT MARINE ECOSYSTEMS

Plant-eating animals could help marine ecosystems to survive global warming, thanks to their voracious appetite for algae.

An international research team created miniature marine ecosystems and tested how they fared in warmer conditions. They found that in the hottest conditions, ecosystems that included limpets – snail-like marine herbivores – fared the best.

Limpets eat algae, and their action prevents the fast-growing algae from

taking over habitable surfaces that may have been vacated by organisms that dislike warmer temperatures.

"When limpets were part of the community, the effects of warming were less harsh," said lead author Imperial's **Dr Rebecca Kordas**. "The herbivores created space for other plants and animals to move in and we saw much healthier diversity and variety in these ecosystems."

Research like this can reveal ways to reduce our negative impacts on the natural environment. ■

Ones to watch

4

Phytoform Labs, a start-up founded by PhD students **Will Pelton** and **Nicolas Kral**, claimed first prize in the White City Incubator Innovators' Programme, winning £8,000 and membership to the White City Incubator hub. Participants in the Climate-KIC Accelerator programme, Phytoform Labs use gene editing technologies to hone plant breeds in decades rather than years. Their work could increase yields and improve the economics of breeding valuable vegetable crops, as well as boost resilience to climate change and diseases.

5

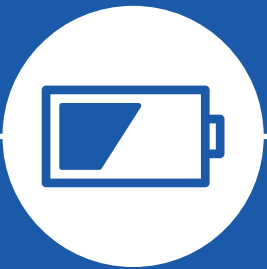
The planet's protective ozone layer has been seriously declining globally since the 1980s. Since damaging chemicals were banned by the 1987 Montreal Protocol, there has been some recovery at the poles. However, a new study shows that the same is not true for lower latitudes above densely populated parts of the globe. Co-author **Professor Joanna Haigh** is concerned that the cause is currently unknown and says that efforts must be focused on getting more precise data to determine exactly what is happening.

6

Sky Ocean Ventures will work with the Grantham Institute to protect the environment by supporting promising business and scientific innovations and sharing inspiring messages about the benefits of eliminating plastic waste. **Skipping Rocks Lab**, whose pioneering plant-based water bottle replacement Ooho! was developed at Imperial, is one of the first start-ups to benefit from a £25 million commitment by global media company Sky plc. The partnership also harnesses academic expertise from the College's **Ocean Plastic Solutions Network**.



TECHNOLOGY



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LOW-CARBON TECHNOLOGIES.
THIS INFOGRAPHIC ILLUSTRATES
THE NEED FOR R&D INVESTMENT.
BIT.LY/LOW-CARBON-TECHNOLOGY

Imperial College London is known world-wide for its engineering and technology expertise. Here at the Grantham Institute, we promote existing low-carbon technologies, such as wind and solar photovoltaic electricity generation, and solar-powered heating. These should be rolled out widely in order to play their greatest role in reducing greenhouse gas emissions. Additionally, more challenging sectors of the economy require new solutions to help avert and adapt to climate change. We have identified 18 promising low-carbon technologies that are ripe for research and development.

Looking closely at the roles for existing technologies, we have dived more deeply into the potential for

nuclear energy, biofuels for aviation and electric vehicles to bring down greenhouse gas emissions.

Our work is wide-ranging, from modelling the impact of technologies, to engineering low-carbon kit with a sustainable lifecycle. We have welcomed four new Grantham Lecturers to the Institute, who bring with them exciting new research and engagement opportunities. Chemist **Dr Andreas Kafizas** develops low-cost, sustainable coatings that use sunlight to drive chemical reactions that can neutralise pollution or make hydrogen fuel. He joins Drs Paulo Ceppi, Yves Plancherel (both p11) and Joeri Rogelj (p18). ■

DR TAMARYN NAPP

PROFILE



*Grantham Institute
Research Associate*

Dr Tamaryn Napp uses energy systems modelling to understand how different countries can achieve a lower-carbon future.

“Our model examines how energy is produced and used, considering the cost and efficiency of different technologies, and how these will change over time,” Dr Napp explains. “The results show us a variety of ways to meet the emissions targets of the Paris Agreement, while still allowing for population and economic growth.”

