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University of Greenwich

With its research into renewable energy, biofuels and more, the work of the University's **Bio-Energy Research Group** will have a positive effect on African countries in particular

The use of biofuels instead of fossil fuels is an important route by which to achieve major gains in the reduction of carbon emissions. Among renewable energy sources, only biofuels can be used to fuel combined heat and power (CHP) or cooling, heat and power systems (CCHP), and new technologies based on the exploitation of industrial by-products such as glycerol, food wastes, and agricultural by-products are paving a way forward to ensure food production is not compromised and renewable resources are not wasted.

CHP describes technologies that generate electricity simultaneously with useable heat in one single, highly efficient process at or close to the point of energy use. Tri-generation technologies can provide cooling as well as heat and power (CCHP).

The Bio-Energy Group at the university, led by Professor Pat Harvey, undertakes research into renewable energy, biofuels and the use of algal and non-food plant systems for CO_2 capture and the synthesis of novel chemicals. The Group has expertise in the analysis, extraction and catalysis of plant and microalgal energy reserves, and researching solutions for food and plant-based 'wastes' for energy extraction; plant growth in contaminated/degraded environments, and establishing global plant-based supply chains to meet future needs. Overseas project work includes capacity building in South Africa, Namibia and Ghana to create sustainable, non-food bio-oil and microalgal supply chains for providing CHP electricity, and in the future, the chemical feedstocks needed to replace fossil fuels.

Professor Harvey is leading on a £750,000 EU-ACP sponsored 'BioFuels Africa' project to accelerate the capacity building of biofuels technologies in Africa. This collaborative project is taking advantage of transferable breakthrough technologies in Europe and combining these with local expertise, business incentives and specific project opportunities to accelerate development of biofuel supply chains for CHP/CCHP applications that will deliver distributed energy systems to remote locations in African countries.

Anaerobic digestion (AD) is an efficient way to sustainably process heterogeneous food waste and plant by-product streams to produce bio-methane for CHP and take-up of AD in Europe is accelerating. Innovative processes are now being developed to couple biogas clean-up with microalgae cultivation in open ponds, offering the potential for simultaneous carbon recovery, energy capture, gas purification, nutrient sequestration and cleaning of AD effluent water.

Co-development of a glycerol biofuel market is predicted to stimulate and stabilise the biodiesel industry sector providing the necessary timelines to establish alternative, new sources of glycerol, ultimately the better fuel. In this regard, significant attention is now being paid to halophytic microalgae that generate up to 80% of their mass as glycerol in highly saline environments. However, industrial-scale production of glycerol from algae still needs fundamental and applied research to optimise economical ways to deliver micro-algal glycerol from saline waters. This has now become a major theme in the bio-energy research programme at the University – a project that is expected to feature as a very significant output of the ACP programme and of great importance in Namibia, where halophytic microalgae occur abundantly in salt ponds along the coastline.

Salt pond in Namibia – the red colour is attributable to Dunaliella Salina (red algae)