The role of energy in achieving the environment
Millenium Development Goals

Acronyms................................................................................................................... 2

Chapter 1 Introduction ............................................................................................ 4
  1.1 Energy........................................................................................................... 4
  1.2. Environment and Millenium development goals (MDGs) [NEW]............. 6

Chapter 2 Challenges in the environment related to MDGs [new] ............... 8
  2.1 Environmental situation in the world........................................................... 8
  2.2 Main problems ......................................................................................... 11
  2.3 Methodological issues not addressed in MDG7 ....................................... 13
  2.4 Environment sector and limits to successful achievement ..................... 14

Chapter 3 Opportunities for energy interventions ........................................... 15
  3.1 Energy and the MDGs ................................................................................ 15
  3.2 How is energy a concept related to the environment [ NEW] .................... 17

Chapter 4 Possibilities to use energy [unchanged]........................................... 18
  4.1 Traditional energy: definition and characteristics...................................... 18
  4.2 Traditional fuels and poverty: moving up the energy latter...................... 18
  4.3 Energy efficiency and energy conservation.............................................. 20

Chapter 5 Implications of energy planning in the development sector .......... 21
  5.1 Political implications ................................................................................ 22
  5.2 Economic implications ............................................................................. 23
  5.3 Social implications: How do energy services shape the society? ............ 24

Chapter 6 Cross sectoral linkages ..................................................................... 25
  6.1 Energy and gender [unchanged] ................................................................. 25
  6.2 Environmental issues and impact on gender [NEW] .................................. 28
  6.3 Empowering women with environment and energy interventions [NEW] 29
  6.4 Energy environment and other development sectors [NEW] .................. 30
  6.5 Environment and multi sectoral planning procedures [NEW] .................. 32

Chapter 7 Selection criteria and environmental interventions [NEW] .......... 34

Chapter 8 Framework for energy sensitive project [unchanged] ................. 36
  8.1 Problem analysis and logical framework ................................................... 36
  8.2 The problem tree analysis ....................................................................... 37

Chapter 9 Future challenges: poverty, environment and renewable energy ... 39

Appendix................................................................................................................. 43

Further readings : selected bibliography and websites................................. 47

Final Draft, 12 October 2007
Acronyms

AFDB African Development Bank Group
CDIAC Carbon Dioxide Information Analysis Center
CFC ChloroFluoroCarbons
CILSS Comite Permanent Inter-Etats De Lutte Contre La Secheresse Dans Le Sahel
$\text{CO}_2$ Carbon dioxide
COP Conference of the Parties
DFID UK Department for International Development
DGIS Netherlands Ministry of Foreign Affairs
ECA United Nations Economic Commission for Africa
ECOWAS Economic Commission of West Africa States
EIA Environmental impact assessment
EU European Union
FAO United Nations Food and Agriculture Organization
GDP Gross Domestic Product
GEF Global Environment Facility
GEF/SGP Global Environment Facility’s Small Grants Programme
GHG Greenhouse gases
GTZ German Agency for Technical Cooperation
HDI Human Development Initiative
International Energy Agency International Energy Agency
ILO International Labour Organisation
LDCs Least Developed Countries
LPG Liquefied Petroleum Gas
MA Millennium Ecosystem Assessment synthesis report
MDG Millennium Development Goal
MDGR Millennium Development Goals Report
MDGs Millennium Development Goals
NGO Non-governmental organisation
NORAD Norwegian Agency for Development Cooperation
PPP Purchasing Power parity
PRS Poverty Reduction Strategy
PRSP Poverty Reduction Strategy Paper
PV Photovoltaic  
SGP Small Grants Programme  
SHD Sustainable Human Development  
SIDA Swedish International Development Cooperation Agency  
SSA Sub-Saharan Africa  
**SWOT analysis** Strength Weaknesses, Opportunities and Threats  
UNCTAD United Nations Commission for Trade and Development  
UNDP United Nations Development Programme  
UNEP United Nations Environment Programme  
UNESCO United Nations Educational, Scientific and Cultural Organization  
UNF United Nations Foundation  
UNFCCC United Nations Framework Convention on Climate Change  
UNIDO United Nations Industrial Development Organization  
WB World Bank  
WHO World Health Organization  
WSSD World Summit on Sustainable Development
Chapter 1 Introduction

Objective: Master the key definitions and concepts and introduction to relationships between energy, environment and the MDGs

Key concepts and learning goals:
- Energy definition
- Different forms of energy
- Energy chain and energy services
- Defining environment and relationships with MDGs
- MDG 7 (Environment): target and indicators

1.1 Energy

The energy sources or primary energy can be split into three broad categories: fossil fuels, renewable sources, and nuclear sources. There are many types of fossil fuels of which the most important are coal, petroleum, and natural gas. The main renewable energy sources are solar, wind, hydropower, biomass, and geothermal power. The nuclear-powered sources are fission and fusion.

**Fossil fuels:**
Fossil fuels have been widely used since the Industrial Revolution just before the dawn of the 20th century. They are relatively easy to use to generate energy because they only require a simple direct combustion. However, a problem with fossil fuels is their environmental impact. Indeed their combustion leads to a great deal of greenhouse gas emissions particularly in the case of coal.

**Renewable energy sources:**
The most important of these sources are hydropower, solar, wind and biomass. Renewable energy sources' main assets are their environmental cleanliness, low maintenance and running costs compared with fossil fuels and they cannot be exhausted. Major constraints so far are their high investment cost compared with fossil fuels. In light of increased fossil fuels prices and environmental concerns, renewable energy are becoming more and more attractive.

Renewable energy technologies encompass a diverse array of technologies, and the current status of these different technologies varies considerably. Some technologies are already mature and economically competitive (e.g. geothermal and hydropower), other technologies need additional development steps to become competitive without subsidies.
Costs of renewable energy technologies

<table>
<thead>
<tr>
<th>Energy</th>
<th>2001 energy costs</th>
<th>Potential future energy cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electricity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind</td>
<td>4-8 ¢/kWh</td>
<td>3-10 ¢/kWh</td>
</tr>
<tr>
<td>Solar photovoltaic</td>
<td>25-160 ¢/kWh</td>
<td>5-25 ¢/kWh</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>12-34 ¢/kWh</td>
<td>4-20 ¢/kWh</td>
</tr>
<tr>
<td>Large hydropower</td>
<td>2-10 ¢/kWh</td>
<td>2-10 ¢/kWh</td>
</tr>
<tr>
<td>Small hydropower</td>
<td>2-12 ¢/kWh</td>
<td>2-10 ¢/kWh</td>
</tr>
<tr>
<td>Geothermal</td>
<td>2-10 ¢/kWh</td>
<td>1-8 ¢/kWh</td>
</tr>
<tr>
<td>Biomass</td>
<td>3-12 ¢/kWh</td>
<td>4-10 ¢/kWh</td>
</tr>
<tr>
<td><strong>Heat</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geothermal heat</td>
<td>0.5-5 ¢/kWh</td>
<td>0.5-5 ¢/kWh</td>
</tr>
<tr>
<td>Biomass - heat</td>
<td>1-6 ¢/kWh</td>
<td>1-5 ¢/kWh</td>
</tr>
<tr>
<td>Low temp solar heat</td>
<td>2-25 ¢/kWh</td>
<td>2-10 ¢/kWh</td>
</tr>
</tbody>
</table>

All costs are in 2001 $-cent per kilowatt-hour.
Source: World Energy Assessment, 2004 update

**Nuclear energy**

Nuclear power is interpreted as the utilization of the fission reactions in a nuclear power reactor to produce steam for electric power production, for ship propulsion, or for process heat. The use of nuclear power to generate electricity began in the late 1950s. Nuclear power remains the most controversial of all energy sources. The main benefit is the use of nuclear power in place of coal, oil, and natural gas to greatly reduce emissions of carbon dioxide, which is believed to be a factor in global warming. However, extremely high costs of nuclear power plants, reactor safety and disposal of highly radioactive wastes are key constraints. In Africa, South Africa is the only country with nuclear power facility.

**Energy services and poor people needs**

The energy sources or primary energy described above are only the vectors to supply energy energy services. Access to energy services is essential for sustainable development and poverty eradication. The energy services approach means planners have to be much more aware of the social and economic circumstances of the target group which should easily link to taking poverty into account. The diagram below shows the links between energy sources or primary energy and energy services.
1.2. Environment and Millenium development goals (MDGs) [NEW]

On September 2000, 191 countries adopted a resolution at the United Nations General Assembly called the Millenium Declaration. The MDGs are derived from this declaration. Most of the goals and targets were set to be achieved by 2015 on the basis of the global situation during the 1990s.

The main purpose is a vision for the future, a world with less poverty, hunger and disease, better health and education, equal opportunities for women, a healthier environment and a world in which developed and developing countries work in partnership for the betterment of all. The Millenium Development Goals, or MDGs, are an integrated set of eight goals and 18 time-bound targets to be reached by 2015.

**Exercise 1.1**

Identify in your country the main energy sources or primary energy sources. What secondary energy are using poor people to meet their energy services. Are all social groups (poor, middle income, high income) using the same secondary energy? What energy policy do you suggest to improve the livelihood of poor people
In order to fulfill the seventh millennium development goal, to ensure environmental sustainability, conventional approaches to energy must be reoriented. The use of cleaner fuels and improved energy efficiency can ensure a wiser use of natural resources while reducing emissions and respecting the local and global environment. Environmental sustainability is fundamental to achieving all of the Millennium Development Goals.

Defining the environment and the MDGs

**Environment is a broad concept.** It's everything that makes up our surroundings and affects our ability to live on the earth such as air pollution, deforestation, the quality of water that covers most of the earth's surface, biodiversity (plants and animals) etc. For our purpose, environment is defined in relationship with energy and the MDGs. Increasing energy consumption within current energy sources and technologies is already endangering local and global environment.

