

2019–20

Outlook

**What can
you do about
climate change?**
Read the
experts'
top tips

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**Cleantech
cluster**
Meet the
entrepreneurs
looking to
clean up

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**Co-Director
Joanna Haigh
retires**
“It has been
an honour,”
she says

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Foreword

The Grantham Institute's mission to contribute to, and lead on, world-class research, training and innovation towards effective action on climate change and the environment is more relevant now than ever.

Grass-roots movements have risen up to demand action on climate change across society and to face the tough changes needed at all levels. Recognising the all-encompassing nature of this challenge, I joined the heads of 12 leading institutions from six continents in founding the Global Alliance of Universities on Climate (GUAC) to propel worldwide climate action.

We are proud that in 2019, then-Prime Minister, Theresa May, chose Imperial as the backdrop for announcing the UK's ambitious net-zero target for greenhouse gas emissions, reflecting the high quality of our work in low-carbon technologies, climate research and policy analysis.

Of course, we must practise what we preach, and we were delighted to appoint Professor Paul Lickiss as Imperial's new Academic Leader in Sustainability. From November 2019, he will head our Greening Imperial programme, developing ambitious climate change and sustainability goals for the College. These goals will integrate our operations with our mission of education, research and innovation.

We are committed to creating new opportunities for sustainable technologies and business models that solve environmental challenges. With support from the Greater London Authority, we are launching a fundraising campaign to create a hub on our White City Campus where inventors, designers, investors and experienced businesspeople come together to propel ideas and research discoveries into commercial successes.

Finally, we give our thanks to Professor Joanna Haigh, Co-Director of the Grantham Institute for the past five years, who retired after a very successful 35 year career at Imperial. Her legacy of research discoveries, mentored students and academic leadership is a significant contribution to the world. We wish her an enjoyable retirement from official duties, and welcome her continued involvement as a bold advocate for climate action.

Please do read on and find out more about the Institute's plans for the coming year. ■



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

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INTRODUCTION FROM THE CO-DIRECTOR

PROFESSOR MARTIN SIEGERT FRSE
Co-Director of the Grantham Institute

In 2019, global heating trends became all too familiar to anyone in Western Europe, America, India and just about every other part of the planet. Temperature records were exceeded around the world – 46°C in France and 39°C in the UK in July – and the tangible effects became hard to deny. Unseasonal wildfires from the Amazon to Siberia; flooding from the United States to Turkey; droughts in Australia, India and sub-Saharan Africa – one-in-a-hundred-year extreme weather events are becoming one-in-ten-year events. This is not the world I want for me and my family, but there is still time to make the changes necessary for us to inhabit our planet sustainably.

At the Grantham Institute, we want to make a difference. A recent IpsosMORI poll showed that 85 per cent of Britons are worrying about climate change, and visible public movements have galvanised concerned citizens, with thousands adding their voices to the warnings of experts. Find out what you can do about climate change, with our latest evidence-based information campaign (p10–11).

“85 per cent of Britons are worrying about climate change.”

Across the political spectrum, initiatives like Green Great Britain Week, London Climate Action Week, and the UK’s new legal commitment to reducing emissions to net zero by 2050 (p4–5), are bridging cultural gaps and will bring a greener, cleaner, fairer future to everyone. We are proud to be providing evidence to promote the



policies, initiatives and innovation needed to drive ambitious emissions reductions (p6–9).

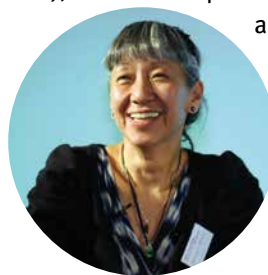
This year, our Annual Lecturer, the artist, activist and Honorary President of the Black Environment Network, Judy Ling Wong OBE (pictured), reminded us that climate change action must work for all our diverse and disadvantaged communities. She also explained how many are already engaged and making a huge contribution to the natural environment. She compared the ‘beautiful’ diversity of nature with that of human beings, and urged people to connect with it emotionally, saying, “We love what we enjoy and we protect what we love.”

Looking ahead, we welcome the news that Glasgow will host the United Nations’ climate change

negotiations – known as COP26 – in 2020. The assembly of world leaders, policy actors, innovators and grassroots movements, as well as the media, makes it an imperative for the UK to overcome its political divisions, raise ambitions as per the 2015 Paris Agreement, and set course for a universal and just transition to net zero carbon emissions.

“We love what we enjoy and we protect what we love.”

I would finally like to extend my gratitude to Professor Joanna Haigh who retired after five years as Co-Director (p18). Jo’s leadership of was truly exemplary, and we will miss her insights on climate science and its translation to the public, policy and business communities. We look forward to the appointment of a replacement to join our friendly, supportive and communicative Institute in 2020. ■





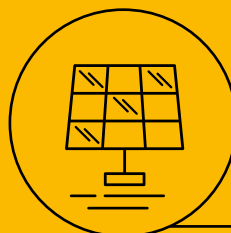
HIGHLIGHTS

Here are some of the highlights of Grantham Institute activities in 2018–19, showing how we contributed towards our vision for a sustainable, resilient, zero-carbon society.



① On the agenda at COP24

A delegation of 12 academics, students and communications professionals made up some of the official ‘observers’ at the 24th Conference of the Parties (COP24) to the United Nations Framework Convention on Climate Change (UNFCCC) in Katowice, Poland in December 2018. Chair in Mineral Processing **Professor Jan Cilliers** (pictured centre) joined a workshop with the Mayor of a coal-dependent Polish town, seeking to identify the priorities for making a ‘just’ transition away from coal mining to an economically strong future. **Dr Robert Gross**, Policy Director at Imperial’s Energy Futures Lab, chaired Imperial’s official side event, which focused on the challenges and opportunities for renewable energy and energy storage in avoiding further rise in global temperatures.



