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**Activities of the United Nations Human Settlements Programme
(UN-Habitat), including coordination matters**

**Activities of the United Nations Human Settlements Programme:
progress report of the Executive Director**

Report of the Executive Director

Addendum

Energy consumption in human settlements

Summary

There are approximately 2 billion people who lack access to electricity and a further 2 billion depend on traditional fuels, such as wood and animal and crop waste, for cooking and heating. Over 1 billion of these reside in informal settlements within developing country cities. For one third of the world's population, dependence on traditional fuels results in a significant number of hours being spent each day gathering wood, primarily by girl children and women, even in urban areas. Partly because of poor infrastructure and prohibitively high costs, the poor often end up spending much more on energy than those who are better off. This is compounded by the limited access to appropriate financing schemes that can allow the poor to overcome the high up-front costs of cleaner energy devices and appliances. Other important energy challenges facing the poor include low incomes that are not sufficient for the procurement of energy services to meet basic needs such as cooking, to provide affordable transport, to power pumps for drinking water; to sterilize medical equipment and to provide space heating.

Most of the commercial and non-commercial energy produced today is used in and for cities and a substantial percentage is used by the household sector. Developing country cities are at present faced

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with the need to increase their energy production to accelerate development and raise the living standards of their populations, while at the same time reducing energy production costs and energy-related pollution. Increasing the efficiency of energy use to reduce its polluting effects and to promote the use of renewable energies must be a priority in any action taken to protect the urban environment. This will require major policy changes from the “business-as-usual” approach to imaginative innovations in lifestyle, energy use and energy policy planning, with a view to shifting the current focus on energy supply to an end-use-oriented approach, and thus contributing to attainment of the sustainable human settlements development goals.

The fifteenth session of the Commission for Sustainable Development, which will take place from 30 April to 12 May 2007, offers an ideal opportunity to focus the world’s attention on the energy needs of the world’s urban poor, particularly those residing in informal settlements. The United Nations Human Settlements Programme (UN-Habitat) must build on the momentum created for enhancing access to clean, modern energy services by the urban poor residing in informal settlements – momentum resulting from its participation at the Commission’s fourteenth session in May 2006. No other United Nations organization dealing in the area of energy for sustainable development has the mandate specifically to deal with the energy needs of the urban poor.

Concerted action will be required at all levels to incorporate renewable energy sources in the national energy matrix, but success will primarily depend on the abilities of developing countries to support private renewable-energy investors through selective and well-targeted subsidies, fiscal and other forms of incentives and innovative venture capital schemes to speed up the commercialization of renewable energy technologies. The private sector has been – and will remain – a key driving force behind the successful diffusion of clean energy-related technologies. UN-Habitat must work with private sector companies and government regulators to ensure an open and level playing field in terms of market-entry into the sustainable energy field.

Implementing urban environmental strategies to tackle energy-use-related problems will require the integration of environmental considerations into existing responsibilities, the initiation of new environmental actions or programmes designed to tackle critical problem areas and the mobilization of financial resources to perform the related tasks. UN-Habitat will be working with a variety of United Nations partners, including – but not limited to – the United Nations Development Programme (UNDP), the World Health Organization (WHO), the United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Programme (UNEP) in the development and implementation of plans, programmes and projects in the area of improving access to clean modern energy for the urban poor.

For most developing country cities, capacity-building will be a long-term and dynamic process, refining and strengthening existing strategies, skills and capabilities. External assistance will be crucial in building the necessary capacity to plan and implement environmental strategies at the local level. Principal areas where such support should be considered include, first, the environmental research and policy analysis needed to formulate urban environmental strategies and action plans at the local level; second, policy reform, institutional development and resource mobilization; and, third, financial support for improving the efficiency of urban energy services and for the promotion of renewable energy technologies.

I. Introduction

1. As the world moves forward into the twenty-first century, energy-related challenges are growing increasingly severe in cities throughout the world and in countries at all levels of development. In all corners of the globe, city residents are exposed to unhealthy levels of energy-generated pollution. Urban emissions are also having negative regional development impacts, reducing crop yields and forest integrity in wide areas across North America, Europe and Eastern Asia. Furthermore, the greenhouse-gas emissions generated in the course of providing power to the world's cities are contributing significantly to the problem of global climate change.

2. At the same time that the negative environmental impacts of urban energy consumption are manifesting themselves at local, regional and global levels, the demand for energy continues to grow. This relentless growth in demand for modern energy resources is understandable in cities throughout the developing world, where per capita consumption rates still remain comparatively low. Unfortunately, the environmental externalities generated by conventional energy systems are eroding the health and productivity of citizens in many developing country cities: thus new paths towards more efficient and sustainable patterns of energy consumption must be pursued in these areas.

