

Energy sources

There are five ultimate primary sources of useful energy:

1 The Sun.

2 The motion and gravitational potential of the Sun, Moon and Earth.

3 Geothermal energy from cooling, chemical reactions and radioactive decay in the Earth.

4 Human-induced nuclear reactions. 5 Chemical reactions from mineral sources.

Renewable energy derives continuously from sources 1, 2 and 3 (aquifers). Finite energy derives from sources 1 (fossil fuels), 3 (hot rocks), 4 and 5. The sources of most significance for global energy supplies are 1 and 4. The fifth category is relatively minor, but useful for primary batteries, e.g. dry cells.

Environmental energy

The flows of energy passing continuously as renewable energy through the Earth. For instance, total solar flux absorbed at sea level is about 12×10^{17} W.

Thus the solar flux reaching the Earth's surface is ~ 20 MW per person; 20 MW is the power of ten very large

Storage after energy transformation, e.g. battery charging or hydrogen production, is also possible and may become increasingly important especially in small systems. Thermal storage is already common.

3 Load control. Parallel arrangements of end-uses may be switched and controlled so as to present optimum total load to the supply. An example of a microhydro load controller for household power is shown in Figure 1.5(c) (see also Section 8.6). The principle may be applied on a small or large scale, but is perhaps most advantageous when many varied end-uses are available locally. There are considerable advantages if load control is applied to renewable energy systems:

a No environmental energy need be wasted if parallel outputs are opened and closed to take whatever input energy flow is available. Likewise, the capital-intensive equipment is well used. b Priorities and requirements for different types of end-use can be incorporated in many varied control modes (e.g. low priority uses can receive energy at low cost, provided that they can be switched off by feed forward control; electrical resistive heaters may receive variable voltage and hence variable power). c End-uses having storage capability (e.g. thermal capacity of water heating and building space conditioning) can be switched to give the benefits of storage in the system at no extra cost. d Electronic and microprocessor-based control may be used with benefits of low cost, reliability, and extremely fast and accurate operation.