Northumbria University NEWCASTLE

S2Cool project lead Dr Muhammad Wakil Shahzad

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Innovative project receives £2.8 million to develop energy-efficient cooling solutions to combat extreme heat

In response to increasing frequency of extreme heatwaves in Pakistan, an international research initiative has been awarded £2.8 million by UK Research and Innovation (UKRI) to develop energy-efficient cooling technologies that could save lives and reduce environmental impact.

The S2Cool project, led by Northumbria University, brings together an interdisciplinary consortium of over 30 partners, including academics,

industry experts, and policymakers from the UK and Pakistan.

It is one of thirteen UK research projects which have each received a share of £33 million through UKRI's Ayrton Challenge Programme that will address urgent global energy and climate challenges.

Responding to a climate emergency

In June 2023, Pakistan endured temperatures soaring beyond 52.2°C, resulting in a tragic loss of 120,000 lives and $16 billion in economic losses. With severe heatwaves threatening human health, livelihoods, and the nation's economy, Dinushika Dissanayake, Amnesty International's Deputy Regional Director in South Asia, called for urgent action – a call the S2Cool project team has embraced through research-driven innovation.

Traditional Mechanical Vapor Compression (MVC) air conditioning systems present three major challenges: high energy consumption, high maintenance costs and use of hazardous refrigerants.

Indirect Evaporative Coolers (IEC) were developed as an alternative to MVCs, utilizing water's evaporative potential to cool supply air. However, there are known limitations with current IECs, such as poor performance, frequent maintenance requirements and complicated manufacturing.

Dr Muhammad Wakil Shahzad, Associate Professor from Northumbria's Department of Mechanical and Construction Engineering and lead on the S2Cool project, has been working with a team of researchers to develop pioneering water and cooling technology solutions for the last decade.

"The S2Cool project aims to design and develop a Novel Indirect Evaporative Cooler (NIEC) which will represent a significant breakthrough in cooling technology, addressing the constraints of current IEC systems through simplified design and optimised airflow," explained Dr Shahzad.

S2Cool technology works by 'supply air' – air that has been conditioned - and 'working humid air' – air used to cool the supply air – passing through a series of dry and wet channels. These channels are separated by high performance non-corrosive conductive material. During the evaporative cooling process, the water droplets in the wet channel evaporate in the

stream of air and pass from a liquid to a gas. This transition requires energy, which is extracted from the supply air in the form of heat. As a result of this process, the supply air is cooled down before it leaves the device.

“This is a basic principle which is scalable by increasing the number of channels so more supply air can pass through a device at one time,” added Dr Shahzad.

The system is also designed to operate on renewable solar photovoltaic power with battery storage, ensuring off-grid capability and resilience against frequent power outages. AI-driven system optimisation will also be a key focus for the project.

The team believes that S2Cool could deliver transformative benefits, including up to 65% energy savings compared to conventional air conditioning systems, a 50% reduction in purchase costs and 65% reduction in operating costs for domestic air conditioners, elimination of chemical refrigerants, and significant reductions in CO2 emissions, contributing to a more sustainable and eco-friendly cooling solution.

Adoption of the technology could lead to an estimated reduction of 23 million tonnes of CO2 emissions over a decade – equivalent to approximately 23 million barrels of imported oil – and could result in significant public health impact, mitigating heat-related illnesses and chronic diseases – potentially saving thousands of lives.

The projected productivity gains are worth £16.25 billion annually, alongside other benefits such as job creation and reduced fossil fuel imports.

Global significance

With global air-conditioning energy demand projected to triple by 2050 putting further strain energy grids, especially in underdeveloped countries, the need for affordable, efficient alternatives has never been more urgent.

Aligning with the UN’s Sustainable Development Goals (SDGs) 7 (Affordable and Clean Energy) and 13 (Climate Action), the S2Cool project supports international climate pledges, including the COP26 Glasgow Breakthrough and COP28 Cooling Pledge.

As prototype trials at Northumbria University supported by Northern Accelerator funding have already demonstrated promising results, the project is poised to redefine cooling technology globally. “Our co-designed solution will not only address the immediate needs of country and its vulnerable populations but also sets a precedent for tackling similar challenges globally,” explained Dr Shahzad.

“The quality and importance of this approach extend within and beyond the fields of decarbonization, sustainable development, public health and climate adaptation. Our multi-faceted strategy leverages low-cost, energy-efficient technologies, community-based initiatives, targeted training through a newly created International E-Centre for Sustainable Cooling, and policy support to ensure comprehensive and sustainable impact,” Dr Shahzad added.

UKRI’s Ayrton Challenge Programme is an interdisciplinary, challenge-led research initiative which aims to enable a transformative transition to low-carbon energy systems in developing countries. Supported by the UK Government’s Ayrton Fund – a £1 billion commitment to research and development in clean energy technologies and business models – the projects will foster equitable partnerships with in-country researchers.

Frances Wood, UKRI International Director, said: “The Ayrton Challenge Programme demonstrates the power of research and innovation to address critical global challenges. These projects exemplify how equitable, interdisciplinary collaboration can unlock transformative solutions, ensuring a sustainable and inclusive energy future for all.”

Academic collaborators on the S2Cool project include UK institutions Aston University, University College London, University of Leeds, University of Birmingham and Newcastle University, who will work together with Pakistan-based institutions Bahauddin Zakariya University, Ghulam Ishaq Khan Institute of Engineering Science and Technology, Government College University, Lahore University of Management Sciences, National University of Sciences and Technology and The University of Agriculture Faisalabad.

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Notes to editors

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Northumbria is a research-intensive university that unlocks potential for all, changing lives regionally, nationally and internationally. Named Modern University of the Year 2025 by *The Times* and *The Sunday Times*, Northumbria is based in Newcastle upon Tyne, with an additional campus in London.

Two thirds of Northumbria's undergraduate students come from the North East region and go into employment in the region when they graduate, demonstrating Northumbria's significant contribution to social mobility and levelling up in the North East of England.

Find out more about us at www.northumbria.ac.uk

UNIVERSITY OF THE YEAR 2022 (Times Higher Education Awards)

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--- Please contact media.communications@northumbria.ac.uk with any media enquiries or interview requests ---

Contacts

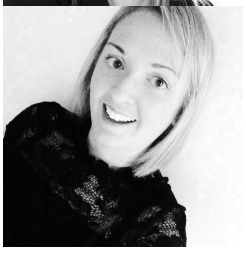
Rik Kendall
Press Contact
PR and Media Manager
Business and Law / Arts, Design & Social Sciences
rik.kendall@northumbria.ac.uk
07923 382339

Andrea Slowey
Press Contact
PR and Media Manager
Engineering and Environment / Health and Life Sciences
andrea.slowey@northumbria.ac.uk
07708 509436

Rachael Barwick
Press Contact
PR and Media Manager
rachael.barwick@northumbria.ac.uk
07377422415

James Fox
Press Contact
Student Communications Manager
james2.fox@northumbria.ac.uk

Kelly Elliott
Press Contact
PR and Media Officer
kelly2.elliott@northumbria.ac.uk



Gemma Brown
Press Contact
PR and Media Officer
gemma6.brown@northumbria.ac.uk