The key question is how to meet world energy requirements and ensure environmental sustainability which is MDG 7. It encompasses three targets and seven indicators (see appendix). The relationship between environment is summarised under target 9 and the five associated indicators (table below).

<table>
<thead>
<tr>
<th>MDG 7 Ensure environment sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Target 9 Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources</strong>“.</td>
</tr>
<tr>
<td>25. Proportion of land area covered by forest</td>
</tr>
<tr>
<td>26. Ratio of area protected to maintain biological diversity to surface area</td>
</tr>
<tr>
<td>27. Energy use (kilograms of oil equivalent) per $1 GDP</td>
</tr>
<tr>
<td>environmental resources</td>
</tr>
<tr>
<td>28. Carbon dioxide emissions per capita and consumption of ozone-depleting chlorofluorocarbons</td>
</tr>
<tr>
<td>29. Proportion of population using solid fuels</td>
</tr>
</tbody>
</table>

Only a limited number of developing countries have set indicators for this target as illustrated by the following chart.

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2 There are two other targets access to safe drinking water under MDG 7 (access to safe drinking water; improvement in the lives of at least 100 million slum dwellers) which have only indirect links with energy (see appendix). These two targets will not be addressed in this module.
To ensure environmental sustainability, conventional approaches to energy must be reoriented. The use of cleaner fuels, improved energy efficiency, energy conservation, renewable energy etc. can ensure a wiser use of natural resources while reducing emissions and respecting the local and global environment.

Chapter 2 Challenges in the environment related to MDGs [new]

Objective: Understand the world environmental situation, key issues and challenges

Key concepts and learning goals:
- World environmental situation
- Greenhouse gas emission
- Deforestation
- What is global warming
- Climate change, and impact on poor countries
- Institutional framework and its limits
- Methodological issues not addressed in MDG7
- Environment sector and limits to achieve success

2.1 Environmental situation in the world

Deforestation and greenhouse gas emissions are good indicators to assess world wise the environmental situation

2.1.1 Greenhouse gas emissions: past, current situation and prospects

Globally, greenhouse gas emissions increased more than four-fold in the last half of the twentieth century and they are still growing.
Rising demand will drive up CO2 Emissions. Global energy-related emissions of carbon dioxide will grow slightly more quickly than primary energy demand. They are projected to increase by 1.8% per year from 2000 to 2030 in the Reference Scenario, reaching 38 billion tonnes in 2030. This is 16 billion tonnes, or 70% more than today. Two-thirds of the increase will come in developing countries. Power generation and transport will account for about three-quarters of new emissions.

The geographical sources of new emissions will shift drastically, from the industrialised countries to the developing world. The developing countries’ share of global emissions will jump from 34% now to 47% in 2030, China alone will contribute a quarter of the increase in CO2 emissions, or 3.6 billion tonnes, bringing its total emissions to 6.7 billion tonnes per year in 2030. Even then, however, Chinese emissions remain well below those of the United States.

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Energy efficiency (cf module energy and poverty) is a key indicator to assess the performance of the relationship between the economy and energy use. According to the UN MDGs report, efficiency has increased although globally CO₂ emissions continue to rise. However as far as energy efficiency is concerned, the performance in Sub-Saharan Africa, over the period 1990-2003, remains very poor as illustrated by the following diagram.

![Energy efficiency diagram](image)

Source UN MDGs report,

2.1.2 Deforestation

According to the UN MDG report, deforestation continues but the net loss of areas is slowing down. Most of sub-saharan Africa has experienced sharp deforestation during the last three decades. The main causes of deforestation are conversion of forests to
agricultural land, over grazing and the lack of affordable fuel substitutes for cooking such as LPG. Land degradation is one of the major causes of rural poverty, as well as one of its effects. This is particularly the case in the arid and semi-arid regions that account for well over 40% of the Earth’s potentially productive land. Poverty remains the overarching constraint to a strategy aimed at sustainable management of forests.

2.2 Main problems

Climate change and its impact on developing countries
There is a broad-based agreement within the scientific community that the Earth’s climate is changing due to human activities that produce emissions of greenhouse gases, principally carbon dioxide. The burning of fossil fuels and non sustainable use of forests, are contributing to a higher concentration of greenhouse gases, global warming as a result

Proportion of land area covered by forests, 1990 and 2005 (Percentage):

Source: UN MDGs report.
impacting on climate change. The definition of the greenhouse effect is a warming of the lower atmosphere and surface of a planet by a complex process involving sunlight, gases, and particles in the atmosphere. The ‘greenhouse’ effect received its name from the similarities it has to the effect that happens in a greenhouse. A greenhouse is a small glass house that lets the sunlight in and doesn’t let the heat escape, usually to keep plants warm in winter or to grow tropical fruits and plants.

When fossil fuels are burnt they release carbon dioxide (CO2) into the atmosphere. Increased levels of CO2 are contributing to the “greenhouse effect”, which causes climate change. The greenhouse effect is a natural process, which involves the warming up of air trapped in the Earth’s atmosphere; without it, we would freeze. The temperature of the air around the globe is gradually rising because less heat energy is able to escape because of this build up of greenhouse gases. (see also diagram in appendix: global warming, causes and effects)

The impacts of climate change could, in the longer term, be substantial. Many millions more people exposed to hunger, water stress and flooding. Additionally, low-lying areas, wetlands and small islands will be exposed to risks from rising sea levels, especially in South East Asia. There will be irreversible losses of biodiversity.

The burden of environmental degradation falls disproportionately on developing countries that are limited in their capacity to respond to climate change and depend on environmentally sensitive activities such as agriculture and fishery. The poor, especially in rural areas, depend on biodiversity for food, shelter, medicines and livelihoods.

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4 World Book Encyclopaedia, 2000, V 8, p 382
Reliable energy services are essential to growth and development, but current patterns of energy production and consumption threaten the environment and as a result biodiversity on local and global scales.

**Institutional framework and its limits**

The UN Framework Convention on Climate Change (UNFCC) was agreed at the Earth Summit in Rio de Janeiro in 1992 and, five years later, the Kyoto Protocol was agreed. In 2004 September, Russia accepted it making the protocol legally binding internationally. This committed developing countries to targets that should reduce their emissions of a basket of six greenhouse gases to below 1990 levels over the period 2008-2012. However, not all developed countries ratified it, particularly the USA the biggest CO2 producer in the world; even amongst those countries that did, greenhouse gas emissions have continued to grow.

**2.3 Methodological issues not addressed in MDG7**

Target 9 is worded in a broad and qualitative way. It is therefore not quantifiable nor time-bound. The Target addresses the “integration of the principles of sustainable development into country policies and programmes” and separately it calls for the reversal in “the loss of environmental resources”. These are very different elements requiring different strategies, policies, and practices at the global, national, and sub-national levels.

The Target addresses the need for global and national indicators, but national indicators are most important in making decisions within a country. The Target applies to all countries – meaning all countries have important natural resources and all countries can monitor the quantity, quality, usefulness, and value of those resources at different scales. Two examples will illustrate the methodological limit of target 9 and two key indicators: forest cover and energy use.

a- Forest cover: current MDG indicator: proportion of land covered by forest (indicator 25)

There is currently no difference made between plantation forests and old growth forest. Additional indicators are needed to reflect forest quality and at least one of six elements of sustainable forest management: biological diversity; forest health and vitality; protective functions; productive functions; socio-economic functions; legal, policy and institutional framework.

For instance at national level national indicators can be expanded to include area under sustainable forest management. This is an important component of energy strategy for many sub-Saharan countries which is not taken into consideration in the MDGs nor eligible for carbon credit.
b- Energy use  Current MDG indicator: Energy use per unit of PPP\(^5\) (Indicator 27)

This indicator is restricted to a measure of energy efficiency. The indicator does not tell us anything useful about the sources of energy – coal, wind, oil, etc. and therefore does not indicate potential environmental impacts. In addition the heterogeneity in energy intensity among the sectors is so large that unless disaggregated by sector, the indicator can be misleading.

Energy is related to all aspects of MDGs, It can be emphasized in its relation to poverty reduction, to consumption, and to environmental sustainability. These linkages are currently not captured:. The current three energy-related indicators (among the 48 indicators) are solely grouped under MDG 7. They therefore provide a limited basis for devising a policy response at the national level.

The lack of data at the national level presents a major challenge. In about half of the national MDG reporting, energy-related indicators are left blank, due to the lack of data. However even incomplete data or data with some margin of errors (as long as they are clearly so stated) can provide a starting point for policy debates, a better situation compared with no reporting. For example, in the case of the use of solid fuels, reporting on traditional biomass use should be a good starting point.

2.4 Environment sector and limits to successful achievement

Undoubtedly since the first Earth Summit held in Rio in 1992, a great deal has been achieved with respect to tackling environment key issues such as global warming, deforestation, penetration of renewable energy, energy efficiency and conservation etc.

a- However world wide the situation has also evolved and energy consumption of fossil fuels has dramatically increased particularly to meet domestic, industrial and transportation needs of new big emerging countries such as China, India, Brazil. China and India listed under Kyoto as Annex II, are not yet required to cut their emissions. Given the low level of oil consumption per head, it is very likely that for the next couple of decades the consumption in these countries will continue to increase to meet the development targets and consequently the emissions of greenhouse gas emissions will continue to raise.

b- The United States are the biggest energy consumer and producer of GHG. According to the UNFCC The U.S. alone produces about 25% of the world's greenhouse gases. The US pollutes more, absolutely and per head, than any other country. Overall, total U.S. emissions have risen by 15.8 percent from 1990 to 2004\(^6\). In 2004, total U.S. greenhouse gas emissions were 7,074.4 Tg CO\(_2\) Eq.

