

# Sustainable Development Goals





# SDG Explainer

United Nations Sustainable Development Goals. The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including poverty, inequality, climate change, environmental degradation, peace and justice.

- GOAL 1: NO POVERTY**
- GOAL 2: ZERO HUNGER**
- GOAL 3: GOOD HEALTH AND WELL-BEING**
- GOAL 4: QUALITY EDUCATION**
- GOAL 5: GENDER EQUALITY**
- GOAL 6: CLEAN WATER AND SANITATION**
- GOAL 7: AFFORDABLE AND CLEAN ENERGY**
- GOAL 8: DECENT WORK AND ECONOMIC GROWTH**
- GOAL 9: INDUSTRY, INNOVATION AND INFRASTRUCTURE**
- GOAL 10: REDUCING INEQUALITY**
- GOAL 11: SUSTAINABLE CITIES AND COMMUNITIES**
- GOAL 12: RESPONSIBLE CONSUMPTION AND PRODUCTION**
- GOAL 13: CLIMATE ACTION**
- GOAL 14: LIFE BELOW WATER**
- GOAL 15: LIFE ON LAND**
- GOAL 16: PEACE, JUSTICE, AND STRONG INSTITUTIONS**
- GOAL 17: PARTNERSHIPS FOR THE GOALS**

[SDGS.UN.ORG](https://sdgs.un.org)

# Contents

- 04** Foreword by Professor David Nabarro
- 05** Foreword by Professor Alice Gast
- 06** Introduction
- 08** Tackling the threat of antimicrobial resistance
- 09** Empowering communities with innovative off-grid energy solutions
- 10** Boosting global crop yields to end hunger
- 11** Leading the fight to eradicate malaria
- 12** Driving the global transition to zero pollution
- 14** Nurturing generations of Change Makers to tackle global challenges
- 15** Cleaning the air we breathe
- 16** Helping the injured victims of conflict around the world
- 17** Delivering vaccines to those who need them most
- 18** Empowering enterprising women to drive societal change
- 20** SDG Start-ups
- 22** Design and innovation meets global development
- 23** The world's most advanced centre for disease and emergency analytics
- 24** Paving the way for next-gen quantum tech
- 25** Innovation for global energy challenges
- 26** Getting a grip on infectious disease
- 27** The unique centre striving for more sustainable global business
- 28** The WISER project – working towards cleaner water to prevent schistosomiasis
- 29** Building equitable, healthy cities for the future
- 30** School students around the world compete to tackle the SDGs
- 31** Tackling childhood mortality in sub-Saharan Africa
- 32** Inclusive STEM learning and innovation
- 34** Research by Imperial physicists spans local energy and health tech discoveries
- 35** Delivering innovative solutions to improve global health
- 36** Managing rainforests for the ecological and economic benefit of all
- 37** Synthetic biology paves the way for new drugs, materials, fuels and food
- 38** Mastering the elements
- 39** Calculated progress – Mathematicians progressing the SDGs number by number
- 40** Imperial's new Global Development Hub



## Foreword

**Pursuing world-leading research and education for the benefit of society has always been at the heart of Imperial College London's mission.**

Our staff and students operate across sectors and disciplines to develop new technologies, discover new cures, educate and inspire the next generation and find ways to answer the greatest of challenges. Amplified by a network of collaborations in over 192 countries, Imperial's research and education transforms lives, creates opportunity and moves us towards achieving the United Nations' 2030 Agenda for

Sustainable Development. The case studies selected for this booklet illustrate the College's breadth of talent, diversity of thinking and extensive global outreach creating culturally relevant solutions. We are proud to have the greatest concentration of high-impact research of any major UK university and to have a unique environment where students at all levels work alongside our leading researchers in multi-cultural, multi-national teams. Our deep-seated culture of entrepreneurship, innovation and community-embedded solutions adds an extra

dimension to this environment and our ability to impact on the SDGs. Imperial's new White City Campus is home to a significant cluster of start-ups and growing enterprises developing new technologies to tackle global challenges. One such start-up, RFC Power, is developing a low-cost, long-duration battery that will facilitate the transition to 100% renewable energy and is working on a project to improve access to clean, reliable and affordable energy in Sub-Saharan Africa. Another small company, VUI Diagnostics has a new retinal imaging tool that dramatically speeds up the diagnosis of diseases that lead to sight loss. With 90% of the world's blind people living in the developing world, they hope to bring retinal imaging to isolated regions that

previously did not have access to equivalent technology. These are just a few examples of the many ways Imperial's staff and students are turning academic thinking into transformative, real-world innovations that will enable and advance sustainable development. We know that 'leaving no one behind' applies as much to our local London community, as it does to cities and communities around the world. We believe that by joining forces with local, national and international partners, we have an important role to play in fulfilling the SDGs. More importantly, we know that our students will go on to be the innovators, entrepreneurs and leaders of the future who will take this agenda forward. Our new Global Development Hub will advance our contribution to the SDGs by building communities of practice across sectors and disciplines. It will be a vital connection point for building new institutional partnerships focused on policy impact and translation of research into economic and social progress. We take our position on the global stage seriously and by working together we are confident that we will continue to make further progress towards creating a better society.

**ALICE GAST**  
PRESIDENT OF IMPERIAL COLLEGE LONDON

## Introduction



**Professor David Nabarro is Co-Director of the Institute of Global Health Innovation and the WHO Director General's Special Envoy on COVID-19. Prior to joining the College, Professor Nabarro was the Special Adviser to the United Nations (UN) Secretary-General on the 2030 Agenda for Sustainable Development. He played a key part in the analysis and development of the Sustainable Development Agenda and Goals. His particular area of focus was food and nutrition, and the reduction of hunger, which evolved into Goal 2 of the SDGs.**

In September 2015, the leaders of the world's nations agreed on a vision for the future of our world. It establishes priorities for urgent action to ensure the well-being of all people and the regeneration of our planet's natural resources. It was produced through the worldwide collaboration of thousands of citizens from all walks of life. It took more than two years of soundings, dialogue, expert consultations, and intense negotiations. It is called the 2030 Agenda for Sustainable Development. The vision focuses on the needs of people, wherever they live. It is interconnected and calls for integrated responses, implemented through collective action. At its heart is a strategy built around 17 goals with multiple targets. Implementing this strategy calls for innovation in social organisation, governance, business strategies and political leadership. As an international university focused on science, engineering, medicine and business, Imperial College London is making major contributions through collaborating in both research and education. Here is what I have seen

since I arrived in 2018. First, elements of the strategy are incorporated into the underlying values and everyday behaviours that are reflected across the College. Its principles and goals are incorporated into core teaching, extra-curricular competitions and opportunities for all students. Second, the College seeks to ensure that vital STEM education can be accessed by school-aged students around the world. This contributes to the SDGs and inspires future generations to achieve more in years to come. Third, the 2030 Agenda encourages Imperial to nurture innovations that have relevance in a variety of different contexts internationally. Priority is given to approaches that are relevant to the SDGs and these are showcased here. Fourth, the College's leadership is increasingly focused on the complex systems challenges that result in persistent inequities, infectious diseases, climate change and the damage to nature. These have been made more visible as nations have sought to respond to the COVID-19 pandemic. The Imperial community is

fully engaged in research, analysis, policy formulation and action that relate to contemporary systems challenges. As we advance into the current decade, I sense that the College will increasingly be guided by the 2030 Agenda when contributing to human and planetary well-being. That is why I am so pleased that the College's contributions will be accelerated through a Global Development Hub, which will increase the synergy and impact of innovations flowing from groups across the College. I am delighted that our Institute of Global Health Innovation will be part of this effort. For me the 2030 Agenda is both a compass and an inspiration. I am excited to be part of the College community as we intensify our commitment to a world of the future that is sustainable, equitable, just and leaves no one behind.

**DAVID NABARRO**  
CO-DIRECTOR OF THE INSTITUTE OF GLOBAL HEALTH INNOVATION AND WHO DIRECTOR GENERAL'S SPECIAL ENVOY ON COVID-19.

**At the heart of Imperial's mission has always been the pursuit of world-leading research in science, technology and medicine and its translation into innovative solutions that benefit industry and wider society.** Perhaps most famously, Fleming's discovery of the antibiotic penicillin at St Mary's Hospital in 1928 heralded a global revolution in medicine and healthcare. The College has also played host to other pioneers such as Richard Barrer, one of the first 'green' chemists, whose work in the 1950s on highly efficient zeolite catalysts

transformed modern industry and focused attention on sustainability. As a global society we now face an urgent and unprecedented set of challenges, including the all-encompassing spectre of climate change; plateauing crop yields in the face of a growing global population; the continuing epidemics of malaria, tuberculosis and HIV in addition to our proven global vulnerability to infectious diseases like the novel coronavirus; health inequalities; and rising air pollution in our rapidly expanding cities. The United Nations' 17 Sustainable Development Goals (SDGs) – which came into effect in 2016 – provide

a framework for tackling these challenges, and endeavour to achieve a sustainable future for humanity and the natural world. Crucially, the SDGs provide a focal point for universities, industry, third sector and government partners working across disciplines to come together to develop and deliver innovative solutions to shared global challenges. Imperial has an established track record of leading multidisciplinary research collaborations, as well as convening a broad spectrum of external partners to bear on societal and industrial problems, particularly through the work of established

centres and institutes such as the Grantham Institute for Climate Change and the Environment; Institute of Global Health Innovation; Centre for Environmental Policy; and Energy Futures Lab. These centres have already had a transformative impact in helping to achieve the SDGs. For example, by pioneering new advances in electrochemical materials to improve batteries and fuel cells for sustainable cities and transport; driving improvements in disease screening by combining artificial intelligence (AI) and clinical medicine; and helping farmers in Africa improve crop

yields and protect against drought with innovative new financial instruments. This multidisciplinary approach now permeates Imperial's entire ecosystem and is exemplified through the creation over the past few years of dozens of new Networks of Excellence and Centres of Excellence – including those focused on Air Quality; Sustainability through Life Cycle Approaches; Translational Nutrition and Food Research; Ocean Plastic Solutions; Malaria and more. Meanwhile, Imperial's White City Campus is being purpose-built to facilitate cross-disciplinary

research and innovative solutions in partnership with industry, third sector and the local community. The launch of Imperial's Academic Strategy in 2020 saw another step change in this approach with a focus on creating a world in which society is healthy, sustainable, smart and resilient. The new strategy has facilitated the launch of several transformational cross-disciplinary programmes in research, education and innovation that will help our society, including Transition to Zero Pollution, Institute of Infection and Imperial-X. These programmes bring together a litany of examples where

Imperial academics, students and staff are engaging with the Sustainable Development Goals. Their scope, goes beyond the 2030 timeframe of the UN's SDGs, highlighting a key point about the nature of Imperial's fundamental research: we have always been, and will continue to be, focused on anticipating and preparing for challenges that might arise 20, 30 even 50 years into the future. As a world-leading STEM institution, we recognise our urgent and critical role in accelerating society towards this resilient, sustainable future. Yet such ambitions cannot be

achieved alone: The 17 SDGs are interconnected and require a truly collaborative approach. Imperial will therefore continue to create collaborative platforms such as our Global Development Hub for multidisciplinary research, capacity building and knowledge exchange to achieve long-term social and economic impact. Whilst we have much to offer, we also have a great deal to learn. Imperial welcomes global partners and friends to engage with us on this pathway so that we can collaborate and learn from one another to achieve our shared goal of a sustainable world for all.

