

annexes

Annex I. Matrix of Energy and the Millennium Development Goals

| Goal | IMPORTANCE OF ENERGY TO ACHIEVING THE GOALS Some Direct and Indirect Contributions |
|---|--|
| 1) Extreme poverty and hunger <ul style="list-style-type: none"> ■ To halve, between 1990 and 2015, the proportion of the world's people whose income is less than one dollar per day. ■ To halve, between 1990 and 2015, the proportion of people who suffer from hunger. | <ul style="list-style-type: none"> ■ Access to affordable energy services from gaseous and liquid fuels and electricity enables enterprise development. ■ Lighting permits income generation beyond daylight hours. ■ Machinery increases productivity. ■ Local energy supplies can often be provided by small scale, locally owned businesses creating employment in local energy service provision and maintenance, fuel crops, etc. ■ Privatisation of energy services can help free up government funds for social welfare investment. ■ Clean, efficient fuels reduce the large share of household income spent on cooking, lighting, and keeping warm (equity issue – poor people pay proportionately more for basic services). ■ The majority (95 percent) of staple foods need cooking before they can be eaten and need water for cooking. ■ Post-harvest losses are reduced through better preservation (for example, drying and smoking) and chilling/freezing ■ Energy for irrigation helps increase food production and access to nutrition. |
| 2) Universal primary education <ul style="list-style-type: none"> ■ To ensure that, by 2015, children everywhere will be able to complete a full course of primary schooling. | <ul style="list-style-type: none"> ■ Energy can help create a more child friendly environment (access to clean water, sanitation, lighting, and space heating/cooling), thus improving attendance at school and reducing drop out rates. ■ Lighting in schools helps retain teachers, especially if their accommodation has electricity ■ Electricity enables access to educational media and communications in schools and at home that increase education opportunities and allow distance learning ■ Access to energy provides the opportunity to use equipment for teaching (overhead projector, computer, printer, photocopier, science equipment). ■ Modern energy systems and efficient building design reduces heating/ cooling costs and thus school fees, enabling poorer families greater access to education. |
| 3) Gender equality and women's empowerment <ul style="list-style-type: none"> ■ Ensuring that girls and boys have equal access to primary and secondary education, preferably by 2005, and to all levels of education no later than 2015. | <ul style="list-style-type: none"> ■ Availability of modern energy services frees girls' and young women's time from survival activities (gathering firewood, fetching water, cooking inefficiently, crop processing by hand, manual farming work). ■ Clean cooking fuels and equipment reduces exposure to indoor air pollution and improves health. ■ Good quality lighting permits home study and allows evening classes. ■ Street lighting improves women's safety. ■ Affordable and reliable energy services offer scope for women's enterprises. |
| 4) Child mortality <ul style="list-style-type: none"> ■ To reduce by two thirds, between 1990 and 2015, the death rate for children under the age of five years. | <ul style="list-style-type: none"> ■ Indoor air pollution contributes to respiratory infections that account for up to 20 percent of the 11 million deaths in children each year (WHO 2000, based on 1999 data). ■ Gathering and preparing traditional fuels exposes young children to health risks and reduces time spent on child care. ■ Provision of nutritious cooked food, space heating, and boiled water contributes towards better health. ■ Electricity enables pumped clean water and purification. |
| 5) Maternal health <ul style="list-style-type: none"> ■ To reduce by three quarters, between 1990 and 2015, the rate of maternal mortality. | <ul style="list-style-type: none"> ■ Energy services are needed to provide access to better medical facilities for maternal care, including medicine refrigeration, equipment sterilisation, and operating theatres. ■ Excessive workload and heavy manual labour (carrying heavy loads of fuelwood and water) may affect a pregnant woman's general health and well being. |
| 6) HIV/AIDS, malaria and other major diseases. By 2015, to have halted and begun to reverse: <ul style="list-style-type: none"> ■ the spread of HIV/AIDS ■ the scourge of malaria ■ the scourge of other major diseases that afflict humanity. | <ul style="list-style-type: none"> ■ Electricity in health centres enables night availability, helps retain qualified staff, and allows equipment use (for example, sterilisation, medicine refrigeration). ■ Energy for refrigeration allows vaccination and medicine storage for the prevention and treatment of diseases and infections. ■ Safe disposal of used hypodermic syringes by incineration prevents re-use and the potential further spread of HIV/AIDS. ■ Energy is needed to develop, manufacture, and distribute drugs, medicines, and vaccinations. ■ Electricity enables access to health education media through information and communications technologies (ICT). |
| 7) Environmental sustainability <ul style="list-style-type: none"> ■ To stop the unsustainable exploitation of natural resources; and ■ To halve, between 1990 and 2015, the proportion of people who are unable to reach or to afford safe drinking water. | <ul style="list-style-type: none"> ■ Increased agricultural productivity is enabled through the use of machinery and irrigation, which in turn reduces the need to expand quantity of land under cultivation, reducing pressure on ecosystem conversion. ■ Traditional fuel use contributes to erosion, reduced soil fertility, and desertification. Fuel substitution, improved efficiency, and energy crops can make exploitation of natural resources more sustainable. ■ Using cleaner, more efficient fuels will reduce greenhouse gas emissions, which are a major contributor to climate change. ■ Clean energy production can encourage better natural resource management, including improved water quality. ■ Energy can be used to purify water or pump clean ground water locally, reducing time spent collecting it and reducing drudgery. |