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\(^5\) A purchasing power parity exchange rate equalizes the purchasing power of different currencies in their home countries for a given basket of goods. These special exchange rates are often used to compare the standards of living of two or more countries. The adjustments are meant to give a better picture than comparing gross domestic products (GDP) using market exchange rates.

\(^6\) Source UNFCC, national report USA, executive summary
http://yosemite.epa.gov/OAR/globalwarming.nsf/UniqueKeyLookup/RAMR6MBLP4/$File/06ES.pdf
Carbon Dioxide Emissions of the three biggest polluters:  (source UNFCC quote by http://www.vexen.co.uk/USA/pollution.html)

<table>
<thead>
<tr>
<th>Population of world:</th>
<th>The USA</th>
<th>EU Countries</th>
<th>China</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>% to World economy:</td>
<td>4.6%</td>
<td>6.3%</td>
<td>21%</td>
<td>31.9%</td>
</tr>
<tr>
<td>CO₂ Emissions:</td>
<td>24%</td>
<td>14%</td>
<td>13%</td>
<td>51%</td>
</tr>
</tbody>
</table>

In an agreement known as the Kyoto Protocol, most industrialized countries have agreed to cut their greenhouse gas emissions. The Kyoto Protocol determined that the USA were to cut their 1990 emissions by 7% by 2012. Unfortunately, the United States pull out from treaty in March 2001 and refuses to ratify the Kyoto Protocol to protect the domestic economy and particularly the energy sector and industries which heavily rely on fossil fuels to maintain their competitiveness world wide.

C- Nuclear energy is increasingly considered as an important option to cut greenhouse gas emissions despite nuclear waste disposal has not yet been sorted out. Such an option may lead to hampering the growth of decentralised renewable energy such as micro and small hydro power, solar, wind etc. which are more suitable for developing countries particularly Sub-Saharan Africa which will continue to rely on a large scale on fossil fuels and non sustainable biomass for their energy needs. To revert this trend major investment and technology is needed in renewable energy.

Chapter 3 Opportunities for energy interventions

Objective: Understand the relationships between energy, environment and MDGs; understand and shape energy interventions to address key issues

Key concepts and learning goals:

- Relationships energy and MDGs
- Energy and Human development index, Energy and GDP
- Energy and environment

3.1 Energy and the MDGs

Energy is not a goal as such but its input is crucial to reaching most of the millenium development goals. There is a strong correlation between energy and human development as illustrated by the following chart:

Energy consumption and Human development index in selected African countries
Excise 3.1  Using the concepts of the GDP and the HDI, rank your country. What are the key differences between the two concepts and how each concept is related to poverty?

**Electricity** is needed to power small industry and enterprise, run health clinics and light schools. Without it, rural poverty will not be eradicated. There is also an urgent need to address the continuing dependence on biomass for domestic energy, both to reduce the amount of time spent collecting fuel and to improve health. Respiratory infections caused by smoke pollution cause 1.8 million deaths each year.

Meeting the millennium development goals and targets will therefore require a huge increase of energy consumption for income generation and social services. Poverty eradication, reduction of child and maternal mortality and environment protection (MDGs 1, 4, 5 and 7) imply a wider energy access and the penetration of modern forms of energy (electricity for health centers and schools, energy for agro-processing, cleaner fuels households). Although energy is not a goal, there is a set of energy indicators to measure the environmental sustainability (MDG7, target 9).

**Environmental sustainability and energy indicators**

**Goal 7 Ensure Environmental sustainability**

Target 9. Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources

- Land area covered by forest, percentage
- Protected areas, sq. km.
- Protected area to total surface area, percentage
- Energy use (Kg oil equivalent) per $1,000 (PPP) GDP
- Consumption of ozone-depleting CFCs in ODP metric tons
- Carbon dioxide emissions (CO2), thousand metric tons of CO2
- Consumption of all Ozone-Depleting Substances in ODP metric tons
- Population using solid fuels
For instance if we consider the population using solid fuels, it is obvious that energy pattern of consumption is impacting on environment sustainability (Goal 7). Most sub-Saharan (SSA) countries rely heavily on biomass (firewood, charcoal, agro-residues) to meet their basic energy needs. As a result the forest cover has decreased from 29.3% in 1990 to 27.1% in 2000. Average deforestation remains constant at 1% over the decade, in SSA some countries lost up to 33% of their forest cover over the same period. Only 8 African countries will meet their MDGs targets with respect to forest sustainability out of which only two countries (Gambia and to a lesser extent Swaziland) with an energy consumption pattern in which biomass is the main household fuel. This means in all other SSA sustainable management of forests will remain a key issue and challenge.

| Exercise 3.2 |
| What main energy services are currently used in the agriculture, health sector? |
| How modern energy services in your country can contribute to achieving the MDGs? |

### 3.2 How is energy a concept related to the environment [NEW]

#### 3.2.1 Energy production, transformation consumption

Energy production, transformation consumption and recycling are closely linked to environment. The 2002 Earth Summit held in Johannesburg recognized public access to modern energy services as one of the necessary conditions for meeting the MDGs. In the MDG7, there are several indicators under target 9 which are specific to the energy sector.

| Goal 7 Ensure Environmental sustainability |
| Target 9. Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources |
| Land area covered by forest, percentage |
| Energy use (Kg oil equivalent) per $1,000 (PPP) GDP |
| Carbon dioxide emissions (CO2), thousand metric tons of CO2 (CDIAC) |
| Population using solid fuels |

#### 3.2.2 Forests

Forests are an important resource that support both national economic development as well as the subsistence needs of rural people. Forests also have many important ecological benefits, including the protection of soil and watersheds from erosion, as habitat for flora and fauna, the maintenance of biological diversity, and for hydrological and climatological stability.

In Sub-Saharan countries the traditional use of biomass, often supplied from non sustainable forest resources represents more than 70% of household energy. This trend is contributing not only to deforestation particularly around major urban areas but also to indoor air pollution mainly affecting women and children. **Management of natural resources** demands efficient and reasonable use of fossil fuels, sustainable biomass
management as well as increased use of renewable resources (solar, wind, hydropower, etc.).

3.23 The majority of the two billion people who do not have access to modern energy services live in rural areas increasing therefore the impact on local eco systems. Meeting their energy needs is hindered by low population density and the dispersion of rural populations, particularly in sub Sahara Africa. In addition regulatory and legal frameworks are often poorly adapted to rural areas. Reliable technical solutions now exist for decentralised energy production particularly from renewable energy. For instance decentralised service companies, delegated management of public services in rural areas, have been developed to take account of the needs of civil society. Decentralised service companies (SSD) which guarantee electricity in homes for 10 years are being Implemented on a wide scale in many countries among them South Africa, Mali Morocco benefiting several hundred thousands of 200,000 people.

Chapter 4 Possibilities to use energy [unchanged]

Objective: Understand the concepts and contents of traditional energy, renewable energy and linkages with poverty

Key concepts and learning goals:
- Traditional energy: definition and characteristics
- Energy efficiency and energy conservation
- Energy ladder
- Renewable energy

4.1 Traditional energy: definition and characteristics
The concept and definition of traditional energy may differ according to the context. Very often in developed countries, traditional energy is a reference to fossil fuels which are currently commonly used and accounting for the bulk of the energy consumption. In this case the concept of traditional energy is defined by comparison with renewable energy and nuclear power which are considered as new forms of energy.

In developing countries, traditional energy are those energies derived from wood such as firewood, charcoal but also agro residues and animal waste. The concept of traditional energy is defined by comparison with conventional energy such as petroleum products (LPG, kerosene, mineral coal etc.).

4.2 Traditional fuels and poverty: moving up the energy latter:

The marginalisation of the traditional energy services
Energy sector planning in many countries of Sub-Saharan Africa shows that traditional fuels, although they occupy a dominant place in the overall energy balance and in the consumption of households, have received little attention and investments from the policy makers. Moreover, traditional energy were not accounted for in energy balances.
Although many countries have now made efforts to show the whole picture of the energy sector, data from the traditional energy sector are not very accurate and little efforts are devoted to put in place a sustainable information system.

The basic energy requirements are mainly for cooking, lighting and space heating. Cooking needs are mainly met by traditional fuels in the rural areas, but also to a large extent in many urban areas. The importance of traditional energy (fuelwood and charcoal) in terms of total energy consumption is significant. In low-income countries such as Burkina Faso and Ethiopia, the household sector accounts for more than 80 percent of total energy consumption and projections call for this rate of consumption to continue into the 21st century. Most traditional energy is used for household consumption (cooking and heating).

Energy services met by traditional fuels are very often of poor quality, less efficient and are associated with higher health risks compared with modern energy services. These parameters can be measured by the calorific value for each fuel and their impact on health. A basic definition of the calorific value of a fuel is the heat energy (calories or thermal units) contained in one unit of a substance and released when a certain quantity is burned. By and large modern fuels have higher calorific values and are cleaner than traditional fuels.

Solid fuels or biomass fuels are less efficient than oil, natural gas or propane. Solid fuels produce dramatically less heat for the amount of fuel consumed and produce dramatically more pollution. The dirtiest fuels such as grass and animal dung are at the bottom. Going up the ladder, step by step with wood, then coal, until the next most efficient type of fuel is used. Natural gas and propane are dramatically less polluting than solid or liquid fuels. Renewable energy such as wind, solar and hydropower are the cleanest forms of energy, as there is no combustion.

For the same energy service for instance, cooking, various forms of energy and equipment (firewood, charcoal, LPG, etc.) can be used. There is a strong correlation between the use traditional energy and poverty as illustrated by the energy ladder. The least attractive fuels are at the bottom of the ladder, and the most attractive fuels are at the top.
4.3 Energy efficiency and energy conservation

Efficient energy use, sometimes simply called energy efficiency, is using less energy to provide the same level of energy service. An example would be insulating a home to use less heating and cooling energy to achieve the same temperature. Another example would be installing fluorescent lights instead of incandescent lights to attain the same level of illumination. Efficient energy use is achieved primarily by means of a more efficient technology or process rather than by changes in individual behaviour.

