MACMILLAN DICTIONARY OF

ENERGY

GENERAL EDITOR
MALCOLM SLESSER

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Introduction

Energy pervades every aspect of modern society. Following the energy crisis of 1973, the word energy was used by almost everyone from technologists through to politicians. New words were generated, old words misused and a lot of loose thinking unleashed. As the world wrestles with a multitude of solutions to the problems of energy supply and energy costs, with antagonism to nuclear energy, with proposals for renewable energies, the range and breadth of terms used within the energy context has become wider and wider. It had become obvious that there was a need for an inter-disciplinary dictionary of energy. This is it. It covers fuel technology, science, economics, the built environment, the external environment, renewable and alternative energies, energy transformation, biology, fossil and nuclear fuel and fuel treatment.

The problem with written language is that there is a limited number of words available but there is an unlimited number of concepts and descriptions. One discipline borrows a word from another, and in the process may subtly change its meaning, extending it into an arena which renders it obscure. For example, most of us know what we mean by elasticity. It suggests stretchability, and we can imagine stretching things like catapults, corsets, car tyres and fan belts. The economists have adopted this word to suggest just such a phenomenon of how people respond to price changes. It is, if you like, the stretchability of our purses in the face of the change in price of a commodity. What better word could they pick, yet its meaning is not immediately obvious. This dictionary will explain to the non-economist in adequately simple language what is meant by the economic concept of elasticity, and go on, I am afraid, to use it frequently.

A cross-disciplinary dictionary cannot be all things to all men. It would not be useful to provide definitions of terms in nuclear engineering which could only be understood by nuclear engineers and physicists, or in economics which could only be understood by economists. There are a number of excellent definitive works to serve the experts in their own fields. This dictionary aims to provide information for intelligent people searching for concepts, ideas, definitions and explanations in areas outside that of their own expertise. Thus a definition in a technical area may not wholly satisfy an expert in that area. As editor, it has been my task to judge just how far a definition has to be precise in order to be adequately accurate, yet straightforward enough to be understood by the non-expert. There is, therefore, compromise between accuracy and simplicity. I cannot fail to be criticized. Some of it will be merited, and let us hope that it may serve to produce an even better second edition.

The dictionary is not just for experts outside their own field. I hope it will help those who claim no expertise at all but seek information in a brief, lucid and succinct form. Thus I hope it will serve the student, the businessman, the sociologist, the politician; that it will find its way into public libraries, and that the general reader will consult it to clear up points that arise in his daily work and conversation.

A fascinating aspect of editing such a dictionary is to find the extent to which some disciplines have borrowed words from others for their own needs. Thus efficiency means quite different things to the economist and the scientist. Absorption connotes quite different processes to a chemist and a nuclear engineer. Cross-section is adapted to express a very neat concept by the nuclear engineer, while the economist does the same with elasticity. Equally fascinating is the way that identical concepts are differently named in different disciplines. Calorific value to a fuel technologist is enthalpy to a chemist and combustion energy to others. It is dispiriting to find these differences between allied sciences, but it is no more than a recognition that disciplines retain their own boundaries, in spite of attempts at unification, such as the SI (Système International) system of units now used by virtually all European schoolchildren for whom the Btu or the calorie are museum pieces. It is also dispiriting to find that in spite of international solidarity among scientists, there still exist minor differences in the definition of such fundamental scientific units as a joule of energy – the ultimate unit of definition. Some conversion tables show 4.184, and others 4.187 joules per calorie. Both are correct, depending on whether you hearken to the international joule or the absolute joule. The error is too small to be measurable in the affairs of nations or firms, but could be a factor in scientific experimentation.

There are many terms in this dictionary which do not have obvious energy connotations. They appear here because they represent concepts or terms essential to understanding all the various aspects of energy. Indeed, a dictionary which included only terms including the word energy would be brief but lamentably inadequate. Consider energy as the inside doll in a set of Russian dolls, as one might, mathematically, consider a set within a set within a set and so on. Energy is the inside doll or set. It pertains to many things within the larger set, which in turn may need explanation by recourse to an even larger set of terms.