# Tackling the threat of antimicrobial resistance

Growing levels of resistance to antimicrobial treatments present a threat to all human health (SDG3) which Imperial is tackling through an interdisciplinary programme of research and translation.

In 1928, Alexander Fleming ushered in the era of modern medicine when he discovered the antimicrobial properties of penicillin whilst working at St Mary's Hospital (now part of Imperial). Yet, he also presciently warned that bacteria might eventually adapt and become resistant to antibiotics.

Without action to address antimicrobial resistance (AMR) there could be an estimated 10 million extra deaths a year by 2050 – with simple infections no longer easily treatable – and yet, initially the SDGs did not have a single indicator specific to AMR. However, modern medicine, as well as SDGs 1,2,3 and 8, depends on ensuring that life-saving drugs continue to work.

Professor Alison Holmes leads Imperial's response to this challenge as Director of the Antimicrobial Research Collaborative. "There will be no single solution to the global threat of antimicrobial resistance," she comments.

"We need to tackle this problem synergistically, on multiple fronts, which will require an unprecedented level of international cooperation."

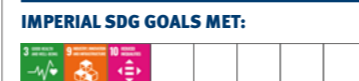
Imperial has a strong track record in addressing drug resistant infections and AMR. The College is at the forefront of multidisciplinary research into improving how we use antimicrobials, highlighted by the establishment of the DHSC-funded Centre for Antimicrobial Optimisation (CAMO), led by Professor Holmes. CAMO explores and develops innovative solutions

spanning technological, behavioural and policy approaches. For example, artificial intelligence for clinical decision support; pragmatic surveillance systems; online GP prescribing tools to optimise antibiotics use; interventions targeting health-seeking and health-provision behaviours; point-of-care diagnostic systems to identify pathogens and resistance; and microneedle biosensors that track patients' antibiotic levels.

As well as SDG3 (health and wellbeing), this work also contributes to SDG9 (industry, innovation and infrastructure)

**BELOW:** Professor Alison Holmes leads a regular ward round in the adult intensive care unit at Hammersmith Hospital, where healthcare professionals are constantly vigilant for antimicrobial resistance

through co-design of technology, implementation research and local entrepreneurship and innovation; and to SDG10 (reduced inequalities) by looking at timely access to effective anti-infectives and excess use of antibiotics, investigating where the burden is highest within and across countries.



# Empowering communities with off-grid solutions

An innovative social enterprise from the Imperial ecosystem is helping to deliver affordable, reliable, sustainable and modern energy to communities across Africa (SDG7).

Global access to electricity has been steadily rising in recent decades; yet some 840 million people around the world are still entirely without it and close to three billion rely primarily on inefficient and polluting cooking systems.

In 2008, three Imperial students established a charitable organisation called e.quinox. The charity, which is still going strong today, sees students creating and installing solar kiosks in remote villages in countries such as Tanzania and Rwanda, providing electricity to communities for the first time.

After graduating, the students setup Bboxx, a next generation utility, transforming lives and unlocking potential through access to energy. Bboxx provides solar and clean cooking installations on a

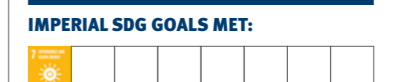


**ABOVE:** Electricity enables local businesses to take off and catalyzes enterprise as the key to unlocking economic growth at scale

"pay-as-you-go" basis, helping people in areas with limited energy infrastructure access electricity and cooking solutions which they pay for using mobile money.

Bboxx has installed over 500,000 systems, monitored with Bboxx Pulse® and using machine learning to track customers' energy use and payments. In 2019, the company raised a \$50 million Series D round, led by Mitsubishi Corporation, to expand to more homes and communities in Africa. They also launched a new product line, Bboxx Cook, providing clean cooking services for both urban and rural areas using LPG.

Mansoor Hamayun, CEO and Co-Founder of Bboxx, said: "In 2021 it is unacceptable for billions of people to live in energy poverty. We are steadfast in our mission to use technology to transform lives and unlock potential and Bboxx Cook is fundamental to helping meet SDG7 – clean energy for all."



# Boosting global crop yields to end hunger

Working alongside industry, Imperial initiatives have helped to boost crop yields sustainably and ensure access to safe, nutritious and sufficient food all year round (SDG 2)

Imperial's institute of Chemical Biology (ICB) Centre for Doctoral Training (CDT) provides key opportunities for students to develop next generation molecular tools and technologies to strive towards the fourth industrial revolution. One focus of the CDT is agri-science, which is driving innovation to support an increase in food demand, given the world's population is estimated to grow to nine billion by 2050.

Students work on various complimentary research projects to develop new technologies to explore how agrochemicals, including fertilisers and

insecticides, are transported within plant cells. They also look at how they interact once they reach their target. A number of the projects also team with industry leaders such as Syngenta, in order to find ways to increase plateauing yields whilst making crop production environmentally sustainable and resilient to climate changes.

Several students from the programme have established successful agri-tech start-ups. These include:

- **FungiAlert** which has developed a unique technology to provide data about the soils' microbial community to reveal how the

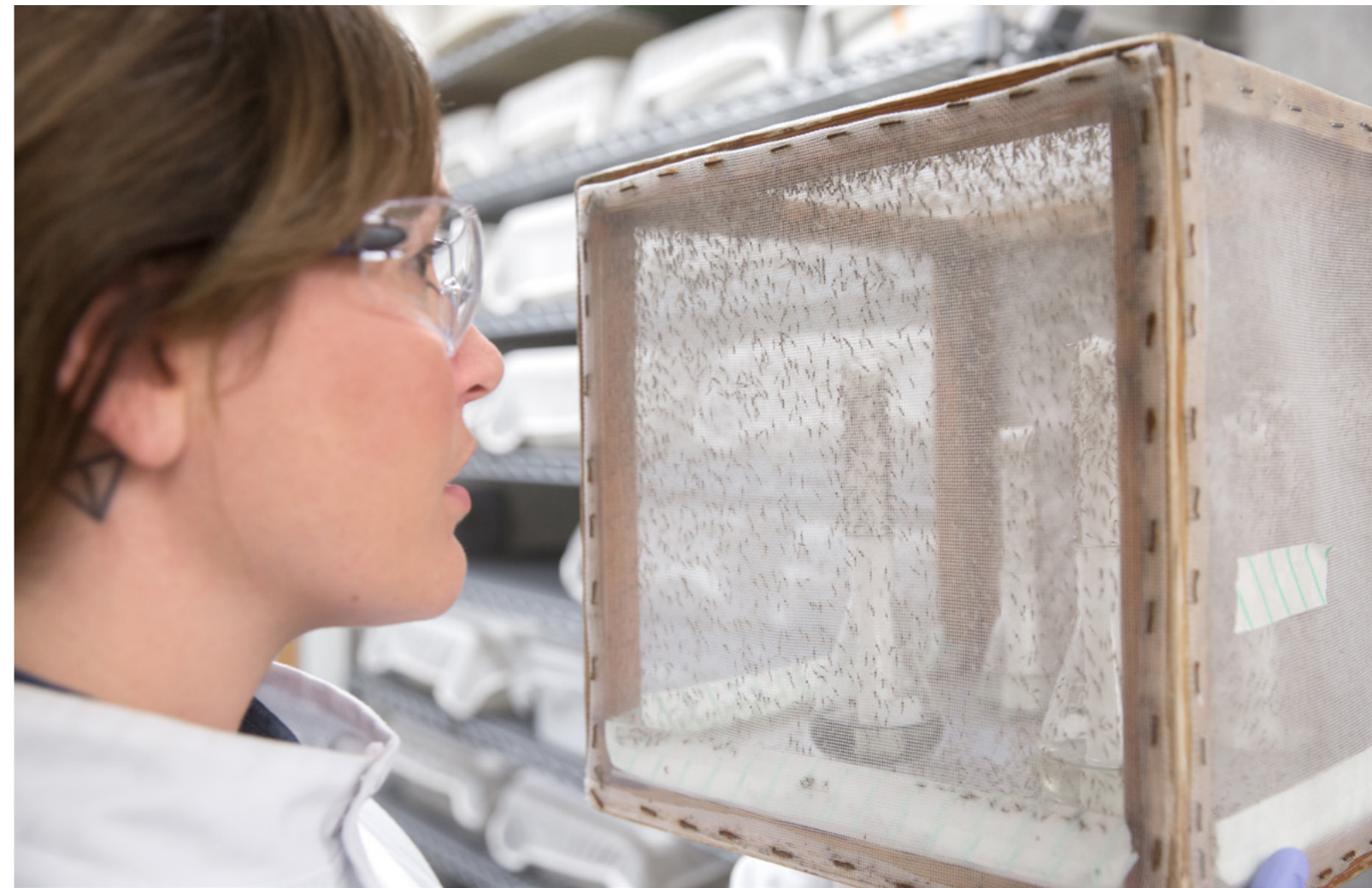
**BELOW:** FungiAlert delivers soil health analysis tools to increase agricultural productivity and sustainability

microbial dynamics vary with different farming practices and to identify new microbial candidates for agricultural products.

- **AnywhereHPLC**, which is developing a handheld device to monitor pesticide levels in the soil. By giving instant results it means less carbon-emitting travel for lab tests and a reduction in the over-fertilisation of crops, decreasing negative environmental impact.

Dr Laura Barter, Deputy Director of the ICB CDT, said: "By directly partnering with industry, our students learn about the agrochemical innovation pipeline, turn their research into practical tools which are having a significant impact upon society."

IMPERIAL SDG GOALS MET:



# Leading the fight to eradicate malaria

Researchers at Imperial are delivering major breakthroughs and radical new approaches in the fight to eradicate malaria by 2030 (SDG 3).

Despite considerable progress in preventing and treating malaria in the past two decades, the disease continues to take a heavy social and economic toll, especially in Africa. In 2018, there were around 228 million malaria cases and an estimated 405,000 deaths worldwide, mostly of children under five years old.