Recently, Dr Napp has been studying how innovations in technologies can help: “In the past, the focus has been on innovations in energy supply,

for example in renewable solar and wind power. There has been less attention on energy consumption, but our results indicate this will be crucial to reducing greenhouse gas emissions at a lower cost.”

In a report for the OECD published for 2017’s G20 meeting in Berlin, Dr Napp and colleagues identified 18 key technologies that are critical for a low-carbon economy. The technologies, including hydrogen-based fuel and electrolysis, require substantial R&D investment to become commercially viable. “The innovation gaps include sectors that are the most challenging to decarbonise, such as aviation, shipping and industry. However, we also found areas where we are making progress, such as in energy storage.” ■

MYTHBUSTING: IS DRIVING AN ELECTRIC VEHICLE BETTER FOR THE CLIMATE?

Are electric cars really better for the climate than the petrol-based alternatives? That was the question tackled by **Dr Ajay Gambhir** and **Dr Iain Staffell** in an infographic that compared the emissions produced by driving a kilometre in each of these vehicles.

Using data on how much of the global warming gas carbon dioxide is produced to generate electricity in the United Kingdom, China and the United States, they concluded that electric cars outperform the best-selling petrol vehicles in those countries.

As well as reducing carbon dioxide emissions, electric vehicles also produce less localised air pollution, which has a positive impact on people with respiratory diseases like asthma, and reduces the associated costs on the health service of treating those illnesses. ■



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CLIMATE-IMPACT](http://BIT.LY/ELECTRIC-CARS-CLIMATE-IMPACT)

DON'T WAIT FOR A UNICORN, SAY EXPERTS

If the United Kingdom invested more in today's low-carbon energy technologies, it would collectively save more money in the long term than if it waited for future technologies that may never materialise. These were the findings of Imperial's **Dr Clara Heuberger**, **Dr Iain Staffell**, **Professor Nilay Shah** and **Dr Niall Mac Dowell** in a study published in *Nature Energy*.

The authors fear that, when planning for the future, some decision makers prefer to wait for the

perfect (but mythical) 'unicorn technology' that generates low-cost and highly-flexible electricity and zero greenhouse gas emissions, rather than invest in imperfect current technologies. They calculate that waiting for a technology that never materialises would increase costs by 61% compared to deploying existing technologies. Investments made today will achieve the maximum emission reductions at the lowest cost. ■

Ones to watch

NUCLEAR OPTION DISCUSSED

The Grantham Institute and Imperial's Centre for Nuclear Engineering hosted a panel discussion in July to debate the role of nuclear power as the UK aims to reduce greenhouse gases emitted by generating electricity. The event marked the launch of a briefing paper by Grantham Institute Senior Policy Fellow **Neil Hirst**. The panel included representatives from the Department for Business, Energy and Industrial Strategy (BEIS), energy company EDF Energy, climate change think tank E3G and the Centre for Nuclear Engineering at Imperial.

While there was no consensus amongst the speakers, the majority were in favour of nuclear continuing to form part of the UK energy mix, with Hirst commenting that "for the time-being it makes sense to continue to develop our nuclear

industry. However the industry's future will depend on shortening construction times and will be influenced by the rates at which battery and energy storage technology improve."

Dr Ben Britton from the Centre for Nuclear Engineering suggested that "nuclear energy is not as risky as climate change", while Hirst concluded that, "ultimately, the case for nuclear power comes down to timing and the options available for the UK's low-carbon strategy." ■



READ MORE
[NEIL HIRST ANSWERED READERS' QUESTIONS ON THE REDDIT ENERGY FORUM](https://www.reddit.com/r/energy/comments/2w8v8q/neil_hirst_answered_readers_questions_on_the_reddit_energy_forum/)
[BIT.LY/NEIL-HIRST-REDDIT](https://bit.ly/neil-hirst-reddit)

PLANTS TO POWER PLANES

The aviation sector is expected to continue growing at around 5% a year globally, posing a significant challenge to the Paris Agreement goal to reduce greenhouse gas emissions. In November, research postgraduate **Jonathan Bosch** and **Dr Raphael Slade** published a briefing paper discussing the options available to the aviation industry and focusing specifically on biojet – a kerosene jet fuel derived from plant matter (biomass).

