

TEACHERS NOTES (GEOGRAPHY STUDY FILES)

INTRODUCTION

Using the school as a resource for teaching about renewable energy brings academic study out of the classroom and into the real world, with all its constraints and problems and opportunities.

This resource enables students to carry out a feasibility study investigating the potential for the use of small scale renewable energy technologies to meet real small scale energy needs within the school. The resource provides either the opportunity to work with the technology department to generate real development proposals, or to base the students assessment on standard development options provided within this resource.

The resource also provides students with the opportunity to investigate siting issues on a more regional and national basis with a series of case studies looking at the development of a wind farm, a waste incinerator and a tidal barrage.

CURRICULUM TARGETS

The main curriculum areas will be within geography 'A' level projects, working either independently on a site analysis of the school, or with the technology department working on a part of the TEP energy module. In addition the project might be appropriate for 6th form General Studies courses or whole school approaches to Economic and Industrial Understanding and Environmental Education.

UNIT 1 - SITE ANALYSIS

Unit Aims

1. To investigate the effects of urban development on the microclimate of an area.
2. To investigate the microclimate of the school grounds and to decide on the best site for the location of either a solar hot water panel, or a wind generator.
3. To assess the range of opinions within the school on the renewable energy proposals.

Timing

The timing for this unit will depend on the options adopted within the school. However the basic data collection and analysis should take in the region of 5-8 hours with the more in depth environmental assessment and economic analysis taking an extra 5-8 hours.

It is important that a reasonable amount of wind/solar radiation data is collected to enable an effective assessment. Several weeks of data collection is a minimum, 1 months data would be better.

The review of the proposals could take approximately 6 hours depending on the scale of the review within the school.

Process

- Introduction to project, context, motivations, brief discussion of microclimates etc.
- Choice of whether to investigate sun or wind or both, as well as identifying which groups will do what. To get a full picture of the school grounds it will probably be necessary for each small group (no more than three to four students per group) to take responsibility for data collection within different areas around the school.
- Investigation planning. Within their groups students will need to plan their investigation. They will need to identify the information they need, how it will be collected (bearing in mind the resources they have available) and who will do what within the group. The groups should consider in advance where they think the prime sites will be, and why they think their hypothesis is valid.
- Wind speed data and solar radiation data should be collected having first established how the data will be presented.
- Having produced the collected data for analysis the groups should identify the three sites that have the greatest potential for a wind generator and the three sites with the greatest potential for a solar panel. The suggested student outcome at this stage

would be an initial site selection report, as outlined within the student sheets. How appropriate were the student's original hypotheses?

- Having collected their data, presented it, and analysed it, students should investigate the potential for utilising the power of the wind in more detail.

This level of analysis will require at least one month of wind speed data at the selected sites, preferably more.

The students will need to assess the three most promising sites already identified in terms of:

- Technical potential - the potential amount of energy that might be produced from the site.
- Economic analysis - the potential capital and running costs that might be incurred as a result of developing the site.
- Environmental Impact assessment - the potential environmental impact produced as a result of developing the site.
- These assessments should be carried out with reference to either the proposals put forward by the technology department where this option has been chosen, or the options outlined within the wind power data sheets provided.
- Groups should identify a preferred site and present their findings to the class, before obtaining feedback on the opinions of the 'local population'.
- An important stage in deciding upon the best proposal for site and technology is an assessment of local public opinion. The public in this case is the school or college population. There are a number of different ways that this may be carried out depending on the time available, the numbers of students involved etc. Details of the first two are outlined within the Student Sheet provided.

1. *Survey* - this could be carried out by way of a questionnaire which could be given to selected targeted groups e.g. some of the Governors, the staff, other students etc. The findings could then be presented as a wall display or as oral presentations. As with all questionnaires, care needs to be taken with the wording and format to guard against unnecessary bias and to make sure you get results which can be easily analysed.

