

## Notes & Sources

[1] Turkey and Belarus are Annex I nations that have not ratified the Framework Convention on Climate Change and did not commit to quantifiable emissions targets under the Kyoto Protocol.

[2] The Kyoto Climate Change Protocol, devised by the United Nations Framework Convention on Climate Change, requires reductions or limits to the growth of carbon emissions within the Annex I countries (Australia, Austria, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, the United Kingdom, and the United States) between 2008 and 2012, resulting in a 4-percent reduction in emissions relative to 1990 levels. The Protocol has not yet been ratified by any of the Annex I countries.

[3] This range was calculated by removing consumption of the most carbon-intensive fossil fuel possible, coal, and the least carbon-intensive fuel possible, natural gas, with the understanding that it probably would be impractical to reduce consumption of coal only, and a combination of fossil fuels would have to be reduced.

[4] Calculations based on International Energy Agency statistics.

[5] The comparisons use 1997 as a base year rather than 1998 or 1999, because the latest historical year of data available in IEA's World Energy Outlook 2000 is 1997. Because there is some small variation between historical estimates, the oil production increments are calculated separately for each forecast.

[6] In some places, such as Japan, deregulation policies could lead to less gas use; in the United States, deregulation is expected to increase gas use.

[7] Proven reserves, as reported by the Oil & Gas Journal, are estimated quantities that can be recovered under present technology and prices. Figures reported for Canada and the former Soviet Union, however, include reserves in the probable category. Natural gas reserves reported by the Oil & Gas Journal are compiled from voluntary survey responses and do not always reflect the most recent changes (see box on page 46 for discussion of reserves). Significant gas discoveries made during 2000 are not likely to be reflected in the reported reserves.

[8] For more information about gas-to-liquids technology and proposed projects, see Energy Information Administration, International Energy Outlook 2000, DOE/EIA-0484(2000) (Washington, DC, March 2000), p. 59.

[9] Throughout this chapter, tons refers to short tons (2,000 pounds).

[10] Recoverable reserves are those quantities of coal which geological and engineering information indicates with reasonable certainty can be extracted in the future under existing economic and operating conditions.

[11] Internationally, the term "hard coal" is used to describe anthracite and bituminous coal. In data published by the International Energy Agency, coal of subbituminous rank is classified as hard coal for some countries and as brown coal (with lignite) for others. In data series published by EIA, subbituminous coal production is included in the bituminous category.

[12] The exchange rate for the Australian dollar was US\$0.64 in December 1999, 20 percent below its recent historical peak of US\$0.80 in May 1996. The exchange rate for the South African Rand was US\$0.16 in December 1999, 41 percent below its recent historical peak of US\$0.27 in January 1996. Between August 1998 and December 1999, the Russian ruble lost 75 percent of its value compared with the U.S. dollar.

[13] During Japan's fiscal year 1999 (April 1, 1999, through March 31, 2000), Australian steam coal

suppliers received an average of \$25.81 per ton (FOB port of exit in 1999 U.S. dollars) for coal delivered to Japan's electric utilities, 5 percent below the negotiated reference price of \$27.17 per ton.

[14] Approximately 1.4 tons of coking coal are required to produce 1 ton of coal coke. However, according to information provided by the World Coal Institute, each ton of coal injected to the blast furnace through pulverized coal injection (PCI) equipment displaces only about 0.6 to 0.7 tons of coal coke. As a result, each ton of PCI coal displaces approximately 1 ton of coking coal. Steel companies are able to reduce their operating costs, however, because coal used for pulverized coal injection is typically less expensive than the higher quality coals required for the manufacture of coal coke.

[15] Measured as the net summer capability of operating units.

[16] United States, France, United Kingdom, Germany, Italy, Canada, and Japan.

[17] The defined "standard turbine" or "reference turbine" is actually a series of turbine types operating at an average wind speed of 5.5 meters per second at 30 meters height with logarithmic height profile and a roughness length of 0.1 meters in specific conditions averaged over a period of 5 years using an internationally recognized and EU-approved power curve model.

[18] Primary biomass is defined as agricultural crops grown specifically for use in biomass energy production. Secondary biomass is defined as agricultural and forest residues.

[19] Hybrid systems work with a renewable energy source that is backed up by a nonrenewable component. For example, a photovoltaic-diesel system would have a diesel generator that would start up when there was not sufficient sunlight to operate the photovoltaic component.

[20] All fuel share projections in this chapter are from the Energy Information Administration's World Energy Projection System (2001).

[21] A "qualifying facility" is defined as a cogeneration or small power production facility that meets certain ownership, operating, and efficiency criteria established by the FERC.

[22] The Herfindahl-Hirschman index is a commonly accepted measure of market concentration. It is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers. The index takes into account the relative size and distribution of firms in a market and approaches zero when a market consists of a large number of firms of relatively equal size. For more information, see U.S. Department of Justice, web site [www.usdoj.gov/atr/testimony/hhi.htm](http://www.usdoj.gov/atr/testimony/hhi.htm).