3. It has been estimated that about three quarters of the world's commercial energy is consumed in cities. More specifically, over 75 per cent of carbon emissions from fossil fuel burning and cement manufacturing and 76 per cent of industrial wood consumption occur in urban areas. A primary function of the world energy system is to provide urban settlements with massive quantities of electricity, petrol and heat for use in their commercial, transport and residential sectors.

4. Urban societies in developing countries are dual in nature: in some segments of the society, incomes are quite high and their energy-consumption patterns are similar to those of industrialized countries, with increasing demand for high-intensity energy-consuming services, such as refrigeration, air-conditioning and personal transport. For the remaining segments of society, which constitute the overwhelming majority of the population, consumption patterns are similar to those in rural areas. Indeed, almost 1 billion urban residents live in informal settlements in developing country cities in conditions identical to – or in some cases worse than – their rural poor counterparts.

5. Energy is a key input for meeting basic needs and for achieving social and economic development goals that include, among others, fuel for cooking, heating and lighting in households, power for industry and petroleum products for transportation. The supply of and the demand for virtually every type of energy generate varying degrees of environmental externalities that affect human health, environmental stability and economic development. These effects can occur at the household, local, regional, national or transnational level.

6. There are approximately 2 billion people who lack access to electricity and a further 2 billion depend on traditional fuels, such as wood and animal and crop waste, for cooking and heating. Over 1 billion of these reside in informal settlements within developing country cities. For one-third of the world's population, dependence on traditional fuels results in a significant number of hours being spent each day gathering wood, primarily by girl children and women, even in urban areas. Partly because of poor infrastructure and prohibitively high up-front costs, the poor often end up spending much more for energy than those who are better off. This is compounded by limited access to appropriate financing schemes that might allow the poor to meet the high up-front costs of cleaner energy devices and appliances. Other important energy challenges facing the poor include their low incomes that are not sufficient for the procurement of energy services to meet basic needs such as cooking, to provide affordable transport, to power pumps for drinking water; to sterilize medical equipment and to provide space heating.

7. With their high population densities, cities tend to concentrate environmental problems that elsewhere are geographically dispersed. A classic example of this is air pollution in cities, where both point sources (such as industrial emissions from smokestacks) and non-point sources (such as vehicle exhaust) are concentrated in a limited, densely populated geographical area. The degree of the problem varies with prevailing winds and thermal stratification patterns, urban geography, levels of industrialization and motorization and the incidence of indoor and outdoor human exposure. It is important to note that the cause of many of these problems may be urban but the impact can be felt both inside and outside the city. In addition, ambient air pollution may affect the health of urban residents and damage the crops of farmers in rural areas.

II. United Nations mandates for work in the field of energy

8. Access to affordable, modern energy services is a prerequisite for sustainable development and poverty alleviation and, more specifically, for attainment of all the Millennium Development Goals. Lack of access to reliable, safe and environmentally-friendly energy is a strong constraint on human development. Energy services can play a variety of direct and indirect roles in facilitating attainment of the Millennium Development Goals:

(a) *Access to energy facilitates economic development*: access to energy means that value-adding income-generating activities are enhanced. Micro-enterprise and other livelihood-related activities can be extended beyond daylight hours, creating additional employment opportunities. Access to energy assists in bridging the digital divide;

(b) *Access to energy reduces hunger and improves access to safe drinking water*: energy services can improve access to safe drinking water through pumping facilities;

(c) *Access to energy reduces disease and reduces child mortality*: energy is a key component of a functioning health system, through refrigerating medicines, sterilizing equipment and providing transport to clinics;

(d) *Access to energy helps promote universal primary education and the empowerment of women*: energy reduces the time spent by women and children on basic survival activities (fetching water, firewood, cooking, etc.); lighting permits improved levels of home study for children;

(e) *More efficient use of energy promotes environmental sustainability*: improved energy efficiency and use of cleaner alternative forms of energy helps to achieve a more sustainable use of natural resources and reduces harmful emissions;

(f) *Access to energy for affordable transport enhances urban mobility*: improved urban mobility allows better access to wider employment and other economic opportunities within the city.

9. The World Summit on Sustainable Development, building on the outcome of the ninth session of the Commission on Sustainable Development, identified the following five key areas as critical to achieving the goal of energy for sustainable development:

- (a) Increasing access to energy services, particularly for the poor;
- (b) Improving energy efficiency;
- (c) Increasing the proportion of energy obtained from renewable energy sources;
- (d) Advanced energy technologies;
- (e) Reducing the environmental impact of transport.