Imperial is now at the vanguard of the global fight against malaria, taking a truly multidisciplinary approach to the problem through the Network of Excellence in Malaria. Here, researchers are focusing on every stage of the complex life cycle of the disease, as well as diagnostics, treatment of clinical symptoms, epidemiology, mathematical modelling and economics of the disease.

Imperial also leads an international consortium, Target Malaria, which is backed by the Bill & Melinda Gates Foundation and the Open Philanthropy Project, and aims to reduce the numbers of malaria mosquitoes to reduce the transmission of the disease. Projects being led include development of innovative gene drive technology that spreads a variant rapidly through malaria-causing mosquito populations, ultimately causing their numbers to crash. The work has been validated in caged populations of mosquitos and computer modelling shows it could significantly reduce malaria in the wild. The teams are working with local communities in the sub-Saharan African countries where Target Malaria trials will take place.

**ABOVE:** The Baum laboratory focuses on the biology of every stage of the malaria parasite lifecycle in order to develop strategies to combat it

**BELOW:** Professor Jake Baum



Meanwhile, another Imperial group has spearheaded efforts to identify compounds that could prevent malaria parasites from being able to infect mosquitoes, halting the spread of disease.

The leader of this research, Professor Jake Baum said: "Fighting malaria is a constant battle as parasites become resistant to antimalarial drugs. Since transmission occurs in the mosquito, drugs targeting this process have the added benefit of being naturally much more resistance-proof, which could be essential for eliminating malaria."

IMPERIAL SDG GOALS MET:



# Driving the global transition to zero pollution

Imperial's aim to help the world transition to a zero pollution future encompasses many of the Sustainable Development Goals and several research projects and start-ups are already helping to create the innovative new industries and frameworks required. (SDG 2,3,7,12,13)

Imperial's pioneering new research and education programme, Transition to Zero Pollution, will help tackle the challenge of global pollution.

The programme, led by materials scientist Professor Mary Ryan, aims to help society build a future free from human-made pollution and will bring together scientists, engineers and economists collaborating on a scale not seen before.

The programme will inspire fundamental changes in areas such as the way materials are used in manufacturing (SDG12), how we produce food and energy (SDG 2 & 7), and will help mitigate the impact of air pollution on people's health (SDG3 and 13).

Professor Ryan, Vice-Dean (Research) of the Faculty of Engineering, said: "We see CO2 as a pollutant, a major and urgent pollutant, but not the only thing we should be thinking of."

"It's really about an entire system. Thinking about how to address pollution at source and understanding the impact of it in the whole life cycle."

Professor Ryan says momentum is building around the zero pollution space, but there's even greater opportunity for government, industry and research-intensive universities to work together on

**"It's really about an entire system: thinking about pollution in the whole life cycle"**

problems. The programme will look to identify solutions which take a global approach to pollution and not 'simply offshoring our problems' to other developing countries.

Professor Ryan says "We need to be wary when, for example, somebody proposes making the most efficient, highest capacity battery that's ever been made, without a sense of where the raw materials for that will come from and whether it's recyclable and how that links into a broader infrastructure of power supply."

Imperial has the foundations to deliver a framework for zero pollution through its unique multi-disciplinary centres, including the Grantham Institute – Climate Change and the Environment; the Energy Futures Lab; and Centre For Environmental Policy.

**IMPERIAL SDG GOALS MET:**



Imperial is collaborating with startup Arborea to develop pioneering 'BioSolar Leaf' technology to improve air quality in cities



## Nurturing generations of Change Makers to tackle global challenges

Since its inception in 2012, all of Imperial’s students have had the opportunity to become Change Makers. Aligning with SDG 4, cross-departmental teams of students are tasked with using their skills to design broad, innovative and inclusive solutions for global challenges.

In the first-year Change Makers module, students are introduced to the SDGs by critiquing the framework through the lenses of strategy, measurement and innovation. Over 240 students registered for this optional module in 2020, demonstrating the student body’s immense enthusiasm for interdisciplinary and solutions driven learning.

Following that, the modules are directed towards teams of students designing feasible solutions for real-world sustainable development challenges. This builds upon the students’ knowledge of the SDGs, with projects focusing on the inclusion of women in development

(SDG 5), smart cities (SDG 11) and health and wellbeing (SDG 3).

Postgraduate students are also offered the opportunity to experience Change Makers. Elysia Lucas, a PhD candidate in the Department of Chemical Engineering, embarked on an undergraduate module and has since returned to the programme as a co-learner. Elysia states that “The Change Maker module truly enriched my degree by allowing me to explore the wider sustainable development context. Now as a co-learner, I have the opportunity to facilitate a similar experience for current students.”

Course director Dr Elizabeth Hauke is keen to emphasise

**ABOVE:** Imperial students are introduced to the SDGs and tasked with using their skills to design solutions

**BELOW:** Dr Elizabeth Hauke



the real-world impact that every person has the power to make. She states: “The first steps are for the students to build their own understandings of the issues facing humanity, alongside exploring the SDG framework. Students need to feel that the SDGs capture and frame issues that they care deeply about and empower them to create and live change in their own communities and beyond.”

IMPERIAL SDG GOALS MET:



## Cleaning the air we breathe

Imperial College’s NExAir – Air Quality Network is bringing together a multi-disciplinary network of researchers to find a range of solutions to improving air quality for all (SDG 3, 11, 12, 13 & 15).

**A**ir pollution is a pervasive global threat to both environmental and human health, estimated to affect 91% of the world’s population and contribute to more than 7 million deaths globally every year. Air quality is an issue that is intrinsically linked to other environmental, public health and urban challenges. Therefore, in order to tackle this global problem, researchers at Imperial are conducting multi-disciplinary research to better understand air pollution and inform changes in policy and people’s behaviour.

The Network of Excellence in Air Quality (NExAir – Air Quality Network) was set up with the aim to create a cross-disciplinary platform to deliver new insights and identify the next big frontiers in air quality research. The network sits across Imperial College Faculties of Natural Science, Engineering, Medicine and the Business School, providing a diversity of expertise in air pollution.

NExAir members work on a large range of research areas relating to air pollution including modelling and monitoring emissions, helping local authorities quantify the ‘hidden costs’ of air pollution (SDG 7), better understanding health and well-being impacts of inhaled toxins (SDG 3) and developing health-promoting built environments and policies (SDG 11).

Dr Audrey de Nazelle, Senior Lecturer at the Centre of Environmental Policy and one of the Leads at NExAir, said: “Within the network, we bring together multiple disciplines and interests related to air pollution, so we’re better prepared to work collaboratively in developing systemic solutions with far ranging impacts to make the world a healthier and more sustainable place.”

IMPERIAL SDG GOALS MET:



Dr Apostolos Voulgarakis uses high resolution satellite images at the Global Data Observatory in the Data Science Institute to examine the impact of wildfires on the environment.



## Helping the injured victims of conflict around the world

Researchers at Imperial are committed to improving the health, quality of life and opportunities of survivors of blast and conflict injuries around the world (SDG 3 & 10) through interdisciplinary programmes of research and technology development.

Conflict-related death and injury are major contributors to the global burden of disease. In 2017, a partnership between Imperial, the University of Moratuwa (Sri Lanka) and the American University of Beirut (Lebanon) set up a conflict-injury hub. The group is working to understand the injury burden from wars in Sri Lanka, Lebanon and Gaza, and how to save limbs after blast and gunshot injuries. The team is developing a low-cost external fixator that can be made in low-resource settings from local materials, using local machines. It is also developing biodegradable scaffolds which may also be able to prevent osteomyelitis – a bone infection often seen in these injuries.

Furthermore, the College is working in partnership with groups in Cambodia to develop a low-cost prosthesis that specifically caters for the economic, environmental, lifestyle and cultural requirements in low-resource countries. In 2019, researchers from the Centre for Blast Injury Studies (CBIS), together with Save the Children, launched the world's first guide for treating children severely injured by explosives. The Paediatric Blast Injury Field Manual is designed for medics in war zones who often lack specialist training and is now in use across the world (including Sierra Leone, Yemen, Iraq, Syria, Turkey, The Philippines, Afghanistan, Nigeria and Myanmar). It is currently being used to train medics and first responders from humanitarian organisations.

**ABOVE:** Imperial's Dr David Henson develops healthcare technology projects with a focus on lower-limb prosthetics in the UK and overseas

Project lead, Professor Anthony Bull, says: "The UN Sustainable Development Goals encompass a target to promote peaceful and inclusive societies (SDG 17), but we must also address the harmful legacy of past and current conflicts around the world. Through our programmes of interdisciplinary translational research we aim to improve the health and well-being of survivors of conflict injuries in line with SDG 3. Crucially we want to try and reduce the inequalities facing this community (SDG 10), often living with disabilities, through development of assistive technologies."



## Delivering vaccines to those who need them most

Imperial is a world-leading centre for vaccine research and is pioneering new approaches to manufacturing and outbreak response – ultimately helping to end the epidemics of coronavirus, AIDS, tuberculosis, malaria and infectious diseases (SDG 3).



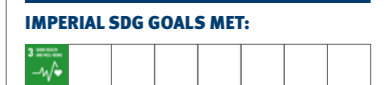
Vaccines are one of the great success stories of modern medicine, having eradicated or controlled many severe infections of major global importance, improving the lives of millions across the world. Yet, nearly one in five infants across the world, or 19.5 million children, do not currently have access to basic vaccines. Almost one third of deaths among children under five could be prevented through vaccine use. Distributing vaccines in developing countries, particularly in rural areas, is often difficult because of the costs associated with producing, transporting, and storing the vaccines using limited resources. The Imperial-led Future Vaccine Manufacturing Research Hub has developed a range of strategic partnerships with researchers,

national centres and industry to revolutionise this area. Professor Robin Shattock and his team work on the manufacturing of self-amplifying RNA vaccines to enable quicker responses to outbreaks of known pathogens, such as a flu, as well as unknown pathogens. His team is developing synthetic RNA vaccines, which harness the body's own cell machinery to induce an immune response. Synthetic RNA vaccines could allow regions and cities to manufacture their own vaccines – which are 'globally approved but locally made'. The COVID-19 pandemic has accelerated the technology and the team's self-amplifying RNA vaccine could be used to adapt to new coronavirus variants, to boost other

**ABOVE:** The Imperial-led Future Vaccine Manufacturing Research Hub is developing a range of innovative vaccine technologies and platforms  
**BELOW:** Professor Robin Shattock



vaccines and to be deployed against future pandemic threats. Professor Shattock said: "Vaccines have been the single most effective public health implementation globally. They have saved more lives than any other medicines. "Our approach could enable us to develop vaccines with a speed that's never been realised before, revolutionising how we respond to disease outbreaks in future." Other teams in the Hub are also working on making vaccines that can withstand extreme temperatures, avoiding the need for refrigerated distribution and storage.