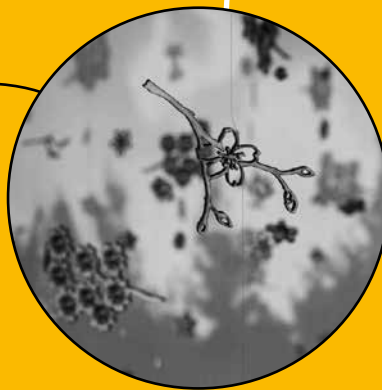
② Online learning supports clean power revolution

The Grantham Institute joined forces with Children’s Investment Fund Foundation (CIFF) to launch the Clean Power Programme in April 2019. These three short online courses aim to educate and address the policy and political challenges holding back low-carbon energy. Course leaders, including Imperial academics **Professor Joanna Haigh**, **Dr Kris Murray**, **Professor Richard Green**, **Dr Ajay Gambhir**, **Dr Jeff Hardy** and **Dr Clementine Chambon**, focus on reasons to shift to clean power, pro-renewables policy and regulation, and incorporating renewable energy into electricity grids. Read more p21 & 23.

3 Grantham Art Prize

The Grantham Institute teamed up with the Royal College of Art to commission six new works of art that spark meaningful contemplation and conversation about climate change. At the opening exhibition of the Grantham Art Prize in April 2019 at Imperial’s Main Reception, Peter Kennard, contemporary artist and Professor of Political Art, joined the prize winners to discuss how art can help people get emotionally involved in this essential issue. The exhibition continued at the Great Exhibition Road Festival in June and the Royal College of Art’s Dyson Gallery in August. Pictured above is Yoshino Cherry Tree, by artist Michiko Yamamoto in collaboration with Imperial’s **Dr Kris Murray** and **Sonia Tiedt**.

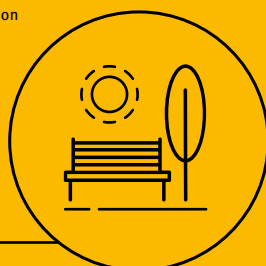
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5 Ministerial address

Then-Prime Minister, Theresa May announced historic plans to end UK carbon emissions by 2050 at Imperial in June 2019. The news, which made the UK the first G7 nation to legislate for net zero emissions, came just weeks after **Professor Joanna Haigh**, former Grantham Institute Co-Director, led a group of eminent climate researchers in urging the PM to enshrine the target into UK law. Professor Haigh joined Imperial’s Provost **Professor Ian Walmsley** in welcoming Mrs May and Minister of State for Energy & Clean Growth **Claire Perry** to the College.

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4 Park up for London Climate Action Week

Londoners sought shade at South Kensington’s Great Exhibition Road Festival during London Climate Action Week and the summer heatwave in June 2019. Imperial PhD students **Hamish Beath**, **Karina Corada-Perez**, **Catalina Cruz** and **Rosie Riley** worked with **Emma Brassington** from University of the Arts London and Meristem Design to set up a temporary ‘parklet’ (small park). Visitors sat amongst planters containing wildflowers, bushes and vegetable patches covering two car parking spaces, whilst chatting to scientists about the benefits of greenery in our cities.



6 Green GB Week and IPCC launch at Imperial

Minister of State for Energy & Clean Growth **Claire Perry** launched the first ever Green Great Britain & Northern Ireland Week (Green GB Week) at Imperial in October 2018, hosted by the Grantham Institute. This event also served as a Europe-wide launch of the Intergovernmental Panel on Climate Change (IPCC) Special Report on Global Warming of 1.5°C, and featured presentations by key figures from the United Nations, the UK government, and the IPCC, including Grantham Lecturer **Dr Joeri Rogelj**.



THE FUTURE WE SEE



READ MORE

IMPERIAL AND KING'S COLLEGE LONDON ARE LEADING A NEW CENTRE FOR THE STUDY AND PREVENTION OF WILDFIRES (P9)

“Our house is on fire,” warned teenage climate activist Greta Thunberg at the World Economic Forum in Davos, and the only response is to take immediate and radical action to reduce greenhouse gas emissions. The result will be a far better life for everyone. In June 2019, then-Prime Minister Theresa May came to Imperial to visit the low-carbon technology research facilities, and enshrine in law the UK’s target of net zero carbon emissions by 2050. Businesses, policymakers in different sectors, international stakeholders and citizens expect

to understand the rationale for this target, their role in delivering it, the implications for investment and the wider benefits for society. The Grantham Institute has embarked on a new programme, with the Grantham Research Institute at the London School of Economics (LSE), to provide evidence-based information on a range of questions related to the net-zero agenda. Initially, we will set out our vision for the future we want to see. We will then address the most concerning issues and share our answers with decision makers and the public. ■

PROFESSOR JENNY NELSON

PROFILE



*Professor of Physics and
Head of Grantham Institute's
Mitigation Team*

Professor Jenny Nelson joined Imperial 30 years ago as a post-doctoral researcher. Now a Clarivate Analytics/ Web of Science Highly Cited scientist (one of the most influential 600 scientists in the world), she specialises in the science of materials and devices for solar energy conversion.

“I’ve been involved with the Grantham Institute since its foundation. I wanted to know whether our research, if successful, would actually make a difference when it came to tackling climate change,” she says.

Professor Nelson heads up the Institute’s Mitigation Team, a group of researchers carrying out interdisciplinary research on topics related to reducing greenhouse gas emissions. She explains: “One of our goals is to determine how new technologies fit in to the global response to climate

change. Using modelling tools and knowledge of energy technologies, policy and the economy, we try to assess the impact of different approaches to climate change mitigation. We also hope the findings will help researchers to direct their work.”

For example, analysis by the team identified that swapping one component material for another in solar cells actually improved the lifetime costs and resource efficiency for solar electricity overall, despite causing a drop in the efficiency of the individual cells.

Does she think we can find a workable response to the challenges of climate change? “Working together collaboratively towards this common goal could bring other benefits, such as a more egalitarian society. Important changes are happening at grass roots, but not yet at higher levels. We need to find a way for our political systems to respond to the growing movement to act on climate change,” she says. ■



CAPE TOWN TEETERS ON RIM OF DROUGHT DISASTER

In 2018, following several years of low rainfall in South Africa, Cape Town, which is home to 4 million people, risked becoming the first major city in the modern era to run out of water – a critical juncture termed ‘Day Zero’.

