

SÊR CYMRU NATIONAL RESEARCH NETWORK FOR LOW CARBON, ENERGY AND ENVIRONMENT (NRN-LCEE)

The NRN-LCEE is an ambitious, £7M collaborative endeavour funded by the Welsh Government Sêr Cymru initiative and the Higher Education Funding Council for Wales. The Network, which is initially funded until 31 December 2018, will address the *Low Carbon, Energy and Environment Grand Challenge* identified as a priority in the 'Science for Wales' strategy of the Welsh Government. Although led by the Aberystwyth-Bangor Strategic Alliance, the network is a pan-Wales initiative comprised of partners from Bangor, Aberystwyth, Swansea, Cardiff and South Wales Universities, in collaboration with the Centre for Ecology and Hydrology, Natural Resources Wales, British Geological Survey, and the UK MetOffice.

The overarching aim of the NRN-LCEE is to create a major new initiative for research into the interactions between water, provision of food and energy production. This major societal issue has been identified in the Welsh Governments' *Science for Wales* as a crucial area of research with local, regional and global relevance:

"How to integrate the sustainable use of natural resources for the provisioning of energy, water and food with the delivery of other ecosystem services".

The vision for the Network is to make Wales a world-leader in a systems-based approach to natural resource management embedded in a linked social-ecological system. This requires a new, whole-system approach to environmental science integrating research at different spatial scales, and across air-land-freshwater-marine domains. Because of the interdisciplinary and boundary-crossing structure of the network, it will directly feed policy development and implementation and will increase commercial opportunities for businesses in Wales. This strategy maps onto the emerging environmental research strategy in Wales and the ambition to explore the interfaces between research that crosses traditional boundaries amongst UK and EU funding agencies.

The NRN-LCEE will examine the opportunity, cost and the potential synergies of the delivery of different ecosystem services on land and the coastal zone. It will focus on the complex issues related to food, energy and water security. Biotechnology, biorenewables and renewable energy topics will be addressed and the research community challenged to provide relevant research in the face of environmental, societal and economic constraints on local through to global scales.

An overall aim is to increase the excellence and sustainability of research being conducted in Wales, and as such a key deliverable of the NRN-LCEE will be a significant increase in the successful securing of research funding bids from funding sources including RCUK and the EU.

Because of its boundary-crossing ambitions, and the excellence of the partner organisations, the NRN-LCEE will provide an exciting opportunity for the research community of Wales to address questions that are to date under-represented in the research portfolios of the partner organisations. The NRN-LCEE will set out to attract researchers with excellent track records working in the environmental, bioscience and energy fields. A driving ethos of the Network will be to encourage research that crosses traditional boundaries between disciplines and improves cooperation and knowledge exchange between Universities, Research Centres, industry and third sector parties.

The NRN-LCEE research will broadly address the following four main themes:

- 1. Sustainable intensification**
- 2. Low carbon energy pathways**
- 3. Developing the bio economy – social, economic and technological modelling**
- 4. Impacts and mitigation of climate change and human activity**

1. Sustainable intensification

NRN-LCEE research will address the sustainable intensification of agriculture and aquaculture with a broad objective to improve food security within environmental and spatial constraints, and with maintenance of other ecosystem services. This theme includes:

- ❖ Crop adaptation to changing environments; increased production with reduced inputs and waste; food safety and environmental impacts assessment and life-cycle assessment along the entire farm-supermarket chain.
- ❖ Mechanisms that balance food security with other ecosystem services such as maintaining biodiversity and soil functions, and the social and economic benefits related to these.
- ❖ Synergies and trade-offs between sustainable intensification of agriculture, aquaculture, and environmental services at the land/ocean interface.
- ❖ Exploitation of new technologies, such as plant-animal-microbial 'omic' technologies to deliver new solutions for sustainable and productive land and coastal use.

2. Low carbon energy pathways

This theme will address the boundaries of viability, spatial-specificity, socio-economic and environmental impacts of low carbon energy pathways from biomass, waste streams, wind and marine technology in an interdisciplinary context. This theme includes:

- ❖ Maximising energy output and minimising waste and adverse impacts of biorenewable and offshore renewable energy sources and biorefinery activities.
- ❖ Environmental sustainability, and the socio-economic viability, of energy production pathways as well as topics such as carbon sequestration.
- ❖ Life cycle assessments incorporating aspects of transport, land-use and diversification and exploring alternative pathways, using exemplars from rural sites linked to urban case studies, in order to provide objective case studies for policy and industry.
- ❖ The provision of opportunities for businesses and industries to access innovative and sustainable methodology and products developed under the NRN-LCEE.

3. Developing the bio economy – social, economic and technological modelling

This research theme addresses the significant challenges associated with building an economy based on raw materials, processes, manufacturing sites and products that impact or depend on the natural environment. This will require collaboration between all disciplines supported by the UK research councils and EU, including engineers, social scientists, biologists, environmental scientists, technologists and others. This theme includes:

- ❖ An agri-environmental focus integrating small-scale systems within constrained observational and modelling frameworks.
- ❖ Modelling and evaluation of natural resource 'stocks and flows' leading to the identification of synergies and constraints which can be used to e.g. inform both rural and urban planning.
- ❖ Provision of an evidence-base for circular bio-processing and bio-refining economies (linked closely to themes 1 and 2).

4. Impacts and mitigation of climate change and human activity

Research in this theme will investigate impacts of rapid climate change, anthropogenic pressures, and extreme events at local to regional scales on exchanges of energy and matter from catchment to coast, and between earth surface and atmosphere in the contexts of ecosystem sustainability and human health. This theme includes:

- ❖ Linking drivers and impacts within the natural resources spectrum (atmosphere-soil-freshwater-water-marine) of a biophysical system that includes anthropogenic activities.
- ❖ Determining tipping points/ thresholds, and developing predictive models for public and commercial use.
- ❖ Addressing the need to comprehensively quantify the relationships and trade-offs between UK biodiversity and the ecosystem services it supports.
- ❖ Addressing how health and social aspects of wellbeing are linked to ecosystem services, and increasing our understanding of how to account for them in decision-making.