Appendix C

Conversion Factors, Abbreviations, and Glossary

Conversion Factors

Area

1 square kilometer (km^2)=
0.386 square mile
247 acres
100 hectares

1 *square mile=*
2.59 square kilometers (km^2)
6.4xl0 acres
2.59xl0^2 hectares

1 acre=
0.405 hectare (ha)
1.56x10^{-3} square miles
4.05 square kilometers (km^2)

1 *hectare=*
0.01 square kilometer (km^2)
3.86x10^{-3} square miles
2.47 acres

Weight

1 kilogram (kg}=
2.20 pounds (lb)

1 *pound (lb)=*
0.454 kilogram (kg)

I *metric ton (ret) (or "long ton' ')=*
1,000 kilograms or **2,200** lbs

1 short ton=
2,000 pounds or 907 kg

Energy

1 quad (quadrillion Btu)=
1.05x **10^{18}** Joules (J)
1.05 exajoules (EJ)
3.60xl0^5 metric tons, coal
1,72x10^6 barrels, *Oil*
2.36x10^5 metric tons, oil
2.83x101° cubic meters, gas
1.07x10^{12} cubic feet, gas
2.93xl0^2 terawatt hours

1 *kilowatthour=*
3.41x10^3 British thermal units (Btu)
3.6x10^6 Joules (J)

***1** Joule=*
9.48x10^4 British thermal unit (Btu)
2.78x10^{-7} kilowatthours (kWh)

I British thermal unit (Btu)=
2.93x10^4 kilowatthours (kWh)
1.05x10^3 Joules (J)

Volume

1 liter (1)=
2.64x10^{-1} gallons (liquid, U. S.)
6.29x10^{-3} barrels (petroleum, U. S.)
1x10^{-3} cubic meters (m^3)
3.53x 10^{-2} cubic feet (ft^3)

1 *gallon (liquid, U.S.)=*
3.78 liters (1)
2.38x10^{-2} barrels (petroleum, U. S.)
3.78x10^{-3} cubic meter (m^3)
1.33x10^{-1} cubic feet (ft^3)

1 *barrel (bbl) (petroleum, U.S.,)=*
1.59x10^2 liters (1)
42 gallons (liquid, U. S.)
1.5%10-' cubic meters (m^3)
5.61 cubic feet (ft^3)

1 cubic meter (#)=
1x10^3 liters (1)
2.64xl0^2 gallons (liquid, U. S.)
6.29 barrels (petroleum, U. S.)
35.3 cubic feet (ft^3)

1 cubic foot (ft^3)=
2.83x 101 liters (1)
7.48 gallons (liquid, U. S.)
1.78x10^{-1} barrels (petroleum, U. S.)
2.83x10^{-2} cubic meters (m^3)

1 *cord wood=*
128 cubic feet (ft^3) stacked wood
3.62 cubic meters (m^3) stacked wood
1 dry (i.e., *no* moisture) ton of wood

Temperature

From Centigrade to Fahrenheit:
((9/5) X ("C))+ 32 =°F

From Fahrenheit to Centigrade.
(5/9) x (oF - 32)= °C

Temperature changes:
—To convert a Centigrade change to a Fahrenheit change:
9/5 x (change in 'C) = change in OF
—-To convert a Fahrenheit change to a Centigrade change:
5/9 x (change in 'F) = change in °C
—-Example: a ***3.0 °C rise in*** temperature = a 5.4 OF rise in temperature

Carbon Contents of Various Fuel

Fuel	Pounds of carbon per common unit of measure[a]	kg C/10^9 J	mg C/Btu
Wood (dry poplar)	1,032 lbs C/cord	24.9	26
Bituminous coal (dry)	1,300 lbs C/short ton	24.4	26
Heating oil	6.4 lbs C/gal.	20.0	21
Diesel fuel	6.0 lbs C/gal.	19.7	21
Crude oil	255 lbs C/bbl	18.9	20
Gasoline	5.5 lbs C/gal.	18.9	20
No. 2 diesel fuel	6.0 lbs C/gal.	18.8	20
Gasohol	5.3 lbs C/gal.	18.8	20
Ethanol	3.5 lbs C/gal.	17.6	19
Methanol	2.5 lbs C/gal.	16.6	18
Propane	9.5 lbs C/hundred cubic ft.	16.3	17
Natural gas	3.3 lbs C/hundred cubic ft.	13.6	14
Natural gas	3.3 lbs C/therm	13.6	14
Electricity (U.S. avg)	0.4 lbs C/kWh	50.5	53

[a]To convert carbon to CO_2, multiply by 3.667; from CO_2 to carbon, multiply by 0.27.