Case study 1: electricity generation and efficiency: fossil fuels and renewables

The efficiency of generation varies widely with the technology used. In a traditional coal plant, for example, only about 30-35% of the energy in the coal ends up as electricity on the other end of the generator. The latest coal technology, known as integrated gasification combined cycle or IGCC, is capable of efficiency levels above 60%. The most efficient gas-fired generators achieve a similar level of efficiency. In renewable generation, efficiency is less of an issue for the simple reason that "fuels" like wind and sunlight are essentially inexhaustible and free. A typical wind turbine, for example, might achieve 45% efficiency in converting the physical force of the wind into electric power.

Case study 2 Transmission & Distribution

The transmission and distribution, or "T&D" system includes everything between a generation plant and an end-use site, i.e. a residential home or commercial business. Along the way, some of the energy supplied by the generator is lost due to the resistance of the wires and equipment that the electricity passes through. Most of this energy is converted to heat. Just how much energy is taken up as losses in the T&D system depends greatly on the physical characteristics of the system in question as well as how it is operated. Generally speaking, T&D losses between 6% and 8% are considered normal in developed countries.

Exercise 4.1

Considering the energy ladder and cooking, on average how do you position your country? Is there a difference between rural and urban areas? What are the main advantages and disadvantages when moving up the energy ladder?
It is possible to calculate what this means in monetary terms by looking at the difference between the amount of electric energy generated and the amount actually sold at the retail level.

**Energy conservation** is different to energy efficiency in that it involves using less energy to achieve a lesser energy service, and usually requires behavioural change. Examples would be heating a room less in winter, or driving less, or working in a less brightly lit room. As with other definitions, the boundary between efficient energy use and energy conservation can be fuzzy, but both are important in environmental and economic terms.

**Exercise 4.2**

*Most sub-Saharan countries are heavily dependent on non sustainable biomass energy such as firewood and charcoal to meet their basic household energy services. How can we improve the efficiency of the biomass sector? What impact should be expected from these interventions?*

**Chapter 5 Implications of energy planning in the development sector** [unchanged]

**Objective:** Understand the relationships between energy planning and political, economic, legal, social and environmental implications

**Key concepts and learning goals:**

- Political decentralisation and impact on energy sector
- Energy services and economic implications
- Energy services and the society
5.1 Political implications

Decentralisation and institutional reforms

Energy planning is only a component of a wider political, institutional economic and social framework. For the last couple of decades, most African countries were characterised by concentrated power in single-party national governments. Usually local governments were denied the power to tax and were left dependent on the central government for both their financing and their policies over roads, schools, energy services delivery etc. Centralisation and bureaucracy are therefore major constraints to the development of energy services taking into consideration the needs of the majority of the population particularly in rural areas. Centralised energy planning exercises cannot pay attention to the variations in socioeconomic and ecological factors of a region which influence success of any intervention. Political and institutional reforms are therefore pre-conditions for a wider access to modern energy services as illustrated by the following example.

Centralized and decentralized off grid rural electrification

Till late 90s, public utilities were the main operators. Centralisation, public monopoly on production transport and distribution of electricity and financial constraints meant that there was little incentive to reach decentralised populations. It is therefore very likely that peri urban centers will be grid connected in priority, then large villages not far from the national grid. Remote areas with small populations are likely to be the last to receive an electricity supply.

It is now conventional wisdom that utilities companies should concentrate on grid extensions to areas of high population density and to larger industries. Public utilities companies are still often given an obligation to supply low population and low potential demand areas. Reaching these target groups through conventional means led to heavy subsidies. This is a non-sustainable model which explains the very low rate of rural electrification. Involving the private sector will be more cost effective and will increase more rapidly the rural electrification rate. As a result, increasingly off grid rural electrification is being left to the private sector, through concessions, and para-statal independent agencies on household energy and rural electrification.

Exercise 5.1
The energy institutional framework involves a large number of stakeholders such as local authorities, communities, utilities, and government. In what ways, the impact of institutional reforms might be crucial on the livelihood of poor people.

7 This is particularly the case in North and West Africa
5.2 Economic implications

Economic preconditions to implement energy services?
The energy diagnosis in many sub-Saharan countries shows that access to modern energy services is limited to a minority of the population mainly in urban areas. Cost and to a lesser extent access influence the type of energy people use. As a consequence, poor people are at the bottom of the ladder using wood for cooking and even for lighting at night (see 4.2 Traditional fuels and poverty: moving up the energy latter). The key constraint with the transition up the ladder is, of course, that the attractive energy forms tend to be more expensive as well as the equipment required to use the energy.

For instance there is a sharp difference in the electrification rate between rural and urban areas. Apart from poverty which is also acute in urban areas, remoteness of rural populations are major constraints explaining the geographical differentiation regarding access to modern energy services. Although it is very often more costly to deliver services to isolated locations, there should be at national level a kind of perequation in order to widen energy service access to poor people, low density areas and remote locations. In many countries this is not the case as illustrated by the following ECOWAS example (see chart)

In order to mitigate deforestation, fuel switching policies have been implemented and subsidies granted to LPG. However such policies did not improve energy services access
for rural population because of the lower purchasing but also due to higher transportation costs which means that market prices in rural areas are much higher than in urban areas. Senegal which is often considered as a success story in West Africa regarding fuel switching. However urban populations were the main beneficiaries and for many years the heavily subsidised LPG benefitted middle and high income groups.

Exercise 5.2
In some instances, subsidies might be necessary to promote access to clean energy services. Do you know examples where such policies have been implemented. Who were beneficiaries? What was the economic impact of these policies?

5.3 Social implications: How do energy services shape the society?

In developed countries the energy consumption pattern does not differ dramatically according to the various social groups. For instance, cooking fuels and devices are not perceived as a social criterion in energy surveys. Although the challenge is not the same, energy and society in developed countries is also crucial issue. Indeed, lifestyles have a big influence on energy consumption. These social choices have a great impact not only on energy consumption but also on environment. For instance more people are traveling further by cars and planes often for leisure purposes increasing therefore the energy consumption and greenhouse gas emissions.

A similar trend exists also in Sub-Saharan Africa and needs to be addressed. However the big challenge lies in the types of energy services and technologies a the household level. People are generally observed to make the transition to modern, efficient stoves and clean fuels as soon as they are available and affordable. These technologies are preferred for their convenience, comfort, cleanliness, ease of operation, speed, and other attributes. Not only there is an increase in efficiency, but also moving up the energy ladder is associated with a higher social status.

Cooking is the single largest energy use in many developing countries. There is a well-established transition in cooking fuels associated with higher incomes, improved supply availability, and urbanization. In rural areas, and in poor urban households, traditional fuels (wood, crop wastes, and dung) are used in simple stoves. In more affluent households, people switch to modern stoves...
and clean, convenient fuels such as kerosene, Liquefied Petroleum Gases (LPG), and electricity. Because wood stoves are relatively inefficient, households that use kerosene or LPG can consume significantly less energy for cooking than those using wood and charcoal. Lighting technologies follow a similar technological progression, from candles or light from firewood in some rural areas, to kerosene and butane lamps, to electricity, which is a highly prized energy service. As in other sectors, there is a transition in transportation technologies. Walking and use of domesticated animals are the dominant transport technologies in poorer and rural areas. The next step up is bicycles, and then the internal combustion engine. Very often the type of energy services and devices is an indicator of the economic and social status. For instance when electricity is available, a new range of social services become available such as communication, information impacting on the social relationships within a community and between communities.

Exercise 5.3
It many rural areas access to electricity brings about a lot of social and economic changes. Based on a typical village, describe the social and economic changes after the village has been electrified. Domestic, social and productive activities should be considered.

Chapter 6  Cross sectoral linkages

Objective: Understand the relationships between energy and gender, energy and other development sectors (education, agriculture etc.)

Key concepts and learning goals:
- Energy services and gender
- Gender and energy planning
- Environmental issues and impact on gender
- Empowering women with environment and energy interventions
- Energy, environment and education
- Energy, environment and water
- Energy, environment and agriculture
- Environment and multi sectoral planning procedures

Energy is a key input to almost all sectors, domestic, transportation, industry, agriculture, social services such as education, health etc. Energy is also a cross cutting theme in which gender is being increasingly recognised as an issue in energy projects and programmes.

6.1 Energy and gender [unchanged]
6.1.1 Energy services and gender analysis

Gender analysis is not about looking at women alone. Gender analysis asks questions, in relation to men and women, about who is doing what, who owns what, who makes decisions about what and how, who gains and loses by a planned intervention. Gender analysis examines what is happening within the household and makes linkages with the different levels of the wider society.

The energy services approach means that it is not only the technology which is important but also other non-technical aspects such as affordability which can be a key issue for women whose assets are usually less than men’s. Innovative ways are needed to enable women’s access to the energy services they require. Training in the use of the technologies is also important to ensure equipment continues to function well and women should not be overlooked from these opportunities. Experiences in the water sector, have shown that women are more effective at hand pump maintenance than men, because it is women’s role to provide household water. Men do not see the necessity for them to mend drinking water pumps (irrigation pumps are a different matter!)

6.1.2 Specific needs [unchanged]

Energy needs at household level are directly related to women's workload and their time. Apart from cooking, grain processing is the major area of energy, where women spend a considerable time and labor that involves exhaustive physical exercise. In most of the developing countries, women are the ones involved in managing biomass fuels and food processing (like rice huskig, grinding grain, and so on) spending their own physical energy.