*"In total 253 female entrepreneurs have been supported, 34 ventures have been incorporated and £3.2 million has been raised in funding."*



*"Over the past five years, the WE Innovate programme has supported hundreds of women on their entrepreneurial journeys."*

**253**  
Female entrepreneurs have been supported



*"The businesses to emerge from the programme have the potential to disrupt industries, solve problems and improve lives."*



# Empowering enterprising women to drive societal change

**A thriving community of entrepreneurial women has emerged at Imperial, whose ideas, start-ups and social enterprises are having a profound impact on the Sustainable Development Goals.**

**A** 2019 government-backed review found that the UK is losing out on £250 billion of economic value every year because women face barriers to becoming successful entrepreneurs. Meanwhile a recent Harvard Business Review revealed that among venture capital-financed, high-growth technology start-ups, only 9% of entrepreneurs are women. Catalysing women's entrepreneurship and economic empowerment will accelerate the achievement of the Sustainable Development Goals, especially SDG 5 on achieving gender equality and empowering all women and girls. Imperial has been working in

this area for several years with the WE Innovate pre-accelerator programme, which caters for early stage business ideas led by women. In total over 350 female entrepreneurs have been supported, 59 ventures have been incorporated and £3.2 million has been raised in funding. Crucially, these start-ups are having an impact on the UN Sustainable Development Goals. Alumna Olivia Ahn founded start-up Planera which has developed the world's first certified zero-waste, flushable menstrual pads to tackle the environmental impact of disposable sanitary products. Planera is working with the Indian

government to develop low cost reusable sanitary pads, that can be given to schools and villages in a bid to make menstrual health and hygiene sustainable and accessible to all. Another student from the programme, Clementine Chambon, launched Oorja Development Solutions, which is currently working in rural India installing pay-as-you-go community solar pumping systems, as an alternative to expensive and unreliable diesel irrigations pumps. They have already run three successful pilots in the region – transforming the fortunes of farming communities. Professor Maggie Dallman,

**ABOVE:** Olivia Ahn founded Planera to develop zero-waste, flushable menstrual pads  
**BELOW:** Professor Maggie Dallman

Vice President (International) and Associate Provost (Academic Partnerships) comments: "Over the past five years, the WE Innovate programme has supported hundreds of women on their entrepreneurial journeys. At a time where fewer than one in ten venture capital dollars go to female-founded companies, this support is critical. "The businesses to emerge from the programme have the potential to disrupt industries, solve problems and improve lives."



**IMPERIAL SDG GOALS MET:**

--	--	--	--	--	--	--	--	--

# SDG goals start-ups

Imperial's innovative ecosystem has produced a plethora of startups and social enterprises that are tackling the entire spectrum of SDGs

## BREATHE BATTERY TECHNOLOGIES

Developing state-of-the-art control software known as 'health-adaptive charging' to speed-up the time it takes to charge electric vehicles.



## CAPTA

Capta has developed a low-cost, smart diagnostic tool for diagnosing parasitic works using smartphones.



## CERES POWER

Founded using Imperial research, Ceres Power is helping develop a clean energy economy by developing fuel cells that can be used to generate low-carbon electricity.



## CHARCO NEUROTECH

Offers a novel, non-invasive wearable device that reduces symptoms of slowness and stiffness for people with Parkinson's disease.



## CHEESECAKE ENERGY

Developing the world's greenest energy storage technology, lowering the cost of medium to long-duration energy storage, and turning renewable energy sources like wind and solar into reliable, on-demand power.



## DNA NUDGE

Fuses technology, engineering, genetic testing and up to date nutrition research to provide a genetic testing service that guides consumers to make the best food purchase choices to improve health and reduce obesity.



## FRESH CHECK

A start-up that is combatting waste in the food industry by developing novel products to detect the presence of bacteria on surfaces.



## HUMANISING AUTONOMY

A behavioural AI company that uses predictive AI to help urban mobility systems become more agile, safer, greener and smoother.



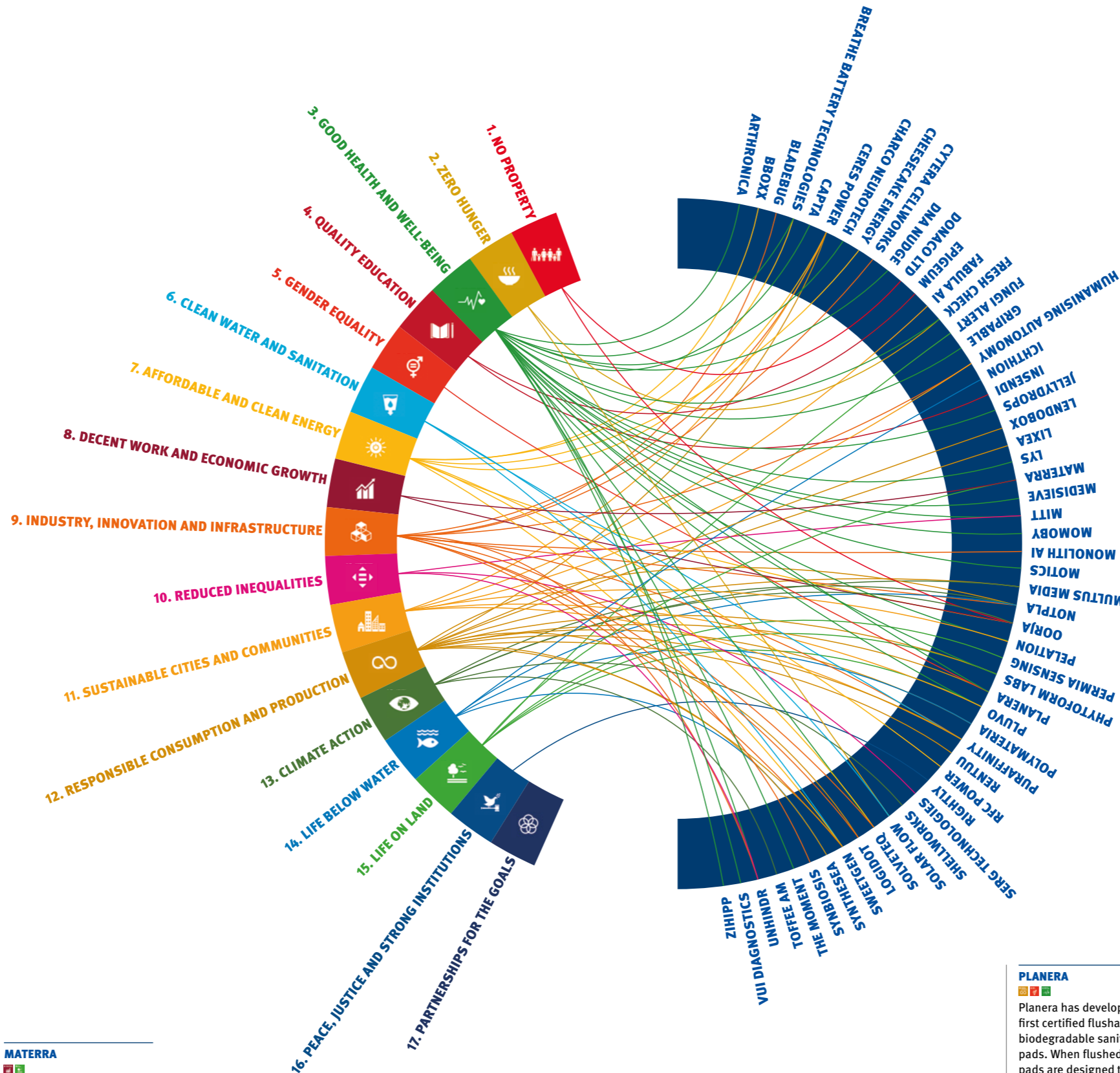
## LENDOBOX

Product and rental reuse to support the growth of the Circular Economy and reduce the amount of waste that will need to be recycled or sent to landfills.



## LIXEA

An innovative novel chemical process that uses waste wood, agricultural by-products and sustainably grown biomass to produce a greener alternative to the petrochemical industry.



## MATERRA

A planet-centric technology company that's building agile, climate-resilient agriculture systems to produce more sustainable cotton for the fashion industry.



## MITT

A revolutionary upper limb prosthesis that aims to address the limitations of artificial prosthetics.



## MULTUS MEDIA

Seeks to innovate the cultivated meat industry by developing animal free, environmentally sustainable, and ethically sourced growth media.



## NOTPLA

A sustainable packaging start-up, Notpla creates unique and revolutionary biodegradables made from seaweed and plants.



## PLANERA

Planera has developed the first certified flushable and biodegradable sanitary pads. When flushed the pads are designed to disintegrate quickly in existing infrastructure, with a similar environmental impact to toilet paper.



## POLYMATERIA

Polyateria provides a tailored biodegradable solution for conventional plastic packaging, aiming to stem the global plastic pollution endemic.



## OORJA

Oorja is a project developer of solar PV systems to power affordable, reliable energy for livelihoods in emerging markets.



## PELATION

A cycle technology company that deploys innovative design and engineering to eliminate sustainable mobility barriers.



## PURAFFINITY

Specialises in designing and manufacturing novel advanced materials for environmental benefit, such as removing harmful pollutants from water and wastewater.



## RFC POWER

Developing the world's lowest cost flow battery, with a mission to enable the transition to 100% renewable energy by developing the cheapest form of long duration energy storage.



## SOLAR FLOW

Solar Flow's patented technology harnesses solar energy and converts this into both electricity and useful heat with higher efficiencies than existing conventional panels.



## SOLVETEQ

Offers a low-energy and low-pollution solvent-based alternative to current smelting processes for recycling lead-acid batteries.



## SYNTHESEA

Building a biological platform to produce sustainable omega-3 for aquaculture that's up to 80% cheaper than fish oil.



## SYNBIOSIS

Building material modelling capabilities that can greatly increase the speed and accuracy of materials developments and enable a greater understanding of new sustainable composites, as well as the design and construction of machines and infrastructure.



## TOFFEAM

Optimises product designs for Additive Manufacturing (AM) – also known as 3D printing – cutting down on logistic, waste of materials and energy waste.



## UNHINDR

Unhindr develops wearable devices by combining AI with Robotics and Microfluidics in a unique, award-winning, and innovative way.





CHRIS NATT

## Design and innovation meets global development

Imperial's Dyson School is training the next generation of design engineers to create breakthrough solutions to global sustainable development challenges through the GoGlobal programme (SDG 3, 4, 11, 12).