International System of Units **(S1): Prefixes**

Prefix	SI symbol	Multiplication factor
exa	E	10^{18} (1,000,000,000,000,000,000)
peta	P	10^{15} (1,000,000,000,000,000)
tera	T	10^{12} (1,000,000,000,000)
giga	G	10^{9} (1,000,000,000)
mega	M	10^{6} (1,000,000)
kilo	k	10^{3} (1,000)
hecto	h	10^{2} (100)
deca	da	10

EXAMPLES: 1 Teragram or Tg (10^{12} or 1,000,000,000,000 or 1 trillion grams); 1 megawatt-electric or MWe (10^{6} or 1,000,000 or 1 million watts-electric).

EXCEPTION: 10^{15} (1,000,000,000,000,000) British thermal units (Btu) is not generally referred to as a PBtu. Instead it is known as a quad, or one quadrillion Btu's.

Abbreviations

ACP —Agricultural Conservation Program
ADF —African Development Foundation
A.I.D. —Agency for International Development
AQMP —Air Quality Management Plan
ASCS —Agricultural Stabilization and Conservation Service
ASD —Adjustable speed drive
ASHRAE —American Society of Heating, Refrigeration and Air-Conditioning Engineers
ATNT —Accelerated Turnover and New Technologies
BEPS —Building Energy Performance Standards
BLS —Bureau of Labor Statistics
BMPs —Best management practices
Btu —British thermal unit
CAFE —Corporate Average Fuel Efficiency
CARE —Cooperative for American Relief Everywhere
CARP —Cooperative Automotive Research Program
CBO —Congressional Budget Office
CFCs —Chlorofluorocarbons
CGIAR —Consultative Group on International Agricultural Research
CH_4 --Methane
CNG —Compressed natural gas
CO_2 —Carbon dioxide
COBRA —Comprehensive Omnibus Budget Reconciliation Act
COCOM —Coordinating Committee on Multilateral Export Controls
CORECT —Committee on Renewable Energy Commerce and Trade
CRP —Conservation Reserve Program
CRS —Congressional Research Service
DOE —U.S. Department of Energy
DSM —Demand-side management
EAA —Export Administration Act
EADC —Energy Analysis and Diagnostic Center
EES —Energy Extension Service
EIA —Energy Information Administration
EITC —Energy investment tax credit
EPA —Environmental Protection Agency
EPRI —Electric Power Research Institute
ESMAP —Energy Sector Management Assistance Program
FAO —Food and Agriculture Organization
FBC —Fluidized-bed combustor
FEMIA —Federal Energy Management Improvement Act
FEMP —Federal Energy Management Program
FERC —Federal Energy Regulatory Commission
FIP —Forestry Incentives Program
GAO —General Accounting Office
GATT —General Agreement on Tariffs and Trade
GCM —General circulation model
GDP —Gross Domestic Product
GNP —Gross National Product
GRI —Gas Research Institute
HCFC —Hydrochlorofluorocarbon
HERS —Home Energy Rating System
HFC —Hydrofluorocarbon
HUD —U.S. Department of Housing and Urban Development
HVAC —Heating, ventilation, air-conditioning equipment
IAF —Inter-American Foundation
ICP —Institutional Conservation Program
IDB —Inter-American Development Bank

IEA —International Energy Agency
IGCC —Integrated gasification-combined cycle
IPCC —Intergovernmental Panel on Climate Change
IPPF —International P1anned Parenthood Federation
ISTIG —Intercooled steam-injected gas turbine
ITTO —International Tropical Timber Organization
LCP —Least-cost planning
LIHEAP —Low-Income Home Energy Assistance Program
LIMB —Limestone injection multistage burner
LWR —Light water reactor
MAGPI —Multi-Agency 'Working Group for Power Sector Innovation
MDB —Multilateral Development Bank
MFN —Most Favored Nation
MHD —Magnetohydrodynamics
MHTGR —Modular high temperature gas reactor
N_2O —Nitrous oxide
NAECA —National Appliance Energy Conservation Amendments
NAHA —National Affordable Housing Act
NASA —National Aeronautics and Space Administration
NCSBCS —National Council of States Building Codes Standards
NGO —Non-governmental organization
NIST —National Institute for Standards and Technology
NOAA —National Oceanic and Atmospheric Administration
NPPC —Northwest Power Planning Council
O&M —Operation and maintenance
OECD —Organization for Economic Cooperation and Development
OIP —Office of Industrial Programs
OPIC —Overseas Private Investment Corp.
ORNL —Oak Ridge National Laboratory
PACER —Program for the Acceleration of Commercial Energy Research
PURPA —Public Utility Regulatory Policies Act
PV —Photovoltaic
RCS —Residential Conservation Service
RD&D —Research, Development, and Demonstration
REDAC —Renewable Energy Design Assistance Center
SCS —Soil Conservation Service
SECP —State Energy Conservation Program
SEECB —Solar Energy and Energy Conservation Bank
SEED —Support for Eastern European Democracy
SERI —Solar Energy Research Institute
SES —Shared Energy Savings
SLAP —State and local assistance programs
TCM —Transportation control measure
TDP —Trade and Development Program
TFAP —Tropical Forestry Action Plan
UNDP —United Nations Development Program
UNEP —United Nations Environment program
UNFPA —United Nations Fund for Population Activities (UN Population Fund)
USDA —U.S. Department of Agriculture
USECRE —U.S. Export Council for Renewable Energy
USFS —U.S. Forest Service
UV —Ultraviolet radiation
VAFE —Volume Average Fuel Economy
VMT —Vehicle miles traveled
WAP — Weatherization Assistance Program
WMO — World Meteorological Organization

