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Energy Data Sheets

Cliff Day, who compiled the Energy Data Sheets, first became interested in teaching about alternative energy sources when he was at Glen Eyre School, Southampton. He developed a special interest in solar energy and many of his pupils were caught up in project work which was entered successfully in local competitions and found an important place in exhibitions of school work.

His development work soon became well known to local teachers and to the Department of Education at the University of Southampton where, in 1978, he took up a Hartley Research Studentship, for two years full-time, to refine and develop the materials already available and to extend his study to other sources of energy.

The Purposes of the Energy Data Sheets

As teachers, who are involved in teaching the applications of science, extending the work of craft, design and technology or in encouraging project work, will know, it is extremely useful to have relevant data collected under one cover, presented attractively and provided in an orderly way. This has been achieved.

The purposes of the book are to encourage: the study of alternative energy sources especially in the light of the 1973-74 energy crisis; the investigation of ways of conserving the energy we have through such things as thermal insulation and the redesign of machinery to improve energy conservation efficiency; the use of data and information derived from books, journals and reports in decision making.

At the end of the day it is hoped that the Energy Data Sheets will aid the inclusion of such material into schools' curricula generally, taking young people out of the classroom and laboratory to carry out experiments using sunshine and wind as energy sources. Hopefully, too, teachers, parents and others may find the publication useful when planning ways of saving energy in the home or at work, or when discussing economies on a larger scale.

Contents

The Contents are presented under the main headings

Energy Use
Sunshine, its distribution and collection
Heat, thermal losses and collector performance
Solar panels, efficiency and construction
Water heating, system design and operation
Windpower, its distribution and collection

Each section is illustrated liberally with clear well drawn line diagrams and includes a wealth of valuable and carefully selected data.

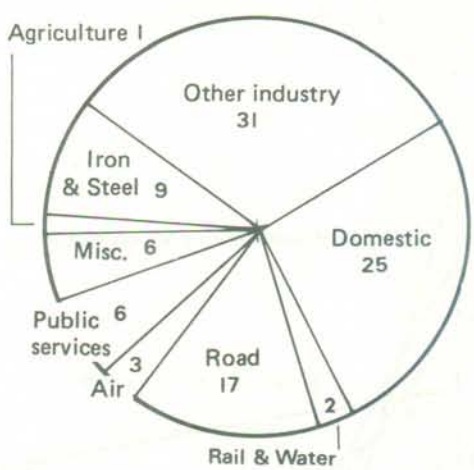
A good book list, a set of references and conversion factors are provided at the front of the book.

Energy Use

The increasing energy demand worldwide is illustrated graphically. The total United Kingdom energy use, the proportions of the different fuels used and where the energy was applied in 1976 are provided.

WHERE WAS THIS ENERGY APPLIED

We have seen what fuels provided our energy during 1976, and we have seen what proportion we used of each of them in our various roles as worker, traveller, etc. Now let us look at how much of that total energy bill went to various sectors. This chart shows the total energy 'cake' split into users – industry, agriculture, etc. A number of interesting facts emerge from it; for example the small size of our total energy requirement represented by aircraft (one thirtieth!), even though we think of planes as supremely greedy guzzlers of fuel. Similarly, the large proportion of our total energy need that is



burnt in the home means that it is genuinely important in the national interest that we should all minimise the energy – heating, lighting, etc. – that we use at home (it also saves money!).

