

Resources for Renewable Energy Education

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We are entering the golden age of renewable energy. Growing concern about climate change, pollution and resource depletion has pushed the large-scale use of renewable energy sources high up the political agenda. The recent introduction of Feed-in Tariffs (FITs) is stimulating rapid growth and the creation of new jobs in the UK renewable industries. The introduction of the Renewable Heat Incentive (RHI) in April 2011 will further accelerate growth in this sector.

As a theme, renewable energy is highly interdisciplinary and an excellent way of linking together a wide range of topics in the D&T and science curricula. I had the good fortune to engage in postgraduate research in solar energy in the mid-1970s, and found it to be a fascinating field of study, covering such diverse topics as meteorology, instrumentation, heat transfer, thermal, optical and mechanical properties of materials, solid state physics, electronics, electrochemistry, optics, numerical modelling and computer programming. Colleagues working on other renewable energy technologies were applying and

developing their knowledge in aerodynamics, hydrodynamics, geophysics, statistics, chemistry, biology and agriculture.

To the uninitiated, renewable energy may seem an unexciting subject, in comparison with (say) space science or robotics, but there are numerous areas of overlap between those fields, which can be exploited to stimulate students' interest. Examples of space technologies that are being applied in the renewable sector include photovoltaic (PV) cells, fuel cells, spectrally selective coatings, and heat pipes used in evacuated tube collectors.



Curriculum resources

As with other technical subjects (such as electronics and systems and control), lack of staff training and expertise in the subject matter may deter many schools from embedding renewable energy (RE) in their curricula. However, the beauty of an interdisciplinary theme such as RE is that you can start with the topics with which you're already familiar and develop your knowledge, experience and confidence step by step.

The best RE teachers' guides with which I'm familiar are those produced by the Science Enhancement Programme (SEP) and the Centre for Alternative Technology (CAT). Their guides can be purchased either as hardcopies or downloaded as pdfs from their respective websites (see Hot Links panel for web addresses). Relevant SEP publications include 'Solar Power: Electricity from the sun', 'Wind Power', 'Biofuels' and 'Recycling and Sustainability'. Each of these excellent booklets includes ideas and suggestions, activity sheets and background science. The equipment used in the activities can be obtained from Middlesex University Teaching Resources (MUTR). More advanced practical activities and background information can be found in 'Energy – Post 16' published by the Technology Enhancement Programme (TEP).

Though much older, CAT's educational booklets include many great ideas for practical activities. CAT booklets include 'Teacher's Guides to Solar Electricity', 'Solar Water Heating', 'Wind Power and Water Power', and 'Pupil's Guides to Solar Power'. The equipment used in the activities can be obtained from either CAT's online Eco Store or MUTR. CAT also runs public courses and residentials for schools and colleges and provides INSET for teachers.

Practical Action has produced some very good digital resources on RE in developing countries, which can be downloaded from its website.



Equipment for practical activities

Commercially available equipment for use in practical activities ranges from low-cost components such as PV cells, motors, leads, turbine blades, etc., through kits and laboratory apparatus, to vocational training versions of 'real' RE systems for use in further and higher education.

Low-cost components and 'hobby' kits can be obtained from almost any supplier of science and technology equipment for schools. These are already in widespread use in primary and secondary schools, so I'm going to focus instead on some of the more interesting and less well-known products.

Though significantly more expensive than 'hobby' kits, school laboratory apparatus is usually sturdier, and easier to use and maintain. EcoStyle manufactures three well-designed sets: Wind Turbine Kit, Solar Photovoltaic Kit and Solar Water Heater Kit. Instruments Direct markets the EcoStyle kits, two fuel cell car kits and a Renewable Energy Education Set. The latter comprises a modular experiment set designed to demonstrate the workings of a complete clean energy technology system on a miniature scale. Instruments Direct is also UK distributor for h-tec – German manufacturer of beautifully crafted (and hence pricey) solar hydrogen and fuel cell education equipment.



Solar-Active has long been a vigorous advocate for embedding RE in the curriculum. It markets a range of solar education resources based on its unique flexible triple-junction PV cells (which generate significant output even under diffuse light conditions), and has also developed several portable RE demonstrations: a fully functioning solar water heating system, wind turbine and Pelton wheel. Its education resources and problem-solving approach can help schools meet new sustainability and Key Stage 3/4 curriculum targets, as well as foster enthusiasm and raise attainment in STEM subjects. Solar-Active delivers 'Energy without Batteries' school workshops that address the existing shortfall in knowledge and experience in RE technologies.

