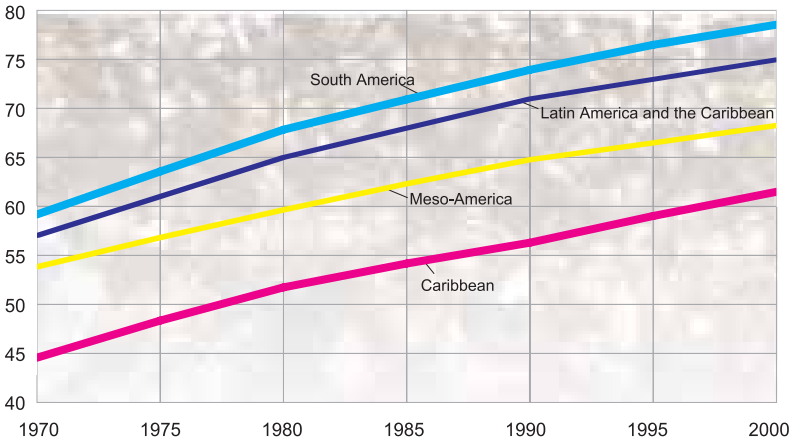
Urban areas

Meso-America and South America have highly urban populations. Urbanization levels are expected to reach 85 per cent by the year 2025.

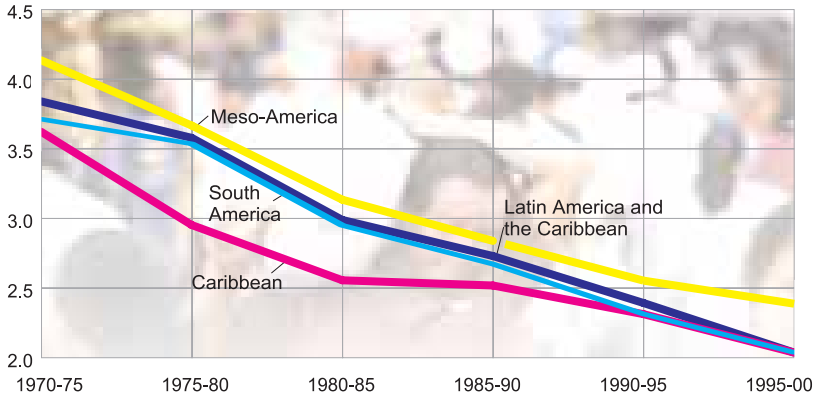
About half the world's population lives in urban areas, and their numbers are growing at almost 160 000 per day (UNEP 1999a). Cities have an impact on areas much larger than those they physically occupy because of their need for electricity, food and other resources, and also because of the regional and global effects of their waste and emissions into the soil, air and water.

Urban population, 1970-2000 (as a percentage of the total population)



Source: Centro Latinoamericano y Caribeño de Demografía (CELADE): http://www.eclac.cl/Celade-Esp/index.html, downloaded January 18, 2000.

Urban population growth, 1/ 1970-2000 (annual rate)



1/ Based on an exponential growth model

Source: Centro Latinoamericano y Caribeño de Demografía (CELADE): http://www.eclac.cl/Celade-Esp/index.html, downloaded January 18, 2000

Most of the one billion new urban dwellers projected for 1999–2010 will most likely be absorbed by cities in developing countries, which already face a shortage of housing and infrastructure and already struggle with overcrowded transportation, insufficient potable water, deteriorating sanitation systems and environmental pollution. More than 600 million urban dwellers in Africa, Asia and Latin America live in slums or as squatters, and their population growth rate in some cases exceeds 20 per cent per year – twice as high as in the cities themselves. Despite this, migration from rural areas to the cities continues, fuelled by complex economic and environmental patterns and by the attractive urban consumption model and life style.

Latin America and the Caribbean already have a largely urban population. In 1950, 43 per cent of the total population lived in urban areas, and this increased to 73 per cent in 1995, but with strong regional variations. Between 1975 and 1995, the regional urban population practically doubled, from 192 million to 344 million, and it is estimated that in 2000 the figure will be 380 million (CELADE 1999). The majority of urban dwellers live in large cities, such as Mexico City (15.4 million), Saô Paulo (15.6 million) and Rio de Janeiro (9.5 million). In the early 1990s, Buenos Aires, with 11.2 million inhabitants, and Santiago, with 4.6 million, housed around 35 per cent of the total population of Argentina and Chile (CEPAL 1999a).