There are omissions, some deliberate, some accidental. Words that could be found in a standard English language dictionary are omitted, unless they have a special energy connotation. For example, one can find the term energy in every such dictionary, where it will be described along the lines 'power of doing work'. That is a pretty good succinct definition, but not enough to understand all that needs to be understood about energy and work, and begs the question of what is meant by power. In the ever-expanding set of Russian dolls that comprise an inter-disciplinary dictionary one must call a halt somewhere. It is arbitrary. I admit that. Nevertheless I believe this is the most comprehensive energy dictionary ever produced. It is, however, a dictionary and not an encyclopedia. The first part of each definition is intended to be elementary. Often a second part goes into more detail. Sometimes a diagram is inserted to assist understanding. There are some long entries: in particular, that of nuclear reactors. To have described each reactor individually and unambiguously would have required enormous repetition and constant referral to other terms in the dictionary. The manner of presentation allows the reader to go from the simple to more complex, gathering his or her impression of this or that type of reactor in increasing depth, with each reactor type given its own unique space.

Units. A considerable problem for anyone entering another discipline is to have a feel for the units used. If somebody tells you the cost of something in Japanese yen, and you've never been to Japan and don't know the rate of exchange, the information is meaningless. The dictionary has decided to reduce all terms to those proposed under the Système International d'Unités – the International System of Units (SI). A barrel – a measure used in the oil industry – is related to litres. Temperature is expressed in Kelvin, which relates to the degree centigrade. The standard unit of length is the metre. Nevertheless all the old favourites are listed, and a conversion table provides a means of arriving at a numerical answer if that is wished for. Similarly, but without the benefit of an international convention, the US dollar has been chosen as the unit of money throughout.

Finally, an inter-disciplinary dictionary should be international. Though foreign terms are not listed, many institutions in many countries are included.

MALCOLM SLESSER
Dunblane, February 1982

Acknowledgements

The dictionary is the work of five advisory editors, and two specialists who have selected the entries and formed the definitions. Their names are listed on the title page. However, special thanks must go to those who typed the entries, read them to ascertain their comprehensibility, and helped with the unrewarding task of filing, noting, sorting and annotating. In particular, I should like to thank Mrs Evelyn Smith and Mrs Ann Lawson of the Energy Studies Unit, University of Strathclyde, and my wife, Janet Slesser.

Accreditation

Accreditation is noted at the end of each entry by initials, indicating the writer. Thus:

MS	Malcolm Slesser
TM	Thomas Maver
JWT	John Twidell
DB	Donald Bennet
CL	Christopher Lewis
PH	Patricia Howell
WG	William Gibb
MC	Mick Common

Conversion Tables

Table 1: energy, heat, work
To convert horizontal row into vertical column multiply by

Units	electron-volt	joule	calorie	Btu	kWh	thermie	*TCE	*TOE	quad
electronvolt	1	6.24×10^{8}	—	—	—	—	—	—	
joule	—	1	4.184	1055	3.6×10^{6}	4.184×10^{6}	30×10^{9}	44×10^{9}	1.055×10^{18}
calorie	—	0.239	1	252.5	—	10^{6}	7.17×10^{9}	10.52×10^{9}	2.525×10^{17}
Btu	—	9.48×10^{-4}	3.96×10^{-3}	1	3412	3.96×10^{3}	2.85×10^{7}	4.17×10^{7}	10^{15}
kWh	—	2.78×10^{-7}	6.64×10^{-8}	2.93×10^{-4}	1	1.163	8.34×10^{3}	1.22×10^{4}	2.93×10^{12}
thermie	—	2.39×10^{-7}	1×10^{-6}	2.52×10^{-5}		1	1.25×10^{5}	1.84×10^{5}	2.525×10^{11}
*TCE	—	3.33×10^{-11}	7.96×10^{-12}	3.51×10^{-8}	1.198×10^{-4}	7.96×10^{-6}	1	1.467	3.51×10^{7}
*TOE	—	2.27×10^{-11}	5.43×10^{-12}	2.39×10^{-8}	8.174×10^{-5}	5.43×10^{-6}	0.68	1	2.39×10^{7}
quad	—	9.479×10^{-19}	3.96×10^{-18}	10^{-15}	3.41×10^{-13}	3.96×10^{-12}	2.85×10^{-8}	4.184×10^{-10}	1