10. In its paragraph 145, the Habitat Agenda states: "The use of energy is essential in urban centres for transportation, industrial production, and household and office activities. Current dependence in most urban centres on non-renewable energy sources can lead to climate change, air pollution and consequent environmental and human health problems, and may represent a serious threat to sustainable development. Sustainable energy production and use can be enhanced by encouraging energy efficiency, by such means as pricing policies, fuel switching, alternative energy, mass transit and public awareness. Human settlements and energy policies should be actively coordinated.

11. At its fifty-sixth session, in 2001, the United Nations General Assembly reiterated that mutually supportive efforts at the national and international levels are imperative in the pursuit of sustainable development, which includes the provision of financial resources and the transfer of technology for the application of cost-effective energy and the wider use of environment-friendly, renewable energy technologies.

12. Under the United Nations Framework Convention on Climate Change, parties have agreed to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. As the global energy system is the major source of

greenhouse gases, this commitment will have to be considered in the design of the future world energy system. The Kyoto Protocol provides the first specific step in dealing with the issue, building on the principle of common but differentiated responsibilities.

13. Progress is being made in forging the necessary will to tackle the energy problem at the appropriate levels. In April 2006 for example, at its fourteenth session, the Commission on Sustainable Development highlighted the value of networking among centres of excellence in the area of access to energy services, so that these could support and promote efforts in capacity-building and technology transfer activities, as well as serving as information clearing houses. The Commission agreed that lack of local capacity was a major obstacle to expanding energy services in the developing world, stressing the importance for institutions, infrastructures and human resources in developing countries to be strengthened through international public and private cooperation that supported sustainable development objectives. The Commission also remarked that information and knowledge-sharing on technologies and policies facilitated efforts to achieve energy for sustainable development and that relevant information could direct decision-makers to suitable policy and energy supply options. The lack of such information and knowledge sharing was identified as a barrier preventing countries from adopting new approaches in energy planning and technology applications.

14. The fifteenth session of the Commission for Sustainable Development, which will take place from 30 April to 12 May 2007, offers a unique opportunity to focus the world's attention on the energy needs of the world's urban poor, particularly those residing in informal settlements. UN-Habitat must build on the momentum created by its participation in the Commission's fourteenth session to enhance access to clean, modern energy services for the urban poor residing in informal settlements. No other United Nations organization in the area of energy for sustainable development has the particular mandate to deal specifically with the energy needs of the urban poor.

III. Historical patterns of energy production and consumption in cities

15. Historically, cities throughout the world have been arenas of tremendous economic and social development. The higher densities of people and material resources found in urban areas allow significant gains in productivity to be achieved, while reducing human impacts on natural ecosystems. These higher densities also make it easier to provide basic services to citizens and, as a result, urban areas also have the potential to offer better health, education, sanitation and electrical services than are found in most rural areas. From both a human development and environmental point of view, therefore, it makes eminent sense to encourage the continued growth of high-density population centres — provided underlying developmental problems can be solved.

16. Urban structures do, however, affect energy requirements and consumption patterns in many distinct ways. Low-income rural-migrant populations, generally used to relatively easy access to non-commercial fuels in their villages, find it hard to secure such fuels when they migrate to cities and are often forced to buy commercial fuels for the very first time and at great expense.

17. Traditional food processing and cooking are too time-consuming for most women as they have to seek paid work to earn the money necessary to purchase essentials: thus, an increasingly important activity in these burgeoning urban settlements is the street sale of foods, often prepared on cooking appliances that are extremely inefficient in their use of energy.

18. As a whole, global reliance on hydrocarbon resources has increased exponentially throughout the modern era. Today, coal, oil and natural gas resources combined provide approximately 90 per cent of all world commercial energy requirements. The non-hydrocarbon industries of nuclear energy and large-scale hydroelectric power together provide most of the remaining 10 per cent. All alternative energy technologies combined (small hydro, geothermal, wind, solar and tidal) currently provide less than 1 per cent of the world's commercial energy; a sobering statistic for those concerned about the environmental sustainability of modern urban society.

IV. Structure of urban energy use

A. Household energy

19. Energy is used in buildings for cooking, heating and cooling of space, lighting and also for productive activities. The patterns of energy use within buildings vary a great deal according to use and location. In residential buildings, household income and climate have a great influence both on energy sources and end-use patterns. In most low-income countries a high proportion (up to 90 per cent) of the energy used in residential building is for cooking. In poor urban communities, firewood alone often meets nearly all the energy needs of households. In areas where there is a substantial annual heating requirement, coal is often used, the combustion of which adds considerably to urban air pollution. As a result of the lack of available information on how households use energy, it is difficult to make a scientific assessment of past levels of efficiency and to understand how efficiency increases could affect future demand. Even where data are available on the energy use of the sector, the economic impact of household energy conservation cannot be assessed, except in very general terms. Without such information, it is difficult for Governments to prioritize conservation programmes or to allocate programme funds to those areas that promise the greatest return.