Women as the primary users and beneficiaries of household energy have expertise in local biomass resources including their properties as fuels and fuel-saving techniques. For instance, women can differentiate between those fuelwood species which burn fast with high heat and those, which burn in slow speed with low heat and those which smoke. Women are also the ones most affected by the energy crisis. For instance, the growing scarcity of firewood and other biomass resources add hours to a woman's workday.

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8 This section is largely based on material and manuals developed by Energia, the energy network on energy and gender.
Box A rural woman’s working day in Africa

Rising at 5 a.m. she carries out her work in difficult conditions, relying only on her own strength. She walks long distances to fetch water, which can take several hours each day. She prepares a meal, and then spends at least another hour pounding grain. Then she must process the produce from fruit gathering, animal breeding and fishing, as well of course providing for the needs and education of her children. In addition to all of this, she labors on the family farm and her own vegetable plot.

This hectic schedule leaves her neither time nor energy for herself or her children. There is certainly no time left to develop any kind of profitable business activities. In the busiest farming periods, women sometimes don't even have the time to prepare meals and the whole family can stay hungry until the following day.

This general lack of time and the unequal workload accounts for the fragility and vulnerability of rural women. It has direct and adverse consequences too for the men and the children, in fact for the whole community. Lightening the arduous work of village women is therefore a priority in order to effectively combat poverty. Time saved can be devoted to education, health and childcare, as well as to generating extra income.

6.1.3 Gender and energy planning [unchanged]

Despite knowing the above facts, the majority of energy planners rarely consult with women and see the problems from their perspectives. Assumptions are flatly made regarding any energy interventions and acceptance of technology is often taken as granted.

Energy is often considered as highly technical, large-scale, and capital intensive which falls under the control of men, while the basic energy requirements mainly managed by women, either for subsistence or small-scale activities are ignored (Cecelski, 1995).

Most policy makers view energy policies as gender neutral, despite knowing the fact that men and women are affected differently by such policies in the developing countries. For instance, an evaluation of biogas program in India showed that women are concerned with the smokelessness and convenience of biogas plants but the men placed higher value on the benefits of manure produced (Dutta, 1997).

Similar cases were observed in Nepal. For instance, operation of biogas plants is women's work, while men select the land for installing the biogas plants. However, women's involvement in selection of location is very important in order to ensure their efficiency in performing the tasks such as fetching water, carrying dung and so on.

Any energy interventions in rural areas have a potential to reduce the women's drudgery in managing household energy systems. Given the fact that women are direct users and
beneficiaries of household energy system, their roles, potentials, needs and priorities regarding the household energy should not be undermined while making any energy interventions.

**Exercise 6.1**

Do you think that one of the reasons biomass energy has received so little attention in national energy planning is that it is ‘women’s fuel’? In other words, if men were the prime collectors of firewood, would something have been done about it long ago?

The points related to gender and energy had been addressed in the energy and poverty course. See module 6.1 energy and gender, 6.1.1 Energy services and gender analysis; 6.1.2 Specific needs; 6.1.3 Gender and energy planning

**6.2 Environmental issues and impact on gender [NEW]**

According to the FAO, the rural poor depend upon biological resources for an estimated 90 percent of their income (http://www.fao.org/Gender/en/envb2-e.htm) Since the beginning of the 20th century, about 75 percent of the genetic diversity among agricultural crops has been lost.

Women and men have a stake in the preservation of the environment and in environmentally sustainable development. Since the early 1980s considerable attention has been devoted to the relationship between women and the environment, and extensive efforts have been made to identify the effects of the international environmental crisis on women. These efforts culminated with the finalization of the Women's Action Agenda 21, elaborated in the run-up of the 1992 UN Conference on Environment and Development (UNCEDA), whereby the important relationship between women and the environment was stressed.

Poverty is a leading cause of environmental degradation in the developing world. Very often, women have a lower income and social status than their male counterparts. Women farmers are trying to make a livelihood on marginal lands, with no or little access to agricultural resources. They are often driven to adapting less labour-intensive crops and practices that may harm the environment with as a result soil erosion, polluted water and declining yields. Furthermore, as women rarely own land they cultivate there is little incentive for them to make environmentally sound decisions, while their lack of access to credit hampers them from buying technologies and inputs that would be less damaging to natural resources.

In many cases, water resource policies and programmes have proven detrimental to women's water rights and, therefore, to their sustainable management and use. Interventions such as irrigation habitually fail to take into consideration the existing imbalance between men and women's ownership rights, division of labour and incomes.
Women's entitlement to water is often precarious. By raising the value of the land, irrigation brings about social change which usually favours men.

Often the technologies that are available to women do not respond to their needs, such as pumps with handles they cannot reach or manipulate or that they have not been trained to repair.

These negative factors set up a cycle of declining productivity, increasing environmental degradation and food insecurity for the future.

**6.3 Empowering women with environment and energy interventions [NEW]**

Ensuring women's use and control of land - and irrigation water - is fundamental. Studies have shown a direct correlation between independent land and irrigation rights for women and a higher productivity of land and labour. Thus, land allocation under irrigation schemes should be to individual farmers rather than to households. Women should also be guaranteed leadership positions based on the proportion of women as members or as participants in the scheme.

Men and women need to be alerted to the threats that environmental degradation pose to food security. Women in particular, need to be informed about alternative methods of cooking, farming, heating and waste disposal. Gender-sensitive planning in training and technology development would not only improve production today, but it would also ensure the protection of the environment for tomorrow.

Women employ methods such as fallowing (leaving fields uncultivated for at least a season), crop rotation (planting a field with different successive crops), intercropping (planting several different crops in a field at one time), mulching (spreading organic material on the soil around plants to avoid water evaporation) and a variety of techniques that promote soil conservation, fertility and enrichment. Planners are now recognizing the value of learning from women's local knowledge to protect and sustain the environment.
6.4 Energy environment and other development sectors

6.4.1 Energy, environment and education

There has been an enormous rise in energy demand since the middle of the last century and a significant impact on local and global environment. That increase has resulted from not only rapid industrial development in but also population growth. More than 90 percent of the energy produced and consumed in the world today is from non-renewable sources such as coal, oil, natural gas, and the uranium used for nuclear power. These resources cannot be replaced as they are used, or can only be replaced very slowly by natural processes.

Despite the importance of energy to every aspect of our lives, not all stakeholders have the basic energy knowledge to make informed decisions or determine what can be done to manage energy resources and protect the environment. Education is therefore paramount to deal with environment, energy and also other major topics. Access to information and making use of this information requires education. Only an informed public can make useful contributions to discussions of energy issues. Education brings about a greater awareness of the environmental, economic, and other impacts and benefits that can result from personal behaviours and choices. For instance energy and environment courses for communities, local authority, policy makers, NGOs etc. had a major impact in awareness raising about the energy and environment crisis and the social, economic, cultural technical options to deal with. The following two examples show how energy education and literacy are key to the process.

Compact fluorescent light bulbs (CFLs) are cooler-burning, and use only one-fourth the energy of standard bulbs. While initially expensive, CFLs soon pay for themselves via reduced energy bills, and they last 10 times as long as standard bulbs, most households, administration, companies still are not taking full advantage of such efficient technologies. Education and awareness raising for all stakeholder coupled in some cases with financial incentives particularly for poor people should contribute not to energy savings and ultimately to mitigate the environmental impact.

Cogeneration is an area where industry could save both energy and money. Process steam from boilers can do double duty, first for the industrial process and then to run a turbine for electricity. This allows up to 90 percent of the energy in fuel to be used productively.

6.4.2 Energy, environment and water

Water and land resources form the basis of all farming systems, and their preservation is crucial to sustained and improved food production. Worldwide, the demand for water is growing rapidly, and in many countries the cost of developing new supplies is becoming prohibitive. Simultaneously, increased water pollution is worsening the imbalance between water supply and demand. For these reasons, water resources development and irrigation are of critical importance in efforts to improve food security and sustainable agricultural production.
Other challenges relate to governance of water and energy resources. Over the years, African governments have made little, if any, investment in energy and water resource development. Multi-lateral financing of giant energy and water development has also dwindled. At the moment, governments are increasingly pulling out of the total control of the sectors, opening way for private sector participation in the provision of energy and water services to those without access. But numerous institutional, policy and regulatory obstacles continue to stifle development and full participation of business these sectors, and questions remain about the viability of large-scale privatization, especially in terms of rural areas and marginalized urban communities.

According to the International Panel on Climate Change (IPCC), the African continent is the most vulnerable to climate change. Runoff and water availability are expected to decline in the northern and southern regions of the continent; the frequency of floods and droughts will increase. In many regions, safe water is already a scarce commodity. Furthermore the combination of poverty and lack of water and sanitation management is a serious threat to the quality of water resources. Often, rubbish and sewage are deposited in the surrounding area or the nearest river. This creates a vicious cycle in which environmental degradation undermines the habitability and fertility of living spaces and thus the natural bases of life, especially of the poor and future generation.

As a result, 25 African countries are expected to experience water scarcity or water stress over the next 20–30 years. “Modern energy services and associated equipment are a necessity to increase the productivity and consequently alleviate poverty in rural areas. For instance, Irrigation at a significant scale requires either electric motor pumps or diesel driven pumps. Off grid rural electrification, based, when feasible, on local resources (wind, solar, micro-hydro etc.) – offer many advantages for meeting the needs of the rural population.