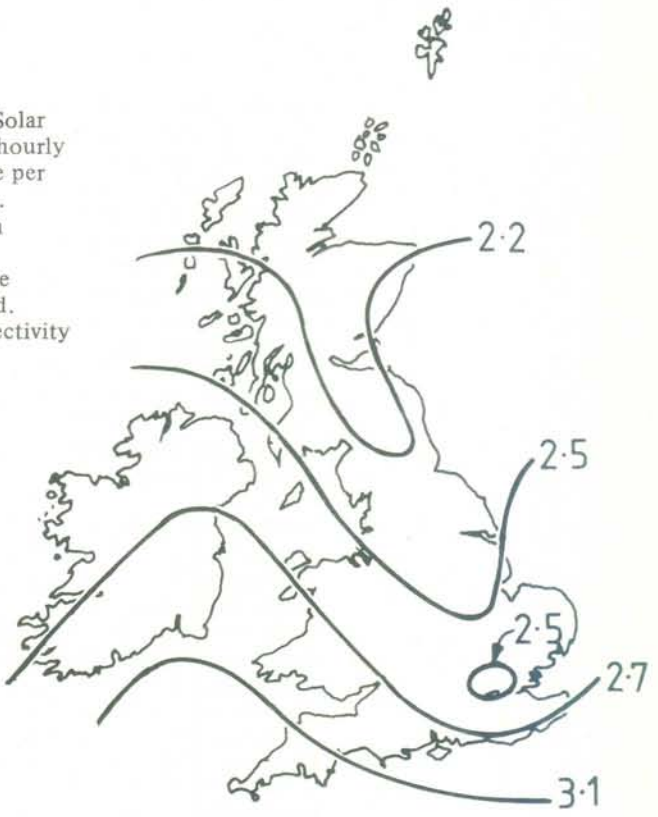
In 1979/80 the total energy used per person in the U.K. was roughly equivalent to 5 tonnes of coal or 100 50kg bags. This fact gives a simple way of interpreting the lower chart; e.g. Each person uses 25% of their energy, or 25 bags of coal equivalent at home; and so on.

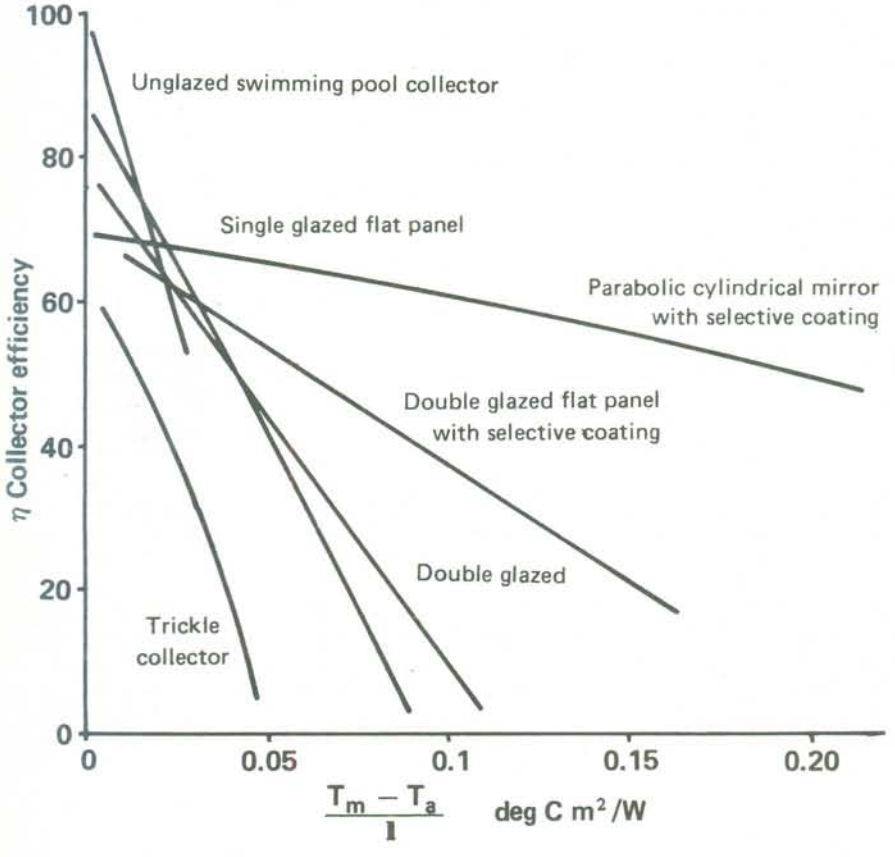
The known world distribution of oil is included together with possible U.K. ongoing energy plans based on high growth and low growth futures. The production energy requirements (kWh/kg) e.g. for steel, titanium, cement, are listed as are transport energy requirements for 'people' and 'freight'.

