Newton Fund

Newton Prize 2018

Foreword from the Minister

As the UK's Minister for Science and Innovation, I am clear that the UK's research and innovation excellence is founded on our openness and global engagement: science has no borders and the best science is done working internationally.

The uniqueness of the Newton Fund is the partnership working between the UK and partner country at all levels from government to government, delivery partner to delivery partner through to project lead to project lead. From energy and healthcare, to agriculture and digital, the Newton Fund demonstrates how bringing researchers together has enormous potential to change lives for the better across the world.

The annual £1m Newton Prize builds upon, celebrates and further encourages these research partnerships. It's great to see this year's applications representing the breadth of the Newton Fund's work from public and private sector organisations based around the world.

This year's prize coincides with the first anniversary of the publication of the UK's modern Industrial Strategy, which identifies and prioritises the strong foundations of our economy to meet the challenges and opportunities of the future. The Industrial Strategy includes our commitment to the biggest increase in public and private R&D investment in our history, to reach 2.4 percent of GDP invested in research and development by 2027 and 3 percent in the longer term.

International collaboration in partnerships such as those in Latin America, celebrated within this publication, sit alongside this step change in investment. That's good news for innovative nations like the UK and our Newton Fund partner countries.

I would like to congratulate all the researchers and innovators – their inspiring projects demonstrate what can be achieved when we work together in partnership.

Sam Gyimah MP
UK Minister of State for Universities, Science, Research and Innovation

Department for
Business, Energy
& Industrial Strategy

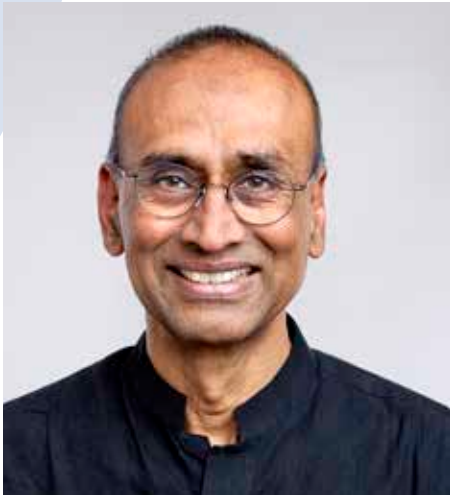
Foreword from the Newton Prize Committee Chair

Last year I was impressed by the fantastic work done through the 2017 Newton Prize projects and hearing first-hand the excited reaction of the winners. In what is now my second year as the Chair of the Newton Prize Committee, I have really enjoyed learning about the collaborative endeavours in Latin America.

Science by its nature has always been an international enterprise. The Newton Prize exemplifies this by allowing international research partners to continue working together on solutions that change lives. The Newton Prize recognises and celebrates the outstanding work and impact of the pioneering ideas and cutting-edge research and innovations that come from these Newton Fund partnerships.

There were over 140 applications for this year's Newton Prize demonstrating the strong partnerships between UK and Latin American researchers. Narrowing it down to the 22 shortlisted projects was only possible thanks to the excellent work of the over 400 external peer reviewers from around the world. Selecting the winners was not easy but having UK and Latin American experts on the independent committee, bringing their knowledge and insights, was crucial in arriving at the eventual winners – so a big thank you to everyone involved.

As well as a Newton Prize for each country, I am honoured to present a special Chair's Prize, for the project that best demonstrates regional or global impact. After all, our world today faces many challenges, from energy to sustainable food production; from disease prevention to city planning. It is only through partnership and international collaboration that we can hope to tackle, and solve, these issues.



Sir Venki Ramakrishnan, FRS
Newton Prize Committee Chair
President of the Royal Society

Introduction

The Newton Fund builds research and innovation partnerships with 17 active partner countries to support economic development and social welfare, and research and innovation capacity for long-term sustainable growth. It tackles global challenges such as sustainable food and water resources, natural hazards, atmospheric pollution, and resistance to antibiotics. These issues have a major impact on the lives of people across the globe.

The total budgeted UK investment for the Newton Fund is £735 million from 2014 to 2021, and partner countries provide matched resources within the Fund, making it a truly equitable partnership. It is managed by the UK Department for Business, Energy and Industrial Strategy (BEIS) and delivered through seven UK delivery partners.

The Newton Prize

The Newton Prize is a £1 million fund which recognises the exciting research and innovation the Newton Fund has invested in since its launch in 2014. It celebrates impactful partnerships between the UK and Newton countries, and encourages new international collaborations to address some of the world's most pressing challenges.

Each year, from 2017 until 2021, a minimum of five Newton funded projects, fellowships or other awards will be awarded the Newton Prize. Each Prize will be worth up to £200,000, and must be used to advance or develop existing Newton funded work. The Prize will be awarded for the best research or innovation that demonstrated impact in economic development and/or social welfare.

The Newton Fund supports the United Nations 2030 Agenda for Sustainable Development and the collaborations shortlisted for this year's Prize each tackle one or more of the UN's Sustainable Development Goals; addressing areas of critical importance for humanity and the planet.

In 2018, the Newton Prize is being awarded for projects, fellowships or other awards as part of the Newton partnerships with Brazil, Chile, Colombia and Mexico.

globalgoals.org

The partner countries

Brazil
Newton Fund Brazil was launched by the UK Finance Minister in 2014. The Newton Fund invests in partnerships with Brazilian ministries, research funding agencies and foundations to promote social and economic development through science and innovation. It plays a crucial role in bringing together specialists from both countries to tackle challenges such as neglected infectious diseases, environmental threats and to collaborate on sustainable agriculture, biodiversity and urban transformation. More than 50 joint calls have been launched to date.

Chile
The Newton-Picarte fund is named after Chilean mathematician Ramón Picarte. The fund has supported collaborations across the scientific spectrum in key sectors that include agriculture, engineering, natural and social sciences and medical and health research. From 2018 the fund in Chile will address wider global development challenges, reflecting Chile's graduation from the DAC list. Projects shortlisted for this year's prize will build on the impact they have achieved within Chile to benefit other countries in Latin America and globally.

Colombia
The Newton-Caldas Fund is named after Francisco José de Caldas, considered the father of engineering in Colombia and the inventor of the hypsometer, an instrument for measuring height or elevation. The UK and Colombia work together through the Newton-Caldas Fund on: biosciences, food security, post conflict transitions, health, agritech research and innovation. Biodiversity research and innovation through the £20m Colombia Bio programme are a major component of the programme, with a focus on exploration, research, and sustainable bioproducts.