The Regional solar programme, funded by the European Union, implemented in 9 Sahelian countries by the Inter-governmental Committee to control drought in the Sahel (CILSS) is a good example of the positive impact between energy, environment and poverty. During its first phase between 1990-1998 the following achievements have improved the livelihood of more than 1.5 million people thanks to improved solar water pumping systems, solar refrigeration, education etc.:

- 610 water pumping systems for drinking water and cattle benefitting villages between 1,000 to 40,000 inhabitants;
- 158 solar refrigerators for rural health centers
- 477 solar systems for households and social services such as schools, training centers, mosques etc.
- 14 solar battery chargers units

In order to extend and sustain the impact, a second phase, based on lessons learnt from the first phase, is currently being implemented.
6.4.3 Energy, environment and agriculture

Two-thirds of the developing world’s population, about 2.5 billion people, live in rural areas with low standards of living based largely on low resource farming. This type of farming is characterized by high labor requirements, low productivity per hectare and, because of the marginal subsistence, strong risk aversion.

There are close links between land use, environment, and fuelwood and energy use. Rural populations have little access to modern energy services, fuels and technologies and only limited connection with the modern economy. Traditional villages are complex, highly interconnected systems with their environment and the harsh realities of surviving on meager resources. Because the villages are largely closed systems, changes in any one part affect other elements of village life. Changes in agricultural practices, for example, change the amount and type of energy supplies available. In turn, energy sector developments, such as rural electrification, can have major impacts on agricultural practice and income distribution.

Worldwide, about 800 million people depend on agricultural residues for household energy. Projections for the year 2000 show that 3,000 million people will be unable to obtain their minimum energy needs (Barnard in Dankelman and Davidson 1989). In areas of increasing population densities, forest resources for energy are becoming scarce. Biomass, which is essential for maintaining soil fertility, is often converted to an energy source as fuel. As less firewood is available from forests, people must shift to dung and agricultural wastes (see energy ladder) in order to meet their household energy needs. Thus, the energy crisis is directly related to the food problem. With increased deforestation, there is more substitution for fuel of agricultural residues that are otherwise needed to restore soil fertility.

Rural households are key to maintaining on a sustainable basis and replenishing renewable sources, especially biomass. Providing households with better and more appropriate information and technologies on energy production, transformation and use can help to ameliorate biomass fuel shortages, reduce the time and energy spent, mainly by women, in collecting biomass, and the pressure on the surrounding environment. For instance, fuel-conserving stove programs have contributed to reduce consumption of biomass at both the household and institutional level. Fuel-efficient stoves are now produced for industrial use in restaurants, hospitals, and schools, as well as for domestic use.

6.5 Environment and multi sectoral planning procedures

It is increasingly established that the achievement of the MDGs is dependent on expanding access to modern and affordable energy services. However increasing energy

\[\text{footnote}{For further reading on this section, see Mulugetta, Dunnett, Jackson, Khennas and Rai, Energy for rural livelihoods: a framework for sustainable decision making, chap 5 environment and resource assessment., ITDG Publishing, 2005.}\]
consumption per capita within current energy supply, mainly based on fossil fuels, and technologies may aggravate the environmental risks locally and globally. A multi sectoral approach is therefore a necessity to understanding the relationships between the various sectors. For instance how do we resolve the energy requirements for developing countries to meet their basic household, productive and social energy needs with the necessity to protect the environment.

This chapter shows how environmental planning interferes with other sectors, particularly energy, water, land use. The methods used in environmental analysis will be presented. Environmental impact assessment (EIA) is a key tool that incorporates potential environmental changes due to a particular activity. EIA is a structured approach for identifying, predicting, evaluating and mitigating the potential environmental, social and health effects of a proposed project.

The purpose of the assessment is to ensure that decision-makers consider environmental impacts before deciding whether to proceed with new projects. The broad objectives of IEA include:

- Ensure that environmental considerations are explicitly addressed and incorporated in the planning procedures
- Anticipate and minimize or offset the adverse environmental, social and cultural consequences of a proposed development activity
- Protect the productivity and capacity of natural systems
- Support the goals of sustainable development and optimise resource use.

The main steps of EIA are summarised in the following table.

<table>
<thead>
<tr>
<th>Feasibility</th>
<th>Screening and Scoping</th>
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<tbody>
<tr>
<td>Detailed design</td>
<td>Baseline design, Impact evaluation, Comparison of alternatives, Decision making process</td>
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<tr>
<td>Follow-up</td>
<td>Management and monitoring, Auditing</td>
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</tbody>
</table>

The EIA’s aim is to make explicit the environmental impact of a project with a view of competing demands of economic development and environmental protection. The objective is to increase decision-makers’ awareness of the need to conduct economic and environmental impact assessments to support policy formulation, particularly as they relate to strategic environmental decisions linked to environmental inter-sectoral planning, and sectoral planning. The assessment could be carried out at two levels:

- Macro level by assessing the cost of environmental degradation studies
- Sector level through the assessment of impacts of environmental measures in selected sectors.

Damage costs include impact on human health and on the quality of life (morbidity, mortality, loss in recreational value, etc.) impact on natural resources and ecosystems (water, soil, air, deforestation, coastal zone). The cost of environmental degradation when it has been calculated accounted for a significant amount of the GDP.
Chapter 7 Selection criteria and environmental interventions
[NEW]

Objective: Define and understand the key criteria to implement energy and environmental interventions

Key concepts and learning goals:
- Environmental Criteria for implementing small scale energy schemes (micro hydro power)

In the module on energy and poverty interventions, selection criteria and energy interventions had been addressed. This chapter is aimed at guiding and evaluating the environmental impact and the links with other sectors of a small scale energy project. The check list shows how the project will impact on other sectors such as water, land use, natural resources, local communities etc. It is based on numerous small-scale micro hydro projects implemented mainly in Nepal, Sri Lanka. Very often micro hydro power...
unless middle or large scale hydro power plants has very little environmental or social impact. The check list can be adapted and used for other small scale projects

**Environmental impact of small-scale hydro power plant**

<table>
<thead>
<tr>
<th>Issues</th>
<th>Yes</th>
<th>No</th>
<th>Uncertain</th>
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<tbody>
<tr>
<td><strong>Land ownership, alteration and use:</strong></td>
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<td><em>Will the project take place on:</em></td>
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<td>o State owned land</td>
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<td>o Privately owned land</td>
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<td>o Other</td>
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<td><em>Will the project result in</em></td>
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<td>o Permanent change in topography or ground surface</td>
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<td>o Long term increase in wind or water erosion of soils either on or off the site</td>
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<td><strong>Natural resources:</strong> <em>Will the project result in</em></td>
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<td>o Change in the diversity or numbers of any species or plants</td>
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<td>o Reduce of the numbers of threatened or endangered species of plants</td>
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<td>o Reduce of the numbers of threatened or endangered of animals</td>
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<td>o Significant alteration, deterioration or destruction of existing of wildlife habitat</td>
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<td>o Increase in the rate of use of any natural resources</td>
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<td>o Alteration, destruction or significant impact on environmentaly sensitive areas: critical habitat, costal zones etc.</td>
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<td><strong>Water:</strong> <em>Will the project result in</em></td>
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<td>o Change in currents, or the course or direction of water movements (dam or reservoir construction, site clearing near water etc.)</td>
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<td>o Discharge (liquid or solid waste) into surface waters or in any alteration of surface quality</td>
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<td>o Change in the quantity and/or quality of ground waters</td>
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<tr>
<td>o Reduction of the amount water otherwise available for agriculture,</td>
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<td><strong>Energy:</strong> <em>Will the project result in</em></td>
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<td>o Use of substantial amounts of fuel or energy</td>
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<td>o Substantially increase the demand on existing sources of energy</td>
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<td>o Utilities: <em>Will the project result in the need for new systems or alterations to the following utilities:</em></td>
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<td>o Electric power, fossil fuels or others</td>
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<td>o Drinking water</td>
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<td>o Landfill disposal</td>
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<tr>
<td><strong>Health:</strong> <em>Will the project result in</em></td>
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<tr>
<td>The creation of any health or potential health hazard</td>
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<tr>
<td><strong>Noise:</strong> <em>Will the project result in</em></td>
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<tr>
<td>o Any increased existing nosie levels</td>
<td></td>
<td></td>
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<tr>
<td>o Expose people to sensitive noise</td>
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<tr>
<td><strong>Economic</strong> <em>Will the project result in</em></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><em>Any adverse effect on local or regionaleconomic conditions (tourism, land values, employment, etc.)</em></td>
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</table>
The recommended approach is to agree the aspects and their significance between the stakeholders in the project. This is achieved by involving representatives of all the stakeholders in a participative group process in the early stages of the method.\textsuperscript{10}

\textbf{Chapter 8 Framework for energy sensitive project [unchanged]}

\textbf{Objective:} Master the tools used in designing typical framework for energy sensitive projects

\textbf{Key concepts and learning goals:}
- Problem analysis and logical framework
- Problem tree analysis

An effective strategy for energy projects or policy must incorporate options to improve and extend energy supply structures and infrastructures. It must also seek to allocate resources efficiently and improve the quality of affordable energy services delivered, particularly to poor rural communities and the urban poor.

A number of instruments or tools (surveys, rapid rural appraisal etc.) and frameworks (logical framework and the problem tree analysis, sustainable livelihood framework, SWOT analysis etc.) have been developed to identify the main factors related to the success of the project, bring together in one place a statement of all the key components of a project, present them in a systematic, concise and coherent way. All these instruments and frameworks have been used in the energy sector. This module gives a summary of these instruments and frameworks\textsuperscript{11} and how they can be applied to energy projects.

\textbf{8.1 Problem analysis and logical framework}

A logical framework (logframe) is a matrix that summarizes what a project intends to do and how, what the key assumptions are, and how outputs and outcomes will be monitored and evaluated.

\textsuperscript{10} For a detailed methodology see http://www.esru.strath.ac.uk/EandE/Web_sites/99-00/bio_fuel_cells/groupproject/library/environmentassess/text.htm. A comprehensive excel spreadsheet can be downloaded.