Effects of infrastructure

Although urban development in itself does not necessarily have negative economic or environmental impacts, unplanned urban growth has led to the proliferation of slums in the hearts and outskirts of cities, many of them lacking basic services. Unplanned urban development can exert great pressure on the environment, often worsening generalized environmental problems such as land and coastline degradation, poor air quality, inadequate water supply and sanitation, pollution, and

Urban population growth rates are falling sharply, mainly because of the already very high levels of urbanization in the region.

solid and hazardous waste management. Inefficient urban land use results in the unnecessary loss of valuable land that could have been used for other high-priority environmental and social uses, ranging from water basin protection and biodiversity preservation to safeguarding preferred recreational sites. Ground suitable for cultivation has been built on for many years, and the inexorable growth of urban communities has forced the use of environmentally inappropriate and risky lands (steep slopes and flood plains) for human settlement.

The absence of planning, poor regulation and weak enforcement of controls combine to create a dangerous juxtaposition of residential and industrial activities. Firstly, residents in the poorer city areas are at risk from the inadequate infrastructure itself. Slum areas are overcrowded, often built on steep hillsides, and consist of shacks that do not meet even the most basic building safety standards. Many of them are located near hazardous industrial activities and solid waste disposal sites, exposing the residents to potentially harmful substances. Secondly, as demonstrated by the devastating impact of hurricane Mitch in Central America at the end of 1998 and the floods in Venezuela at the end of 1999, the lack of planning and control enforcement result in extremely high reconstruction costs and a terrible cost in human lives and livelihoods (see 'Disasters' section).

Urban air pollution

The growth of economic activity and population density cause pollution to increase in many cities. Santiago, for example, is one of the most contaminated urban areas in the world. The most significant sources of air pollution there are urban transportation and the proliferation of small and medium-sized industrial enterprises (IMO 1995). Urban residents are suffering severe respiratory problems, and the numbers of pneumonia cases and premature deaths from respiratory diseases are increasing yearly. Medical treatment for these cases is extremely costly, and there is a significant loss in productivity due to absenteeism (O'Ryan 1994). Air pollution in Mexico City, Saô Paolo and Bogota is also severe.

Air quality in the Valley of Mexico Metropolitan Area

In December 1994, the Secretariat of Health of the Mexican Federal Government published official standards to evaluate air quality in terms of its content of ozone, sulphur dioxide, nitrogen oxides, carbon monoxide, lead, total suspended particles (TSP) and suspended particles with a diameter less than 10 microns (PM-10), which represent the breathable fraction of TSPs. These standards established the maximum allowable levels of pollutant concentration, similar to those in the United States and Canada.

The Metropolitan Air Quality Index (IMECA) converts pollutant concentrations into a figure that indicates the level of pollution in a manner accessible to the population. An IMECA of 100 points is the quality standard for a specific pollutant. Air quality is not satisfactory if the index is between 100 and 200, poor if it is between 200 and 300 and very poor if it is over 300.

In the Valley of Mexico, pollutant emissions originate to the north of Mexico City, where the industrial zones are concentrated. However, the highest levels of exposure are located in the south-western part of the city, due to the prevailing north-east–south-west winds. The impact of this pollution on human health has been identified in symptoms such as dyspnoea (breathing difficulties), headaches, conjunctivitis, irritation of the respiratory membranes and coughing. Depending on the symptom and the levels reached in the corresponding pollution indices, the proportion of the population affected can vary between 7 per cent and 19 per cent.

It has been recognized that contamination by ozone is critical since its level exceeds the standard for most of the year, and particularly in the south-western region. The number of days with ozone concentration levels above 200 points diminished during the 1990–1996 period, but there remained a relatively stable number of days with levels of between 100 and 200 points.

The trend for carbon monoxide (99 per cent of it emitted by transportation) shows levels below the standard. By contrast, in the case of nitrogen monoxide the diminishing trend of previous years was reversed in 1995 and 1996, with the increase concentrated between November and February due to the presence of cold air in the Valley of Mexico.

The sulphur dioxide concentration trend has improved as a result of control measures aimed at industry (which generates almost 60 per cent of this pollutant), aided by the distribution of less polluting fuels. There have been hardly any days showing levels higher than the standard since 1993.