Mexico
The Newton Fund in Mexico is the first formal research and innovation partnership programme between the UK and Mexican Governments. Both countries have agreed four priority areas of mutual interest: health and nutrition; agro technology; future and sustainable cities; and clean energy development. The fund is fostering equal partnerships that will build capacity and support social and economic development in Mexico. Over the last four years the fund has been delivered by more than 50 different institutions in Mexico with UK partners.

Shortlist case studies

Brazil

Chile

Colombia

Mexico

Increasing livestock fertility for sustainable agriculture

Brazil is the largest exporter of beef in the world. Livestock supports the economic livelihood and food security of almost 1.3 billion people and contributes 40 percent of the value of agricultural output worldwide. Livestock is also the world's largest user of land resources, with grazing land and cropland dedicated to the production of feed representing almost 80 percent of all agricultural land.

One factor that greatly affects the economic sustainability of both beef and dairy farming is poor reproductive efficiency associated with embryo mortality. Increasing fertility in cattle will support sustainable agricultural production and reduce environmental impacts worldwide.

Cattle in Brazil

Newton-funded researchers from Brazil and the UK are harnessing assisted reproductive technologies to generate robust cattle and avoid embryo mortality. Exposure to environmental stresses can be harmful to offspring health even in the womb. This project has generated a new and exciting in vivo model to understand how the embryo and the mother interact, and how this can go wrong. By understanding communication between the embryo and the maternal environment the researchers can identify interventions to increase successful pregnancy and ensure that offspring are resilient to environmental stresses.

This work has the potential to identify molecules that can be manipulated to enhance pregnancy success or can act as markers of early pregnancy success, helping to transform the sustainable intensification of agriculture in different production systems across the world. If the researchers can implement their findings to help farmers produce more robust cattle that will provide more dairy products and meat, this will have longer term economic and social benefits by increasing the economic viability of small holder farmers.

> **This project has been a springboard enabling us and our Brazilian collaborators to stay at the cutting edge of science. It has facilitated a new way of working.**
>
> Dr Niamh Forde, University Academic Fellow, University of Leeds

The role of extracellular vesicles mediating embryo-maternal communication in bovine

Project leads:
Dr Niamh Forde, University Academic Fellow, University of Leeds and Dr Juliano DaSilveria, University of Sao Paulo

Delivery partners:

Royal Society and São Paulo Research Foundation (FAPESP)

Investigating the treatment of a killer disease spread by sandflies

Leishmaniasis is a neglected tropical disease transmitted by the bite of infected sandflies. After being bitten, humans can experience symptoms ranging from painful skin legions to internal organ failure. It is estimated that between 20,000 and 30,000 people die from the disease each year.

Worldwide, 350 million people are at risk of acquiring leishmaniasis and it is very common in Brazil. Drug treatment used since the 19th century can be toxic, expensive and ineffective. Research conducted by Newton funded scientists indicates that the skin legions patients suffer with are exacerbated by the patient's robust immune response to the parasite. Building on their initial findings, the researchers are investigating how the immune system responds to the disease and how this can help to tailor potential treatments.

As well as directly helping patients through diagnosis and follow-up, the study may lead to new treatments to counteract leishmaniasis and alleviate the suffering of patients. More broadly, the wider biomedical community and government health agencies will benefit from the collection and distribution of new data about leishmaniasis; extending our collective knowledge and understanding about one of most important neglected diseases in the world.

Longer term, the project will allow for the establishment of new research partnerships with national and international scientists who want to study and fight leishmaniasis, as well supporting research capacity building and technical training for scientists.

Project leads standing by their winning poster at the Brazilian Immunology meeting

"The project will provide the base for the development of new expertise in *Leishmania* immunity and support the emergence of innovative and unexplored treatments.

Professor Daniel de Oliveira Gomes, Federal University of Espírito Santo

Characterisation of *Leishmania*–specific T cells in skin and blood during cutaneous and mucocotaneous leishmaniasis caused by *Leishmania brasiliensis*

Project leads:

Professor Arne Akbar, University College London and Professor Daniel Gomes, Federal University of Espírito Santo

Delivery partners:

Medical Research Council, the Brazilian National Council of State Funding Agencies (CONFAP), the Foundation for Support to Research and Innovation of Espírito Santo (FAPES) and the Brazilian National Council for Scientific and Technological Development (CNPq)

Preserving the Amazon with traditional knowledge

Since 1970, over 800,000 square kilometres of the Brazilian Amazon have been deforested – an area four times the size of Great Britain. To combat deforestation, indigenous peoples of Northwest Amazonia have historically practiced sophisticated forms of land management, but these practices are now under threat from erosion of traditional knowledge. As this traditional knowledge is lost, the risk to health, income, nutrition and culture increases.

This Newton funded project is preserving this vital knowledge by drawing upon the historic collections of the Royal Botanic Gardens at Kew, to improve understanding between past and present indigenous knowledge and science. This project will build on the team's work with the records of 19th century botanist Richard Spruce; some of the earliest surviving records we have on Amazonian culture, plants and their uses. The team plan to extend their programme on Spruce's collections to create a long-term digital resource in collaboration with researchers in Brazil. Digitising the collection will make this key reference work on Brazilian ethnobotany available to wider audiences.

Training indigenous people in the collection and recording of biocultural knowledge will enable them to undertake their own biocultural research, bringing fundamental benefits for the sustainable and beneficial use of plants throughout the region. The current focus of the project is across 22 indigenous groups (40,000 people), but the longer-term aim will be to expand this work reconnecting local knowledge and science throughout Brazil and neighbouring countries in the Amazon.

Tuyuka girl collecting chili pepper fruits

> **This project revitalises the knowledge we don't have in the region anymore. I believe that with this knowledge we can recover our ways of living and the wellbeing of our communities.**
>
> Ronaldo Silva, Indigenous leader, Rio Içana, Baniwa

Mobilising the value of bio-cultural collections in Brazil

Project leads:

William Milliken, Royal Botanic Gardens, Kew and Viviane Stern da Fonseca Kruel, Rio de Janeiro Botanical Garden

Delivery partners:

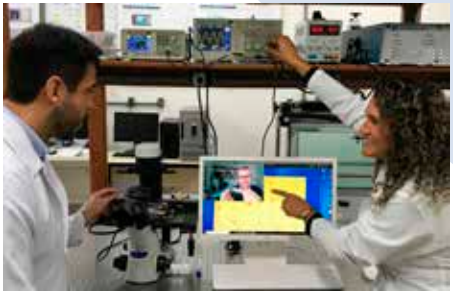
British Council and Rio de Janeiro Botanical Gardens

New technology to fight neglected tropical diseases

Leishmaniasis, a neglected tropical disease, is endemic in 97 countries and up to 1 million new cases occur each year. When left undiagnosed in the early stages, it may progress into serious conditions leading to disability and death. This disease dramatically lowers the quality of life and worsens poverty and inequality.