From air pollution, to sexual health and from Ghana to Russia, the GoGlobal module, which forms part of the Innovation Design Engineering (IDE) dual masters programme, takes students on a three-week cross-cultural collaborative project which covers globally significant themes within a local context. The ethos of the module stems from the philosophy that impactful innovation can be created by bringing together diverse people to work on a common goal.

The module is run by teaching and academic staff from both Imperial and the Royal College of Art, with Dr Weston Baxter and Maria Apud-Bell the most recent module leads from Imperial. "GoGlobal partners with institutions to address pressing human-facing issues – making the project real

is central to GoGlobal's learning structure." Explains Dr Baxter. "The focus is always on working closely with stakeholders in a local context through a human-centred design process."

In 2019 IDE students travelled to Nairobi, Kenya to collaborate with students from the Nairobi Design Institute (NDI) and Gearbox. Students were tasked with creating innovative and actionable solutions to one of two challenges: access to sexual reproductive health services (SDG 3) and waste management and circular economy (SDG 11, 12). The final solutions ranged from cleaner ways for schools to burn rubbish to digital support to help parents talk to their children about sexual reproductive health.

The GoGlobal project has served to strengthen institutional ties, begin research projects and lead to

**ABOVE:** Imperial's GoGlobal module takes students on a three-week cross-cultural collaborative project, covering globally significant themes

a range of provocative ideas for the future. The biggest impact and main focus of GoGlobal, however, has always been the transformational experience students have from participating.

Kevin Chaim, a 2020 IDE graduate said "Perhaps the most powerful and memorable moments [from GoGlobal] stem from cultural immersion, excursions and creative discussions within multi-disciplinary teams. The conversations have offered a new perspective to how design can change behaviour and impact lives with a focus on real contextual projects."

**IMPERIAL SDG GOALS MET:**



## The world's most advanced centre for disease and emergency analytics

The Jameel Institute (J-IDEA) was set up to rapidly respond to emergencies such as pandemics, extreme climate events, and natural and humanitarian disasters (SDG 3, 13, 17). The Institute is part of Imperial College's COVID-19 Response Team, which has been at the forefront of the response to the novel coronavirus pandemic.

The world's most advanced centre for disease and emergency analytics, the Jameel Institute, was set up to rapidly respond to emergencies such as pandemics, extreme climate events, and natural and humanitarian disasters (SDG 3, 13 17).

The Institute is part of Imperial College's COVID-19 Response Team, which has been at the forefront in the response to the novel coronavirus pandemic.

Imperial has a wealth of experience in planning for, and dealing with, disease outbreaks all over the world – these have included ongoing epidemics such as malaria and HIV as well as emergent diseases such as swine flu, SARS, MERS, Ebola and Zika.

In October 2019 this expertise was consolidated with the creation of the Jameel Institute, which brings together leading epidemiologists, biostatisticians, medics and data scientists to form the world's most advanced institute for disease and emergency analytics.

Shortly after its launch, the Jameel Institute mobilised to understand the emergence of the novel coronavirus in China in January 2020. The Institute subsequently had a major influence informing government policy around the world in controlling the pandemic – primarily through its world-class epidemiological modelling.

The Jameel Institute's Director, Professor Neil Ferguson, said: "Our quantitative approach spanning data analytics, epidemiological modelling, and health system analysis, is proving a powerful tool in combating the threat of



COVID-19."

With particular relevance to the UN Sustainable Development Goals, The COVID-19 Response Team has developed tools which have been accessed by over 100 Low- and Middle-Income Countries (LMICs) during the pandemic. Examples includes a weekly short-term forecast of COVID-19 deaths in multiple countries and a hospital planning tool, which calculates how much capacity for the urgent treatment of COVID-19 patients can be obtained with targeted interventions such as cancelling elective surgeries and re-organising care. In addition, working with the

**ABOVE:** The Imperial-hosted Jameel Institute has experience in planning for, and dealing with, disease outbreaks all over the world

**BELOW:** Professor Neil Ferguson

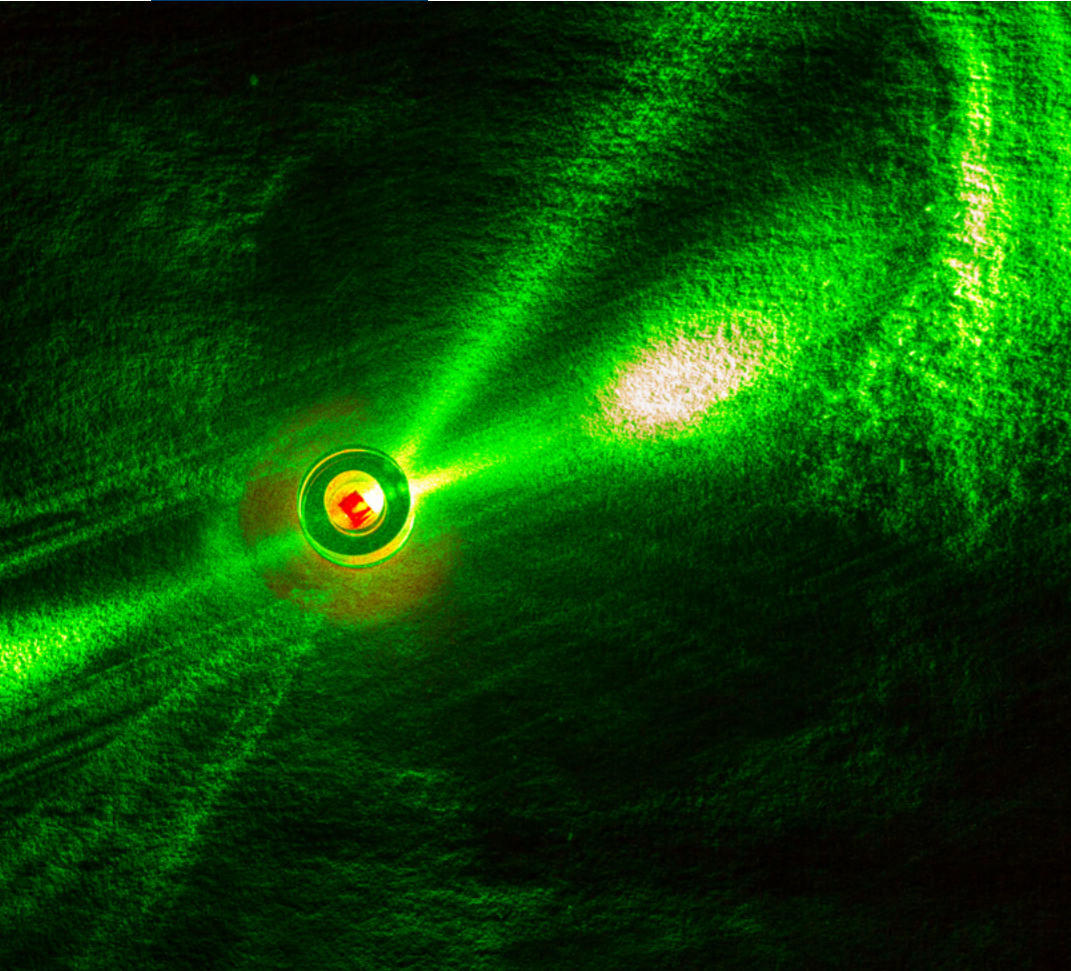


UK's Department for International Development (DFID), the team have produced a public, easy-to-use dashboard for disease projections and planning.

Dr Katharina Hauck, Deputy Director of the Institute says: "We use advanced modelling to provide practical support to lower- and middle-income settings in planning effective policy interventions, particularly in areas with limited modelling capability and constrained healthcare capacity."

**IMPERIAL SDG GOALS MET:**





## Paving the way for next-gen quantum tech

Imperial is pioneering fundamental research into next-generation quantum technologies which could herald a step change in drug design and even climate modelling

Scientific breakthroughs into the behaviour of matter at the smallest scales by figures such as Albert Einstein and Niels Bohr at the beginning of the 20th century underpin our modern world. The semiconductors in our digital devices and the fibres that connect them globally all take advantage of the basic principles of quantum mechanics.

Researchers are now looking to exploit some of the more unusual phenomena of the quantum world, for example where subatomic particles can essentially exist in

more than one state or place at the same time. Imperial has a world-leading presence here, in both theory and practical applications, for example through the work of the Imperial Centre for Quantum Engineering, Science and Technology. Quantum computing is one exciting area of current study.

“There are classes of problems that you just can’t solve on any foreseeable future generation of conventional computer,” says Professor Ian Walmsley FRS, Imperial’s Provost and Chair of Experimental Physics.

“One of the things that is

**ABOVE:** Imperial has driven advances in maser technology, which could be used in applications such as medical imaging and airport security

**BELOW:** Professor Ian Walmsley



plausible is simulations of other quantum systems: the idea that you can understand molecular structures and dynamics better and use that to help design molecules for bioprocesses – such as drugs, or more efficient fertilisers. What quantum computing brings is the possibility that we might have a way to do that, which could be transformative.”

Quantum computers have the potential to help in the design of better energy storage materials, logistics and supply chain problems, and even potentially fluid dynamics modelling for understanding climate change. There are also a whole host of other quantum technologies, such as quantum sensing, quantum imaging and even quantum compasses for better navigation. They all have the potential to help with solving Sustainable Development Goals (SDGs), but the important thing is to seed many ideas as a foundation for the future, says Professor Walmsley.

“The way scientists work is to identify an important question and then to seek the best answer. Nine times out of 10, it turns out not to have an immediate use beyond new understanding, that’s just the nature of exploration. So if we need a group of ideas to build applications from, that will in turn help the SDG challenges, then we better have a large enough pool of good ideas to draw from. In that sense fundamental research remains really critical.”

**IMPERIAL SDG GOALS MET:**



## Innovation for global energy challenges

Imperial brings together science, engineering and policy to generate positive energy solutions for the global stage, in strong alignment with SDGs 7, 9, 11 and 13.

Energy Futures Lab is Imperial’s global energy institute and aims to promote energy innovation and advance systemic solutions for a sustainable energy future. The institute supports researchers by bringing together the science, engineering and policy expertise at Imperial and fostering collaboration with a wide variety of external partners, and runs an outstanding interdisciplinary Masters’ programme. Energy Futures Lab builds networks with leading international institutions to support research with global impact. Imperial’s energy researchers have a strong track record of creating technical solutions and informing policymakers to support the transition to sustainable energy systems across the globe. These advancements strongly align to many of the SDGs – clean and affordable energy, (SDG 7), industry, infrastructure and innovation (SDG 9), sustainable cities (SDG 11) and climate action (SDG 13).