Glossary

Aerosols: Microscopic particles suspended in the atmosphere, originating from both natural sources (e.g., volcanoes) and human activities (e.g., coal burning).

Al bedo: The reflectivity of the Earth.

Appliance: Any household energy-using device.

Biodiversity: Biological diversity, i.e., the variety of species in a given area.

Biomass: Technically, the total dry organic matter or stored energy content of living organisms in a given area. As used by OTA, biomass refers to forms of living matter (e.g., grasses, trees) or their derivatives (e.g., ethanol, timber, charcoal) that can be used as a fuel.

Btu (British thermal unit): The amount of heat needed to raise the temperature of 1 pound of water by 1 'Fat a specified temperature.

Carbon budget: The sum of the flows of carbon to and from a carbon reservoir. See also **Carbon cycle.**

Carbon cycle: General term used in reference to the sum of all reservoirs and flows of carbon on Earth. The flows tend to be cyclic in nature; for example, carbon removed from the atmosphere (one reservoir) and converted into plant tissue (another reservoir) is returned back into the atmosphere when the plant is burned.

Carbon dioxide fertilization: The enhancement of plant growth in response to an increase in the concentration of atmospheric CO_2.

Carbon reservoir or sink: Within the carbon cycle, the physical site at which carbon is stored (e.g., atmosphere, oceans, Earth's vegetation and soils, and fossil fuel deposits),

Chlorocarbon: A compound containing chlorine and carbon; examples include carbon tetrachloride and methyl chloroform, both of which are ozone depleters.

Cloroflourocarbons: Compounds containing chlorine, fluorine, and carbon; they generally are used as propellants, refrigerants, blowing agents (for producing foam), and solvents. They are identified with numbered suffixes (e. g., CFC-11, CFC-12) which identify the ratio of these elements in each compound. They are known to deplete stratospheric ozone and also are ''greenhouse' gases in that they effectively absorb certain types of radiation in the atmosphere.

Climate: The statistical collection and representation of the weather conditions for a specified area during a specified time interval (usually decades).

Climate anomaly: The "significant* deviation of a particular climate variable from its long-term average.

Cogeneration: **The** simultaneous generation of both electric power and heat; the heat, instead of being discharged without further use. is used in some fashion (e.g., in district heating systems).

Deforestation: Converting forest land to other vegetation or uses (e. g., cropland, pasture, dams).

Demand-side management. The planning, implementation, and monitoring of utility activities designed to encourage customers to modify their pattern of electricity usage.

Discount rate: The rate at which money grows in value (relative to inflation) if it is invested.

Emissions: Flows of gases, liquid droplets, or solid particles into the atmosphere. Gross emissions from a specific source are the total quantity released. Net emissions are gross emissions minus flows back to the original source. Plants, for example, take carbon from the atmosphere and store it as biomass during photosynthesis, and they release it during respiration, when they decompose, or when they are burned.

Energy intensity: The amount of energy required per unit of a particular product or activity. Often used interchangeably with ' 'energy per dollar of GNP. '

Energy services: The service or end use ultimately provided by energy. For example, in a home with an electric heat pump, the service provided by electricity is not to drive the heat pump's electric motor but rather to provide comfortable conditions inside the house.

Feedback: When one variable in a system (e.g., increasing temperature) triggers changes in a second variable (e.g., cloud cover) which in turn ultimately affect the original variable (i. e., augmenting or diminishing the warming). A positive feedback intensifies the effect. A negative feedback reduces the effect.

Fluorocarbon: A compound containing fluorine and carbon; among these are chlorinated fluorocarbons (CFCs) and brominated fluorocarbons (haIons).

Fossil fuel: Coal, petroleum, or natural gas or any fuel derived from them.

Generating capacity: The capacity of a powerplant to generate electricity, typically expressed in watts-electric (e.g., kWe or MWe).

Greenhouse effect: The effect produced as certain atmospheric gases allow incoming solar radiation to pass through to the Earth's surface, but prevent the (infrared) radiation, which is reradiated from the Earth from escaping into outer space. The effect responsible for warming the planet.