New technology in the form of rapid and low-cost diagnostic devices offers the prospect of early intervention when leishmaniasis is readily treatable. A parallel investigation is underway to better understand leishmaniasis, helping to find new drugs to treat the condition. This research addresses both these issues, providing cheap, portable and robust solutions.

Newton-funded researchers in Brazil and the UK are co-developing this technology in such a way that the ideas, skills, and trained people remain in the country where they are most needed. Prototypes will be tested in poor regions of Brazil bringing immediate benefits to these people. This will attract publicity, raising awareness of this disease, locally and around the world.



Professors Silva and Moreira in Brazil discuss new diagnostic devices in video link to Professor Drinkwater in the UK

In time, improvements in health will lead to better quality of life and are an economic enabler. These new acoustic devices can break the cycle of neglected tropical diseases in poor regions around the world. The development of new technology in partnership with Brazil will also lead to new skilled jobs in technology and manufacturing.

> **Rapid point-of-care technology and new drugs discovery could revolutionise the diagnosis and treatment of leishmaniasis, benefitting thousands of people in the poorest regions of the world.**
>
> Dr Mardjane Alves de Lemos Nunes, Superintendent of Health Surveillance, Alagoas, Brazil

Acoustophoretic technology: from theory to application

Project leads:

Professor Bruce Drinkwater, Department of Mechanical Engineering, University of Bristol and Associate Professor Glauber Silva, Physical Acoustics Group, Federal University of Alagoas

Delivery partners:

Royal Society and the Brazilian Council for the State Funding Agencies (CONFAP) and Foundation for Support to Research of Alagoas (FAPEAL)

Improving the lives of the Guarani people by saving the Atlantic Forest

2018 winner

The Atlantic Forest in Brazil is one of the world's richest biomes, home to a large number of species unique to that area. It is fundamental to the physical and cultural survival of the indigenous Guarani people, and to the quality of life of more than 70 percent of the Brazilian population who depend on its water supply. Despite this, nearly 90 percent of the forest has been destroyed to make way for pastures, croplands and urban areas, severely affecting the Guarani people and threatening many species with extinction.

A Newton-funded project between researchers in the UK and Brazil is helping the Guarani restore the Atlantic Forest in their territory. By drawing from Guarani ancestral agricultural knowledge and established agroforestry techniques, and by promoting a better understanding of the importance of indigenous peoples for environmental conservation, the team are supporting the preservation and restoration of the forest and improving the wellbeing of Guarani communities.

The project has already benefited more than 3,000 Guarani people. Seed exchanges have helped rescue agrobiodiversity from collapse on Guarani territory and collective plantations have been established, helping to restore degraded land. The team has produced territorial and environmental management plans and ethnomaps representing how Guarani organise their territory, helping to establish agreements that protect the land.

The Guarani have met with governmental and non-governmental organisations to exchange knowledge and discuss solutions. They were also introduced to the Ashaninka, an indigenous community who shared their experience on community organisation and environmental restoration. As well as benefitting the Atlantic Forest and the communities it supports, the results of the project could inform conservation efforts elsewhere.

Seed exchange.

> **Winning the Prize would enable us to include more villages and greatly expand on the success we've already achieved.**
>
> Daniel Calazans Pierri, General Coordination Member, Indigenous Work Centre

Environmental and territorial management in indigenous lands among the Guarani people in the south and south east of Brazil

Project leads:

Jerome Lewis, Reader, Centre for the Anthropology of Sustainability, University College London and Daniel Calazans Pierri, General Coordination Member for the Indigenous Work Centre – CTI

Delivery partner:

British Council and Indigenous Work Centre (CTI)

The race to find new drugs for a neglected tropical disease

Schistosomiasis is a neglected yet important disease which affects the poorest and most vulnerable people in the world. Those infected with the disease can experience liver damage, kidney failure, infertility, or bladder cancer. The disease is spread through contact with fresh water contaminated with parasite flatworms.

The disease is especially common among children in developing countries as they are more likely to play in contaminated water. There is one drug available to treat the disease and yet even this lifeline is in doubt as the parasite is developing resistance to it. The race is on to create new drugs to fight the disease.

Newton funded researchers in the UK and Brazil are using advanced x-ray technology at the UK's national synchrotron science facility. They hope to find a way to prevent a protein prevelant in schistosoma worms – and known to be crucial to its survival – from working, starting the process of drug discovery. The team has also developed a network that shares expertise and builds research capacity in Brazil, a country whose population is particularly at risk from schistosomiasis.

The team hopes to strengthen collaborations with the Brazilian Ministry of Health to enable clinical trials of candidate drugs against schistosomiasis and to create unprecedented capacity in Brazil for state-of-the-art drug discovery, which could be applied to other neglected diseases.

Studying the snail intermediate hosts of schistosomiasis

> **"It's a privilege to have been given the opportunity to collaborate with researchers in an endemic country and take a step closer to advancing new treatments of schistosomiasis.**
>
> Nicholas Furnham, Associate Professor, London School of Hygiene & Tropical Medicine

Building research capacity for schistosomiasis drug discovery and development through high-content imaging and structural molecular biology studies

Project leads:

Nicholas Furnham, Associate Professor, London School of Hygiene & Tropical Medicine and Floriano Silva-Jr, Full Researcher, Oswaldo Cruz Foundation

Delivery partners:

Medical Research Council (originally RCUK), Brazilian Council of State Funding Agencies (CONFAP) and the Foundation for the Support of Research in Rio de Janeiro (FAPERJ)

Affordable solutions for sustainable aquaculture in Chile and Brazil

Infectious diseases are a serious threat to the sustainability of aquaculture and the livelihoods of millions of people globally who depend on the industry. Improving genetic resistance to disease in fish via selective breeding is one promising solution, however the technology this requires is too expensive for many aquaculture systems.

A Newton-funded project has helped tackle the two most important diseases affecting Chilean salmon aquaculture, and established a successful collaboration between research groups in the UK and Chile, that is now expanding to other countries in South America. The team developed an inexpensive method for fish farmers to select disease-resistant fish based on their genetics. This new method led to increased uptake of genetic technology in Chilean salmon farms, contributing to a 41 percent reduction in fish farm mortality and a 32 percent reduction in antibiotic use. Exports of Chilean salmon increased 20 percent in 2017, supporting income and nutrition for communities reliant on aquaculture.