Between 1995 and 1996, the levels of total suspended particles diminished in the north-eastern and south-eastern regions, but increased in the central, south-western and north-western regions. The concentration of particles with a diameter smaller than 10 microns exceeded the standard on more than half the days of 1996, although no days were recorded with levels higher than 200 points.

Lead has shown a downward trend, associated with the reduction of the lead content in gasoline and it is said that the problem has been solved.

Source: INEGI 1998, 1999.

Among the causes of atmospheric degradation, the following can be singled out (UNEP 1999b; INEGI 1998):

- Quantity and quality of fuel consumed, as well as inadequate vehicle emission control, worsened recently in many countries of the region by a rise in used-car imports. For example, in Jamaica, the motor vehicle pool has doubled in the last five years (PJC 1998).
- Industrial activity.
- Inefficient power use.
- High-density urban areas and human settlements.
- Pesticide fumigation in rural agricultural communities.
- Particles resulting from soil erosion and agro-industrial biomass degradation.
- Existing meteorological conditions.

Measures that can be taken to overcome or at least reduce the air pollution problem include the elimination of lead in gasoline, the creation of motor vehicle emission standards, the implementation of inspection and maintenance programmes, and the control of industrial emissions.

The Brazilian programme of adding alcohol to gasoline has not been sufficient although there has been a 30 per cent reduction in carbon dioxide emissions and a general reduction in overall air pollution. The use of private vehicles is now limited in Saô Paolo, as it is in Mexico City and Santiago. In Rio de Janeiro and Saô Paolo, 27 million people are exposed to high levels of contamination from particles in the air, which are believed to cause some 4 000 premature deaths per year (CETESB 1992).

Concerning lead pollution, the main sources of exposure are the emissions of cars using leaded gasoline. These effects are felt principally in urban areas. People living in high vehicular traffic areas usually have higher levels of lead in their blood than those who are less exposed. For about the last ten years the lead content in gasoline has been decreasing in most countries, and unleaded gasoline is now being produced. The countries with the highest proportion of this type of fuel are Brazil (100 per cent), Costa Rica (100 per cent), Guatemala (80 per cent) and Mexico (46 per cent) (Christopher *et al.* 1996).

Other sources of lead and other pollutants are paint manufacturing, food processing, metal foundries, petrochemical industries and battery factories. There are enormous limitations to the proper treatment and disposal of these wastes. Often they just pile up in factories, or on empty lots and municipal dumps, or are discharged directly into rivers with little or no treatment. Inadequate lead waste management has caused the pollution of many sites, resulting in the acute poisoning of children in such countries as Mexico, Jamaica, and Trinidad and Tobago (UNEP 1999b).

Urban poverty

Up to the mid 1970s, poverty was most prevalent in rural areas. In the 1990s, however, regional statistics showed that some 65 per cent of poor households were located in urban areas (World Bank 1996). From 1990 to 1997, the actual proportion of poor households in the urban areas of Latin America (18 countries) decreased from 35 per cent to 30 per cent (CEPAL 1998b). For example, estimates indicate that in Buenos Aires, 17 per cent of the population live with their basic needs unsatisfied (overcrowding, dilapidated housing, scarce access to

potable water and sanitary infrastructure), compared with 22 per cent in the 1980s (La Serna *et al.* 1997). Despite this, between 1996 and 1997, urban areas in some countries still contained close to, or more than, 40 per cent of poor households. Such is the case in Bolivia (47 per cent), Colombia (39 per cent), Ecuador (50 per cent) and Paraguay (40 per cent) in South America, while examples in Meso-America include El Salvador (39 per cent), Honduras (67 per cent), Mexico (38 per cent) and Nicaragua (66 per cent) (CEPAL 1999b). There is no recent information for other countries with high indices of urban poverty, such as Guatemala and Haiti.