Researchers at Imperial have also been integral to the cleantech revolution. Ceres Power, which is one example of a spin off company launched from Imperials’ research, is now one of the UK’s most valuable cleantech companies. It has been making fuel cell technology accessible and cost effective for a variety of applications, including transport, data centres, homes and commercial purposes.

Professor Nigel Brandon, Dean of Imperial’s Faculty of Engineering, and his colleagues in the Department of Materials first produced the research upon which Ceres Power is based over 20 years ago. He states: “Imperial has long



“Imperial has long been at the forefront in developing fuel cells and batteries”

**ABOVE:** A flat-plate photobioreactor for studying growth and hydrogen production kinetics, in the Solar Fuels Lab. Part of the Artificial Leaf Project

been at the forefront in developing and refining electrochemical technologies such as fuel cells and batteries that underpin the shift to low carbon transport – and this work is starting to have a tangible impact as industries mature and scale up.”

**IMPERIAL SDG GOALS MET:**



# Getting a grip on infectious disease

Bringing an end to the epidemics of AIDS, tuberculosis, malaria and infectious diseases by 2030 relies on accurate, cost-effective diagnostic testing – something Imperial is actively pioneering (SDG 3).

Many current screening approaches often call for expensive equipment and trips to the clinic, which may not be feasible in rural or developing areas with little medical infrastructure. The emerging field of point-of-care diagnostics is therefore working on cheaper, faster, and easier-to-use tests.

For several years, the lab of Professor Molly Stevens (pictured, right) at Imperial has been pioneering the design and development of nanomaterials-based biosensors that could be used to detect a number of diseases with global implications including HIV, malaria, tuberculosis, heart disease and cancer.

Professor Stevens and team also published a framework in *Nature* detailing how healthcare workers in low-income countries could use existing smartphones to diagnose, track and control infectious diseases.



Many smartphones have sensors built in that could aid diagnosis, such as heart rate monitors and oximeters, while simple testing technologies, of the like Stevens and team are developing, could be linked to phones. In theory, a person could test themselves using an easy to collect sample, such as a pinprick of blood, and the results would be scanned onto mobile apps and sent to local clinics.

Professor Molly Stevens said: “People increasingly use smartphones to manage their money and connect with the world. It makes sense that phones can also play an even larger role in healthcare than they already do.”

“There’s an exciting opportunity for researchers and policy makers to develop new tools and systems that could drastically improve human health and wellbeing in the future.”

**IMPERIAL SDG GOALS MET:**



**BELOW:** Biosensors could be used to detect a number of diseases with global implications including malaria



SHUTTERSTOCK



# A unique cross-faculty centre on business for society

The Leonardo Centre at Imperial College Business School is using innovative data science techniques to track, assess, and experiment with the integration of Sustainable Development Goals (SDG) in global businesses.

The UN SDGs have been ratified by 193 governments around the world, each committed to achieving all 17 of these targets by 2030 – through action plans, national legislation and budgets.

But the SDGs cannot be achieved without a transformational change in the way companies operate, coherent with a fundamental revision of the very purpose of business. That’s the view of Professor Maurizio Zollo who leads the Leonardo Centre, an innovative, cross-disciplinary, centre of excellence, dedicated to the exploration of sustainable and integrative logics of business.

“The creation of a sustainable, healthy, fair and resilient society requires the redefinition of the purpose of business. Companies are created, grow and thrive through the investment not only of

financial capital, but also of human, social and natural capital. And the investors are not only the shareholders, but also employees, customers, suppliers and the local communities. Communities are key stakeholders because they give companies their license to operate and to impact their social and natural environment” he says.

The Leonardo Centre is tackling this ambitious agenda through collaboration with 15 Imperial research centres and a global community of 150 scholars in 60 universities around the world – the GOLDEN for Impact network.

One key achievement has been the creation of the first machine learning-enabled dataset on corporate sustainability behaviour, with millions of initiatives by 13,000 companies over 12 years, categorised by SDGs and types of action.

**ABOVE:** Imperial has created the first machine learning-enabled dataset on corporate sustainability behaviour

**BELOW:** Professor Maurizio Zollo

The analysis of this unique digital dataset allows the definition of optimal portfolios of sustainability initiatives for each economic sector, maximising companies’ financial, social and environmental performance. This approach enables the design of integrated sustainability strategies, investment decisions and public policy interventions based on frontier research and scientific evidence.

Professor Zollo says: “Our ambition is to contribute to the definition of the most effective evolutionary pathways for companies, sectors and countries towards the realization of SDGs.”



**IMPERIAL SDG GOALS MET:**



# THE WISER PROJECT

## Working towards cleaner water to prevent schistosomiasis

To reduce the incidence of the parasitic disease schistosomiasis, the WISER research group are exploring water processing techniques to remove or inactivate schistosome cercariae (larvae) in infested water.

Schistosomiasis, also known as bilharzia or 'snail fever', is a parasitic disease affecting an estimated 258 million people in 78 countries worldwide. It kills an estimated 280,000 people annually and ranks second only to malaria as the most common parasitic disease. Control of the disease focuses on treatment with the drug praziquantel. However, rapid re-infection is common if people have continued exposure to contaminated water.

Imperial is leading a team of researchers to design sustainable water infrastructure solutions, for example by determining the effectiveness of chlorine at killing the schistosome cercariae that

cause infection. The interdisciplinary 'Water Infrastructure for Schistosomiasis-Endemic Regions' (WISER) team consists of water engineers, synthetic biologists, parasitologists and social scientists. These experts, hailing from the UK, Ethiopia and Tanzania, have come together to help tackle the challenges of SDG 6 (Clean Water and Sanitation) and SDG 3 (Good Health and Well-being). The research is funded by the EPSRC via the Global Challenges Research Fund.

One of the important impacts of this research is that it will inform the forthcoming updated edition of the WHO's Schistosomiasis Fact Sheet, which will serve as authoritative guidance for

**BELOW:** Imperial researchers explore techniques to tackle the schistosomiasis parasitic disease

worldwide schistosomiasis prevention practices. Professor Michael Templeton, the Principal Investigator of WISER also considers that "our research has raised awareness regarding schistosomiasis and its links with water and sanitation in our five research case study communities in Ethiopia and Tanzania, and the aim is that the behaviour change communication techniques that were trialled there during this project will be rolled out to further communities in coming years."

IMPERIAL SDG GOALS MET:



# Building equitable, healthy cities

Partnering with six major cities around the world, Imperial leads a project using interdisciplinary methods and big data to help urban centres become 'inclusive, safe, resilient and sustainable' (SDG 3, 11).

More than half of the world population now lives in cities, with mega-cities such as Beijing and Dhaka home to more than 10 million people. Significant population growth is also expected in smaller cities, largely in low- and middle-income countries in Africa and Asia. Despite greater opportunities and better access to services in cities, there are growing health and life inequalities between the rich and poor.

In 2018, a major new research partnership was launched to explore ways of reducing health inequalities in cities around the world. Led by Imperial and funded by the Wellcome Trust, 'Pathways to Equitable Healthy Cities' focusses on co-production of rigorous evidence

with partners in six cities: London, Vancouver, Tamale, Accra, Dhaka and Beijing.

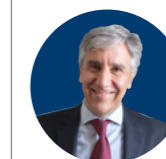
Professor Majid Ezzati, who co-leads the project, says: "People have always lived in cities in order to have better opportunities for health and wellbeing. However, cities in both poor and rich countries are also a setting for inequalities that are fundamental barriers to sustainable human development.

"What we need are plans and policies that leverage cities' potential for innovation to improve the health of low-income and marginalised groups.

Crucially, the project uses interdisciplinary methods from social sciences, engineering, environmental science,

**ABOVE:** Pathways to Equitable Healthy Cities uses methods from social sciences, engineering, environmental science, epidemiology and big data

**BELOW:** Professor Majid Ezzati



epidemiology and big data to evaluate how policies and programmes can improve public health in urban regions.

For example, in 2019, Professor Ezzati and team published research showing how deep learning analysis of street-view images can be used to measure social, environmental and health inequalities in cities. This could be a helpful tool in monitoring the success of policies to reduce inequality, since open source data are updated more frequently than some government surveys or census data.

IMPERIAL SDG GOALS MET:



ANA PITOL

# School students around the world compete to tackle the SDGs

In accordance with one of its key priorities of encouraging STEM engagement from an early age and SDG 4, Imperial has established a Schools Science and Innovation Competition which drives students to design solutions for specific SDGs.



This competition, run by the Faculty of Natural Sciences, was initially designed for London based schools, but soon became popular across the UK and then attracted entrants from around the world including China, India, Thailand and the USA.

Since 2018, the competition has been designed to emphasise innovations which specifically align to the SDGs. Teams of secondary school students select an SDG and create a novel idea to help tackle the SDG. Each team then submits a film depicting their idea and also has the opportunity to create a prototype. Six teams are then

selected from approximately 150 entries from across the world to present their idea in person at Imperial in London. The entries are judged in a Dragon's Den style format by esteemed judges, who for past competitions have included Professor Lord Robert Winston.

Winning ideas include "Aqua Power", submitted by a team from Ashmole Academy in Southgate, UK, which focused on hydropower generation aligning to SDG 7 (Affordable and Clean Energy). A team from Pui Ching Middle School in Macau were successful the following year with their "Zinc-air batteries", also aligning to SDG 7. Competition organiser and

**ABOVE:** A team of pupils from Ashmole Academy in London won Imperial's Schools Science Competition with 'Aqua Power', a project focused on hydropower generation

Faculty Education Manager, Becky Middleton, states, "I am always amazed by the creativity and ingenuity of the ideas that the teams come up with to meet the sustainable development goals. It is an absolute privilege to be able to run the competition, to see such interest in science and innovation from young people across the world, and their genuine passion and enthusiasm for making a difference."



# Tackling childhood mortality in sub-Saharan Africa

Over the past 20 years, Professor Kathryn Maitland and her team have pioneered new research into treating children with severe malaria, anaemia, sepsis and malnutrition in sub-Saharan Africa – conducting some of the largest clinical trials in the continent that have helped drive down child mortality (SDGs 3 & 10).

According to the UN, the global childhood mortality rate for under-5s fell from 93 deaths per 1,000 births in 1990, to 38 deaths per 1,000 in 2019. While this data represents important progress, there is still much work to be done, with the data also revealing that in 2019, an estimated 5.2 million children aged under 5 died in Africa, often from preventable causes.

Since 2000, Imperial's Professor Kathryn Maitland has been based full-time in East Africa, leading a group that has pioneered emergency-care research to tackle childhood mortality in resource-limited hospitals in sub-Saharan Africa.