Salmon eggs

The team will now translate this technology from the advanced salmon industry in Chile to the rapidly developing tilapia breeding and production sector in Brazil. Tilapia – a species of freshwater fish – supports the nutrition and livelihoods of millions of people. Brazil is a potential 'aquaculture superpower' with 240,000 tonnes of tilapia produced each year. The team will work with the Aquaculture Center of UNESP (CAUNESP) in Brazil to implement this low-cost innovation and support this critical food industry.

While the research will initially target Brazil, the ultimate aim is for the widespread adoption of genetics and breeding technology to enhance aquaculture production globally.

> **This project has brought international attention to our research teams in the UK and Chile, provided training opportunities for early career researchers, and has helped spark new collaborations between academic and industry partners.**
>
> Professor Ross Houston, University of Edinburgh

Utilising functional genomic variation for improved disease resistance in Chilean salmon aquaculture

Project leads:

Ross Houston, University of Edinburgh and Jose Yanez, Universidad de Chile

Delivery partners:

Biotechnology and Biosciences Reseach Council (BBSRC) (originally RCUK) and National Commission for Scientific and Technological Research (CONICYT)

New electrical architecture to reduce energy poverty

Growing technological development in Chile has led to the need for a more efficient and sustainable supply of electricity. Power converters are part of the answer. They play a simple role in power systems around the world, allowing us to carry out far more complex processes in the overall management of electrical energy.

This project aims to develop new power converter topologies, connecting separate powergrids to make it easier to manage the supply of electric more effectively, reduce waste and even make electrictity far more available to remote communities, thereby reducing energy poverty.

As well as supporting the creation of skilled and specialised professionals in power electronics, renewable energy and microgrid design, this project will strengthen international cooperation on the important subject of sustainable energy. The team has enabled capacity building in the form of new MSc and PhD programmes; retaining undergraduate students from the University of Talca and attracting new ones from the whole region, providing them with the infrastructure and equipment for their specialist research.

The project has expanded to other countries such as Argentina, Cuba and Serbia and further funding would enable the team to bring these benefits to rural Paraguay.

The 'Usman' rig

The Newton Fund allowed me to be hired as a postdoctoral researcher. I got access to top equipment and was able to conduct high-level research and interact with well-known professors in the field. As a woman in Chilean academia it was my gateway to international research.

Yamisleydi Salgueiro, Post-doctoral student

New configurations of power converters for grid interconnection systems

Project leads:

Jon Clare, Head of the Power Electronics, Machines and Control Research Group, University of Nottingham and Marco Rivera, Head of Energy Conversions and Power Electrics Laboratory, University of Talca

Delivery partners:

Engineering and Physical Sciences Research Council (EPSRC) and the National Commission for Scientific and Technological Research (CONICYT)

Documenting the past for a more peaceful future

2018 winner

Thousands of people around the world are imprisoned, tortured or executed for political reasons. Left undocumented, these actions are often met with denial, revisionism and impunity for those who commit them, threatening democracy, peaceful coexistence and human development.

Examining the case of Chile and the unprecedented documentation work undertaken by civil society organisations during the Pinochet dictatorship, an international research team has shown how the act of documentation itself is an important mode of resistance to human rights violations. Working closely with human rights advocacy organisations, Newton-funded researchers plan to increase the availability of information about human rights violations and inform policy and practice in this important area in Colombia and Mexico.

Documentation and record-keeping is an essential part of seeking truth and justice. It allows affected societies to appreciate – often for the first time – the depth and scale of the trauma suffered by fellow citizens. Both for Colombia and Mexico, this new line of research, virtually unexplored until now, is a decisive contribution to human rights movements. This study will produce recommendations to enhance the registration policy and processes currently underway in Colombia and Mexico, and the results will be shared with human rights organisations to improve registry and documentation systems globally.

Talking to survivors and human rights advocates in the biggest detention centre operating in Mendoza city during the Argentinian dictatorship

Long term, increased documentation will help societies confront and learn from political violence and protect fundamental human rights – a basic condition for peace, sustainable governance and sustainable human and economic development in any society. Crucially, it will support public policy and measures that help us to move towards a more peaceful future.

> **Undertaking our research internationally through the Newton Fund will help us protect human rights in the Latin American region and beyond.**
>
> Dr Oriana Bernasconi, Associate Professor, Alberto Hurtado University

Political technologies of memory: a genealogy of the devices of registration and denunciation of human rights violations under the military dictatorship in Chile (1973-2013)

Project leads:

Professor Vikki Bell, Professor of Sociology, Goldsmiths and Dr Oriana Bernasconi, Associate Professor, Department of Sociology, Alberto Hurtado University

Delivery partners:

Arts and Humanities Research Council and the National Commission for Scientific and Technological Research (CONICYT)

Strengthening energy infrastructure in Latin America

2018 winner

Long electricity blackouts have a big impact on a country's economic activities, social stability and security. Latin America's energy infrastructure currently lacks the resilience to deal with the increasing frequency of climate-related extreme weather events and natural disasters that cause power supplies to fail.

Newton funded scientists in the UK and Chile are using mathematical models to develop a framework that will strengthen power systems in Chile and other countries vulnerable to environmental hazards. The framework will help energy providers prevent or reduce widescale electricity outages when power systems are exposed to high-impact, low-probability events. It will inform planning practices to help shape a robust, cost-effective and low-carbon Chilean transmission network.

Damage caused by an extreme weather event

The research also focuses on community resilience as a way to lessen the impact of outages and manage disasters, by ensuring households have response strategies that are complemented by resilience measures prepared for (and by) the community.

The application of this research will benefit power system planners, regulators and policy makers, contributing to the development of a more resilient, affordable and clean energy supply. Already, the Chilean independent system operator has included resilience as an explicit factor in its system planning for the first time and has proposed resilient network investments worth 50 million US dollars.

National and international networks developed through the project have built the capacity of researchers in the wider region, and the potential impact of this project could benefit countries affected by extreme weather and natural hazards worldwide.

> **Attending the workshops and different activities organised within this project, I learned innovative concepts about planning resilient systems that I applied on a regular basis in policy making.**
>
> Oscar Alamos, Head of Risk Management and Energy Emergencies Unit, Chilean Energy Ministry

Disaster management and resilience in electric power systems

Project leads:

Pierluigi Mancarella, Professor of Smart Energy Systems, University of Manchester and Rodrigo Moreno, Associate Professor, University of Chile

Delivery partners:

Engineering and Physical Sciences Research Council (EPSRC) and the National Commission for Scientific and Technological Research (CONICYT)

Converting palm oil waste into sustainable energy

Colombia's densely populated cities are some of the most polluted in Latin America. Rapid urbanisation and reliance on fossil fuels is damaging the environment, contributing to climate change and negatively affecting the health of urban communities. However, as the leading producer of palm oil in Latin America, Colombia also has the potential for a successful bioenergy sector.