Sunshine

The solar system is presented graphically. Solar power densities, average weather records and hourly distribution of sunshine, solar energy available per day and annual mean solar radiation are given.

Spectral transmission and its variation with incident angle are included and a table of absorptance and emmittance for a whole range of substances and types of surfaces is provided. Several pages are devoted to the sunpath, reflectivity of materials and collectors of solar energy.

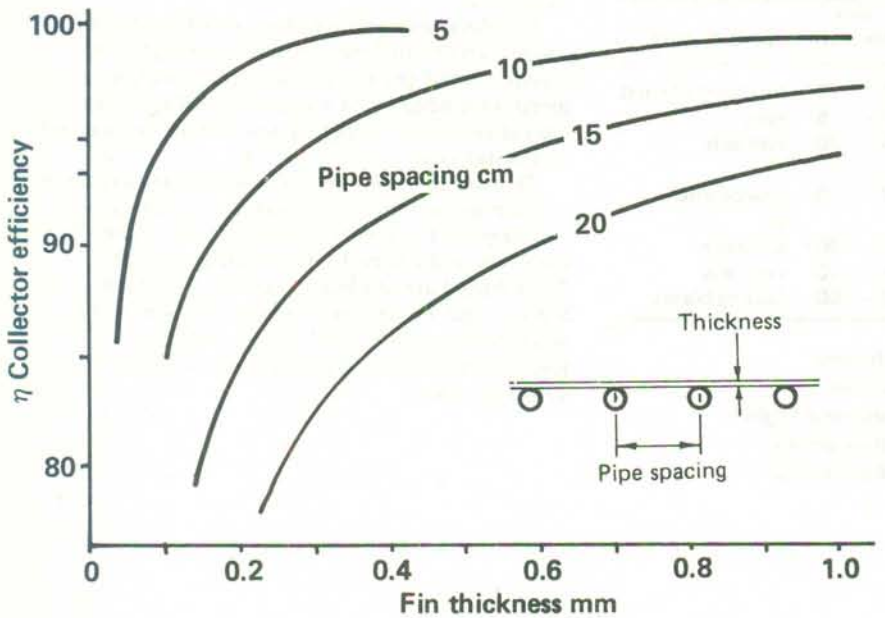




Heat

This section begins with a list of 'U' factors with an explanation of their use in calculating such things as heat losses from buildings made from varying materials. Other physical properties of building materials are tabulated which enable some interesting comparisons to be made.

Solar collector characteristics and the relevance of the 'U' factors are shown and finally the effect of wind and insolation are illustrated.