The authors emphasise the importance of ensuring that food prices aren't pushed up as a result of biofuel crops replacing food crops. In this regard, they expect biojet derived from waste

biomass to prove relatively uncontroversial. While more research may make biojet a more efficient fuel and policies to tax higher emissions (such as a carbon price) may make it financially more viable, the authors conclude that biofuels for aviation are currently "strategically important and technically achievable, but the present economics makes them tough to deliver." ■



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7

A consortium led by Grantham Affiliate **Dr Greg Offer** will receive funding worth £10 million from the UK's national energy storage institute, the Faraday Institution, to develop next generation batteries through multi-scale modelling. Seven universities and seventeen industry partners aim to equip industry and academia with new software tools to understand and predict battery performance in order to extend the lifetime and performance of electric vehicles. The Imperial team also includes **Professor Aron Walsh**, **Dr Billy Wu**, **Dr Sam Cooper**, and **Dr Monica Marinescu**.

8

Grantham Institute staff, students and affiliates are leading the **Greening Imperial** initiative to improve the College's sustainability credentials. An early success has seen single-use plastic cups removed from dining areas, significantly reducing the estimated 850,000 that were given away last year across the College. Aspirations include introducing a coffee cup levy to encourage the use of reusable alternatives, increasing the amount of biodiversity and green space across the campuses and appointing a Director of Sustainability.

9

A team of four undergraduate students won the Faculty of Natural Sciences Make-A-Difference competition for their work using infrared spectroscopy to develop a low-cost tool to identify different types of plastics. **Hans Chan**, **Martin Holicky**, **James Kung** and **David Dai** make up Team Matoha, and hope that their tool (named PlasTell) will improve how plastics are sorted and lead to more waste being recycled rather than going to landfill. Matoha have since joined the Climate-KIC Greenhouse programme at Imperial.



“The next 10 years are critical,” says Dr Joeri Rogelj, IPCC report author

Dr Joeri Rogelj joined the Institute as Grantham Lecturer in Climate Change in May 2018. He is lead author on the Intergovernmental Panel of Climate Change (IPCC)’s Sixth Assessment Report and a co-ordinating Lead Author of the 1.5°C Special Report. He specialises in global transformations – improving the understanding of what it takes to accelerate the transition to a sustainable, prosperous, low-carbon world.

Image: Dr Joeri Rogelj presenting at the 2018 Conference on Climate Change organised by the German Aerospace Centre (DLR) and the United Nations Office for Outer Space Affairs (UNOOSA).

Did you always want to pursue an academic career in climate change-related issues?

It was coincidence that I ended up working in climate change. I spent three years as a project engineer in Rwanda, working on rural electrification and drinking water systems. Working there, it quickly became obvious to me that climate change could exacerbate the problems vulnerable communities face.

What do you think has been the biggest change over the past decade?

I think the biggest change has been the success of the Paris climate summit (COP21) in 2015. The international community now has a clear vision of where it wants to go in terms of climate policy, and a clear architecture of how it can achieve it. Though of course, that doesn’t mean the job is done.

“In an ideal world, we would have started 20 years ago.”

What would you like to see happen in the coming years?

The next 10 years are critical. The world must embark on a path to reduce its greenhouse gas emissions to zero, which is, ultimately, the only way we can stop global warming progressing further. Ensuring that we address

climate change in a way that keeps other objectives – such as eliminating poverty – intact, is both a challenge and a requirement. The earlier we start, the better. In an ideal world, we would have started 20 years ago.

Are you optimistic the world will meet the challenges of climate change?

Climate change issues don’t necessarily resonate with the general public yet, which means that big and important decisions – decisions that might hurt in the near term – simply won’t be taken. Society will manage, but when and how remains an open question.