A team of researchers from Colombia and the UK are working together to turn waste biomass from palm tree residues into sustainable energy solutions that reduce pollution and help drive social and economic development.

Prof. Diana Lopez with a biomass to carbon nanotubes reactor designed by industrial partner HATCH INDISA at the University of Antioquia

When palm oil is extracted from the palm fruit bunches, the empty fruit bunches are often left in the fields to decay and used as a cheap fertiliser. However, this raw material has huge potential to create new bio-based products. With support from the British Council and Colciencias under the Newton Fund, the researchers are examining how the residue biomass of the empty fruit bunches could be used to create clean energy such as batteries to power electric vehicles and biofuels. They have produced bioethanol, lactic acid and furfural – excellent precursors for liquid fuels – and they also used carbon materials from the residue biomass as electrodes in supercapacitors and batteries.

The researchers hope that collaborations with industrial partners such as Tronex, a battery manufacturer, will help them to develop the technology and build the next generation of sustainable and clean energy in Colombia. If successful the project will boost the economy and wellbeing of rural communities, advance Colombia's bio-economy and reduce dependency on fossil fuels in the transport sector.

> **"We're excited to work with Professor Titirici and Professor Lopez on this exciting UK-Colombia project and support them towards the commercialisation of the devices.**
>
> Felipe Gutierrez, Head of Engineering, Tronex Battery Pack

Sustainable products from biomass

Project leads: Professor Magdalena Titirici, Queen Mary University of London and Professor Diana Lopez, University of Antioquia

Delivery partners: British Council and Colciencias - the Administrative Department of Science, Technology and Innovation

A smart solution to sustainable water supply in Colombia

Access to the supply of clean and safe water is one of the most important environmental issues facing the world today. It is estimated that within the next 10 years nearly two-thirds of the world's population will experience water stress. In Colombia, over 40 percent of drinking water is lost on its journey from the water utility company to the point of use, due to leakages and inadequate infrastructure.

A start-up tech company called Greenywave has developed a novel device to reduce water leakage and improve infrastructure planning. Supported by Newton funding through the Royal Academy of Engineering's Leaders in Innovation Fellowship programme, the company is already running several pilot projects with utility companies in three Colombian cities that supply water to over 950,000 people.

Greenywave smart water meter

The invention connects existing water meter technology to the internet, creating a 'smart' water management device which generates online alerts in real time to warn users of leaks and measure water pressure. The data it collects can be used to avoid water waste, help people and companies save money, and ensure that water supply exceeds demand.

Greenywave's team of innovators are now refining the technology and strengthening partnerships with utility companies and government organisations. As well as ensuring the sustainability of Colombia's rapidly growing cities Greenywave plans to support other countries facing the same challenges. In the UK more than 20 percent of water is lost before it reaches homes. As a result of this collaboration, several UK utility companies have shown interest in the technology, demonstrating the potential reach of this project.

> **With Newton Fund's support great things happened. Only eight months have passed, and we are already working on three utilities in Colombia.**
>
> Jimy Alexander Aguirre, Hardware Coordinator, Greenywave

Intelligent metering device for water, energy and other resources

Project lead: Jimy Alexander Aguirre, Hardware Coordinator, Greenywave

Delivery partners: Royal Academy of Engineering, Icetex and Ruta N

Using state-of-the-art technology to treat neglected tropical diseases

Leishmaniasis is a devastating and poorly-understood disease that disproportionately affects poor people in remote communities. In Colombia, cutaneous leishmaniasis is the most common form of the disease. Symptoms include swollen glands and skin lesions which are disfiguring and slow to heal. Left untreated it can lead to more serious, life-threatening disease.

High-tech research approaches that have revolutionised much medical research have not been readily applied to neglected tropical diseases. Seeking to change this, researchers from the UK and Colombia are harnessing the power of 'omic' based technologies to improve treatment and outcomes for people infected with the disease.

Biomarkers – molecules, genes, or characteristics that indicate the presence or severity of disease in the body – play a critical role in disease diagnosis and treatment. Recent omic technologies, such as proteomics (the study of proteins) and metabolomics (the study of small molecules), are rapidly accelerating the rate of biomarker discovery.

Using metabolomics, scientists will be able to show how children infected with the disease respond to miltefosine, the only oral drug registered for treatment of cutaneous leishmanisis. The results of this research will provide urgently needed evidence to support appropriate and personalised therapeutic interventions for children.

So far, more than 100 Colombian researchers have received training in the application of omic technologies to neglected tropical diseases. The project also benefits UK researchers who can apply their expertise, infrastructure and resources for technology driven biomedical research in affected countries.

Glasgow Polyomics technologists apply high resolution mass spectrometry to identify predictive markers of treatment outcomes in Colombian leishmaniasis patients

> **"I have worked on Leishmaniasis throughout my research career. Of all the projects on which I have worked, this is the one with the most obvious potential to have a positive effect on populations that are affected by this devastating and poorly understod disease.**
>
> Richard Burchmore, Senior Lecturer, University of Glasgow

Linking the power of omic technologies to translational research on neglected tropical diseases

Project leads:

Richard Burchmore, Senior Lecturer, University of Glasgow and Maria Adelaida Gomez, Coordinator, Molecular Biology and Biochemistry Unit, CIDEIM

Delivery partners:

British Council and The International Training and Medical Research Center (CIDEIM)

City innovation and social equity in Colombia

Colombia has the second largest number of internally displaced people in the world after Syria, according to the United Nations. The country's recently brokered peace agreement holds the prospect of developing a more equitable society, but it is largely focused on the rural areas worst affected by the conflict. This neglects the needs of those who have found themselves in urban areas and their surroundings, who make up the majority of internally displaced people in Colombia

Researchers in the UK and Colombia are investigating how the implementation of the peace agreement can resolve the urgent need for social and economic development in Medellin – one of the most innovative yet socially unequal cities in Latin America. The project evaluated Medellin's planning experience from the ground up, involving communities and institutions on a level platform. It has already led to changes in the city's municipal development plan, which sets out key policies and actions, and informed local policy on informal rental housing.

The project is now providing community organisations with a strong evidence base to engage other stakeholders and support their access to housing, basic services and livelihood opportunities. It will continue to facilitate dialogue between government and community groups, strengthen the capacity of local and metropolitan government organisations and give them the tools to make informed planning decisions. This will ensure that peace agreement implementation contributes to socio-economic equity and wellbeing in Medellin, and the results could be extended to other cities in Colombia. The work could also be applied to other countries dealing with peace processes and the wellbeing of affected communities.