Greenhouse gas: Any gas that absorbs infrared radiation in the atmosphere.

Halocarbon: A compound containing carbon and at least one halogen.

Halogen: Any one of the following chemical elements: bromine, chlorine, fluorine, iodine, or astatine.

Halogenated: A compound containing a halogen. A fully halogenated CFC is one in which all hydrogen has been replaced with chlorine and/or fluorine. A partially halogenated CFC is one in which some hydrogen remains.

HaIon: Compounds containing bromine, commonly used as fire extinguishing agents.

Heat-island effect: The tendency of large urbanized areas to increase local temperatures, creating 'heat islands' surrounded by cooler countrysides.

Hydrochlorofluorocarbon: A chlorofluorocarbon that contains some hydrogen (i.e., a ''partially halogenated" chlorofluorocarbon); an example is HCFC-22.

Hydrofluorocarbon: Compounds containing hydrogen, fluorine, and carbon. Unlike CFCs, they do not contain chlorine.

Infrared radiation: Radiation with wavelengths roughly between 700 and 1000 nanometers; these wavelengths are longer than those of visible light.

Least-cost planning: In energy planning, the practice of basing investment decisions on the least costly option for providing ***energy services.*** `It` is distinguished from the more traditional approach taken by utilities, which focuses on the least costly way to provide specific types of energy, with little or no consideration of less costly alternatives that provide the same energy service at lower costs.

Life cycle cost: The cost of a good or service over its entire life cycle.

Methane: A compound consisting of one carbon atom and four hydrogen atoms; it occurs naturally, often in association with coal and petroleum (see Natural gas below) and as a byproduct of the metabolic activities of some microorganisms; it also can be synthesized artificially.

Monoculture: The exclusive cultivation of single species (e.g., corn or soybeans), a common practice in modern agriculture.

Montreal Protocol: The principal international agreement under which ozone-depleting compounds are regulated.

Natural gas: A naturally occurring mixture of hydrocarbons (principally methane) and small quantities of other gases found in porous geological formations, often in association with petroleum.

OECD: Organization for Economic Cooperation and Development, an organization that includes most of the world's industrialized, market economies. Members include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States.

Ozone: A molecule consisting of three oxygen atoms; in the atmosphere, it is found in both the stratosphere and the troposphere. Ozone effectively absorbs certain forms of solar ultraviolet radiation known to damage living organisms. It also absorbs certain wavelengths of infrared radiation and therefore is a ''greenhouse' gas.

Ozone **layer:** Ozone found throughout the stratosphere.

Particulate: Airborne particles.

Photochemical reaction: A chemical reaction triggered by sunlight.

Primary **productivity: The** rate at which radiant energy is stored by the photosynthetic and chemosynthetic activities of producer organisms (e.g., green plants) in the form of organic substances which can be used as food materials,

Radiation: See Infrared radiation and **Ultraviolet radiation.**

Radiative forcing: The degree to which changes in the radiative balance of the atmosphere cause changes in temperatures.

Retrofit: To update an existing structure or technology by modifying it, as opposed to creating something entirely new from scratch. For example, an old house can be retrofitted with advanced windows to slow the flow of energy into or from the house.

Sequester: To isolate and remove something. As used here, the processes by which carbon dioxide is removed from the atmosphere and retained for some period in a carbon reservoir (e.g., trees).

Stratosphere: The upper portion of the atmosphere, between 11 and 50 km above the surface of the Earth; in contrast to the troposphere, temperatures change little with changing altitude, clouds are rare, and convection is minimal. The stratosphere also holds relatively higher concentrations of ozone, resulting in what is known as the ''ozone layer'

Sustainable: A term used to characterize human activities that can be undertaken in such a manner as to not adversely affect the environmental conditions (e.g., soil, water quality, climate) necessary to support those same activities in the future.

Temperate: Relating to the region between the tropics and the polar circles (between 23.5° and 66.5 o) in both hemispheres.

Trace gas: Atmospheric gases that exist in relatively small or ' 'trace' concentrations.

Tropical: Relating to the region between the Tropic of Cancer and the Tropic of Capricorn (23.5° North and 23.5° South, respectively).

Troposphere: The portion of the atmosphere which extends outward from the Earth's surface to about 16 km, directly below the stratosphere; temperatures generally decrease rapidly with altitude, clouds form, and convection is active.

Ultraviolet radiation: Radiation with wavelengths roughly between 200 and 400 nanometers; these wavelengths are shorter than those of visible light and longer than those of X-rays.

Watt (W): A common unit used in measuring power (i.e., as the flow of energy overtime), equivalent to 3.41 Btu per hour. Where an ''e' follows the unit (as in kWe or MWe), the watt is in the form of electrical energy. Where a ''t" follows the unit (as in kWt or MWt), the watt is in the form of thermal energy,