What drew you to the Grantham Institute and why do you think its work is important?

As a scientist, my ambition is that my work is both useful and used. The Grantham Institute connects different parts of society – industry, the public sector, academics and students – and this encourages the exchange of ideas, disseminating research, absorbing concerns from the world and understanding how this affects the solutions. I’m eager to become an active part of this microcosm, here at Imperial and beyond. ■

Michelle Jackson

investigates wildlife in hot water



Dr Michelle Jackson is a researcher in the Department of Life Sciences at Imperial. Based at the College's Silwood Park Campus, her work is part of an international project investigating the impacts of global warming on complex ecosystems.



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What does your work involve?

I'm a community ecologist – I study interactions between living things – and I'm interested in the impact that humans have on the natural world.

In the last two years I've travelled to various places in the Arctic, including Greenland, Iceland, Svalbard and Russia. I am looking into the impacts that climate change has on the streams there by studying species interactions, so who eats who, and how that changes with temperature.

We use streams that are geothermally heated with temperatures varying from two degrees Celsius to above 20°C. They create a 'natural experiment' to predict how global warming will alter ecosystems in the future.

I'm also researching how climate change interacts with other man-made factors, such as pollution and invasive species. This area of ecology is becoming increasingly important as very few truly unspoilt environments are left.

How are you collaborating with the Grantham Institute?

At the moment, I'm working with the Grantham Institute on a policy briefing called *Emerging interactions between multiple stressors: biocides and warming* and an event that will have

a range of excellent speakers talking about their climate change research on freshwater animals and plants.

The Grantham Institute has given me media training, and together we have published a briefing paper on the *Adaptation of freshwater species to climate change*, which is aimed at policy makers. I have also written blogs about the exciting field work I do as part of the Ring of Fire project in the Arctic circle.

How does this help you to make a difference?

These meetings, blogs and briefing papers have meant that I can reach a much wider audience with my work.

Working with the Grantham Institute has also helped me explain my research in a way that means it can be used to better manage and protect freshwater environments. ■



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Focus on: Award-winning teaching

Awards for Excellence in Teaching are presented annually to members of Imperial staff judged to have been most outstanding in the quality, organisation and presentation of their teaching.

A recipient of one of these prestigious medals, Dr Mirabelle Muuls is the Programme Director of the Climate Change, Management and Finance MSc Programme, delivered by the Grantham Institute and Imperial College Business School. Now in its third year, this MSc has quickly

established itself as a very special interdisciplinary and forward-facing programme.

It is characterised by a student body with excellent gender, nationality and subject diversity, an instantly positive student experience and a fledgling but highly active student alumni programme. Students on this one-year programme learn from leading practitioners and world-class academics how to put the latest theory, and business and climate change strategies, into practice. ■

Professional development

From October 2018, Imperial, supported by the Children's Investment Fund Foundation, is launching a programme of Massive Open Online Courses (MOOCs) for people working in the power sector looking to move towards cleaner energy.

The Clean Power Hub programme presents best-practice guidelines and political and technical advice from legislators, policy makers, the energy sector, investors and civil society, in an engaging and user-centred way.

Guest lecturers include Alastair Phillips-Davies, Chief Executive of Scottish energy company SSE Plc., Christiana Figueres, Former Executive Secretary to the UNFCCC, Professor Lord Nicholas Stern,

Co-Chair of the Global Commission on the Economy and Climate, and Dr Maria Neira, WHO Director, Public Health, Environmental and Social Determinants of Health.

MOOC1: Why move towards cleaner power

Fit clean power into wider political priorities, learn to present the key arguments in favour of clean power, highlight the implication of inaction and debunk myths.

MOOC2: Creating a pro-renewables environment

Learn about renewable energy policy development through case studies highlighting successes and failures from a breadth of countries.

MOOC3: Incorporating renewable energy into electricity grids

Explore the challenges and solutions to integrating different types of power sources in one stable, reliable electricity system.

Small Private Online Course (SPOC): Challenges and opportunities in the rooftop solar PV market in India

Pre-selected participants will learn about the investment dimensions of renewable power through live online sessions, case studies and challenges.