Medellín

> **It is a testament to the strength of this project that it has been prepared with such a collaborative approach between community and academia.**
>
> Carlos Velasquez, Community Leader

Harnessing innovation in city development for social equity and wellbeing: a critical proposal to build on Medellin's experience as a model for Colombian future cities

Project leads:

Dr Soledad Garcia-Ferrari, University of Edinburgh and Professor Francoise Coupe, National University of Colombia, Medellín

Delivery partner:

British Council and National University of Colombia, Medellín

Turning environmentally damaging coffee waste into electricity

2018 winner

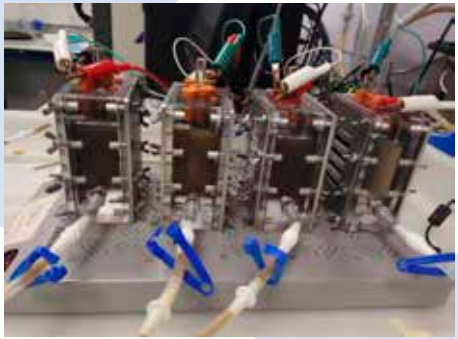
Waste water from coffee processing is harmful to the environment, as it contains substances that take a very long time to degrade. This is a particular problem in Colombia, the world's third largest coffee producer, where nearly all coffee is grown on small, family-owned farms. The farmers are unable to afford the large-scale water treatment systems needed to process the coffee waste, so it ends up in local water courses, which become contaminated.

Scientists working on a Newton Fund project in Colombia have found that environmentally damaging coffee waste could be turned into electricity using a microbial fuel cell. They discovered that if they fed coffee waste to a community of microbes originally found in a wastewater treatment plant, the tiny creatures would eat it, producing energy. This energy could then be captured in the form of electricity.

The research team is now developing a small, inexpensive device suitable for use on Colombian farms. The aim is to initially implement it in the coffee growing area of Southwest Antioquia, where they have already established good relationships with farmers.

By using microbial fuel cells to clean up their waste water, and reusing it, Colombian coffee farmers could relieve a huge strain on their water supply. As well as offering an environmentally-friendly alternative to treat waste water, the generation of electricity could boost social and economic development for Colombia's farming communities. If their fuel cells are used successfully in Colombia, the researchers hope to engage with large coffee companies in Europe to adopt the same approach to treating their waste.

Microbial Fuel Cells (MFCs)



> **This research proposes a potential high-impact solution to environmental, social and economic challenges facing rural sectors.**
>
> Professor Lina María Agudelo-Escobar, Associate Professor, University of Antioquia

Valorisation of agro-industrial waste: A Bioelectrochemical System for waste degradation and energy recovery from industrial coffee waste

Project leads:

Lina María Agudelo-Escobar, Associate Professor, University of Antioquia and Dr Claudio Avignone-Rossa, University of Surrey

Delivery partners:

British Council and Colciencias – the Administrative Department of Science, Technology and Innovation

Increasing productivity and removing toxic mercury from Colombia's gold mines

Artisanal and small-scale mining is important for Colombia's social and economic growth and represents more than 70 percent of the country's total gold production. However, these often informal and unproductive mining operations use mercury – a highly toxic and polluting element – to extract the gold ore. In 2018 the Colombian government banned mercury in gold mining to reduce its impact on the environment and reduce mercury exposure to miners and the general population.

A Colombian innovation and research company has developed a solution that eliminates the need for mercury and supports a clean, profitable and sustainable gold mining sector. With support from Newton funding, Nanotecol is working with the Government of Antioquia to implement a gold extraction process using nano and biotechnology. The process reduces costs, increases production efficiency and improves the quality of gold, all without generating pollutants to the environment.

As well as reducing mercury pollution, Nanotecol's circular economy model rehabilitates degraded soils and reuses the toxic cyanide as fertiliser for a legume plant. The plants can be used as livestock feed and they also capture carbon dioxide; providing additional income for local communities and reducing CO^2 emissions.

Nanotecol has created an alliance with Cornare, an independent body which promotes regional development and the protection of natural resources and CORPOURABA, which implements environmental policy in Antioquia. Together they are working with mining communities to pilot the technology so they can eradicate the use of mercury, protect the livelihoods of artisanal miners and their communities, and help Colombia take the path towards green growth.

First gold extraction plant with nanotechnological and biotechnological procedures, Abriaqui, Antioquia, Colombia

> **This technology will change Colombia. It's the tool the new government needs.**
>
> Gustavo Cordova, former Deputy Director of Corpouraba

Self-sustainable gold mining process

Project leads:

Lina Marcela Hoyos, Co-founder, Professor Universidad Bolivariana, Nanotecol, Yudira Zapata Sánchez, Co-founder and manager and project manager, Nanotecol and Lesli Zapata Sánchez, Co-founder and Assistant Management, Nanotecol

Delivery partners:

Royal Academy of Engineering and Ruta N

Securing a community's right to access safe water and food

Dangerous levels of arsenic are present in the soils and water of the Cerrito Blanco community in central Mexico. Arsenic contamination in the semi-desert area is 2,500 times higher than the limit set by the World Health Organisation, causing poor crop productivity and posing a serious health risk to the people living there.

Responding to this urgent problem, researchers from Mexico and the UK worked closely with members of the community to locate the source of contamination and implement several successful interventions; raising awareness about the risk of exposure, and improving crop safety and community health.

Cerrito Blanco maize field

Supported by Newton funding, the research team implemented a traffic light alert system to help the community distinguish between contaminated and non-contaminated water, and produced a visual guide to help farmers to recognise contaminated crops. A campaign video publicised in the local news helped to raise public awareness and the research team have directed people to alternative arsenic-free groundwater sources. As a result of the interventions, maize yields are significantly higher than preceding years, reaching up to one tonne per hectare for rain-fed crops without the use of fertiliser.

The scientists are also working with community members, the Human Rights Commission in Mexico and other partners to ensure that their right to access clean water and safe food is protected. By strengthening relationships with community members and establishing new partnerships with the private sector, the researchers want to attract investment for the remediation of arsenic contaminated soil to secure the social and economic development of the community.

> **Increased awareness of arsenic contamination has helped Cerrito Blanco communities make the right decisions for their wellbeing.**
>
> Dr Bhaskar Sen Gupta, Heriot-Watt University

Distribution of arsenic on agricultural soils and its influence on exposure risks through maize ingestion and agricultural activities in Matehuala, San Luis Potosi, Mexico

Project leads:

Nadia Martinez-Villegas, Professor in Water Technology, Potosi Institute for Scientific and Technological Research AC (IPICyT) and Professor Bhaskar Sen Gupta, Heriot-Watt University

Delivery partners:

Royal Society and IPICyT (Potosi Institute of Scientific and Technological Research) and the National Council of Science and Technology (CONACyT)

Improving surgical outcomes with virtual reality

Over the course of modern history, surgery has transformed from a risky 'art' into a scientific discipline capable of treating many diseases and conditions. Nevertheless, human errors and life threatening complications still occur, particularly for complex surgical procedures.