*Assume TCE = 30×10^{9} J or 30 GJ/tonne
TOE = 44×10^{9} J or 44 GJ/tonne

Table 2: power
To convert horizontal row into vertical column multiply by

Units	watt	calories per sec.	Btu/hour	kilowatts	horsepower	terajoule/y	*TCE/y
watt	1	4.184	.293	1000	746.3	3.175	952.3
calories/sec	.239	1	4.20	2.23×10^{2}	178.1	758.7	227.8
Btu/hour	3.413	.238	1	3412	2545	1.082×10^{5}	3246×7
kilowatts	10^{-3}	4.48×10^{-3}	2.93×10^{-4}	1	.746	3.17×10^{-2}	.952
horsepower	1.34×10^{-3}	5.615×10^{-3}	3.93×10^{-4}	1.34	1	42.5	1.27
terajoule/year	3.156×10^{-5}	1.318×10^{-3}	9.24×10^{-6}	3.156×10^{-2}	2.35×10^{-2}	1	.03
*TCE/y	1.05×10^{-3}	4.39×10^{-3}	3.08×10^{-4}	1.05	0.784	33.3	1

*Assume 1 TCE = 30×10^{9} joules

How to use the dictionary

1. The dictionary is not in sections but in alphabetical order.
2. Acronyms and abbreviations are not listed in the dictionary but in the list of acronyms on pages x–xii. This will lead to the correct entry location. Thus Btu stands for British thermal unit, which is listed in the dictionary under British.
3. Institutions are listed within their appropriate place in the dictionary. Those with abbreviations are listed on pages x–xii.
4. Scientific notation is not used – see note below on units.
5. A brief list of symbols is given below.
6. Conversion tables for energy and power units are given opposite.

Units and symbols

°C	degrees centigrade
cal	calorie
eV	electron-volt
g	gram, gramme
h	hour
ha	hectare
J	joule
K	kelvin
kW	kilowatt
m	metre
N	newton
s	second
W	watt

Multiples

k	kilo	10^3
M	mega	10^6
G	giga	10^9
T	tera	10^{12}
P	peta	10^{15}

Submultiples

m	milli	10^{-3}
µ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}

Combination units

Scientific notation is *not* employed. Thus joules of heat passing a square metre of surface per second (energy flux) is shown as $J/m^2.s$ not, as in scientific notation $J.m^{-2}.s^{-1}$.

List of Acronyms

ACRS	Advisory Committee on Reactor Safeguards
AEE	Atomic Energy Establishment, Winfrith
AERE	Atomic Energy Research Establishment, Harwell
ANS	American Nuclear Society
API	American Petroleum Institute
ASTM	American Society for Testing Materials
Avgas	aviation gasoline
Avtag	aviation turbine gasoline
Avtur	aviation turbine kerosene
BIS	Bank for International Settlements
BNES	British Nuclear Energy Society
BNF	British Nuclear Forum
BNFS	British Nuclear Fuels Limited
BOD	biological oxygen demand
BSI	British Standards Institution
BTU/Btu	British Thermal Unit
CEA	Commissariat a l'Energie Atomique
CEGB	Central Electricity Generating Board
CHU	centigrade heat unit
CIBS	Chartered Institution of Building Services
cif	cost insurance freight
CNEN	Comitato Nazionale per l'Energia Nucleare
COMECON	Council for Mutual Economic Assistance
DAF	dry, ash-free
DCE	domestic credit expansion
DERV	diesel engined road vehicle
dmmf	dry, mineral-matter free
DNA	deoxyribonucleic acid
DOE (UK)	Department of Energy (UK)
DOE (US)	Department of Energy (US)
EEC	European Economic Community
EFTA	European Free Trade Association
EMS	European Monetary System
EPA	Environmental Protection Agency
ETSU	Energy Technology Support Unit of UK Department of Energy
ERSU	Energy Research Support Unit of Scientific and Engineering Research Council
FAO	Food and Agriculture Organization
FBP	final boiling point
fob	free on board
FOE	Friends of the Earth
GATT	General Agreement on Tariffs and Trade