You can participate in these free courses at www.edx.org. Certification is also available for professional development. ■



PhD opportunities

Imperial seeks to train postgraduates to tackle society's big challenges in a way that harnesses academic study, talent and imagination, brought together in government-funded PhD training centres. Search online for more information about Centres for Doctoral Training (CDTs) and Doctoral Training Partnerships (DTPs) involving Imperial, which are funded by the UK's Economic and Social Research Council (ESRC), Natural Environment Research Council (NERC), and Engineering and Physical Sciences Research Council (EPSRC):

EPSRC CDT in Nuclear Energy

EPSRC CDT in Fuel Cells and Their Fuels

EPSRC CDT in Future Power Networks and Smart Grids

EPSRC CDT in Quantitative Non-Destructive Evaluation

EPSRC CDT in Sustainable Civil Engineering

EPSRC CDT in Mathematics of Planet Earth

EPSRC STREAM Industrial Doctoral Centre for the Water Sector

ESRC London Interdisciplinary Social Science DTP

NERC CDT in Oil & Gas

NERC CDT in Quantitative and Modelling Skills in Ecology and Evolution

NERC Science and Solutions for a Changing Planet DTP

Focus on: Science and Solutions for a Changing Planet

The world-class research conducted during an Imperial College London PhD is the foundation for students on the NERC Science and Solutions for a Changing Planet Doctoral Training Partnership.

Bespoke training and team projects put research into a broader societal perspective and give this multidisciplinary cohort of over a hundred students the necessary skills and experience to create impact beyond academia. Students' primary research falls within NERC's remit including marine, freshwater, atmospheric and polar sciences, and Earth observation.

The programme draws on Imperial's six core research partners and a network of public and private sector organisations in a collaborative, influential and driven community. The partners are: British Geological Survey, Centre for Ecology & Hydrology, Royal Botanical Gardens Kew, Met Office, Natural History Museum, and the Zoological Society of London.

Each year 15 fully-funded studentships are advertised by the Grantham Institute and 15 other Imperial PhD students from different disciplines align with the programme. ■



Threatened reptiles on the edge of existence

In April 2018, a list of 100 weird reptiles on the edge of extinction hit the headlines. It included the Mary River Turtle (pictured) that breathes through its genitals and a tiny chameleon. **Rikki Gumbs**, who led the research as part of his PhD and is part of the Science and Solutions for a Changing Planet DTP, told the *New York Times* that those species do “Tend to be weird and wonderful in the way they live”.

© Chris Van Wyk



Speaking up for environmental activism

On Earth Day 2018, Grantham Institute Director of Policy and Translation **Alyssa Gilbert** spoke to *BBC World Service Radio* about the value of environmental activism, explaining, “The public voice is an important enabler for central government to be able to make those powerful decisions.” When it comes to tackling plastic waste and demanding more renewable energy, Gilbert said, “Corporations are responding to what they hear from their customers and that’s the voice of the public, too”.



Mission ‘unbelievable’

Imperial earth scientist **Professor Christopher Jackson** filmed his daring descent into one of the world’s most spectacular active volcanoes for the *BBC Two* documentary ‘Expedition Volcano’, which aired in November 2017. In a video diary, Professor Jackson described the Nyiragongo volcano as “Unbelievable” and said it made him “Speechless”.



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Get involved

In 2007, the Grantham Foundation for the Protection of the Environment made the visionary decision to support an Institute at Imperial to provide a vital global centre of excellence for research and education on climate change. Today, the Grantham Institute is established as a leading authority on climate and environmental science.

The Grantham Institute is one of Imperial's six Global Institutes established to promote interdisciplinary working and to address some of the greatest challenges faced by society. We drive forward discovery, convert innovations into applications, train future leaders and communicate academic

knowledge to businesses, industry and policy makers to help shape their decisions.

“Our vision is for a sustainable, resilient, zero-carbon society.”

Grantham Institute Co-Directors

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Partner with Imperial College London academics who focus on some of the most important, relevant and timely questions.

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