In response, the municipal government took drastic action to manage water demand and Day Zero was

narrowly averted. However, as the climate changes and populations grow, water shortages will become more common in cities around the world, making the experiences in Cape Town incredibly relevant.

A briefing paper considers what can be learned and offers recommendations for how cities can ensure

long-term water security.

Lead author from Imperial, **Dr Robbie Parks**, commented: “Making changes to this complex infrastructure requires a long-term view and a great degree of interdisciplinary engagement to ensure that all aspects of the system are taken into account.” ■

istock/fivepointsix



READ MORE
EXPERIENCES AND LESSONS IN MANAGING
WATER FROM CAPE TOWN
bit.ly/Cape-town-water

COUNCILS TACKLE CLIMATE EMERGENCY AND SOCIAL INEQUALITY TOGETHER

Tackling climate change can provide multiple benefits to society (known as co-benefits) that include improvements in public health, reduced NHS costs, greater energy security, growth in the low-carbon jobs market and a reduction in poverty and inequality.

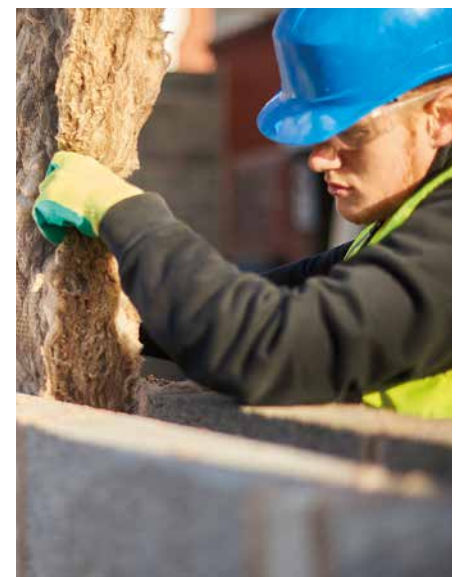
In June, Grantham Institute partnered with the charity Ashden to launch a new briefing paper on the co-benefits of climate action, together with a toolkit by Ashden to help local authorities radically cut carbon emissions.

Dr Neil Jennings, lead author of the paper, said: “It’s essential that climate action is framed in a positive

way that resonates with the everyday concerns of the public. That’s why we were delighted to welcome 60 councils from around the UK to discuss how climate action can help address some of the other key societal challenges. The event was so well received that we are running an equivalent event in Lancaster to reach even more councils to help them achieve their ambitious carbon reduction plans”. ■



READ MORE
CO-BENEFITS OF CLIMATE CHANGE
MITIGATION IN THE UK
bit.ly/Climate-action-co-benefits



istock/sturti

JUSTICE FOR WORKERS MUST UNDERPIN INDUSTRIAL TRANSITION

Avoiding dangerous climate change will inevitably mean a decline in some industries, such as fossil fuel extraction and processing, along with significant changes for people whose lives and livelihoods depend on them. Justice and fairness for these people relies on access to the benefits of new economic activities and modes of working.

“Opportunity for all is the essence of a just transition,” says **Dr Ajay Gambhir**, lead author of a briefing paper discussing the sectors and groups that expect to be adversely affected, how to minimise such impacts, and what lessons can be learned from past and current transitions.

“Governments should draw upon the depth of experience of previous successful just transitions to bring

about the low-carbon economy. In doing so, the transformation stands a better chance of achieving a positive and sustainable outcome for everyone affected.”

An accompanying animation shows how to ensure the low-carbon energy transition is just and equitable for all. ■



READ MORE
 WHAT IS A “JUST TRANSITION”
 AND WHY IS IT CRITICAL TO GETTING
 TO A LOW-CARBON FUTURE?



WATCH
 TOWARDS A JUST AND EQUITABLE
 LOW-CARBON ENERGY TRANSITION
bit.ly/Just-transition

CONTROVERSY OVER NEGATIVE EMISSIONS TECHNOLOGY

While world leaders united behind the Paris Agreement in 2015, computer models showed that delaying action on greenhouse gas emissions meant ‘negative emissions technologies’ would be required later in the century to remove carbon dioxide from the atmosphere. Now, as the 2020 negotiations approach, the pressure is on to deliver a scalable solution.

Bioenergy with carbon capture and storage (BECCS) is the most advanced of these technologies – burning plant matter to release energy whilst capturing the carbon dioxide and locking it away underground. However, some scientists question its capability, let alone at the scale required, or the potential conflict with agriculture and the natural environment. “BECCS must be part of a portfolio of technologies

that could reduce emissions at a sustainable scale,” explain Grantham Institute’s **Dr Alexandre Köberle** and Research Postgraduate **Mathilde Fajardy**, who co-authored a briefing paper clarifying pros and cons, and likely future uses for BECCS.

“Currently, biomass is solely used to produce energy, but adding carbon capture and storage means the approach could help reduce emissions from sectors like aviation, where carbon-negative biofuels could be one of the only solutions,” the authors say. ■



READ MORE
 THE UPS AND DOWNS OF BECCS – WHERE
 DO WE STAND TODAY?
bit.ly/BECCS-ups-downs

Ones to watch

1

National and local government policymakers will hear from experts about the latest Intergovernmental Panel on Climate Change (IPCC) Special Reports on ‘Climate Change and Land’ and ‘The Ocean and Cryosphere in a Changing Climate’.

Professor Liz Bentley of the Royal Meteorological Society will lead a meeting with support from the Grantham Institute and the government departments for Business, Energy and Industrial Strategy (BEIS) and Environment, Food and Rural Affairs (Defra).

2

Imperial’s **Professor Colin Prentice** will lead a new Centre for Wildfires, Environment and Society that begins work in autumn 2019 thanks to £10 million support from the Leverhulme Trust. Imperial and King’s College London lead a consortium of partners including University of Reading and Royal Holloway University of London. The Centre will address the scientific and social context of wildfires.