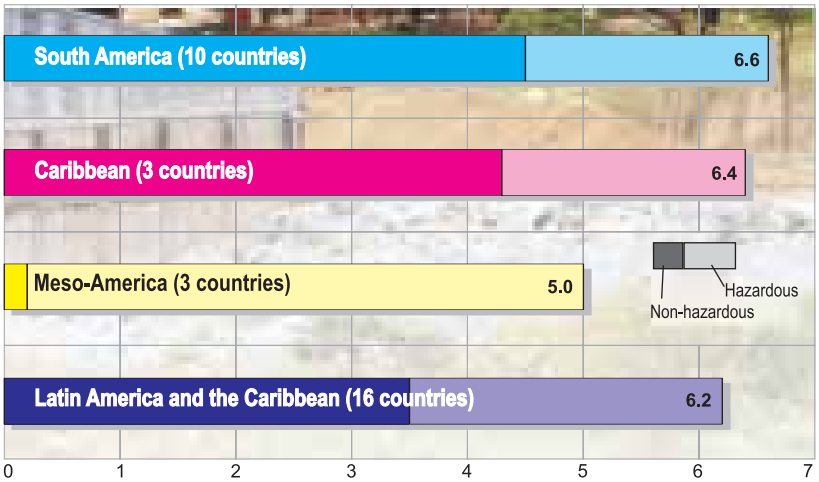
The strongest impact of unplanned urban growth is on the poor, who are forced to settle in marginal areas, more vulnerable to natural hazards. These fringe settlements often lack adequate water and sanitation services, and are much more exposed to natural disasters and to serious diseases such as cholera and dengue. Unplanned growth produces other effects on the environment since the waste water disposal systems are inadequate, the demand for water exceeds supply, and aquifers are being contaminated.

Effluent and solid waste management

Effluent and solid waste treatment is particularly troublesome in Latin America and the Caribbean. Only 30 years ago, the per capita solid waste production was between 0.2 and 0.5 kilograms per day, while it presently ranges between 0.5 and 1.2 kilograms per day, the regional average being 0.92 kilograms. Estimates for 1995 were that the urban population region-wide (some 344 million) was producing around 330 000 tonnes a day of solid waste (CELADE 1999; Acurio *et al.* 1997).

The problem lies not only in the quantity but also in the quality and composition of these wastes, which have gone from being dense and almost completely organic to bulky and ever more non-biodegradable, containing a larger proportion of toxic substances. This trend seems to be directly proportional to city size and to personal income, and to a shift in life styles. More and more plastic, aluminium, paper and cardboard packaging are being used and discarded by homes and by businesses. Just as an example, in Santiago, higher income neighbourhoods produce one kilogram of waste per person per day, while in

Annual per capita production of industrial waste, 1993 (tonnes)



Source: Acurio et al., 1997.

poorer neighbourhoods the production is 0.5 kilograms (Escudero 1996). In Trinidad and Tobago, on the other hand, organic waste production decreased from 44 per cent in 1987 to 27 per cent in 1994, while plastic-based wastes jumped from 4 per cent to 20 per cent in the same period. In 1994, the volume of waste disposed of in the main landfills was 44 per cent greater than in 1979, while in that same period the population grew only 30 per cent (UNEP 1999a).

The region is not equipped to manage hazardous industrial waste.

In addition to residential wastes, so-called 'special' and hazardous wastes must be taken into account, because although small in quantity they have possibly the greatest impact on the environment (Acurio *et al.* 1997). Solid waste includes, among others, solid residues from health centres (estimated at some 600 tonnes per day in the region), expired pharmaceutical and chemical products, expired food products, old batteries, sludge, debris, and bulky residues. Although there are no detailed regional studies on this, surveys carried out by the Pan American Health Organization (PAHO) indicated that in Brazil, for example, less than 8 per cent of the local governments studied adequately disposed of their hospital wastes. In Mexico barely 46 per cent of these wastes are treated before disposal, while in Venezuela the proportion ranges from 30 per cent to 40 per cent. (Acurio *et al.* 1997.)

Hazardous wastes are those solids or semi-solids characterized as toxic, reactive, corrosive, radioac-

tive, flammable, or infectious, and which therefore pose a health or environmental threat if improperly managed, legally or illegally, in urban areas. According to PAHO studies (Acurio *et al.* 1997), these wastes are disposed of in factory yards, empty lots, open-air dumps or controlled landfills, without regard for the damage done to the environment and human health. Despite the existence of a legal framework to control such dumping in some countries – for example Argentina, Brazil, Chile, Mexico and Venezuela – the physical infrastructure and human resources necessary for nation-wide enforcement are usually absent. The problem is aggravated by the importation of hazardous wastes from industrialized nations.