GCV	gross calorific value
GDP	gross domestic product
GNP	gross national product
hex	uranium hexafluoride
HLW	High Level Waste *see* Management of High Level Waste
HP	Horsepower
IAEA	International Atomic Energy Authority
IBRD	International Bank for Reconstruction and Development
ICRP	International Commission on Radiological Protection
IEA	International Energy Agency
IEJE	Institut Economique et Juridique de l'Energie
IFIAS	International Federation of Institutes of Advanced Study
IIASA	International Institute for Applied Systems Analysis
IMF	International Monetary Fund
INFCE	International Nuclear Fuel Cycle Evaluation
I.Nuc.E	Institute of Nuclear Engineers
kg	kilogram
kWh	kilowatt-hour
LDF	light distillate feedstock
LNG	liquefied natural gas
LOCA	loss of coolant accident
LPG	liquefied petroleum gas
MJ	megajoule
MPC	maximum permissible concentration
MPD	maximum permissible dose
MPL	maximum permissible level
MUF	materials unaccounted for
NCV	net calorific value
NEA	Nuclear Energy Agency
NII	Nuclear Installations Inspectorate
NNPT	Nuclear Non-proliferation Treaty
NRPB	Nuclear Radiological Protection Board
NSHB	North of Scotland Hydroelectric Board
OAPEC	Organization of Arab Petroleum Exporting Countries
OPEC	Organization of Petroleum Exporting Countries
OECD	Organization for Economic Cooperation and Development
ORNL	Oak Ridge National Laboratory
OTEC	Ocean Thermal Energy Conversion
PAN	peroxyactyl nitrate
RfF	Resources for the Future

SCF	standard cubic feet
SDR	special drawing rights
SI	Système International
SNG	synthetic natural gas
SSEB	South of Scotland Electricity Board
TVA	Tennessee Valley Authority
TCE	tonnes of coal equivalent
TOE	tonnes of oil equivalent
UKAEA	United Kingdom Atomic Energy Authority
UNCTAD	United Nations Conference on Trade and Development
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
VAT	Value Added Tax
WAES	Workshop on Alternative Energy Strategies
WECS	Wind Energy Conversion System

A

absolute price. The price of a commodity expressed in terms of the rate at which it exchanges for a unit of *money, as opposed to the *relative price which is the quantity of another commodity which exchanges for a unit of the commodity in question. Thus, following the action on oil of OPEC in 1973, the absolute price of oil rose much more than the relative price of oil since the absolute prices of all other commodities rose together with, though typically less than, that of oil.

MC

absolute temperature scale. A scale of temperature that (*a*) has zero at the lowest attainable temperature when all atoms of matter have effectively zero kinetic energy, and (*b*) is defined without reference to any physical properties of materials. Absolute temperature scales have particular importance for studies in *thermodynamics and *radiation. Historically the concept of absolute zero temperature was obtained by extrapolating changes in volume with temperature of an ideal perfect gas to the temperature where the volume would be zero.