3

Grantham Institute is delighted that the UK is hosting the United Nations’ COP26 climate change negotiations for the first time – in December 2020. “This is an important moment for the UK to show leadership on climate change, working together with our global partners to deliver real ambitious action,” says Director of Policy and Translation **Alyssa Gilbert**. “The UK government has set clear targets, but these need to be matched by real policies and measures as soon as possible. COP26 will shine a spotlight on the UK which will push us further, and also allow universities, businesses and the public to showcase what we are doing already, and what more we would like to do.”



9 THINGS YOU CAN DO ABOUT CLIMATE CHANGE



START A CONVERSATION
 ABOUT CLIMATE CHANGE TODAY!
 SEE ALL OUR TOP TIPS AND MORE
 AT bit.ly/Personal-climate-action

This year, people of all ages have been striking and protesting on the streets to demand faster and more significant government action to tackle climate change. In response, UK Parliament and local governments, businesses and other organisations have declared climate emergencies, and climate change has become more prominent in the mainstream media. Here at the Grantham Institute, we have responded to these voices that are asking what can be done to help tackle climate change. We want to harness this positive desire for change towards solutions

that are backed up by our research and evidence. So, we have been sharing our evidence in a way that speaks to the wider public. These top tips, available online, and as a pocket-sized printed leaflet, range from making your voice heard to those in power through to making direct changes in your life – from diet through to transport, and energy use. There is something there for everyone, so take a look at our messages and challenge yourself to take one further step towards contributing to a cleaner, greener, fairer future for us all. ■

DR OYTUN BABACAN

PROFILE



*Imperial College
 Research Fellow*

Dr Oytun Babacan joined the Grantham Institute in November 2018, from the University of California, San Diego. He is investigating how to make electric vehicles a mainstream alternative to petrol and diesel vehicles.

“Currently, there are lots of barriers preventing people from buying an electric car, ranging from upfront costs, to concerns about the range [maximum journey distance], to there being no uniform system to charge your vehicle and pay for the electricity,” he explains. “We are looking at how to overcome these barriers and expand electric vehicle infrastructure so that it is easily available to everyone.”

Electrifying motorised transport could play a key role in reducing greenhouse gas emissions, but only if the electricity comes from low-carbon or renewable sources.

“Currently, many electric vehicles are charged overnight when the UK’s electricity is mainly supplied by nuclear, wind, or natural gas. As it stands, the energy required to power more electric vehicles is most likely be supplied by using more natural gas, hence creating more emissions,” says Dr Babacan. “Ideally, people would be able to use charging infrastructure during the day, when there is more clean energy from solar power on the grid.”

However, to have cleaner air in our cities, we need to cut our transportation demands overall.

“Cities are built around people using private cars – there are over 2 million of them in London. But electric cars still create particulate pollution from their tyres and brakes. To avoid this, people should choose active travel – like walking and cycling – and public transport and new city infrastructure needs to promote these actions,” he says. ■



STUDENTS RECOMMEND ACTIONS TO CUT EMISSIONS FROM FLYING

Awareness of the scale and urgency of climate change has renewed focus on the impact of aviation. Flying is very carbon intensive. A return trip from London to New York produces over 1.1 tonnes of carbon dioxide. This is large, considering in the UK, the average person emits 5.4 tonnes per year.

As part of their annual Challenge Team project, a group of students from the Science and Solutions for a Changing Planet Doctoral Training Partnership have analysed data held by Imperial’s travel booking agency and identified opportunities to reduce carbon emissions from academic travel. “15% of people are responsible for 50% of the emissions recorded in this data,” says Research Postgraduate **Laura Warwick**. This inequality is mirrored across the UK – with 15% of people taking 70% of flights.



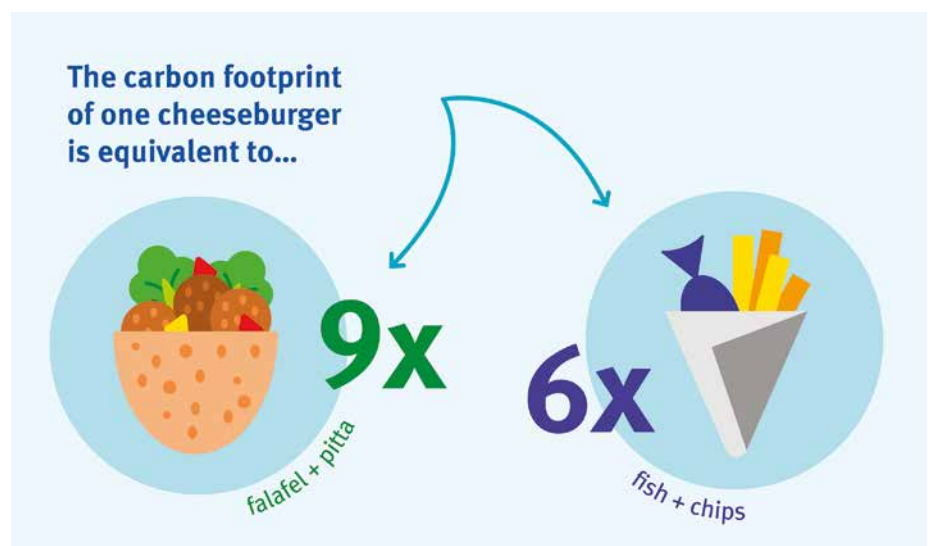
The team assessed what other academic institutions are doing and have recommended actions that any organisation can take to reduce the environmental impact of business travel overall.

EAT SEASONAL AND LOW-CARBON FOOD

Agriculture currently accounts for 26% of global greenhouse gas emissions and over half of this comes from animal products. As well as the resources consumed directly by animals, more land, water and pesticides are required to cultivate their food – driving deforestation in many parts of the world.

Typically, a person who eats 100g of meat per day (two sausages or one beef burger) produces around 2.5 times more greenhouse gases than a vegan person does. Evidence also suggests that people who primarily eat plant-based foods are healthier than people who eat lots of meat.