2. *Display/Exhibition* - information on each of the proposals may be mounted and various groups within the school / college could be invited to evaluate them. There would need to be a carefully worded evaluation sheet to give to each person so that the findings may be easily analysed.

3. *Role Play* - a role play could take the form of a Public Enquiry carried out within the school or college. All relevant information and evidence appropriate to the particular institution should be gathered once the roles have been chosen.

The following briefing sheets can be used to support student study as required:

- Site Analysis - Planning Your Investigation
- Data Collection and Presentation
- Options Assessment - Technical Evaluation
- Options Assessment - Economic Analysis
- Options Assessment - Environmental Impact Assessment
- What Others Think About Wind Power

In addition, the Wind Power Data Sheets provided can be used to support the options assessment if necessary:

DEVELOPING THE ROLEPLAY OPTION

The role play will adapt the procedure of a Public Enquiry so that it makes sense in the context of a school or college.

A proposal for the installation of a renewable energy source within the school or college grounds is to be considered. This proposal may be the result of previous research by the students or may be based on a selection from the details provided. Each role needs to

consider the impact of the proposal, taking time to gather relevant evidence in the form of plans, figures, opinions, etc. in order to formulate and support their viewpoint. The proposal and the arguments for and against are to be presented to the Governing Body of the school or college. Each role will have their turn in presenting the evidence. It is suggested that the Governing Body is made up of people invited in for the occasion.

Suggestions about the roles, including key questions to be considered, are provided but, again, it may be preferable to allow the roles to come up with these themselves.

Suggested Follow-up

A study of a real Public Enquiry into a wind farm development could be used to draw out the way that the role play has mirrored 'real life' in terms of process and inputs. This would enable students to grasp the full relevance of what they have done rather than see it as just an academic exercise.

The Roles:

FINANCIAL MANAGER

- is it part of the job description to explore ways of raising or saving money for the school or college ?
- how convincing are the figures and arguments that fuel bills will be cut?
- how much is currently spent on heating and lighting and what % is this of the overall budget?
- has there been any other recent expenditure regarding the heating and lighting systems?
- what priorities do you have in the day to day running of the school or college?
- what are the regulations concerning contractors that can be employed?

HEAD TEACHER OR PRINCIPAL

- what are your priorities for the day to day running of the school?
- how convincing are the figures and arguments that fuel bills will be cut?

- what are the Health & Safety implications of having the installation on site?
- what measures may need to be taken to prevent vandalism ?
- does conservation and environmental education have a high profile in the school / local community ?
- would a development such as this be good for the image of the school or college?

PARENT

- is this an important educational issue?
- should the school or college be using time and resources for this or are there other more important issues?
- will it be reliable enough?
- how will my child benefit from the proposal?
- will the installation pose a risk to safety?

LOCAL RESIDENT

- will there be a noise nuisance?
- what will be the visual impact?
- is there an increased fire risk?
- will there be a lot of disruption during the construction?

TECHNOLOGY STUDENT OR TEACHER

- how could the proposal be used for educational purposes?
- what are the range of options available?
- how do you evaluate the options?
- how reliable are they likely to be?
- how reliable are the estimated costs?

PE STUDENT OR TEACHER

- how much space is the proposal to take up?
- will there be restrictions on the activities to be carried out in the vicinity of the proposal?
- would it pose a danger?
- will it be distracting in any way e.g. noise?

CONSERVATIONIST

- what are the implications for the environment of the construction process?
- does the proposed site have any other conservation value?
- will there be a noise nuisance?
- what will be the visual impact?
- are there better alternatives to the proposal?
- do the benefits outweigh the costs?

RESOURCES

Copies of the student sheets - at least one per group, one per student would be preferable.

Large scale maps of the school, including the grounds - at least one per group plus some spare copies.

A selection of weather instruments for making data measurements. Exact requirements will depend on what the individual groups decide to do but at the very least a selection of thermometers, solarimeters if available, and instruments to measure wind speed and direction will be required. Solarimeters will measure solar radiation as opposed to air temperature, an important distinction. They are relatively straightforward to make; contact your technology department. Unit 1 outlines how to construct both a solarimeter and an anemometer. Alternatively you could try borrowing instruments from your local university or college. There are also sources for relatively cheap instruments in the documentation for Unit 1 in the technology unit.