Source: DFID, 2002.

Annex II. Energy Units, Conversion Factors, and Abbreviations

TABLE A1. ENERGY CONVERSIONS*

| To: | Terajoule (TJ) | Gigacalorie (Gcal) | Megatonne oil (equiv) (Mtoe) | Million British thermal units (Mbtu) | Gigawatt-hour (GWh) |
|--------------------------------------|-------------------------|--------------------|------------------------------|--------------------------------------|------------------------|
| From: | Multiply by: | | | | |
| Terajoule (TJ) | 1 | 238.8 | 2.388×10^{-5} | 947.8 | 0.2778 |
| Megatonne oil (equiv) (Mtoe) | 4.1868×10^4 | 10^7 | 1 | 3.968×10^7 | 11,630 |
| Million British thermal units (Mbtu) | 1.0551×10^{-3} | 0.252 | 2.52×10^{-8} | 1 | 2.931×10^{-4} |
| Gigawatt-hour (GWh) | 3.6 | 860 | 8.6×10^{-5} | 3,412 | 1 |

* IEA figures. Additional conversion figures available at <http://www.iea.org/stat.htm>

TABLE A2. UNIT PREFIXES

| | |
|---|--------------------|
| k | kilo (10^3) |
| M | mega (10^6) |
| G | giga (10^9) |
| T | tera (10^{12}) |
| P | peta (10^{15}) |
| E | exa (10^{18}) |

TABLE A3. ASSUMED EFFICIENCY IN ELECTRICITY GENERATION (FOR CALCULATING PRIMARY ENERGY)

| Type of power | Assumed efficiency |
|----------------|--------------------|
| Nuclear power | .33 |
| Hydroelectric | 1.00 |
| Wind and solar | 1.00 |
| Geothermal | .10 |

TABLE A4. ABBREVIATIONS

| | |
|-----------------|---------------------------|
| CO ₂ | Carbon dioxide |
| H ₂ | Hydrogen |
| GWe | Gigawatt electricity |
| GWth | Gigawatt thermal |
| MWe | Megawatt electricity |
| TWh | Terawatt - hour |
| GJ | Gigajoule |
| PJ | Petajoule |
| EJ | Exajoule |
| Gtoe | Gigatonnes oil equivalent |
| ha | hectare |
| km ² | square kilometre |
| t | tonne |

contributor bios

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José Roberto Moreira has been Executive Director of the Biomass Users Network, a nongovernmental organisation dealing at the international level with rational use and production of biomass, since 1992, when he also started NEGAWATT, a private company providing engineering consulting activities in the area of energy generation and/or consumption. He previously was Director of CESP, the major electric utility of the State of São Paulo (1983 – 1987), and Undersecretary of Energy at the Ministry of Mines and Energy (1985 – 1986) when PROCEL, the national electricity conservation program, was launched. He has worked in academia (Princeton University and University of São Paulo) and as manager at COALBRA, a state enterprise.

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