Grantham Institute Partnership Development Manager **Dr Neil Jennings** and Research Postgraduate **Lily Peck** produced a leaflet that highlights the health and environmental case for eating less meat and dairy. They also



highlighted how growing food locally and in its natural season requires less energy for refrigeration and transport, so choosing to eat this way can further help to lower our personal carbon footprint. ■



READ MORE
 SAVING THE PLANET, ONE MEAL AT A TIME
bit.ly/Eat-low-carbon



Firstly, they suggest that improving data on travel would help the organisation introduce measurable targets for reducing emissions. Secondly, they recommend establishing a dedicated team to design and implement policies,

such as levying an internal tax on travel emissions or improving the availability of video conferencing, to reduce the number of long-haul flights taken.

Finally, the authors raised the idea of a slow-travel policy, whereby time spent on personal travel can count as work time rather than holiday if the person takes a more environmentally friendly alternative to flying, such as train travel (pictured).

“There is a perception that flying is an essential part of academia – allowing researchers to network and make new collaborations. There is, however, very limited evidence that flying has an impact on professional success,” says Warwick. “Imperial can therefore act on aviation emissions while remaining a world-leading academic institution. In doing so, it will join other major institutions who are taking the lead in responding to the issue of emissions from academic travel.” ■

IMPROVE CITIES BY GOING GREEN (AND BLUE)

Incorporating vegetation and water into urban environments can improve the quality of life for people living in cities. This was the conclusion of a new briefing paper by Imperial’s **Dr Ana Mijic** and **Kathryn Brown**, Head of Adaptation at the Committee on Climate Change Secretariat who was on a secondment at the Institute as a Research Fellow. Urban architecture referred to as ‘blue-green infrastructure’ incorporates



istock/baona

features such as green roofs, grassed areas, trees, parks, rivers and ponds. These absorb carbon dioxide and other pollutants, improve biodiversity and help cities adapt to a warmer climate by providing natural shade and cooling.

The authors warn that despite its importance to people and the environment, blue-green infrastructure is declining rather than increasing in England. They say that better quantifying the financial benefits of blue-green infrastructure could make them more attractive to urban planners. ■



READ MORE
INTEGRATING GREEN AND BLUE SPACES INTO OUR CITIES: MAKING IT HAPPEN
bit.ly/Blue-green-cities

Ones to watch

4

Chemist **Professor Paul Lickiss** has become Imperial’s first Academic Leader in Sustainability. The College created this new role to show greater leadership on climate and environment and push for further improvements like the end to single-use plastic cups and coffee-cup levy brought in by the Greening Imperial campaign. Professor Lickiss has ambitions to set up a network of sustainability champions in every department and division in the College and to set up a sustainability fund.

5

The first London Climate Action Week brought together neighbouring organisations from the Exhibition Road Cultural Group in South Kensington in 2019. Sustainability experts from organisations including the Royal Albert Hall, V&A Museum, Science Museum, Japan House London and Royal Geographical Society (with IBG) have begun meeting to share their world-leading expertise in climate action and low-carbon solutions in areas such as leadership, energy-use, transportation and procurement.

6

Grantham Institute’s student-led Changing Planet seminars feature cross-cutting ideas on climate action. The series kicks off in the autumn with Bloomberg New Energy Finance analyst and author, Jenny Chase, on solar power – just one way to reduce energy use and cut your bills. Previous speakers include Carbon Brief editor, Leo Hickman, London Sustainable Development Commissioner, Maria Adebawale-Schwarte, and author of the 2009 book ‘The Health Practitioner’s Guide to Climate Change’, Professor Mala Rao. Sign up to the Weekly Update newsletter for details of future seminars.



VISION FOR INNOVATION



A new ecosystem of low-carbon technologies, businesses and business models must quickly evolve to help achieve ambitious international climate and environmental goals. So far, Grantham Institute’s innovation team has helped 55 such cleantech start-ups to secure over \$200m of early stage investment – their first foothold on the ladder to success – and now we want to go one step further. Within Imperial’s vision for its fast-developing White City Campus sit plans for a global hub for cleantech innovation.

With support from the Greater London Authority (GLA), we aim to house these emerging businesses in a vibrant innovation environment, alongside other parties who can help to develop and deploy innovations that tackle our climate and environmental challenges. Over 2019–20, we are seeking founding partners to help finance and shape this vision, as well as mentors, budding entrepreneurs and businesses to co-locate activities within the hub. Get in touch to be part of this exciting project. ■

DR ANDREAS KAFIZAS

PROFILE

*Junior Research Fellow and Lecturer
in Climate Change and the Environment*

Dr Andreas Kafizas (pictured left), who joined the Grantham Institute in October 2018, dedicates his research to what he describes as ‘useful chemistry’.

“My work is focused on developing light-activated technologies that can drive a range of beneficial processes,” he explains. “Sunlight is our most abundant renewable energy source, so developing technologies that use it will be key to cleaner, greener, low-carbon future.”

“For instance, I’m developing materials that can use sunlight to convert water into hydrogen fuel, which burns cleanly back to water with no carbon dioxide released. I’m also developing light-activated paints and coatings that can help to tackle air pollution”.

One of the main components of air pollution is nitrogen oxide gases. Paints and coatings that contain the photocatalyst titanium dioxide (TiO₂)

can remove these harmful pollutants from the air.

“These technologies are already being used, but their effectiveness varies when used indoors and outdoors compared with laboratory tests,” says Dr Kafizas.

Dr Kafizas and his research group, Solar Coatings, have built an Air Pollution Simulation Chamber to help them understand how effective these technologies are at improving air quality. In the chamber, they can set the humidity, wind speed and light level to mimic the conditions found in a polluted environment.

What would he want to happen in the next few years? “I would like to see more investment in the research and development needed for the UK to move towards a carbon-neutral economy. The UK have been world leaders in many policy changes related to climate change and the environment. We now need to pledge more investment to ensure we meet the targets that we have promised,” he says. ■

Dr Andreas Kafizas in his laboratory at the Molecular Sciences Research Hub building on Imperial’s White City Campus.

Thomas Angus/Imperial College London

AN AFFORDABLE, EFFICIENT ENERGY SOLUTION FOR RURAL COMMUNITIES

Elizabeth Nyeko, (pictured) Imperial College Business School alumnus and one of MIT Technology Review’s 35 Innovators Under 35, is pioneering an energy solution for rural communities in Africa that could add value to power systems everywhere.