The Celsius (also called *Centigrade) and *Fahrenheit temperature scales are now defined against the corresponding absolute scales of Kelvin (symbol K) degrees and Rankine (symbol R) degrees. Thus degree intervals in the Celsius and Kelvin scales are equal, and similarly with intervals in the Fahrenheit and Rankine scales. The freezing point of pure water (strictly the triple point when ice, vapour and liquid water are all in equilibrium) is at 273.16 K (0 °C) and 491.69 R (32 °F). Temperatures of p °C and q °F are related to absolute temperatures rK and sR by

$$\mathrm{rK} = (\mathrm{p} + 273.2)\,^{\circ}\mathrm{C}$$

$$\mathrm{sR} = (\mathrm{q} - 32 + 491.69)\,^{\circ}\mathrm{F}$$

JWT

absorbed dose. *See* radiation dose.

absorber (solar). A device that absorbs solar energy as *heat. It is usually a system of black surfaces or fluids heated by the sunshine and having pipes fixed to take away the heat for use. *See also* collector.

JWT

absorptance. The fraction of incident radiation absorbed by a material over a specified or implied range of wavelengths. It is loosely synonymous with *absorption coefficient and *absorptivity. Strictly defined, absorptance varies with the angle of incidence and the wavelength of the radiation (*see* monochromatic). However, the term is often defined, rather imprecisely, such that if a radiation beam of intensity *I* has an amount ΔI absorbed then the absorptance equals $\Delta I/I$. Note that materials with one value of absorptance in visible light may have a quite different value in infrared radiation. For example, glass is transparent (has low absorptance) to solar radiation in the visible and near visible region but is opaque (has high absorptance) to the infrared radiation from hot surfaces (*see* greenhouse effect). *See also* reflectance; transmittance.

JWT

absorption. (1) (Chemical) The removal of one or more components of a gas mixture by causing them to dissolve in a liquid or solution (*see* amine).

(2) (of a neutron) The interaction of a *neutron with an atomic *nucleus and its absorption into it. The compound nucleus thus formed is in an excited state and may de-excite by emitting *gamma radiation, in which case the process is known as a capture, radiative capture or (n,γ) reaction. For example,

$$^{23}_{11}\text{Na} + ^{1}_{0}\text{n} \rightarrow ^{24}_{11}\text{Na (excited)}$$
$$\rightarrow ^{24}_{11}\text{Na (ground state)} + \gamma$$

Alternatively, the reaction may produce an *alpha particle in which case it is called an (n,α) reaction. For example,

$$^{10}_{5}\text{B} + ^{1}_{0}\text{n} \rightarrow ^{11}_{5}\text{B (excited)}$$
$$\rightarrow ^{4}_{2}\text{He} + ^{7}_{3}\text{Li}$$

In the case of the heaviest elements, the absorption of a neutron may cause the *fission of the compound nucleus. The rate at which the absorption process takes place in any isotope is characterized by its absorption *cross-section.

The importance of neutron absorption is that it can produce, from naturally occurring isotopes, a large number of radioactive isotopes, including the *transuranium elements. The importance of fission is that it is a source of energy. The operation of a *nuclear reactor depends on the correct balance between fission and neutron capture, and the reactor must be designed accordingly.

(3) (of gamma radiation) The interaction of radiation with an atom, thereby destroying the energy of radiation. Gamma radiation absorption refers to any process in which all the energy of a gamma-ray photon is absorbed in the interaction between it and an atom. As a result the gamma photon ceases to exist. The rate of this type of reaction in any material is characterized by the absorption coefficient, μ, of the material according to the following equation:

$$\text{rate of absorption of gamma radiation per unit volume per second} = \text{flux of gamma radiation} \times \text{number of atoms per unit volume of material} \times \mu$$

An important example of this process in nuclear engineering is the absorption of gamma radiation in the biological shield of a *nuclear reactor, required to contain biologically damaging radiation.

WG, DB, DB

absorption chiller. A refrigeration plant in which a liquid, known as the refrigerant (commonly water), is continuously evaporated from an aqueous solution under pressure, condensed, allowed to evaporate (so absorbing heat) and then reabsorbed into the aqueous solution (commonly lithium-bromide or ammonia). The principal advantage of the absorption chiller over *vapour-compression chillers is that it can operate on low-grade heat energy and has few moving parts.

TM

absorption coefficient. The fraction of radiation or of a substance that is absorbed by a material. Loosely synonymous terms used for radiation are *absorptance and *absorptivity.