Her team conducted the largest trial in critically ill children ever undertaken in Africa, examining fluid resuscitation strategies in children with severe illness. The trial won the prestigious BMJ Research Paper of the Year award and influenced changes to World Health Organization management guidelines.

"The focus of my research is the critically ill child, at the point of hospital admission, and emergency treatments required to bridge the gap until the medications start to work," says Professor Maitland. "Our research is readily translatable, because we design the large clinical trials for the settings in which the actual guidelines will be adopted." Furthermore, the team runs

**ABOVE:** An Imperial team led the largest trial in critically ill children ever undertaken in Africa

other large clinical trials which explore: the quantity and timing of blood transfusions in children with life-threatening anaemia; appropriate feeding regimes to treat complicated malnutrition; optimal oxygen delivery and low-tech respiratory support to give to children with severe pneumonia in the absence of mechanical ventilation; and strategies to deal with children presenting with severe malaria – an area where global progress has stalled, with at least one in 10 children dying.



# Inclusive STEM learning and innovation

At Imperial's multi-disciplinary White City Campus we've been working with the local community in exciting new ways to create inclusive STEM learning opportunities (SDG 4).

Since 2010, Imperial has run the pioneering Wohl Reach Out Lab to inspire and engage young people from all backgrounds in science, technology, engineering, and mathematics (STEM).

With the development of the new White City Campus in West London, the College has taken its model of hands-on STEM outreach even further, opening The Invention Rooms in 2017. This unique space offers local people the opportunity to access workshops, cutting-edge design studios and interactive spaces to help them test out creative ideas, build real prototypes, and learn more about the world of science and technology.

Professor Maggie Dallman, Associate Provost (Academic Partnerships), said: "Our White City Campus is being purpose built to turn cutting-edge scientific research into real-world benefits for society and to address Sustainable Development Goals such as global health – SDG3, clean energy – SDG 7 and climate change – SDG 13."

In addition to this, by engaging with the local White City community in exciting new ways, Imperial is

also striving to create an inclusive society, reduce inequalities and provide equitable lifelong learning opportunities for all, in line with SDGs. Indeed, a specific target of SDG 4 is to 'increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship' – which is exactly what Imperial is striving to do at White City.

A number of transformative initiatives have been running from The Invention Rooms, including Maker Challenge programmes for local young people to develop an idea and see it through to creation; Agents of Change, a unique women's leadership programme and network which aims to support local women lead social change in their communities; and a What the Tech?! programme to help older members of the community get online and get the most out of their smartphones, laptops and other digital devices.

**IMPERIAL SDG GOALS MET:**

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**RIGHT:** Imperial runs various initiatives with the local community in White City including Agents of Change, a unique women's leadership programme and network





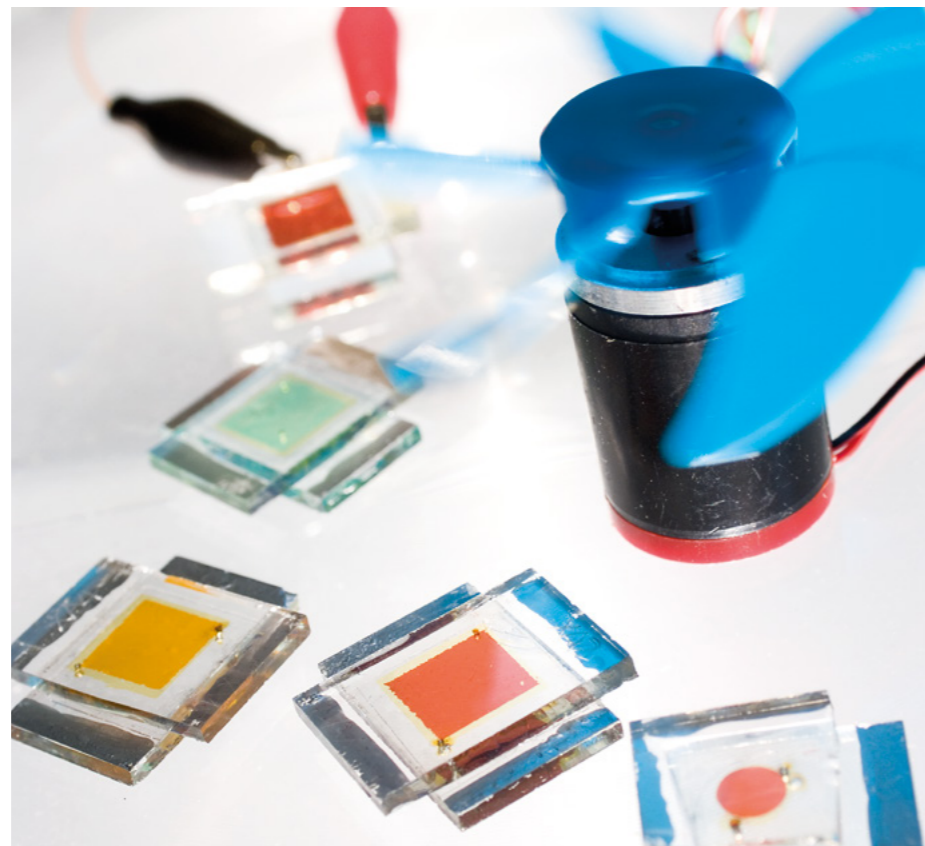
# Research by Imperial physicists spans local energy and health tech discoveries

**"Through a greater understanding of nature, we often gain new insights into how to solve problems facing humanity – something which we actively champion and encourage" – Professor Michele Dougherty FRS, Head of Physics.**

Imperial's Department of Physics has numerous breakthrough achievements to its name. Two such examples are the design of low-cost solar energy technologies to combat climate change, aligning with SDGs 7 and 13, and developing microscopy techniques and cancer research, driving towards SDGs 3 and 12.

Since 1989, Professor Jenny Nelson FRS has conducted research focusing on understanding the properties of semiconductor materials and investigating their application in low-cost organic solar cells. In 2010, Professor Nelson and her team began working with Imperial's Grantham Institute to deliver clean energy systems for developing countries. This research has culminated with the design of 'mini-grids' that incorporate solar and other renewable forms of power generation – delivering working solutions for a refugee camp in Rwanda and a rural community health centre in India.

Professor Paul French, Vice Dean (Research) for the Faculty of Natural Sciences, is driving health technologies through physics. His team is developing an open source, modular, sustainable, low-cost instrumentation platform to widen access to cutting edge microscopy techniques for research, training and diverse applications including histopathology. He also leads a consortium supported by funding from Cancer Research UK to



**"Research in the Department is often interdisciplinary and immensely varied"**

**ABOVE:** Advanced nanocrystalline solar cells fabricated at Imperial, with one cell tested to drive an electric fan

develop innovative 3D fluorescence microscopy techniques to study mechanisms of cancer drug resistance and help screen for new, more effective cancer treatments – ultimately helping to ensure healthy lives at all ages.

**IMPERIAL SDG GOALS MET:**



# Delivering innovative solutions to improve global health

**For 10 years, a unique institute at Imperial has been improving global health through evidence-based innovation – from developing wearables to tackle undernutrition to designing digital apps to support stroke survivors' rehabilitation (SDG 3,10).**

The Institute of Global Health Innovation (IGHI) brings together a multidisciplinary team of clinicians, engineers, designers, policy analysts and scientists. It includes five centres focused on: health policy, robotic surgery and technology, design in healthcare, patient safety, and African research and engagement.

Since forming in 2010, IGHl has had a profound and wide-ranging impact on the SDGs, including ensuring healthy lives at all ages, tackling inequalities in health care, and improved nutrition.

The Institute has developed a range of technologies that are currently being evaluated for their potential use and benefit in real world settings, including a digital platform that supports stroke survivors in their own recovery. IGHl researchers are also developing wearables for a number of different applications, including AI-powered devices that can assess the diets of people in developing nations and thus support the development of policies aimed at reducing undernutrition.

IGHl is also home to a team of digital health experts who are leading an ambitious programme of work on cyber security in healthcare. Their recent global framework for cyber security in healthcare aims to help safeguard health systems across the globe from the growing and present threat of cyber-attacks.

In response to increasing recognition of the impact of climate change on mental health, the Institute has also launched an initiative that aims to better understand and respond to this



complex issue through research, innovation and policy.

In Summer 2019, IGHl partnered with the World Health Organization to make patient safety a global priority and improve the safety of care across the world – with a specific focus on low- and middle-income countries.

Professor the Lord Ara Darzi, IGHl Co-Director, said: "Improving the safety of care is of paramount importance if we are to achieve the ambitious target of universal health

**ABOVE:** The Institute of Global Health Innovation includes the Hamlyn Centre for Robotic Surgery

**BELOW:** Professor the Lord Darzi



coverage, where all people have the basic right of access to the health services they need.

"We can accelerate essential progress in patient safety that brings us closer to attaining international goals to develop safe and universal healthcare."

**IMPERIAL SDG GOALS MET:**



# Managing rainforest for the ecological and economic benefit of all



SAFE ACOUSTICS

For over a decade, Imperial has led one of the world's largest ecological experiments in Malaysian Borneo to understand the impact of agriculture on the rainforest and how to achieve food production (SDG2), economic benefit (SDG8) and ecosystem preservation (SDG15) for the benefit of all (SDG12).

The oil palm industry has helped eradicate poverty and boost food production in the Far East, but unfettered expansion of oil palm plantations can have a detrimental impact on the environment.

The Stability of Altered Forest Ecosystem (SAFE) Project, led by Imperial, seeks to understand if these industries can be run sustainably.

Working at one of the largest ecological research sites in the world, encompassing 8,000 hectares in Malaysian Borneo, Imperial researchers study how a tropical rainforest functions, and how that changes when the forest is under pressure from humans. It

is located within an area that is currently used for commercial logging and will eventually be converted into an oil palm plantation, giving researchers a unique opportunity to assess the impact of gradual habitat degradation.

Over the course of the project the team has gathered a wealth of data, analysing everything from how air temperature increases in logged forest and how certain species are replaced with others, to the level of soil erosion and even soil bacterial diversity. In this way the team has also been able to work with government and stakeholders to recommend optimal 'buffer zones' and 'set-

**ABOVE:** The Stability of Altered Forest Ecosystem (SAFE) Project encompasses some 8,000 hectares of rainforest in Malaysian Borneo

aside' areas of untouched forest. Scientific Director for SAFE, Professor Robert Ewers considers that smarter approaches to land clearing involve facilitating the movement of animals while also promoting biodiversity. He states, "There are options to design these landscapes so that you do get that increased agricultural production, but while minimizing the impact on the natural environment."