Tracking the electricity demand of customers is difficult. This can lead to high costs, overproduction of power and inefficiency. As Chief Executive of Modularity Grid, Nyeko is developing an intelligent cloud-based platform that improves this situation.

The technology is being piloted

in Uganda to address the energy needs of refugees and host communities. Here, the electricity powers rice and maize mills, with waste byproducts (rice husks and maize cobs) used to fuel the mini-grid itself.

“We want to bring down the cost of setting up, installing and operating mini-grids, so that they are viable in a low-income setting,” Nyeko says.

Modularity Grid is also working with Airbus, to adapt the technology to deliver reliable power systems for next-generation spacecraft. ■

Jody Kingzett/Imperial College London



LATIN AMERICA INVENTOR OF THE YEAR TACKLES PLASTIC POLLUTION

Inty Grønneberg was named Latin America Inventor of the Year by MIT Technology Review. The Ecuadorian-Norwegian Postgraduate Researcher is co-founder of startup Ichthion, which is developing technologies to tackle the problem of plastic pollution.

Almost eight million tonnes of plastic enter the ocean each year. This can break down into tiny fragments that are harmful to human health if they enter the food chain. Ichthion’s technologies extract plastic from rivers, coasts and oceans before it enters the marine ecosystem. The systems integrate into existing infrastructure, and

generate their own energy as water passes through their turbines.

“We urgently need to remove plastic pollution from our environment, and we need some real data on the pollution in water streams to drive better policies for a circular economy,” says Grønneberg. “We believe our technology is a real game-changer.”

This year, Ichthion graduated from the Climate-KIC Accelerator run at Imperial, and secured funding worth £1m, including £600,000 from Innovate UK. The company will work with the Ecuadorian government, deploying their technology in two

of the country’s most polluted rivers to help stem the flow of plastic to the Galapagos Islands. ■

Fergus Burnett/Imperial College London



Ones to watch

STARTUP PROBES MICROBES FOR BETTER SOIL HEALTH

Soil should be teeming with life – complex microbial ecosystems are critical to healthy soil and plentiful crops. However, intensive farming practices are degrading soils throughout the world, which is threatening food supplies.

Dr Jim Bailey, Imperial alumnus and founder of P.E.S Technologies, has developed a technology that enables farmers to determine the status of their soil by analysing the soil microbiome. P.E.S. Technologies use sensors that measure microbial activity in soil, identifying what bacteria are doing,

rather than which are present. This allows farmers to monitor long-term changes to their soils' health, helping them to make more accurate land management decisions to improve their yields. As part of the Climate-KIC Accelerator, P.E.S Technologies completed a proof-of-concept, funded by Innovate UK and now plan to produce a near-to-market prototype. ■



FASHION TECHNOLOGY: 'CLOTHES THAT GROW'

Petit Pli, a material innovation and fashion technology start-up founded by Imperial graduate **Ryan Mario Yasin**, introduces clothes that grow with children.

The team created a specially engineered fabric, which has a structure that allows it to expand bi-directionally. This means that a single garment can expand up to seven sizes – typical for the first two years of a child's growth.

Petit Pli hope to make the fashion industry more sustainable by reducing waste with fewer offcuts, using recycled fabrics, keeping clothing in use for longer, and inspiring the next generation to rethink the value of clothes.

“Clothes that grow’ was designed to answer the needs of parents and children, retailers, manufacturers and the environment by offering the opportunity to make the sustainable option more desirable – and able to be implemented today,” says Yasin.

Petit Pli were named a 2019 H&M Foundation Global Change Award winner, and will use their €150,000 prize money to scale-up production, grow the team and push their research and development. ■



Petit Pli

7

Imperial is funding the development of ‘BioSolar Leaf’ technology by start-up Arborea. Designed by founder and Imperial alumnus **Julian Melchiorri**, Arborea is a system that cultivates tiny plant-life – such as microalgae, diatoms and phytoplankton – on large solar panel-like structures, which can remove carbon dioxide and produce breathable oxygen at a rate equivalent to a hundred trees from the surface area of just a single tree. An outdoor prototype will be installed on Imperial’s White City Campus South Site.

8

Breathe Battery Technologies, founded by PhD students **Ian Campbell** and **Yan Zhao**, is developing state-of-the-art control software to enhance electric vehicle fast charging. The technology works by adapting to every battery’s unique condition. The start-up is backed by Climate-KIC and won the ‘Energy & Environment’ category of Imperial Enterprise Lab’s Venture Catalyst Challenge. The duo hold Entrepreneurial Fellowships with the Faraday Institution, and their ultimate goal is to enable widespread transport electrification to combat climate change.

9

Three teams have come out on top of the Climate Launchpad National Final, a cleantech competition that Grantham Institute runs in partnership with Climate-KIC. Mulus Media, who are developing a new growth medium for cultured meat, Treeconomy, who are bringing economic value to the natural environment, and Nu-Oceans, who are cleaning the oceans, one pair of flip-flops at a time, The winning teams, who all contain Imperial students, enter a global grand final in November in November.

“It has been an honour,” says Professor Joanna Haigh upon retirement

Co-Director of the Grantham Institute from 2014–2019 and former Head of Physics, Professor Joanna Haigh leaves behind a legacy of science advocacy and academic leadership. Her career as one of the UK’s top atmospheric physicists has seen her accumulate numerous accolades – including Fellow of the Royal Society and Commander of the Most Excellent Order of the British Empire (CBE) from Her Majesty the Queen and a term as President of the Royal Meteorological Society. Professor Haigh’s research showed how natural variation in the sun’s activity affects our planet’s climate, an understanding that helped to dispel the theory that global warming is linked to solar activity.

Have you always been interested in weather and climate change?

I have very fond memories of camping with my family when I was younger, and this encouraged my interest in the outdoors and the environment. As a teenager, I was taken by the idea that weather could be scientific and I – rather geekily – made my own weather station in the back garden and monitored the temperature, wind, rain and the clouds. So, following my undergraduate degree in physics at the University of Oxford, I joined Imperial for their MSc course in Meteorology, and it was fantastic.