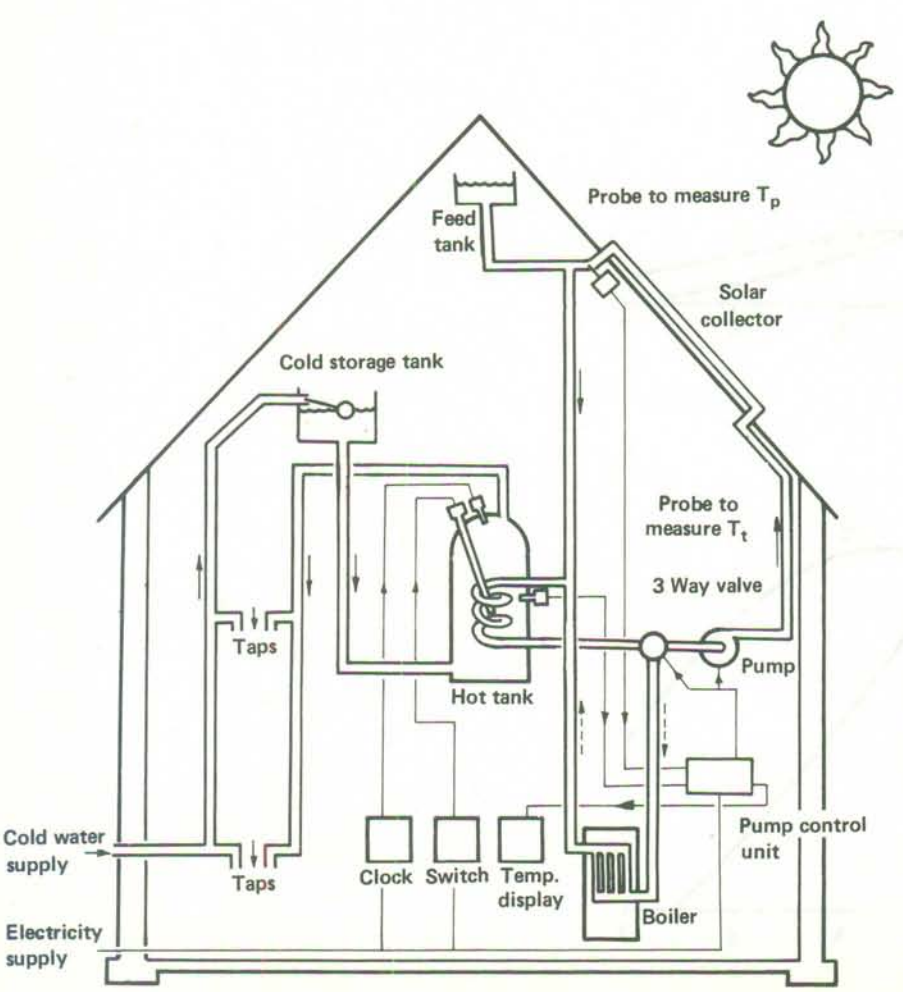


Solar panels

Various types of solar collectors are illustrated and collector efficiency is realted to fin thickness for different pipe spacings.

A reasonable compromise would be 26 swg copper sheet and 15 cm pipe spacing, yielding 93% efficiency. These results assume very good fixing of the pipes onto the plate, by soldering or brazing. Look at Figure 4,1,4, before designing a pipe layout.

The importance of connector.positions and the methods used for the interconnection of panels is explained.

