Enhancing plant-based solar technology for multiple-use energy and food production systems.

Supervisory team:
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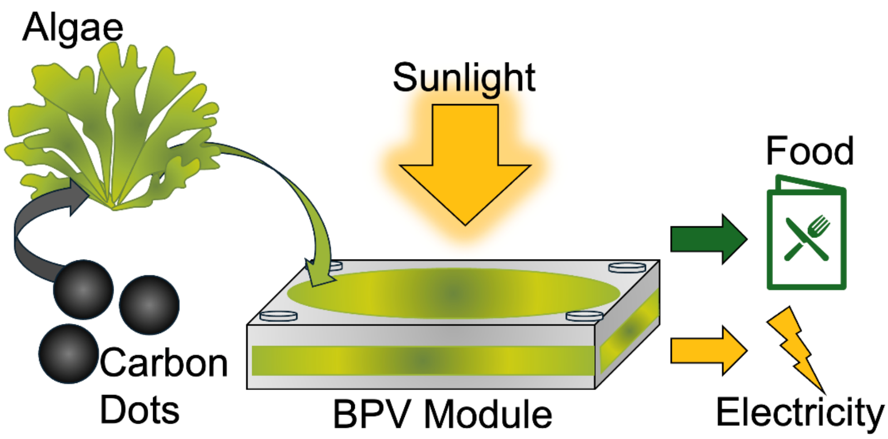
Host institution: University of Bristol

Project description:
What if you could turn a plant into an edible solar panel? This project will investigate a novel renewable energy technology that has the potential to generate electricity while enhancing food security.

Individually addressing the global challenges of food security, reliable renewable energy, and carbon capture to mitigate climate change can sometimes exacerbate the others. For example, solar farms use land that would otherwise be available for food production. Increasing renewable energy capacity also requires huge volumes of raw materials, resulting in mining biodiverse areas capable of capturing carbon.

Biophotovoltaics (BPV) might help combat these challenges. This under explored, interdisciplinary field uses photosynthesis to convert light into electrical energy, which can be 'tapped' to generate a renewable energy supply. Biomass can also be extracted from these systems, potentially converting high value land (such as that in cities) into dual-use electricity and food producing areas.



Far from harming photosynthetic organisms, BPV can reduce damage caused by high light conditions by removing excess energy from the system. This is known as photodamage, which lowers crop yields, and is predicted to become an increasing problem due to climate change.

However, current BPV systems are inefficient, both in terms of electricity and biomass production. But carbon-based nanomaterials could provide the solution. Carbon dots are biocompatible and enhance photosynthetic rates, leading to an increase in biomass and electricity production. Bristol researchers have already shown they significantly increase the photosynthetic rate in a wide range of photosynthetic organisms from algae to plants.

This project will investigate carbon dots' ability to enhance BPV production and if improvements in energy density mean scaling to multiple-use systems – where photosynthetic organisms (e.g. plants) can capture carbon, produce food and generate renewable energy – is feasible. Drawing together expertise in Life Sciences, Engineering, and Chemistry, the project will optimise this system, while building scalability and sustainability into its design.

The project would involve establishing fast evolving algal and cyanobacterial cultures to be investigated and trialled in BPV modules based on existing designs. Synthetic biology methods such as directed evolution would be used to produce strains with enhanced BPV production potential. This would be one of the potential novel adaptations that would be investigated for the feasibility for a multiple-use food-energy system to generate both useful energy and biomass.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.