“I made my own weather station in the back garden.”

What has it been like working with the Grantham Institute?

It has been an honour and a marvellous experience. The Institute has a wonderful sense of direction and clarity of purpose; it also has superb staff and engages widely across Imperial and outside to support science and action on climate change.

Being Co-Director, I was lucky to have many opportunities to talk to people across society who are interested in what climate change is doing to their businesses, their homes, their hobbies

and wider interests, and what they need to do about it.

How do you deal with people who do not believe in the science?

When I started studying the role of the sun in climate change, I got emails from climate change deniers who believed I was questioning the heating effects of greenhouse gases. However, that could not be further from the truth.

Now when people contact me questioning the science, I politely write back to try to explain the subtleties of the research. Very occasionally, I receive a response saying, “Thanks, this is much clearer now”, which feels like a win for science!

What are your biggest career highlights?

Overall, the opportunity to meet people from across the world and become part of a scientific community. Scientifically, having my ideas on solar variability and climate change recognised.

Impact-wise, meeting then-Prime Minister Theresa May on her visit to Imperial, when she announced the government’s legislation for net zero carbon emissions by 2050. ■

Dr Ana Mijic

is ensuring sustainable water use and flood management in the years ahead



Dr Ana Mijic, who joined the Grantham Institute in 2009 as a Research Postgraduate, is now Senior Lecturer in Water Management in the Department of Civil & Environmental Engineering. She is also currently a Natural Environment Research Council (NERC) Innovation Fellow, working with the UK's Environment Agency to develop a systems approach for water management that can underpin the government's '25 Year Environment Plan'.

Can you tell us more about your work?

My research focuses on the interaction between the water cycle and sustainable development. Humans are changing almost every part of the landscape – and this has serious implications for its availability and management. Signals like extreme floods and droughts are the planet's way of saying we are overusing it. I want to find out what will happen to the water cycle in the future, and how we can support economic growth whilst ensuring sustainable water use and flood management in the years ahead.

How has working with policymakers influenced your research?

As an engineer coming from an academic community, it has been eye-opening to work with policymakers. Thinking about how my work could be implemented practically has given me an insight into the complexity of decision-making, and the many different perspectives needed to shape water management systems that benefit the environment, society and the economy.

What does the year ahead hold for you?

This year, I am working on a London-based project – Community Water Management for a Liveable London (CAMELLIA). It brings together local authorities, environment agencies, water companies, developers, local NGOs and citizens to develop a 'systems approach' to urban water management in London. We want to explore solutions that allow for increased housing growth in the city, alongside sustainable water use and environmental protection. My role is to work with the key decision-makers to develop a set of integrated modelling tools and adaptive planning approaches that will help them make the best collaborative decisions about water management.

How can the world meet the challenges of climate change?

Everyone has a role to play as a global citizen, but, ultimately, you cannot put all the responsibility on people living their everyday lives. The problem is so big, and so urgent, that it needs bold action from people who govern and are prepared to implement policies and fund innovation that will help us meet our climate targets. ■



TRAINING LEADERS OF THE FUTURE

Imperial is a one-of-a-kind university in the UK, being home to a global community of scientists, engineers, medics and business experts. Here, we meet some of the students who are using their diverse talents to find solutions to some of the world's biggest challenges – like financing sustainable energy technologies, protecting the world's endangered species and understanding past climate changes.



PROFILE: Marie-Adélaïde Bullukian,
MSc Climate Change, Management and Finance

“I hope the debate will have evolved from ‘how’ to ‘when’”

Marie-Adélaïde Bullukian was born in France and did her undergraduate degree in Economics and Political Sciences at McGill University in Canada. During an internship with United Nations Environment Programme Finance Initiative, she discovered sustainable finance.

“A colleague of mine, who had been particularly supportive, had studied at Imperial, which strongly influenced me to apply for this unique Master’s course,” she says. Having studied taught modules and completed a thesis during the year, Bullukian is now completing a work placement for an asset manager specialising in sustainable investments, a field she plans to work in after she graduates. Speaking about the prospects for sustainable finance to drive investments in clean technologies and a

diverse range of other low-carbon solutions, she says, “There has been a notable shift in thinking both in management and finance. However, the lack of clarity, coherence and global standards hinders sustainable management and finance practices. I hope that in the next ten years the debate will have evolved from ‘how’ to ‘when’ will the transition be achieved. Time is of the essence here.”

Imperial places great emphasis on the integration of Master’s courses with its world class research activities. The one-year MSc Climate Change, Management & Finance, taught by the Grantham Institute and Imperial College Business School provides graduates with the interdisciplinary skills required in business on issues relating to climate change and sustainability. ■

PROFILE: Naomi Pratt, Science and Solutions for a Changing Planet Doctoral Training Partnership

“If you want to make change, you can’t just ask nicely”

Naomi Pratt is approaching the end of her four-year PhD in deep sea corals and palaeoclimate. She came to London in 2015, one of 40 students joining her multidisciplinary PhD programme that year. “I didn’t want to be a hermit, so the community sounded great, and I was keen to get stuck in to public communication and policymaking alongside my research,” she says.

Also around this time, Naomi became involved in climate activism, and helps to run Divest Imperial, a campaign to end investment in fossil fuels. “If you want to make change, you can’t just ask nicely,” she explains. She also campaigns within and for the Labour Party for strong environmental policies like the Green New Deal. What holds her back? “Time and money are the main things, of course! It’s surprising how quickly you gain confidence by just giving stuff a go.”

For now, Naomi has been concentrating on writing her thesis. “I’m itching to get back to the climate strikes and Green New Deal,” she says. “We are in an unprecedented political moment, and have everything to win.”

Imperial trains postgraduate researchers to address society’s big challenges in government-funded PhD programmes that harness academic study, talent and imagination; all supported by extensive professional development.