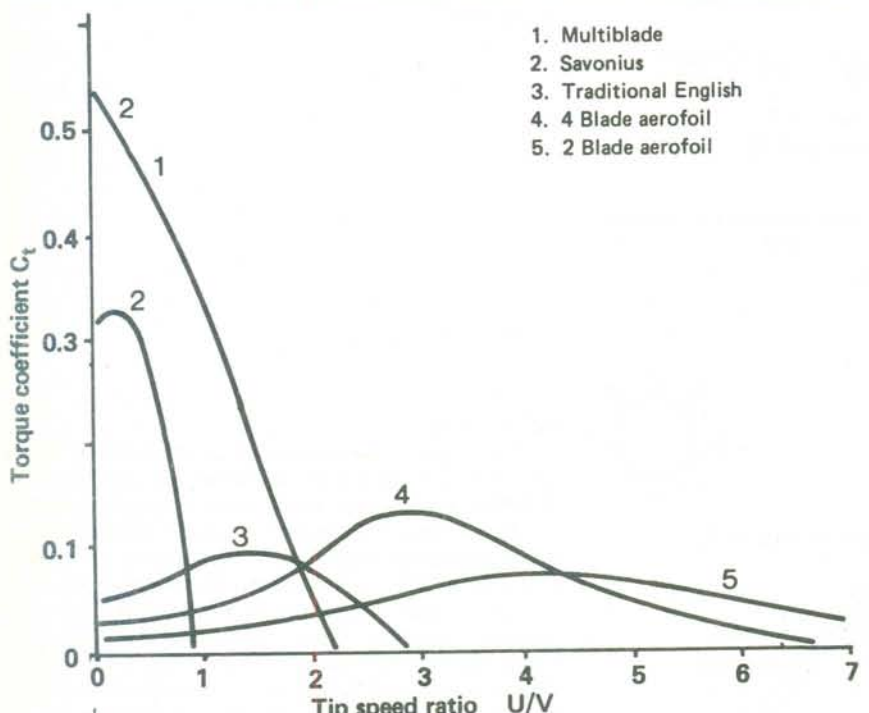


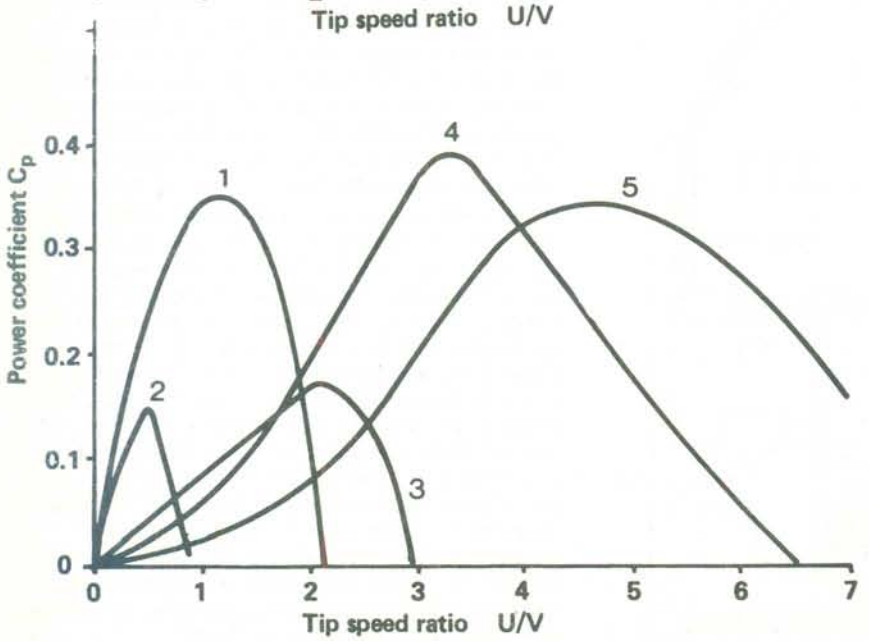
Water Heating

Direct and indirect water systems and their uses are described and local water authority regulations, effects of hardness of water and protection against burst systems due to frost damage are touched on. A comparatively large part of this section is devoted to the installation for domestic water systems.

The diagram shows how to modify a typical pre-solar domestic system. A hot tank and cold storage tank are assumed to exist, heated by an electric immersion heater or by a combination of immersion heater and central heating boiler. Whatever the basis, this modified system requires user participation. A display of water temperature is provided near to the immersion heater switches, which should ideally be prominently displayed in one of the main living rooms. To boost the solar heated or boiler heated water, up to about 50° – 55°C a dual immersion heater is installed. This contains 2 elements, 1 long, 1 short. The short element heats a small volume of water near the top of the tank and could be controlled with a time-switch and tank thermostat at times of the year when solar heat is inadequate. The long element for heating the whole tank for wash-day or a bath would be switched by the householder, if the desired temperature was considered too low and then controlled by a tank thermostat. The three-way valve isolates the boiler circuit from the solar collector circuit, ensuring that when one operates the other cannot, thus for instance stopping boiler heated water from heating the solar collected at night! Hot tanks can be purchased with two separate heat exchanger coils, so enabling separate heating circuits to be built.

Ref	Type	Efficiency	Starting Torque	Speed	Size (metres)	Speed Control
1	Multiblade	high	high	low	1 – 10	turns out of wind
2	Savonius	low-medium	high	low	0 – 5	none
3	traditional English	low-medium	medium	medium	5 – 20	reef sails
4	aerofoil 4-blade	high	low	high	2 – 10	change pitch or
5	aerofoil 2-blade	high	very low	high	2 – 100	air brake
6	Cretan	low-medium	high	low	1 – 10	reef sails
7	Musgrove	high	low	high	2 – 100	folding blades





Wind Power

This final section includes a short treatment of power extraction from the wind, average wind speeds around the British Isles, the variation of wind speed with height and a sample set of readings for the collection of energy by a windmill throughout a calendar year.

The whole book concludes with some drawings of different windmills and some data for each.

Energy Data Sheets assembled and written by Cliff Day and edited by Peter Richmond and Terry Floyd are available from the *Southern Science and Technology Forum, The University, Southampton, SO9 5NH*, £2.50 per copy. Reductions for multiple orders e.g. 10 or over, £2.00 per copy.