**IMPERIAL SDG GOALS MET:**



# Synthetic biology paves the way for new drugs, materials, fuels and food

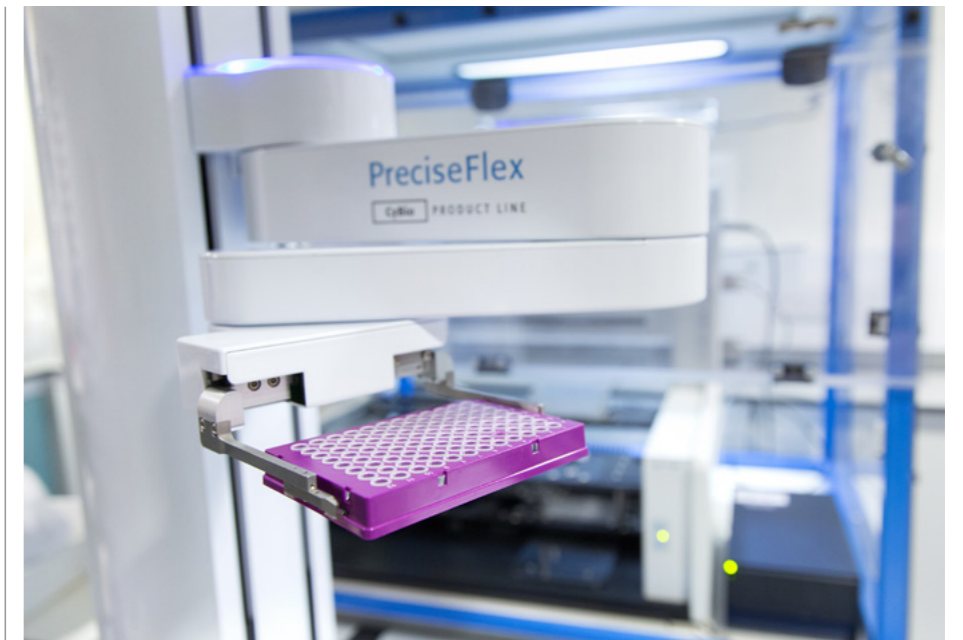
Advances in synthetic biology being made at Imperial are ushering in the next industrial revolution and a suite of new therapeutic drugs, sustainable materials, biofuels and foods. The innovative new organisms and materials produced using synthetic biology have exciting potential to advance many of the sustainable development goals (SDG 3,6,8,9,11,12,14,15)

Synthetic biology uses engineering principles to redesign or construct organisms and biological systems. By exploring new ways to engineer biology, scientists can harness nature to solve many of the challenges facing society today, from healthcare to biomaterials and sustainable energy.

Imperial is a world leader in synthetic biology, with interdisciplinary activities coordinated via the Imperial College Centre for Synthetic Biology (IC-CSynB). The Centre delivers world-class academic research and training and also works in partnership with SynbiCITE, the UK's national centre for industrial translation and commercialisation of synthetic biology research, and the London DNA Foundry, which automates the design and manufacture of biological devices. This offers a unique R&D and innovation pipeline that enables the transfer and application of academic research to tackle global challenges.

For example, in 2018 an Imperial group made a major breakthrough, vastly improving the efficiency and yield of the bioprocess used to make products such as biofuels, bioplastics and new medicines by modifying a key enzyme. It could help bring biofuels to the mainstream for a range of applications such as low-carbon transport and clean electricity generation.

Meanwhile, in 2019 another group developed a new bio-scaffold that actively works with the body's



natural repair systems to drive the healing process. The technique could be used in a variety of injuries such as fractured bones, scar tissue after heart attacks, damaged nerves and diabetic foot ulcers.

Professor Guy-Bart Stan, Co-Director of the Imperial College Centre for Synthetic Biology, says: "The methods and techniques of synthetic biology and the new industries it is creating will be pivotal enablers in achieving many of the UN Sustainable Development Goals – from food security and sanitation through to clean energy and good health. With Imperial's established pipeline of innovation in this area, from fundamental research through to application, we're already having a tangible impact."

**ABOVE:** The Imperial College Centre for Synthetic Biology (IC-CSynB) delivers world-class academic research and training to tackle global challenges

**BELOW:** Professor Guy-Bart Stan



**"The techniques of synthetic biology will be pivotal enablers in achieving many of the SDGs"**

**IMPERIAL SDG GOALS MET:**



# Mastering the elements

Imperial delivers a range of innovative Masters' degrees that equip the scientists and leaders of the future to tackle sustainable development challenges

## GLOBAL HEALTH

Imperial is a world leader in public health research (SDG 3) and is now also helping to equip the future leaders of this field through an innovative education programme. In 2019 the College launched the Global Master of Public Health, its first fully-online degree in the health field, which provides 'inclusive quality education' (SDG4) across the college.

Professor Helen Ward, who is leading the team tasked with developing the new course said: "We face growing epidemics of long-term conditions such as diabetes and obesity, the emergence and re-emergence of some serious infectious diseases, and developing health impacts of climate change, environmental hazards and inequality. Public health tools exist to mitigate many of these threats, but there are far too few people with the expertise to use these to best effect across the world. The Global Master of Public Health is helping to train a cadre of public health leaders to meet these needs.

## MSC ENVIRONMENTAL TECHNOLOGY

Applying a sound understanding of science and technology to develop practical policy and manage solutions to contemporary sustainability issues is the foundation of Imperial's MSc in Environmental Technology. For over four decades students from across the world and from a variety of professional backgrounds have come together to focus on the intersections between science, technology and policy. Tania Castillo Guido, a recent alumnus of



the course from Peru says: "through a combination of lectures, field trips and practicals, the MSc allowed me not only to learn how to identify and mitigate potential environmental impacts but also how to work collaboratively within a multidisciplinary team to create environmental strategies.

## MSC CLIMATE CHANGE, MANAGEMENT & FINANCE

Partnering with prominent Imperial initiatives the Grantham Institute and the Centre for Climate Change and Investment, this masters' programme focuses on climate change and sustainability knowledge tailored for the business

**ABOVE:** Students from MSc Environmental Technology on a fieldtrip

**BELOW:** Professor Helen Ward



world, aligning with SDGs 7, 8, 9 and 13. A recent graduate of the course, Sudhiksha Unnikrishnan says: "the faculty are actively engaged in climate change in one way or another which means that the kind of insights they are able to give in class are unparalleled...the cohort is also extremely diverse, both in terms of nationality and cultures but also in terms of academic background, which means that team work is very exciting."

### IMPERIAL SDG GOALS MET:



# Calculated progress – Mathematicians progressing the SDGs number by number

As mathematics underpins our understanding of life and the universe, research at Imperial's Department of Mathematics spans many diverse topics including measurement towards the SDGs and specific SDG directed research.



**W**hile assessing progress towards the SDGs necessarily relies on statistics, Imperial statisticians have recently interrogated the basis of official statistics and thus the measurement of progress. In their recent publication "From GDP to Sustainable Wellbeing: Changing Lives or Changing Statistics", Professors Paul Allin and David Hand also explore what improvements could be made for wellbeing and the 2030 Agenda. Furthermore, research by Imperial's statisticians has also contributed to a new framework for monitoring COVID across the UK and the world, strongly aligning to SDG 3. With another strong drive

towards SDG 3, the EPSRC Centre for Mathematics of Precision Healthcare connects mathematics, engineering and computer science with medical science to address issues ranging from patient journeys to population analysis. An example of the centre's research is developing mathematical tools to determine disease progression through clusters of symptoms. Climate change (SDG 13) is also a key focus for the Department. The EPSRC funded Mathematics of Planet Earth Centre for Doctoral Training trains students in mathematical and computational techniques required to predict and quantify uncertainty and risk for extreme weather and climate change. The global outreach and

**ABOVE:** Research by Imperial's statisticians is helping to track global progress towards the SDGs

partnering of Imperial's mathematicians is further demonstrated through the relationship with African Institute of Mathematical Sciences (AIMS). AIMS' former President, Professor Francis Allotey, who studied at Imperial in the 1960s, was the first Ghanaian to obtain a doctorate in mathematical sciences. His return to Ghana facilitated the strong relationship between Imperial and Ghana. AIMS has six centres of education and research across Africa and academics which include pure mathematics and statistics.

### IMPERIAL SDG GOALS MET:





SHUTTERSTOCK

## Imperial's new Global Development Hub

**We know that the SDGs can only be realised with strong equitable partnerships and cooperation across the disciplines (SDG 17). For many years Imperial's students, staff, alumni and the wider College community have pursued education and research towards the 2030 Agenda for Sustainable Development and beyond. Imperial's new Global Development Hub aims to create a central repository for these initiatives whilst establishing new networks and education programmes for the College.**

**T**he recently launched Global Development Hub has already hit the ground running. In order to promote the SDG-aligned work across Imperial and the wider community, the Hub has launched an SDG of the Month event series. For the first event, panellists from Imperial's Business School and School of Public Health joined representatives from UNICEF and Good Things Foundation to provide interdisciplinary perspectives on SDG 10, Reduced Inequalities, and the digital divide.

In addition, the Hub has worked with representatives from UNDP posts in India, Nepal, Niger and Palestine to discuss the work of the UNDP Accelerator Labs in their countries towards SDG 5 and reducing gender inequalities. These events create opportunities to explore new innovative partnerships that move away from traditional academic partners to work with local groups that have in-depth knowledge of the issues in their communities.

Hub Co-Chair, Professor Mike Templeton says "We are incredibly

**BELOW:**  
Professor Mike Templeton,  
Professor of Public Health Engineering, leads Imperial's Global Development Hub



excited to be developing this interdisciplinary Hub which connects all Faculties, Institutes and facets of Imperial towards the goal of sustainable development. Imperial's global reach in education and research enables us to forge some fantastic partnerships and we are looking forward to creating more opportunities and programmes going forward."

**IMPERIAL SDG GOALS MET:**

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--



**1** NO POVERTY



**2** ZERO HUNGER



**3** GOOD HEALTH AND WELL-BEING



**4** QUALITY EDUCATION



**5** GENDER EQUALITY




**6** CLEAN WATER AND SANITATION



**7** AFFORDABLE AND CLEAN ENERGY



**8** DECENT WORK AND ECONOMIC GROWTH



**9** INDUSTRY, INNOVATION AND INFRASTRUCTURE



**10** REDUCED INEQUALITIES



**11** SUSTAINABLE CITIES AND COMMUNITIES



**12** RESPONSIBLE CONSUMPTION AND PRODUCTION



**13** CLIMATE ACTION



**14** LIFE BELOW WATER



**15** LIFE ON LAND



**16** PEACE, JUSTICE AND STRONG INSTITUTIONS



**17** PARTNERSHIPS FOR THE GOALS