Further Information

A useful overview of the urban microclimate can be found in Knapp B "Systematic Geography", publ. Allen and Unwin, London (1986) - chapter 6 'Man-made climates'.

A more detailed discussion of individual processes can be found in Monteith, JL and Unsworth, M H "Principles of Environmental Physics" publ Edward Arnold London (1990)

For background information on renewable energy see Flood M. "Energy Without End" FOE (1990)

An outline of the Government's policies for local authorities on planning for renewable energy developments can be found in Dept. of Environment 'Planning Policy Guidance Note 22: Renewable Energy' HMSO (1993) £4

The Renewable Energy Enquiries Bureau, ETSU, Harwell, Oxfordshire OX11 0RA, produces a useful free periodical called 'Review'.

Some useful case study material can be found in 'Making Use of Renewable Energy' produced by the Science with Technology Project and published by the Association for Science Education 1995 at £9.50.

UNIT 2 - NATIONAL RENEWABLE ENERGY POLICY

Unit Aims

- 1 To investigate the major types of renewable energy potentially available in the UK.
- 2 To provide students with an understanding of the issues involved in siting renewable energy projects.
- 3 To consider the above within the context of current Government policy on renewable energy.

Timing

Each major task might involve 5 or 6 hours of contact time plus students self directed study time as required.

Process

Detailed case studies involving three types of renewable energy have been provided:

- the wind farm at Delabole in Cornwall
- the proposed tidal power barrage in the Severn Estuary
- proposed waste incinerator, sited in a fictional area but based on real data.

For each of these case studies a range of resources have been provided which cover facts and differing viewpoints relating to them. Student Tasks have also been provided and may be tackled using the information provided.

The case studies outline activities that consider the impact of these different renewable energy options, both at the site level and within the context of overall energy policy.

All the information for the waste incinerator and the wind farm siting exercises is provided within the resources, the policy exercises and the tidal power case study require the students to carry out some research. However the amount carried out depends on the depth of study required.

This differing emphasis on student research can be used to suit different needs in terms of teaching style or student interest. The Tasks may be carried out collaboratively or as individual pieces of work, and could be presented in written form or as an oral or visual presentation.

There is a choice of ways to use this Unit depending upon the time available and the curriculum requirements:

- Each case study has been designed to 'stand alone' and so it is possible to select just one for the whole group to study.
- The case studies have also been designed to require approx. the same amount of time and input so that if desired the group could be sub-divided in order to cover different options. Each smaller sub-group could then report back in a plenary session so giving all students an overview of all three options.

There are three main stages to the unit:

- *Introduction to unit* *1 hour*
- *Three case studies* *5-6 hours each*
- *Report back in plenary discussion as appropriate* *1-2 hours*

Introduction to Unit

Links need to be made between the approach adopted when looking at the school and the need to carry out a similar approach with larger scale projects.

If the earlier units have not been done then emphasis needs to be placed on the need for rigorous evaluation of environmental, economic, social and technical issues when considering any new energy project. There is no totally benign energy source when considering large scale energy developments to meet our currently large energy demand. There is however a need to try to identify and prioritise the potential impacts of any new energy project to aid the development, implementation and evaluation of any rational energy policy.

The generating options comparison chart provided outlines some features of a range of energy options. Ask the students to consider the chart and either in groups or individually, list the main issues that they think would be of importance for each option when considering a proposal for a new energy development. Their lists would obviously go beyond the issues outlined within the comparison chart.

Consider the issues raised as a class. Is it possible at this stage for students to begin to prioritise these issues?