JWT

absorptivity (Symbol: α). That property of the surface of a body which determines, in relation to its temperature, the quantity of heat radiation it absorbs. Absorptivity is measured as the fraction of incident radiation of a given wavelength that is absorbed by the body.

TM

accelerator (particle). The general name for machines which, by strong electric and magnetic fields, accelerate charged particles to the high speeds and energies at which they can cause nuclear reactions.

DB

acclimatization. The process whereby a living organism gradually readjusts following a change in its environment. This adjustment or *adaptation may take several generations before completion: such a time lag must be taken into consideration when selecting fuel-crop species for rapid growth under unfamiliar conditions within an *energy farm.

CL

accumulator. A rechargeable electric *battery for storing electricity. The most common form of electric accumulator has lead-based plates in sulphuric acid. Each section (cell) of this accumulator has a voltage of two volts when charged.

JWT

acetylene. The *alkyne C_2H_2, the first in the alkyne series. It has a triple bond $HC{\equiv}CH$. At normal pressures it is a highly flammable gas which may be burned to provide a luminous flame. Since the flame is intensely hot the gas is used in welding and metal cutting. Acetylene may explode when under pressure and when in contact with copper or silver. Its gross *calorific value is 50.02 MJ/kg.

WG

acetylenes. Highly unsaturated hydrocarbons (alkynes) in which at least one pair of carbon atoms in the molecules are joined by a triple valency bond. With from two to twelve atoms in the molecule, acetylenes are gases or volatile liquids. They are very reactive and are readily oxidized.

WG

acid dew point. As hot gases containing water vapour are cooled, a temperature is reached at which the water vapour starts to condense as a liquid. This is known as the *dew point temperature. When chimney gases from a combustion process containing water vapour and small amounts of sulphur trioxide are cooled, it is found that condensation takes place at a higher temperature than predicted. This is known as the acid dew point temperature, due to the fact that the sulphur trioxide reacts with the condensed water to form sulphuric acid. Since this acid will cause corrosion of chimney and heat-recovery appliances, the chimney gases may be cooled only to a limited extent and the heat which may be recovered is reduced.

WG

acid mine drainage. Drainage produced when water, passing through surface or underground mines, interacts with pyrites, an impurity in coal, to form sulphuric acid via bacterial action. This acidic water drains into local streams and may destroy aquatic *ecosystems.

PH

acid rain. Rainfall occurring when atmospheric water vapour combines with oxides of sulphur and nitrogen released through the combustion of fossil fuels. The sulphur dioxide combines with water vapour to form sulphuric acid. The very tall chimneys which have been built at power stations in recent years to ensure optimal dispersion of emissions have meant that pollutants are discharged high into the atmosphere and transported great distances by prevailing winds, often across national boundaries, before being washed out by rainfall.

Acid rain is almost entirely a man-made problem, one that has become progressively more serious over the last decade as a result of the steady growth in the burning of fossil fuels. Rainfall with high levels of acidity has been recorded in many parts of the world.

PH

actinide. The collective name for the elements of *atomic numbers 89 to 103, so-called after the first of the series, actinium. The first four of the series (actinium, *thorium, protactinium and *uranium) occur naturally. The others, sometimes called the *transuranium elements, can be produced by nuclear reactions. All the isotopes of the actinides are radioactive.

DB

activated carbon. Amorphous carbon with a porous structure which is capable of the *adsorption of large amounts of matter from a gas mixture or from solution. It has a considerable surface area per unit weight, typically 1000 m^2/g. The carbon may be prepared by the *pyrolysis of a variety of substances such as wood, peat, coal, animal bones and petroleum. The activation is achieved by treating the carbon with steam or carbon dioxide at about 900 °C.

WG

activation. The process whereby non-radioactive *isotopes are converted to radioactive ones as a result of neutron capture (*see* absorption, neutron). For example, in the reaction

$$^{23}_{11}Na + ^{1}_{0}n \rightarrow ^{24}_{11}Na$$

stable sodium-23 is converted into radioactive sodium-24.