In Mexico, a Newton funded entrepreneur is using virtual reality technology to develop a surgical planner and simulator that will allow surgeons to plan and perform an operation before the actual surgery. Supported by the Royal Academy of Engineering's Leaders in Innovation Fellowship programme and the Ministry of Economy in Mexico, Verum VR Medical's technology could result in better surgical decision making, significantly reduce the occurrence of errors and improve the overall surgical outcome.

This new tool can simulate and reconstruct clinical and anatomical conditions, creating a virtual case the doctor can practice on. It is a virtual experience but it provides the surgeon with real life training. The technology has the potential to reduce surgery time by at least 30 percent; lowering costs and limiting chance of life threatening complications and infections.

Two hospitals have started to use the technology to analyse and discuss clinical cases. Now Verum's CEO wants to conduct further clinical studies and strengthen the national and international partnerships he formed through the project, so he can help to revolutionise the way that surgeries are practiced and taught around the world.

A doctor tests the virtual simulator

> **"This tool will be very useful especially for the incoming generations of medics. Using it will help a lot to understand a case and arrive in the operation room with much more confidence.**
>
> Senior trauma surgeon at Hospital Civil Guadalajara in an open medical session

Verum VR Medical

Project lead:

Fabio Antonio Gonzalez Sanchez, CEO of Verum VR Medical

Delivery partners:

Royal Academy of Engineering and the Ministry of Economy in Mexico

Childhood obesity: a Mexican solution to a global problem

Maternal obesity is a major risk factor for childhood obesity and reduced life expectancy. In Mexico, 32 percent of the adult population is obese and the prevalence of childhood obesity is the highest in the world. The current generation of Mexican children may, for the first time ever, have a shorter life expectancy than their parents.

Diet and nutrition during pregnancy can have an impact on the metabolic health of offspring, presenting an opportunity for intervention to stem this growing global problem. This Newton-funded project is developing a therapeutic early intervention that has the potential to improve the metabolic health of future generations; preventing chronic diseases such as diabetes and alleviating the burden of health care costs.

Dr Nozomi Itani, at King's College London cataloguing obese pregnant rats

Researchers in the UK and Mexico have discovered that drinking a novel probiotic extracted from a traditional aguamiel drink ('Honey milk' from Agave salmiana cactus) improves metabolism in obese pregnancy. The probiotic proved highly effective in preclinical trials. Administered daily for one month prior to and throughout pregnancy and lactation, the aguamiel probiotic was found to prevent many of the negative biochemical and metabolic outcomes observed in the offspring of obese rats.

The researchers hope to translate the preclinical studies performed initially in Mexico, to small scale clinical trials in the UK. Successful translation of preclinical studies to the general population could have significant impact on the health and life expectancy of the next generation. The aguamiel probiotic may yet prove to be a Mexican solution to a global problem.

> **This project brings together two of the leading groups in this field and has the potential to develop new avenues of treatment that can help alleviate the obesity crisis.**
>
> Professor Lucilla Poston, Head of School of Life Course Sciences and the Department of Women & Children's Health, Kings College London

Interventions to improve maternal metabolic profile and prevent cardio-metabolic and behavioural deficits in future generations due to programming by maternal obesity

Project leads:

Dr Paul Taylor, King's College London and Professor Elena Zambrano, National Institute of Medical Science and Nutrition Salvador Zubiran

Delivery partners:

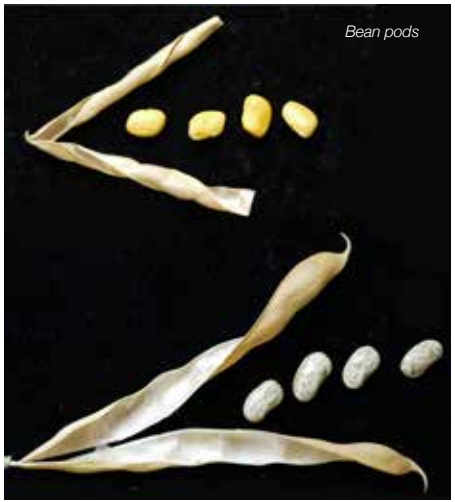
Medical Research Council and the National Council of Science and Technology (CONACyT)

New drought resistant beans for sustainable food supply in Mexico

2018 winner

Beans are central to Mexico's food security, but they are also highly sensitive to drought. Drought can cause up to 80 percent bean yield losses and climate change is making this problem worse. Seventy percent of Mexican farmers are smallholders with no irrigation which makes them particularly vulnerable to droughts and climate change.

Researchers in the UK and Mexico are developing climate ready elite bean varieties to combat drought related crop losses for Mexican and Latin American agriculture. By understanding how plants respond to drought and carbon dioxide through adjusting their stomata (microscopic valves on the leaf surface that open and close), the researchers are finding that reducing bean stomatal numbers could reduce water use by up to 40 percent without affecting yield; potentially saving up to three percent of Mexico's entire agricultural water use.



Bean pods

Using this knowledge, the team want to develop new elite high yielding bean varieties with better water use and nitrogen fixation under drought. With over six million people employed in agriculture and five percent of the population undernourished, developing high yielding, drought resistant beans will benefit the Mexican economy and future food security, as well as people's health and wellbeing.

Longer term, the project could lead to a reduction in rural poverty and improve socio-economic advancement by aiding efficient, competitive and profitable low input farming. Improving bean yields and minimising fertiliser use will also benefit soils, reduce desertification and improve water quality.

> **This is a fantastic opportunity to increase the impact of our work in Mexico, by enabling a much larger, interdisciplinery team of experts to tackle the issues of drought in bean agriculture and Mexican food security.**
>
> Professor Julie Gray, University of Sheffield

Manipulation of bean pod stomata to improve yield under drought and climate change

Project leads:

Dr Caspar Chater, Marie Skłodowska-Curie Individual Global Fellow IBT UNAM, University of Sheffield and Professor Alejandra Covarrubias, IBT UNAM

Delivery partners:

National Council of Science and Technology (CONACyT) and the Mexican Academy of Sciences

Producing natural and nutritionally beneficial food additives from microalgae

In the last two decades, the number of people in Mexico regularly consuming processed foods that contain synthetic additives has grown dramatically. While many synthetic additives are safe in small quantities, they provide no nutritional value and some studies suggest they can be toxic in large amounts.

