Mimicking nature takes us closer than ever to the ultimate green fuel

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A group of scientists at the University of Oxford and York are taking their inspiration from plants to develop a solar fuel system, or 'artificial photosynthesis' system (APS) that is more efficient than the process that happens in leaves. The researchers will be showcasing their cutting-edge science at the Royal Society Summer Science Exhibition, which opens today.

Enough solar energy reaches the Earth in one hour to satisfy our current annual global energy demand. Despite rapid advances in solar panel technology, it is limited because we do not have an efficient way to store excess electricity (batteries can only store energy at low density). This means that solar panel power must be consumed soon after generation which is a problem in the UK where we require the most energy in winter, when it is cold and dark.

Natural photosynthesis uses the energy from the Sun to split water (H_2O) into oxygen and hydrogen. The hydrogen is then combined with carbon dioxide to produce a fuel, a chemical store of energy. The fossil fuels we rely on (oil, coal and natural gas) are the remains of ancient plants which converted solar energy into chemical energy millions of years ago. An alternative way to describe fossil fuels is therefore as 'ancient' solar energy stores.

Taking inspiration from this natural process, the group of Professor Fraser Armstrong at the University of Oxford are investigating critical elements of an idea called 'artificial photosynthesis.' They are looking

into the process of using solar energy to either (a) convert water into molecular hydrogen to yield a carbon-free fuel, or (b) turn carbon dioxide into 'organic' molecules (hydrocarbons) that can be used as a carbon-neutral fuel.

A key challenge is finding novel ways to make the fuel producing reactions happen quickly and in air so we can create a fully integrated artificial photosynthesis system that works just like a leaf: using solar energy to couple the production of oxygen (from water) with the production of fuel. Fraser Armstrong and his group believe that their research into biological catalysts (enzymes) will allow them to develop a practical, integrated model system for artificial photosynthesis because their natural molecules carry out highly selective chemistry and they do not contain precious metals like platinum. At the University of York, Dr Alison Parkin is looking more specifically at how disease-causing bacteria might be able to inspire the design of important hydrogen-producing catalysts.

Dr Rhiannon Evans of Oxford University's Department of Chemistry said: 'We are thrilled to be exhibiting our work at the Royal Society Summer Science Exhibition 2013. We look forward to sharing the fundamental research that we carry out. Learning from systems that nature has had billions of years to perfect in order to create artificial systems will in the future allow us to use sunlight to create 'clean' fuels to power the Earth. This is one of the most important scientific challenges the World must face and this is a great opportunity to showcase our progress.'

The exhibition opens to the public on Tuesday 2 July 2013.

More information: sse.royalsociety.org/2013/

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