In order to collect and bury these wastes in a safe and sanitary manner, a fleet of 30 000 trucks and 350 000 cubic metres of earth a day would be needed. Between 90 per cent and 100 per cent of all garbage is collected in large Latin American cities like Buenos Aires, Santiago, Rosario, Havana, Mexico City, Saô Paolo, Rio de Janeiro, Bogota, Medellin, Cali, Montevideo, Brasilia and Caracas. However, in metropolitan zones, such as Mexico, Saô Paolo and others, this garbage collection does not include the marginal urban areas (Acurio *et al.* 1997). The average collection coverage in large cities is 89 per cent, while in smaller cities the figure ranges from 50 per cent to 70 per cent (Acurio *et al.* 1997).

Although in general terms solid waste collection services have improved, less attention has been paid to waste disposal itself. The waste treatment facilities in the region are split as follows: 35 per cent are sanitary landfills, and 25 per cent are semi-controlled landfills (PAHO 1995). The most commonly used disposal systems throughout the region are open-air dumps and non-sanitary landfills that do not even comply with minimum standards. Some progress has been made in a few cities – a factor that, due to city size, distorts statistics and causes unfounded optimism: the situation in other cities gives cause for concern. In Brazil, a national survey revealed that 88 per cent of the cities have open-air dumps, 9 per cent have controlled landfills, and another 3 per cent have sanitary landfills and other appropriate waste treatment methods (Acurio *et al.* 1997). Eighty-three per cent of the waste treatment facilities in Chile are sanitary, as are 30 per cent in Mexico. In Bolivia, Ecuador, Peru and most of the Central American countries, there are no sanitary landfills outside the capital cities, although Bolivia and Colombia are developing programmes for medium-sized cities (PAHO 1995). A Central American study covering 158 urban sites with more than 10,000 inhabitants showed that industrial and residential wastes were not being treated (Incer 1994). A problem usually overlooked is the management of biotic waste resulting from agricultural practices (including slaughterhouses), which covers agro-chemicals, excrement and carcasses. Another problem is the collection and disposal of bulky items such as vehicles, electrical appliances and furniture, which usually end up dumped in waterways and wetlands.

Other important concerns regarding waste disposal include the following:

- Most of the existing dumps and landfill sites were chosen without preliminary hydro-geological studies.
- Drains, rivers, creeks, wetlands, alleys and other inappropriate sites are being used to dispose of wastes.
- Many informal dump sites have no permits and have resulted from the unmet need for adequate sites.
- The lack of toxic waste disposal facilities forces people to dispose of these wastes in dumps and landfills.
- Lack of suitable waste disposal facilities particularly affects the residents of lower income areas and slums who cannot pay for garbage collection services.

Solid waste production, waste water treatment and garbage collection

	Solid waste per capita (Kg.year)	Wastewater treated (%)	Households with garbage collection (%)
Brasilia	182	54	95
Havana	584	100	100
La Paz	182	0	92
San Salvador	328	2	46
Santiago	182	5	57
By comparison:			
Toronto:	511	100	100

Source: UNEP, 1999a.

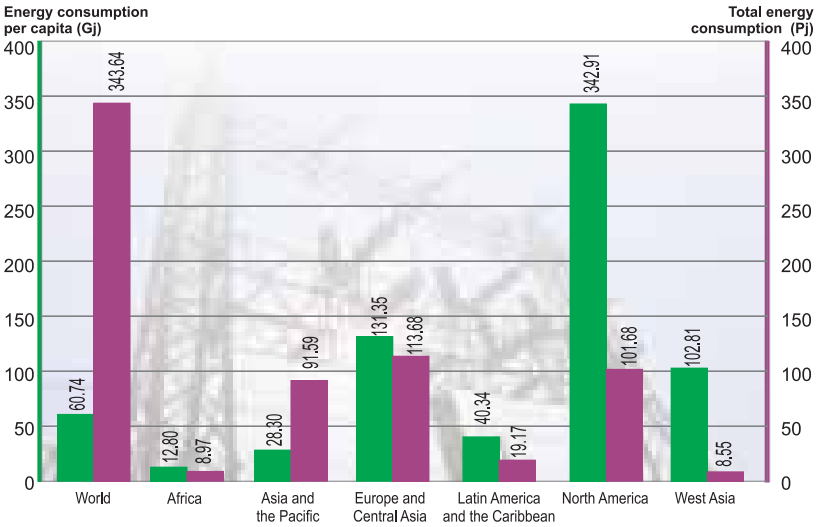
Similar problems are seen when it comes to effluent collection and treatment. In Latin America and the Caribbean as a whole, less than two per cent of waste water receives any kind of treatment (World Bank 1997a). In Brazil, the sewerage system reaches only 49 per cent of the urban population, and lack of clean water and sanitation causes some 8 500 premature deaths in the country's urban areas (Barros *et al.* 1995). In 1991, only ten per cent of the Caribbean population were served by a centralized sewerage system (Vlugman 1992). In that same year, 13 per cent of the treatment plants studied in the Eastern Caribbean were not operating, 58 per cent were operating either poorly or moderately, and 75 per cent of the plants did not comply with existing treatment quality criteria. If corrective actions are not taken in the near future, these problems could pose very serious risks to human health, especially in low-income urban areas, and to the environment, through pollution of rivers, marine environments, and surface and ground water.