\textsuperscript{11} The training manual on environment and energy will provide a comprehensive logical framework on “Actions to help developing countries to effectively participate in and foster the implementation of the UNFCCC”.
<table>
<thead>
<tr>
<th>Goal</th>
<th>Performance Questions and Indicators</th>
<th>Monitoring mechanism and Information sources</th>
<th>Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Purpose</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Output</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Activity</td>
<td>...</td>
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<td>...</td>
</tr>
</tbody>
</table>

The vertical logic identifies what the project intends to do, clarifies the causal relationships, and specifies the important assumptions and uncertainties beyond the project manager's control (columns 1 and 4). The horizontal logic defines how project objectives specified in the project description will be measured, and the means by which the measurement will be verified (columns 2 and 3). This provides the framework for project monitoring and evaluation. The logframe approach encourages a multidisciplinary approach to project preparation and supervision.

In most projects, the once-made logframe serves as a rigid means of assessing whether the project has achieved what it should. It might be better for learning and creating real impact of a project, when the logframe is considered as a more flexible document. The main problem with logframe, as with any 'tool', is that while originally developed and envisaged as a longer process of reflection and correction, with updating of the matrix as and when conditions changed, it is now often carried out as a one-person desk exercise job of filling in a table that is never updated.

8.2 The problem tree analysis

This is a useful instrument to define the objectives of a project and is an important component of the logframe. The problem tree analysis helps to illustrate the linkages between a set of complex issues or relationships by fitting them in a hierarchy of related factors (DFID, 2003). The major assumption underlying the problem tree is the relationship between cause and effect. Given that energy is an enabling component of various sectors, the problem tree analysis can be useful to understand core problem area, causes and effects. The problem tree is often followed by an objective tree where the problems are converted through simple rewording into objectives which will be used in the logframe.
**Basic steps for problem tree analysis**

- Identify and list the main problems based on available information
- Identify a core problem through discussion. The core problem is often derived from the most negative statements
- Determine the causes that lead to the core problem and the effects that result from the core problem
- Arrange in hierarchy both causes and effects
- Follow the exercise with an objective tree to identify the required actions
- It provides a basis for monitoring and evaluation by identifying indicators of success, and means of quantification or assessment

---

**Diagram**

```
Higher costs of products
  ↓
  Higher cost of production
  ↓
  Businesses use backup power

Reduced profits
  ↓
  Negative impact on production
  ↓
  Small firms lack power

Job losses
  ↓
  More days of business

Lower income & increased poverty
  ↓

Unreliable electricity supply
  ↓

Under-capacity
  ↓
  No DSM strategies

Dilapidated systems
  ↓
  Poor O&M

Skills deficit
  ↓
  No skills upgrading plan
  ↓
  Poor staff retention

Insufficient incentive & motivation for staff
  ↓
  Poor planning management & lack of investment
```
Exercise 8.1
This problem tree analysis is about unreliable electricity supply and its impact on small rural businesses. It shows that there are a range of specific and inter-linked causes for supply shortfall. In this case, the causes can be attributed to poor planning and management, inadequate investment to upgrade the capacity and insufficient.

Based on the same methodology of the problem tree analysis, describe the causes and the effects due to the use of non-efficient stoves in rural areas or urban areas. Incentives and motivation for staff. This can lead to a chain of effects ultimately contributing to a loss of jobs and increased poverty in rural areas.

Chapter 9 Future challenges: poverty, environment and renewable energy

Objective: Discuss challenges beyond the MDGs regarding poverty, energy and environment

Key concepts and learning goals:
- Wealth creation and redistribution
- Energy consumption for the poor and mitigating the environmental impact
- Environment beyond the MDGs

Access to modern energy services for the poor and improving their livelihood on one hand, mitigating the environment impact and particularly global warming on the other will remain the key future challenges for policy makers but also for international institutions and the civil society. Indeed meeting the targets for MDGs will require a huge increase of energy for meeting basic energy needs such as cooking, space heating and lighting, productive activities (agriculture, industry etc.) and social services. However access to modern energy services cannot be achieved without a significant economic growth and redistribution of wealth.

Beyond the MDGs: Wealth creation and redistribution

Compared with all other regions in the world, Africa experienced the slowed progress towards the MDGs. Between 1990 and 2000, the number of people living in extreme poverty has even increased by 1% which translates into 73 million additional people below the poverty line (217 million in 1990 and 290 million in 2000). Adult life expectancy has declined from 50 years to 46 years during the same period. Economy growth is paramount to achieving MDGs. Indeed among the 30 SSA countries, only 14 managed to reduce the number of people living with hunger by at least 25%. These countries are more stable and experience higher economy growth. For all the MDGs, a
very limited number of countries will achieve their MDGs targets. For instance only 5 countries are likely to halve the proportion of the population who suffer from hunger (goal 1) and three countries will reduce by two thirds the child mortality rate.

African economies will need a sustained growth of 8 percent per year to meet the MDGs. The recent UNCTAD report (UNCTAD, September 2006) stresses that major reforms in institutions and in current practice are essential “if a 'big push' for African development is to be really successful, putting an end to aid dependency”.

**Reconciling increased energy consumption for the poor and mitigating the environmental impact**

The International Energy Agency has estimated that 85 per cent of the world’s extra energy needs over the next 25 years will be met by fossil fuels and that, without action, global energy demand and carbon emissions will both grow by 60 per cent. The current energy trend is not sustainable and the majority of poor people, particularly rural populations, are excluded.

There is a strong correlation between energy, poverty eradication and development which means than energy consumption is Sub-Saharan Africa should dramatically increase, however the pattern of energy production, transformation and consumption need major changes to cope with the challenge of poverty alleviation and sustainable energy growth. Decentralised renewable energies on a large scale seem the best option to mitigate greenhouse gas emissions and tackle poverty over the long term although renewable energy technologies will not be able to address all energy needs of developing countries over the short term. Compared with fossil fuels, renewable energies offer a number comparative advantage for poor people but also for the country and the global environment.

**Reaching poor people and cost effectiveness**

When costs comparisons are carried out between fossil fuels and renewables, diesel generators are very often quoted as the benchmark. However in almost all cases, environmental costs, access to the source (time spent, power cuts etc.) are not taken into consideration. In addition the structural upward trend of oil prices means that renewables will become the main credible alternative for rural electrification for low population densities far from the grid. Renewable energy technologies based on local energy sources such as modern biomass, small hydro, geothermal, wind, solar etc. are particularly appropriate options to support rural off-grid electrification. Indeed extending electric grids to rural areas is often prohibitive.

**Social and environmental impact**

Conventional energy technologies appear comparably cheap because their social and environmental costs are not accounted for. Thermal power plants and large reservoirs, particularly in tropical regions, emit large amounts of greenhouse gases and have serious impacts on the local environment. According to the World Commission on Dams, large
dams have displaced an estimated 40 to 80 million poor people. In comparison, energy sources derived from wind, solar and small-hydro have much lower social and environmental impacts.

**Empowerment, ownership and income generation**

Energy services delivery from renewable energy sources and technologies are more commonly based on local resources than centralized conventional technologies. They can reduce dependence on conventional energy resources that run the risk of volatile prices and availability. Establishing local, renewable energy resources through cooperatives or small businesses can promote community ownership of energy and encourage participation in control of energy resources, increasing energy independence and self-reliance.

Renewable energy often creates more jobs for the same investment compared with conventional capital-intensive energy systems based on fossil fuels. Furthermore, renewable energy offer better job opportunities for local communities and ultimately the prospects for poverty alleviation are much higher in the case of decentralised renewable energy options. Renewable energy technologies could therefore generate a double dividend for the environment and poverty reduction, and as such present logical responses to the problems of climate change and energy poverty.

However, developing countries and particularly Sub-saharan Africa still need a **massive international support** from the North to adapt to climate change which fall disproportionately on developing countries whereas their contribution to greenhouse gas emissions is extremely low and to overcome the constraint of the lack of capital to develop renewable energy sources and technologies.

**Environment beyond the MDGs [NEW]:**

Since January 2005, three reports have been published that are directly related to the MDGs.

- The UN Millennium Project report (MDGR), “Investing in Development: A Practical Plan to Achieve the Millennium Development Goals,” released in January 2005. The UN Millennium Project report is the result of reports from 10 task forces, composed of a broad array of development practitioners and experts across an enormous range of countries, disciplines and organizations.


- The draft UNDP report, “Environmental Sustainability in 100 Millennium Development Goal Country Reports,” released on 10 June 2005. The UNDP report summarizes results from over 100 MDG country reports (MDGRs) on the seventh
MDG, that of ensuring environmental sustainability (MDG 7), which is a key area of the global sustainable development agenda.

The key findings of these reports give good indication of achievements, gaps, strategies and actions in the near future.

- Environmental issues have not been properly integrated into the MDGs. In their national reports on progress towards the MDGs, countries have reported least on MDG 7, either because they lacked data on the environment or appropriate indicators, or because they found the targets hard to understand.

- Out of the 100 countries reviewed, more than 60 consider environmental issues as constraints to development.

- The loss of services derived from ecosystems is a significant barrier to the achievement of the MDGs related to reduction of poverty, hunger, and disease.

- Mainstreaming of the environment in Poverty Reduction Strategy Papers (PRSPs) is progressing, but from a very low starting point. Even if environmental issues make it to the PRSPs, it is still difficult to get them into the budget. PRSPs pay little attention to biodiversity matters. It is especially important for biodiversity to demonstrate the linkage to poverty and transform it into understandable recommendations that policy makers are interested in.

- Forest environmental income represents a significant income source to many poor rural households. The omission of this forest environmental income in national statistics leads to an underestimation of rural incomes, and a lack of appreciation of the value of environment.