To increase the nutritional value of these foods and reduce the risks associated with some synthetic additives, researchers from Mexico and the UK have found a new, environmentally friendly method of producing two natural pigments, phycocyanin (a shade of blue) and phycoerythrin (a shade of red), on a large scale. This Newton-funded project uses microalgae to produce these pigments which can then be used as natural additives in the food and drink industry. The process generates valuable by-products that are also beneficial for health and nutrition.

In Mexico, spirulina has been consumed as food since pre-Hispanic times. It is also a source of the natural pigment phycocyanin. Phycocyanin and phycoerythrin have anti-oxidant and nutraceutical properties.

Harvesting equipment

This efficient, safe and simple technology only uses a small amount of energy, minimising the environmental impact, allowing for the re-use of water and making the most of the biomass to yield a range of high quality, nutrionally valuable products.

Having shown that it is possible to produce these natural pigments on a large scale, the research will benefit the Mexican agro-industry, supporting the development of a sustainable industry based on high value, non-toxic microalgal products and by-products that also provide consumers with added nutritional value. The commercialisation of these products would extend the project's impact beyond Mexico and the UK to support a global market.

> **The phycopigments project has demonstrated that substantial savings in the costs of algal processing and biorefining are possible using membrane technology.**
>
> Dr Robert Lovitt, Director, Membranology Ltd

Phycopigments: Novel manufacturing methods for high value pigment products from microalgae

Project leads:

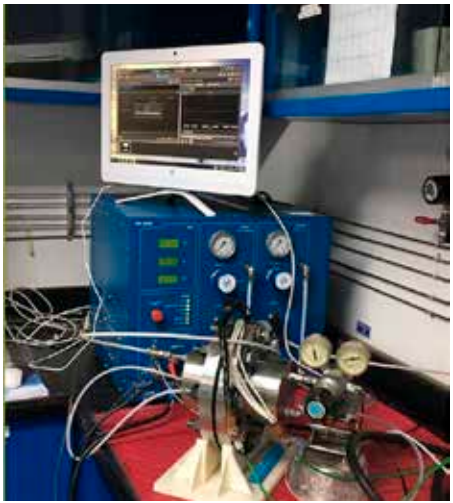
Dr Robert Lovitt, Director, Membranology Ltd and Professor Eugenia J. Olguín, Head of Research Group, INECOL

Delivery partners: Innovate UK and INECOL

Mexico's bright future as a producer of clean hydrogen

Billions of tons of carbon dioxide are let loose into the Earth's atmosphere every year from facilities that produce hydrogen by burning fossil fuels, such as coal, oil and natural gas. Without redress, greenhouse gas emissions from current hydrogen production will continue to hinder efforts to combat climate change.

This Newton-funded project uses waste hydrogen from existing industrial processes and recycles it for the food, chemical and petrochemical industries. The team has built a relatively inexpensive electrochemical compressor, which can purify and store unused hydrogen generated during the production of chlorine and sodium hydroxide. These are two important chemicals used by various industries for the creation of cement and concrete, water treatment, soap making and even food preparation.



Hydrogen compressor connected to a power supply

The electrochemical compressor can reach 50 atmospheres of pressure in a few minutes, equivalent to a column of water the height of the Empire State Building. This is achieved while producing 99.999 percent pure hydrogen, which is immediately useful to industry for zero-emission fuel cells, among other applications.

As well as giving undergraduates and postgraduates the opportunity for hands-on training with this new technology, the UK-Mexico team hopes to play their part in Mexico's bright future as a producer of clean hydrogen. The introduction of new hydrogen technologies to Mexico and Central America could create new technology companies and jobs in sustainable and modern hydrogen energy.

> **Working in collaboration with the University of Southampton has been highly beneficial for the consortium as a whole; they have provided their expertise and state of the art resources and we have built relationships with institutions and businesses in Mexico, providing commercial and educational opportunities that otherwise wouldn't have been available to us.**
>
> Dr. Nick van Dijk, COO PV3 Technologies

Renewable energy source based on the recovery, purification and storage of hydrogen from chlor-alkali plants

Project leads:

Dr David Hodgson, PV3 Technologies and Dr Abraham Ulises Chávez Ramírez, Researcher, Center of Research and Technological Development in Electrochemistry (CIDETEQ)

Delivery partners:

Innovate UK and National Council of Science and Technology (CONACyT)

Membership of the Newton Prize Committee

Chair

Sir Venki Ramakrishnan	President, Royal Society *Discipline - molecular biology*

Committee members

The Baroness Brown of Cambridge Julia King	Engineer and member of the House of Lords *Discipline – engineering*
Paula Caballero	Managing Director for Climate and Water, RARE *Discipline – climate and environment*
Dr Jaime Saavedra Chanduvi	Senior Director, Education Global Practice at the World Bank Group *Discipline – education and inequality*
Professor Dame Jane Francis	Director of the British Antarctic Survey, Cambridge *Discipline – climate and polar science*
Professor Carlos Frenk, CBE FRS	Ogden Professor of Fundamental Physics and founding Director of the Institute for Computational Cosmology of Durham University *Discipline – physics and cosmology*
Dr Jonathan Hague	Vice President Global R&D for Homecare Discover, Unilever *Discipline – research and development leadership*
Dr Celina Maria Turchi Martelli	Researcher of Infectious Disease Epidemiology, Institute Aggeu Magalhães, FIOCRUZ-Pernambuco, Brazil *Discipline – infectious diseases*
Kathy Peach	Interim Head of Nesta's Centre for Collective Intelligence Design *Discipline – innovation in international development*
Dr Fabiola León-Velarde Servetto	President of the National Council of Science, Technology and Technological Innovation (CONCYTEC), Peru *Discipline – biology and physiology*

Delivery Partners

We would like to express special thanks to the UK National Commission for UNESCO, in particular Sarah Shaw, Shara Samra, Kia Da Silva Cunha and Liz Bell for all their work in delivering the 2018 Newton Prize.

We would also like to thank all of the UK and partner country delivery and funding partners involved in this year's Prize for their role in supporting the application and verification process, as well as their continuing work in making the Newton Fund such a successful and impactful initiative.

UK

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Met Office
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UK Research and Innovation, which comprises:

- Arts and Humanities Research Council (AHRC)
- Biotechnology and Biological Sciences Research Council (BBSRC)
- Economic and Social Research Council (ESRC)
- Engineering and Physical Sciences Research Council (EPSRC)
- Innovate UK
- Medical Research Council (MRC)
- Natural Environment Research Council (NERC)
- Science and Technology Facilities Council (STFC)

Brazil

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Chile

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