The topography of most Latin American cities makes it difficult to use conventional methods to make water drinkable, to treat sewage and to collect effluents and solid waste. Contaminated runoff from impermeable surfaces in developed areas exerts additional pressure on the environment, on top of the already high load of contaminants in industrial effluents discharged into urban waste waters. The pressure of development will continue to increase as the urban areas grow, and as people continue to settle in sensitive areas – especially on steep slopes and over underground aquifers.

Energy

Energy consumption in Latin America and the Caribbean is less than ten per cent of the world total, while for Canada and the United States it is almost one-third of the total. As with other developing areas, when international oil prices climbed in the early 1970s the region sought other, non-hydrocarbon sources. Between 1980 and 1996, the region's electrical power production more than doubled, jumping from 361 billion to 810.3 billion kilowatt/hours. The dependence on hydrocarbons to generate this electricity dropped to 16.6 per cent of the total, while hydropower increased to 64.1 per cent. Exemplified by Gurí (Venezuela), Tucuruf (Brazil) and Itaipú

Total and per capita energy consumption, 1995



Source: data compiled by UNEP GRID Geneva from UNSTAT, 1997.

(Brazil–Paraguay), enormous hydroelectric projects modified the regional power-generation scenario. In Paraguay and Brazil, hydroelectric generation satisfies, respectively, 99.7 per cent and 91.7 per cent of national requirements. In Central America, the proportion is more than 50 per cent. However, dependence on hydrocarbons has been growing in some countries, including El Salvador, Haiti, Nicaragua, Jamaica and Cuba. Power generation in the Caribbean is based primarily on fossil fuel – mostly oil, but also natural gas, as in Trinidad and Tobago (PNUMA 1999c),

Energy consumption in Latin America and the Caribbean is less than 10 per cent of the world total, while North America (Canada and the United States) have almost one-third of the total.

Despite the growing importance of hydroelectric power generation in the region, the conflict between access to water and water use also continues to grow because of the vulnerability of water to climatic variation. Uruguay, for example, relies heavily on water sources to produce electricity, and the severe droughts of recent years have forced the country to assign water sources to this use, with direct effects on agriculture. Additionally, in some countries such as Argentina, Brazil and Colombia, and due to deregulation of the sector, there is a tendency to switch from renewable energy sources to fossil fuel for power production and transportation (Rosa *et al.* 1996). Private investors seem to favour fossil-fuel thermal plants over hydroelectric installations because the capital cost is less and the return on investment is faster – even though the cost of the energy is higher (Tolmasquim 1996). In many coun-

tries that depend on non-renewable sources for power generation, a fundamental barrier to the switch to renewable resources is the huge investment already made in fossil fuels, in their processing, and in the equipment set up to utilize them. Such is the situation in the insular Caribbean countries.

In addition to hydroelectric power generation, other technologies using renewable sources to produce electricity are:

- biomass conversion;
- wind energy;
- solar energy systems, both active (thermal and photo-voltaic) and passive (low-energy architecture);
- oceanic thermal energy conversion, and
- geothermal energy.

However, some of these technologies could have negative impacts on the environment. Biomass conversion, for example, poses a potential risk to biodiversity because it replaces natural forests with monoculture forests. There is also competition to use agricultural land and the need to preserve and improve soil quality. Many solar and wind power systems are land-intensive.

Coal, oil and natural gas continue to be the least expensive fuels. Wind power costs almost the same as oil, but depends on specific geographical conditions and requires a certain critical mass of facilities to ensure that maintenance is efficient. Active solar power systems are economically viable only in remote areas where it would be more expensive to lay power cables.