LEGO® has recently introduced its 9688 Renewable Energy Add-on Set which includes a solar PV panel, motor/generator, turbine blades, LED lights and energy meter. This is intended for use with either its 9686 Simple & Powered Machines Set or MINDSTORMS® robotics education range. Schools already using the Simple & Powered Machines Set can greatly extend its capabilities with this new RE Add-on Set, at reasonable cost. Included in the Add-on Set are building instructions for six RE activities. A separate CD-ROM details the six main RE activities and four additional problem-solving activities that enable students to explore wind, solar and hydropower. RE background science and images are included. The new LEGO® Energy Meter displays the following experimental data: input and output in volts, amps and watts, and energy storage level in joules. Any or all of these data can be logged by a LEGO® MINDSTORMS® NXT brick connected to the Meter, and used for programming or viewed in the MINDSTORMS® Education NXT Software v.2.0 data logging window on a PC or laptop. This potent combination of RE and robotics technologies enables many exciting possibilities, including sun tracking of a PV panel and automated laboratory investigations in wind, solar and water power. Building instructions and programs for two RE activities can be downloaded from the MINDSTORMS® Education website.

More advanced work in RE requires site-analysis tools and instrumentation. The Solar Pathfinder is a very effective and easy-to-use tool for solar thermal and PV site analysis. (The optional Solar Pathfinder Assistant 4.0 software automates the calculations.) Digital-Meters.com is a good source of affordable anemometers and other environmental instrumentation. Accurately calibrated solar irradiance instruments (pyranometers/solarimeters and PV reference cells) are inherently expensive; there is a need for low-cost models or alternatives for school use.



Marlec Renewable Power is a world-leading UK supplier of micro wind and solar battery charging systems for marine and other 'off-grid' applications. Marlec's 'Green Power Ed' product range comprises three kits of RE system components – Junior, Senior and Graduate – for use in secondary, further and higher education.

In Germany, where FITS were introduced in 2000, 170,000 people are now employed in the renewable sector. Christiani Technical Institute for Vocational Training has been a leading provider of distance learning and vocational training there since 1931. It markets a range of superbly engineered laboratory apparatus for vocational training in solar thermal and PV systems and ground source heat pumps.

Further ideas

Renewable Energy UK is a good source of ideas for practical RE school projects. Another way in which schools can gain practical experience with RE is to integrate such systems into their power and heating infrastructures. Substantial grants are available for professionally designed and installed systems. The British Gas 'Generation Green' programme aims to install free solar PV panels in 750 UK schools.

U4energy is a European Commission competition to promote sustainability in primary and secondary schools. It comprises three categories: energy efficiency measures at school, pedagogic actions in energy education, and ideas and actions for an awareness-raising campaign. The competition is open until May 2011.

I hope this overview will encourage you to venture more deeply into the realm of renewable energy and engage your students in this fascinating and highly topical field of endeavour.



Hot Links

British Gas Generation Green: www.generationgreen.co.uk

Centre for Alternative Technology: www.cat.org.uk

Christiani: www.christiani-tvet.com

Digital Meters: www.digital-meters.com/categories/Anemometer/

EcoStyle: www.ecostyle.co.uk

Griffin Education: www.griffin-education.co.uk

Hands On: www.handson.co.uk

h-tec: www.h-tec.com

Instruments Direct: www.inds.co.uk

Low Carbon Partnership: www.ourplanet.org.uk

Marlec Green Power Ed: www.marlec.co.uk/products/systems/green-power-ed/

Middlesex University Teaching Resources: www.mutr.co.uk

MINDSTORMS Education: www.mindstormseducation.com

Philip Harris: www.philipharris.co.uk

Practical Action: www.practicalaction.org.uk/renewable-energy-resources

Rapid: www.rapidonline.com/Educational-Products

Renewable Energy Centre: www.therenewableenergycentre.co.uk/educational-resources/

Renewable Energy UK: www.reuk.co.uk/education.htm

Science Enhancement Programme: www.sep.org.uk

Solar-Active: <http://new.solar-active.com>

Solar Pathfinder: www.solarpathfinder.com

Technology Enhancement Programme: www.tep.org.uk

TTS: www.tts-group.co.uk

U4energy: www.u4energy.eu

US Department of Energy: www.eere.energy.gov/education/

US Energy Kids: www.eia.doe.gov/kids/