[23] Belgium and Ireland were given an additional two year grace period to catch up with other European Union members to abide by its electricity directive. Belgium chose to wave its grace period. Greece was given three years.

[24] For example, the Energy Policy Act of 1992 sets new vehicle purchase mandates for vehicle fleet owners, whereby 70 percent of all vehicles must be fueled by alternative fuels by 2006. Also, under the Low Emission Vehicle Program, 10 percent of all new vehicle sales in States that agree to participate will be zero-emission vehicles by 2003.

[25] Credits for 15 ppm diesel fuel can be accrued prior to this date if the refiner can certify that the fuel is to be used in vehicles certified to meet the heavy-duty engine standards for model year 2007.

[26] Small refiners are defined as those with fewer than 1,500 employees and corporate capacity of less than 155,000 barrels per day.

[27] Including, Colorado, Idaho, Montana, New Mexico, North Dakota, Utah, Wyoming, and parts of Alaska.

[28] The Mercosur trading block is made up of Argentina, Brazil, Paraguay, and Uruguay. Chile and

Bolivia are Associate Members.

[29] Carbon dioxide emissions from energy use are reported here in metric tons carbon equivalent. One million metric tons carbon equivalent is equal to 3.667 million metric tons of carbon dioxide.

[30] The Kyoto Protocol will enter into force 90 days after it has been ratified by at least 55 Parties to the UNFCCC, including developed countries representing at least 55 percent of the total 1990 carbon dioxide emissions from this group. The following Parties to the Convention had ratified the Protocol as of February 5, 2001: Antigua and Barbuda, Azerbaijan, Bahamas, Barbados, Bolivia, Cyprus, Ecuador, El Salvador, Equatorial Guinea, Fiji, Georgia, Guatemala, Guinea, Honduras, Jamaica, Kiribati, Lesotho, Maldives, Mexico, Micronesia, Mongolia, Nicaragua, Niue, Palau, Panama, Paraguay, Samoa, Trinidad and Tobago, Turkmenistan, Tuvalu, Uruguay, and Uzbekistan.

[31] In terms of rates of changes, the Kaya Identity can be expressed as  $[d(\ln C) / dt = d(\ln C / E) / dt + d(\ln E / GDP) / dt + d(\ln GDP / POP) / dt + d(\ln POP) / dt]$ , which shows that, over time, the rate of change in carbon emissions is equal to the sum of the rate of change across the four Kaya components (i.e. the rate of change in carbon intensity, plus the rate of change in energy intensity, plus the rate of change in output per capita, plus the rate of change in population).

[32] Compared with the industrialized world, a much larger share of energy consumption in the developing world (especially Africa and Asia) comes from biomass—including wood, charcoal, and agricultural residues. Because data on biomass use in developing countries are often sparse or inadequate, IEO2001 does not include the combustion of biomass fuels in its coverage of current or projected energy consumption.

[33] Turkey and Belarus, which are represented under Annex I of the UNFCCC, do not have quantified emission targets under the Kyoto Protocol. The Protocol does include emission targets for 4 countries not listed under Annex I (Croatia, Liechtenstein, Monaco, and Slovenia). Collectively, the 39 Parties (38 countries plus the European Union) with specific emissions targets under the Kyoto Protocol are referred to as “Annex B Parties,” because their targets are specified in Annex B of the Protocol.

[34] Annex A of the Kyoto Protocol lists all the sector and source categories for all greenhouse gas emissions covered under the agreement.

[35] Article 3.3 of the Kyoto Protocol allows Annex I Parties to count toward their emission targets net changes in greenhouse gas emissions resulting specifically from afforestation, reforestation, and deforestation since 1990. Article 3.4 leaves the door open for the inclusion of other land use and forestry activities that release (emit) or remove (uptake) greenhouse gases.

[36] The Kyoto Protocol emission targets are based on the average of emissions between 2008 and 2012 (the first commitment period). Because 2010 is the midpoint of the first commitment period, it is commonly used as the reference year for calculating emissions reductions under the Kyoto agreement.

[37] Energy 21 is the action plan the Danish government put forward in 1996 to achieve by 2005 a 20-percent reduction in its total carbon dioxide emissions from their 1988 level. See web site [www.ens.dk/uk/index.asp](http://www.ens.dk/uk/index.asp) for further details on Danish energy policy and reforms.

[38] As of September 2000, the six participant governments in the Prototype Carbon Fund were Canada, Finland, the Netherlands, Norway, Sweden, and the Japan Bank for International Cooperation.

[39] Energy Information Administration, International Energy Annual 1999, DOE/EIA-0219(99) (Washington, DC, January 2001).

[40] Projections for West Germany and later unified Germany have been removed from the values considered here because of the lack of continuity in the coal data series after reunification.