The Science and Solutions for a Changing Planet Doctoral Training Partnership trains and inspires a new generation of experts and leaders to tackle some of the toughest environmental challenges of our time. ■



PROFILE: Mohamedweli Mohamed, Clean Power Program

“The perfect way to learn and have a balance”

Mohamedweli Mohamed is one of more than 500 alumni from Imperial’s online Clean Power Program on EdX.

Mohamed works on humanitarian projects in the Gedo region of Somalia, a country where most people lack basic electricity access and renewable electricity is very expensive and little used.

“I wanted to know more about clean power since I am advocating how to achieve the Sustainable Development Goals in our area,” he says. The online course is, “the perfect way to learn and have a balance between work, family issues and studies.”

Learning about case studies in countries like Denmark, Mexico, China and India that have achieved 50% clean power inspired Mohamed’s ideas for his home country. “I am planning to set up small mini grids that use clean power as the area is very sunny and windy throughout the year,” he says.

Imperial’s vision is to develop and deploy cutting edge technology to transform the learning and teaching experience.

The Grantham Institute and partners have produced three online courses about the shift to a low-carbon energy system, that are accessible from anywhere in the world and available for free on EdX. The courses cover the opportunities and advantages of clean power, the tools needed to build a global low-carbon power sector and the challenges and solutions of the energy transition. ■

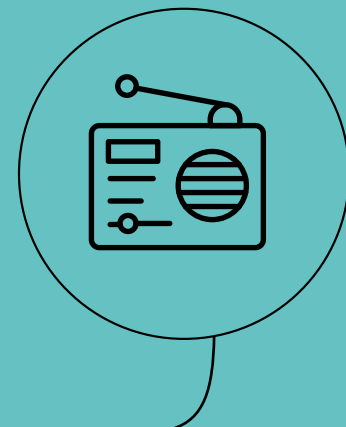


LEARN MORE
ABOUT THE CLEAN
POWER PROGRAMME
AND OTHER WAYS
TO STUDY AT
IMPERIAL
ON P23.

Heatwaves set newsrooms alight

“If we don’t do anything now, the 1.5°C threshold will be passed in 2030.” Institute Co-Director **Professor Joanna Haigh** renewed her calls for urgent climate action during the record-breaking 2019 heatwave while talking to the BBC. She said: “The government is distracted, but it needs to focus on this.” Other Imperial academics joined her call to action, speaking to *BBC Breakfast*, *Radio Wales*, *ITN* and *The Jeremy Vine Show*, *The Guardian*, *France 24*, *London Live TV* and *TRT World*.

© BBC



Listeners’ phone-in addresses climate concerns

In May 2019, the UK’s Committee on Climate Change (CCC) released a new report, saying the nation can end its contribution to global warming within 30 years. Grantham Institute Director of Policy and Translation **Alyssa Gilbert** answered listeners’ questions on BBC Radio 5 Live’s *Your Call*, about the CCC’s ‘Net Zero’ report, and how the UK can cut its greenhouse gas emissions. Other Imperial experts featured on *BBC Radio 4*, *edie.net* and *The Guardian*.



Antarctic warming makes headlines

In April 2019, Royal Meteorological Society and Grantham Institute experts briefed journalists about climatic conditions during the Pliocene – an epoch around 2.7 million years ago – when Earth’s atmosphere last had today’s level of carbon dioxide. Co-Director **Professor Martin Siebert**, (pictured, second from left) offered a glimpse of future climate change impacts: “The headline news is the temperatures are 3–4°C higher and sea levels are 15–20 metres higher than they are today.” The story made headlines in *The Guardian*, *The Metro*, *BBC*, *Daily Mail*, *Press Association* and *The Independent*.



Study at Imperial

Imperial is a one-of-a-kind university in the UK, focusing exclusively on science, engineering, medicine and business. To help you explore all the ways you could advance your knowledge at Imperial, we group our Master’s and Doctoral courses into four different global challenge course guides.

· [Discovery and the natural world](#)

· [Engineering novel solutions](#)

· [Health and wellbeing](#)

· [Leading the data revolution](#)

These guides are designed to help you search our courses by theme. The reason for this is that Imperial is highly interdisciplinary. As such, many of our departments welcome students from outside their exact area of expertise as long as they have a background in a relevant discipline. So, we encourage you to use our course guides to look for courses related to your interests – it may not be in a way you previously considered or thought you might be qualified for.

Download our global challenge course guides at:
imperial.ac.uk/study/

Online professional development

Imperial now provides professional development taught by Imperial academics, with best-practice guidelines, and political and technical advice from legislators, policymakers, investors and civil society, all presented in an engaging and user-centred way.

The **Clean Power Program**, developed by the Grantham Institute and funded by the Children’s Investment Fund Foundation (CIFF), consists of three Massive Open Online Courses (MOOCs) that are accessible from anywhere in the world and available for free on EdX. Those who complete the courses can pay a small fee to receive a Professional Certificate. Technical expertise came from academics across Imperial, including the Digital Learning Hub, the Centre for Environmental Policy, Energy Futures Lab, the Grantham Institute and Imperial College Business School.

MOOC1: Why move towards cleaner power

Understand how clean power fits into wider political priorities, and learn to present the key arguments, highlight the implications of inaction and debunk myths.

MOOC2: Create the conditions for renewable energy deployment

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

MOOC3: How to incorporate renewable energy into the grid

Explore different types of power in one stable, reliable system. ■

Find out more at: bit.ly/CleanPowerProgram

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.

Work with us

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

Study at Imperial

See page 23 or visit our website to find out more about Master's, PhD and professional online training programmes at Imperial College London.

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If you would like to offer support or discuss the role you could play in helping us achieve our goals, please contact Clare Dodds, Head of Trusts & Foundations on 020 7594 1829 or c.dodds@imperial.ac.uk.

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Become a founding partner in our cleantech hub at London's White City and help to finance and shape the vision for this exciting project. Contact cci@imperial.ac.uk

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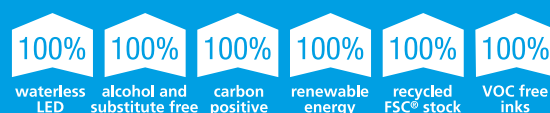
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