Activation analysis is the procedure whereby traces of elements can be analysed by activating the element itself and measuring the *radioactivity of the isotopes so formed.

DB

active solar energy system. (1) A system in which a purpose-built device absorbs solar radiation and the resulting heat or work is passed for use at a distance from the device. In contrast a *passive solar energy system uses the energy directly.

(2) In the USA especially, a system that uses energy forms such as wind or *biofuels, that arise from solar radiation. One example is a wind turbine. *See also* renewable energy.

JWT

activity. *See* radioactivity.

acute radiation syndrome. *See* biological effects of radiation.

acute toxicity. The capacity of an agent or material to cause injury to an organism as a result of a single exposure. Acute toxicity tests usually involve the measurement of the lethal dose to kill 50% of the exposed population.

PH

adaptation. Some alteration(s) in the morphological, physiological, or behavioural aspects of an organism, resulting in greater compatibility between itself and its *environment. Thus a fuel crop may have to change in some way when confronted by unfamiliar growth conditions. An example would be the case of a plant forced to grow in an arid zone where water conservation is a priority. Such a plant would have to adapt by keeping its stomata (leaf pores) closed during the hot day and open them only at night when water loss through evaporation is less likely.

CL

additive. A substance added to a product to modify its properties. Additives may be used with petroleum fuels to improve their combustion characteristics or in lubricating oils to improve their ability to prevent metal wear, etc. Additives used in motor spirit include antiknock agents, antioxidants, anti-icing agents, upper-cylinder lubricants, and dyes.

WG

adiabatic lapse rate. The rate at which the temperature of air decreases with the height above the ground.

PH

adiabatic process. A process in which no heat is supplied to or rejected from a fluid during its change of state.

TM

admittance. (1) (electrical, symbol: *Y*). The inverse of *impedance in an electric circuit. Admittance is measured in *siemens.

(2) (thermal, symbol: *Y*). The property of building materials and the spaces they enclose which determines their response to sinusoidal variation in external temperature. Admittance values (in units of $W/m^2.k$) have been estimated for a range of wall and roof types.

TM

adsorption. The removal of one or more components of a gas mixture, or the removal of a dissolved substance from an aqueous solution, by contact with a solid surface. The adsorbed components are held on the surface of the solid by physicochemical forces and thus porous substances with a large surface area per unit weight are most effective. *See also* activated carbon.

WG

ad valorem tax. A tax for which the rate is specified as a percentage of price, as distinct from a specific tax for which the rate is specified per unit of the commodity. Examples of ad valorem taxes are local sales taxes in the USA and *value-added tax in Europe. Taxes on *natural resources, such as *severance taxes on oil extraction, may be either ad valorem or specific. As the price of the taxed commodity changes, an ad valorem tax yields a constant percentage of the net of tax price per unit of the commodity, whereas a specific tax yields a changing percentage of the net of tax price.

MC

advanced gas cooled reactor (AGR). *See* nuclear reactor.

Advisory Committee on Reactor Safeguards (ACRS). A statutory group of 15 scientists and engineers which advises the NRC on safety matters referred to it and on the adequacy of proposed reactor safety standards.

Address: 1717 H St. N.W., Washington, D.C. 20555, USA.

PH

aerobic. Surviving in or requiring air and oxygen. It is used of bacteria that develop on material open to oxygen. *See also* anaerobic.

JWT

aerofoil. *See* airfoil.

aerogenerator [wind generator; wind turbine; windmill]. A machine that generates electricity from the wind. All such machines require a tower or support for the turbine which will have a number of blades. The axis of the turbine may be horizontal or vertical (or very occasionally at an intermediate slope). An electric generator is connected to the turbine, often through a gear box or hydraulic connection. The fewer the number of blades (optimally one), the higher the frequency of rotation in a given windspeed and the easier the generation of electricity. However, fewer blades produce increased structural problems for