- The MA Synthesis Report reveals that it is the world’s poorest people who suffer most from ecosystem changes. The regions facing significant problems of ecosystem degradation – sub-Saharan Africa, Central Asia, some regions in Latin America, and parts of South and Southeast Asia – are also facing the greatest challenges in achieving the United Nations’ Millennium Development Goals. In Sub-Saharan Africa, for example, the number of poor people is forecast to rise from 315 million in 1999 to 404 million by 2015.
Appendix

The Millennium development goals (see appendix MDGs and the 18 targets)

**Goal 1. Eradicate extreme poverty and hunger**
- Target 1. Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day
- Target 2. Halve, between 1990 and 2015, the proportion of people who suffer from hunger

**Goal 2. Achieve universal primary education**
- Target 3. Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling

**Goal 3. Promote gender equality and empower women**
- Target 4. Eliminate gender disparity in primary and secondary education, preferably by 2005, and to all levels of education no later than 2015

**Goal 4. Reduce child mortality**
- Target 5. Reduce by two thirds, between 1990 and 2015, the under-five mortality rate

**Goal 5. Improve maternal health**
- Target 6. Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio

**Goal 6. Combat HIV/AIDS, malaria and other diseases**
- Target 7. Have halted by 2015 and begun to reverse the spread of HIV/AIDS
- Target 8. Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases

**Goal 7. Ensure environmental sustainability**
- Target 9. Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources
- Target 10. Halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation
- Target 11. By 2020 to have achieved a significant improvement in the lives of at least 100 million slum dwellers

**Goal 8. Develop a global partnership for development**
- Target 12. Develop further an open, rule-based, predictable, non-discriminatory trading and financial system nationally and internationally
- Target 13. Address the special needs of the least developed countries
- Target 14. Address the special needs of landlocked countries and small island developing States
- Target 15. Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term
- Target 16. In cooperation with developing countries, develop and implement strategies for decent and productive work for youth
- Target 17. In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries
- Target 18. In cooperation with the private sector, make available the benefits of new technologies, especially information and communications
### Table 1 African countries likely to achieve MDGs targets

<table>
<thead>
<tr>
<th>Goals and targets</th>
<th>Countries likely to achieve the target</th>
</tr>
</thead>
</table>
| **Goal 1**: Eradicate extreme poverty and hunger  
**Targets**: - Halve the proportion of people whose income is less than a dollar a day  
- Halve the proportion who suffer from hunger | **Poverty**: Algeria, Botswana, Burkina Faso, Cameroon, Egypt, Ghana, Lesotho, Libya, Mauritius, Morocco, South Africa, Uganda  
**Child malnutrition**: Botswana, Chad, Egypt, Gambia, Mauritania, Sudan and Tunisia |
| **Goal 2**: Achieve universal primary education  
Ensure that children will be able to | **Both net enrolment and completion rate**: Algeria, Botswana, Cape Verde, Egypt, Gabon, Mauritius, Namibia, Rwanda, Sao Tomé & Principe, Seychelles, South Africa and Zimbabwe |
| **Goal 3**: Promote gender equality and empower women  
**Target**: Eliminate gender disparity in primary and secondary education | **Primary level education**: Botswana, Lesotho, Mauritius, Namibia, Rwanda, Swaziland and Zimbabwe  
**Secondary level**: Algeria, Botswana, Lesotho, Libya, Namibia, Tunisia and Rwanda |
| **Goal 4**: Reduce child mortality  
**Target**: Reduce by 2/3 the under five mortality rate | Algeria, Cape Verde, Egypt, Libya, Mauritius, Morocco, Seychelles and Tunisia |
| **Goal 5**: Improve maternal health  
**Target**: Reduce by three-quarters, the maternal mortality ratio | Algeria, Botswana, Cape Verde, Egypt, Gambia, Libya, Mauritius, Morocco and Tunisia |
| **Goal 6**: Combat HIV/AIDS, malaria and other diseases | **HIV/AIDS**: Algeria, Botswana, Egypt, Libya, Tunisia, Uganda and Zimbabwe  
**Malaria**: Algeria, Benin, Cameroon, Central Africa, Comoros, Egypt, Gambia, Guinea-Bissau, Kenya, Libya, Morocco, Tunisia and Rwanda  
**Tuberculosis** (**TB**): Algeria, Angola, Egypt, Gabon, Gambia, Libya, Madagascar, Morocco, South Africa, Swaziland, Tunisia and Zambia |
| **Goal 7**: Ensure Environmental sustainability  
**Targets**:  
- Integrate the principles of sustainable development and reverse the loss of environmental resources  
- Halve the proportion of people without to safe drinking water and basic sanitation | **Sustainable development** (**forest area**): Algeria, Cape Verde, Egypt, Gambia, Libya, Morocco, Swaziland and Tunisia  
**Access to safe drinking water** (**rural**): Algeria, Botswana, Burundi, Egypt, Gambia, Ghana, Malawi, Mauritius, Namibia, South Africa and Tanzania  
**Access to sanitation** (**urban**): **Algeria**, **Egypt**, Ghana, Libya, Mauritius, Morocco and Tunisia |
<table>
<thead>
<tr>
<th>Goal and Target</th>
<th>Importance of Energy to Achieving the Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GOAL 1: ERADICATE EXTREME POVERTY AND HUNGER</strong></td>
<td></td>
</tr>
<tr>
<td>• Target 1 - Halve the proportion of people with income &lt; US$ 1/day between 1990 and 2015</td>
<td></td>
</tr>
<tr>
<td>• Target 2 - Halve the proportion of people who suffer from hunger between 1990 and 2015</td>
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<tr>
<td>▪ Access to energy services enables enterprises development</td>
<td></td>
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<tr>
<td>▪ Lighting permits income generation beyond daylight hours</td>
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<tr>
<td>▪ Machinery increases productivity</td>
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<tr>
<td>▪ Local energy supplies can often be provided by small scale locally-owned businesses creating employment in local energy service provision and maintenance</td>
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<tr>
<td>▪ Privatisation of energy services can help free up government funds for social welfare investment</td>
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<tr>
<td>▪ Clean, efficient fuels reduce the large share of household income spent on cooking, lighting and keeping warm</td>
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<tr>
<td>▪ The majority of staple foods need cooking before they can be eaten and need water for cooking</td>
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<tr>
<td>▪ Energy for irrigation helps increase food production</td>
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<tr>
<td><strong>GOAL 2 - ACHIEVE UNIVERSAL PRIMARY EDUCATION</strong></td>
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<tr>
<td>• Target 3 - Ensure that by 2015 children will be able to complete a full course of study</td>
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<tr>
<td>▪ Lighting in schools helps retain teachers, especially if their accommodation has electricity</td>
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<tr>
<td>▪ Electricity enables access to educational media and communications in schools and at homes that increase education opportunities and allow distance learning</td>
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</tr>
<tr>
<td>▪ Availability of modern energy services frees children’s and especially girls’ time from helping with survival activities</td>
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<tr>
<td><strong>GOAL 3 - PROMOTE GENDER EQUALITY AND EMPOWER WOMEN</strong></td>
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</tr>
<tr>
<td>• Target 4 - Eliminate gender disparity in primary and secondary education by 2005 and to all levels by 2015</td>
<td></td>
</tr>
<tr>
<td>▪ Availability of modern energy services frees girls’ and young women’s time from survival activities</td>
<td></td>
</tr>
<tr>
<td>▪ Clean cooking fuels and equipment reduces exposure to indoor air pollution and improves health</td>
<td></td>
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<tr>
<td>▪ Good quality lighting promotes home study and allows evening classes</td>
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</tr>
<tr>
<td>▪ Street lighting improves women’s safety</td>
<td></td>
</tr>
<tr>
<td>▪ Affordable and reliable energy services offer scope for women’s enterprises</td>
<td></td>
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<tr>
<td><strong>GOAL 4 - REDUCE CHILD MORTALITY</strong></td>
<td></td>
</tr>
<tr>
<td>• Target 5 - Reduce the under-five mortality rate by two-thirds between 1990 and 2015</td>
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<tr>
<td>▪ Indoor air pollution contributes to respiratory infections</td>
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<tr>
<td>▪ Gathering and preparing traditional fuels exposes young children to health risks and reduces time spent on child care</td>
<td></td>
</tr>
<tr>
<td>▪ Provision of nutritious cooked food, space heating and boiled water contributes towards better health</td>
<td></td>
</tr>
<tr>
<td>▪ Electricity enables pumped clean water and purification</td>
<td></td>
</tr>
<tr>
<td><strong>GOAL 5 - IMPROVE MATERNAL HEALTH</strong></td>
<td></td>
</tr>
<tr>
<td>• Target 6 - Reduce the maternal mortality ratio by two-thirds between 1990 and 2015</td>
<td></td>
</tr>
<tr>
<td>▪ Energy services are needed to provide access to better medical facilities for maternal care, including medicine refrigeration, equipment sterilization, and operating theatres</td>
<td></td>
</tr>
<tr>
<td>▪ Excessive workload and heavy manual labour (carrying heavy loads of fuelwood and water) may affect a pregnant woman’s general health and well-being</td>
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</tr>
</tbody>
</table>

Global warming: Causes and effects

Earth's temperature has risen about 1 degree Fahrenheit in the last century. The past 50 years of warming has been attributed to human activity.

During the past 100 years global sea levels have risen 4 to 8 inches.

Greenhouse gases are emissions that rise into the atmosphere and trap the sun's energy, keeping heat from escaping.

Most of the world's emissions are attributed to the United States' large-scale use of fuels in vehicles and factories.

The United States was responsible for 20 percent of the global greenhouse gases emitted in 1997.

Burning fuels such as coal, natural gas and oil produces greenhouse gases in excessive amounts.

Some predictions for local changes include increasingly hot summers and intense thunderstorms.

Damaging storms, droughts and related weather phenomena cause an increase in economic and health problems. Warmer weather provides breeding grounds for insects such as malaria-carrying mosquitoes.

Source: Environmental Protection Agency
Further readings: selected bibliography and websites

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