ELECTRICITY GENERATING OPTIONS COMPARED

	Wind Farm	Municipal Waste Incinerator with energy recovery	Severn Barrage	Large coal fired power	UK electricity 1992
Typical capacity	2.5 MW	32 MW (electric) 50 MW (heat)	7200 MW	1200 MW	66,110 MW
Typical annual output	20 GWh	200 GWh (electric) 370 GWh (heat)	13,000 GWh	8,400 GWh	322,132 GWh
Sufficient to supply electricity for number of homes	4700	47,000 (electric) 7500 (heat)	3 million	2 million	22 million homes plus industry and commerce
Carbon dioxide emissions per KWh per year	0	0.47 kg per KWh of heat and electricity	0	1.3 kg	0.72 kg
Total carbon dioxide emissions	0	268,000 tonnes	0	11 million tonnes	198 million tonnes

One MegaWatt (MW) = 1000 kiloWatts (kW) These are measures of power. A one bar electric fire needs 1 kW of electrical power. One GigaWatt hour (GWh) = One thousand MegaWatt hours (MWh) = One million kiloWatt hours (kWh) These are units of energy consumption. A one bar fire (one kiloWatt) being used for one hour will consume one kWh of electrical energy.

Report Back and Discussion

Presentations should not be more than 10 minutes each and should give the groups an opportunity to outline their findings and their conclusions. Time should be allowed for questioning of the groups following their presentations.

The following discussion however should focus the students thoughts about the role of renewable energy within a future energy policy, including the constraints and opportunities that might exist. How does energy efficiency fit into energy policy development? What about nuclear power?

DETAILED CASE STUDY INVESTIGATIONS

**Power from the Wind
Windfarm Siting**

Task
Is visual intrusion the major concern for windfarm developments?

- Filling out chart
- Short report

Resources

- Summary of the Environmental Impact Statement
- Attitude survey of local population
- Maps of site
- Scale drawings of wind turbines
- News cuttings



National Policy

Task
Report on impact of windfarms within designated landscapes

Resources

- Government policy briefing sheet
- Map of UK wind speeds and designated areas



**Power from Waste
Waste Incinerator Siting**

Task
To identify the pros and cons of three potential sites for a waste incinerator

Resources

- Technical specification for proposed incinerator
- Guidance for siting incinerators
- Map of Burfield area
- Three detailed siting maps



Regional Policy

Task
To develop a strategy for waste disposal in Burfield over a 15 year period

Resources

- Breakdown of currently active landfill sites in Burfield
- Newspaper cuttings
- Article on landfill gas



Tidal Power

Task
To produce a report for government officials on whether or not the Severn Barrage should go ahead

Resources

- Information sheets on the Severn Barrage
- Newspaper cuttings



RESOURCES

Renewable Sources of Electricity in the SWEB Area. SWEB/ETSU 1993
Warmer Bulletin plus series of good fact sheets on waste - provided by return of post. Warmer Campaign
Severn Barrage Information Bulletins. DTI/ETSU
Attitudes Towards Wind Power - A Survey of Opinion in Cornwall and Devon. ETSU 1993
Where the Wind Blows. Centre for Alternative Technology. 1993

ORGANISATIONS

Renewable Energy Enquiries Bureau

Energy Technology Support Unit (ETSU), Building 156, Harwell
Laboratory
Oxfordshire, OX11 0RA. Tel: 01235 432450

Warmer Campaign

83 Mount Ephraim, Tunbridge Wells, Kent, TN4 8BS.
Tel: 01892 524626

Centre for Alternative Technology

Machynlleth, Powys, SY20 9AZ. Tel: 01654 702400

Friends of the Earth

26-28 Underwood Street, London, N1 7JQ. Tel: 0171 490 155

Severn Tidal Power Group

Balfour Beatty Ltd, Marlowe House, Station Road, Sidcup, Kent,
DA15 7AU
Tel: 0181 300 3355

British Wind Energy Association

4 Hamilton Place, London, W1V 0BQ. Tel: 01753 882447

RSPB

The Lodge, Sandy, Bedfordshire, SG12 2DL. Tel: 01767 680551

South West Electricity plc (SWEB)

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