

# Transdisciplinary research training to address the climate and nature emergencies

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## Pockets of research excellence create skills gaps in academia and industry

Tackling the interconnected climate and nature emergencies will require a transformation of our society: how we generate and use energy, how we manufacture and dispose of products, how we produce our food. This transformation [will generate new jobs and opportunities](#) but will require innovations that span many areas of expertise and demand a holistic approach. The skills required (often dubbed 'green skills') are inherently transdisciplinary. There is a critical need for researchers and innovation leaders with the skills, aptitude and networks to work across disciplines and traditional academic/industrial boundaries to create solutions to the biggest challenges society faces.

The siloed nature of research training means that PhD students often graduate with limited experience of working with researchers from other disciplines, and often no experience of working with end-users of the knowledge they generate. While the research skills required to support these societal transformations will inevitably come from areas across the remits of the Research Councils, environmental scientists have a leading role to play in addressing the climate and nature emergencies.

We suggest that doctoral training that crosses traditional boundaries (e.g. training those looking at nature based solutions to climate change alongside those training in sustainable food production) will provide solutions-focused scientists able to network and collaborate to realise the rapid societal and technological advances needed.

There is clear evidence of rising demand for green skills. For example, [the UK Government's Energy White Paper](#) recognises skills shortage as a major challenge. [The Green Skills Taskforce 2021 report](#) explicitly suggests that funders of doctoral training programmes (such as industry and UK Research & Innovation) work with universities to ensure that the training of doctoral students enables delivery of the research, innovation and knowledge required for the UK's net zero transition, and importantly, that these skills fit locally within the region.

Wales especially has need for green skills, while also having the research capacity to make genuinely novel advances through a transdisciplinary CDT. The Primary Sector in Wales is dominated by businesses that deal with renewable energy and the natural environment (making up [11% of all companies in Wales](#) compared with 5% for the UK overall, and 85% of Wales is used for farming). Wales also [punches above its weight](#) in the quality of its research addressing the Sustainable Development Goals (which includes targets on climate change and nature conservation).

## Wales has incredible research capacity to address the climate and nature crises

The UK continues to maintain its position as the [fourth largest producer](#) of high-quality natural sciences research in the world.

Welsh environmental research is especially world leading. Welsh research on the UN Sustainable Development Goals (especially those related to the environment such as SDGs 13 Climate Action, 14 Life below Water and 15 Life on Land) is [cited more often than that of other nations](#) of the UK, the USA and European countries.

Wales is also [home to cutting-edge research facilities](#) which can provide a powerful platform for students to gain transdisciplinary research experience.

For example, two research vessels, the Prince Madog (Bangor) and the Mary Anning (Swansea) are used extensively by marine energy, aquaculture, fisheries and wildlife researchers and industry. Research farms at Aberystwyth (Trawscoed, Pwllpeiran) and Bangor (Henfaes) allow landscape-scale study and experimentation including exploration of nature-based solutions to climate change and sustainable food production.

In both the marine and terrestrial realm there are important industries where research strengths would benefit from better integration across disciplines in doctoral training and appropriate research strengths.

Marine: There is complementary research expertise between Bangor, Swansea and Cardiff Universities tackling marine energy problems from the wider oceanographic and grid perspectives (Bangor), array-scale issues (Swansea) and device-scale issues (Cardiff). Marine mammal collision risk studies are underway at Swansea and Bangor. Both aquaculture and marine fisheries are strengths at Bangor, Aberystwyth and Swansea, with focus on low-carbon food production systems through shellfish aquaculture. All have strong industrial partnerships. There is also excellent ecological and conservation science research which could be better integrated to further explore the impacts of new advances in these important industries for Wales.

Terrestrial and freshwater: Aberystwyth, Bangor and UKCEH have expertise in reducing emissions from farmland. There are also advances being made in Cardiff on how land and water management support climate change mitigation and adaptation. There is particular strength in Swansea, Bangor and UKCEH in the role of peatland and forest management in carbon sequestration. The Cardiff Water Research Institute leads in multidisciplinary catchment research. Cardiff is renowned in social science research exploring what is needed for just climate and social transformations. World-class remote-sensing research at Aberystwyth is feeding into national and policy and science. Cardiff co-leads the NERC Omics Centre which is applying cutting-edge molecular tools. Again, this expertise could be brought together to deliver the sort of transdisciplinary doctoral training we envisage.

## Research training can deliver excellence and enable our response to climate change

A regionally targeted investment in postgraduate research training with a focus on industry engagement and transdisciplinary relationships across that span the remits of the Research Councils could deliver research excellence of national and international significance, as well as ensuring the UK builds the research capacity and skills base required to achieve net zero while tackling the interconnected climate and nature emergencies.

In 2020 the Committee on Climate Change identified that [to achieve net zero there is an “ambitious” and “urgent” need](#) to address the skills gaps in many sectors of the UK economy. For example, research is needed to help advance sustainable food production and reduce agricultural emissions while capitalising on opportunities for farmers to cross into new industries. New crops are emerging which can be used as low carbon fuels, or to manufacture green materials of the future, as well as opportunities for carbon sequestration and forest restoration.

However, a [wide range of pressures](#) impact our freshwater systems which are intimately linked to the decisions made by other sectors that operate within their catchment areas. Without transdisciplinary thinking we risk losing the vital services these systems provide including water supply, renewable energy, flood management, waste disposal, fisheries and recreation.

Freshwater and coastal research share issues around recreation, fisheries, and flooding, with the addition of marine energy [poised to become a major employer](#) in coastal regions of the UK. Understanding how marine developments interact with natural ecosystems is key to sustainable development.

Creating the next generation of transdisciplinary researchers who can propose holistic solutions that span these different economic sectors is critical to the UK [maintaining its position as a scientific superpower](#), exporting its research and innovation.

Postgraduate research projects are an effective way to build industry-academic collaborations. Small businesses especially value them as it allows them to innovate in ways they would otherwise not have the capacity to do and to expand their networks. Close links between industry and academia also help researchers better target their research and reduce the time from research to implementation.

The EU-funded pan-Wales [KESS2 \(Knowledge, Economy and Skills\) programme](#) produced 645 PhD and MRes students each partnered with industry, but this programme is coming to an end in 2023. Failing to replace aspects of this programme will leave a very substantial gap in the supply of highly skilled researchers in Wales and in high-quality research output.

## About this document

This evidence submission was created in response to a NERC call for evidence in skills gaps across the UK. It was coordinated by [Sêr Cymru Low Carbon Energy and Environment Research Network Wales](#) with the help of our advisory group of professors in each of the major Welsh research institutions and industry partners. Our [advisory group of 11 members](#) represents a wide range of research areas, including agriculture, marine energy, bioprocessing, remote sensing & environmental monitoring, conservation biology and ecology. They represent sectors spanning government, research, third sector, and funding, and drew upon their expertise and strong links with industrial partners.

Our mission, as Low Carbon Energy and Environment Research Network Wales, is to support Wales' world-leading research in low carbon energy, nature-based solutions to environmental challenges, the bioeconomy, and sustainable food production. We aim to enhance and build on the excellent research capability in Wales, and to increase competitive research funding secured in Wales. Our vision is to build on the excellent research capability in Wales, partly through better networking across Welsh universities, to deliver world-leading research strength that contributes innovation internationally and economic strength domestically. We connect researchers from across different fields that are working toward goals in environmental and low carbon energy research.