B. Energy embodied in buildings

20. While the largest component of energy consumption in the household and building sectors is consumption from within buildings in use, the energy used in the production of buildings themselves is a significant and growing element of this total energy use. There are proven reasons, mainly environmental ones, for seeking to reduce what is known as “embodied energy” – the energy consumed by all the processes associated with the production of a building. In general, the energy consumption in the production of buildings is a relatively small part of the total lifetime energy use, perhaps 10–15 per cent, if a lifetime of about 25 years is assumed. But much of this lifetime energy use, particularly in developing countries, is in the form of cooking energy, over which the initial design of buildings has little effect. A high proportion of the energy incorporated in buildings (80–90 per cent) is related to the production and transportation of energy-intensive building materials such as cement, steel, bricks, concrete, aluminium, etc. Increasing the efficiency of energy use in the production of building materials is, therefore, an essential prerequisite in reducing the cost of materials and arresting the environmental impacts caused by excessive use of energy in the production process. Some strategies to optimize the use of energy in the production of building materials are: careful study and auditing of all kiln processes; use of low-grade fuels where possible; use of recycled materials; reduction of transportation costs by expanding the small-scale sector; use of locally available and indigenous building materials; use of solar energy or waste kiln heat in low-temperature operations, etc.

C. Renewable energy technologies for human settlements development

21. The field of renewable energy technology, involving the use of sun, wind, hydro-power and biomass, is extensive, complex and multidisciplinary and, accordingly, generalizations about it are difficult to make. At the present state of development, renewable sources of energy have a limited role globally but could play an important role at the local level, particularly within informal settlements in cities in developing countries. An overall description of the present situation as regards renewable energy provision is also made difficult by the fact that some technologies are mass-produced and widely used on a small scale but remain at an early and experimental stage when it comes to large-scale applications. This is primarily because the cost-effectiveness and hence the commercial viability of different energy conversion technologies is strongly influenced by the scale of operation. It is well known that economies of scale apply to larger systems, but the variation of economy of scale with size differs considerably for different technologies. Hence, some technologies become much more economical when scaled up but others (like solar photo-voltaic) do not offer similar variations with size and, therefore, initially tend to be most economically competitive for the smallest applications.

22. Currently, the most viable option for meeting the energy needs of the majority of urban poor in cities within developing countries is the rational use of biomass. To this end, the conversion of biomass into gas, through the use of digesters, and the use of improved and more energy-efficient stoves constitute the most effective ways of using this resource. The technologies of solar photo-voltaic systems offer prospects for meeting the lighting, telecommunications, refrigeration and other power needs of the rural poor in a cost-effective and efficient manner, in areas that are remote from national electricity grids. For households in urban areas, the use of low-power energy-efficient appliances and

the judicious substitution of cost-effective new technologies for fossil fuels, such as solar water-heaters and other space-heating and cooling devices, offer opportunities to reduce the cost of energy services, while, at the same time, conserving resources.

23. An important constraint faced by most developing countries is that renewable-energy technologies designed and developed in industrialized countries are often not compatible with the levels of managerial and manufacturing skills available in developing countries. Another constraint is posed by the lack of information about developments in renewable-energy technologies: this has greatly impeded investment in these technologies in developing countries. Public awareness about the use of renewable-energy sources, their costs, benefits and reliability is very limited. Consequently, entrepreneurs are not motivated to venture into investment in unknown technologies with uncertain market potential. The lack of financial resources, at both individual and government level, is another constraint to the propagation of technologies. The transition from traditional fuels that cost nothing, such as wood or cow-dung, to a modernized renewable fuel, such as biogas, or to an energy-efficient wood stove requires an initial capital investment on the part of the individual user, which is beyond the capability of the urban poor. The attitude of key policy-makers towards renewable-energy technologies ranges from caution to scepticism and as a result they are not given high priority in national energy planning. Each of these problems is of considerable economic and political complexity and, unless initiatives are taken at the national and international levels, the inadequacy of existing technology-transfer mechanisms will remain a barrier to the introduction of renewable-energy technologies.

24. Biomass already supplies 14 per cent of the world's energy, and many future projects are being assessed which, if implemented, could increase the role of biomass in the overall energy system. On average, biomass produces 38 per cent of the primary energy in developing countries (90 per cent in some countries), where it is the largest single energy source. Biomass energy is likely to remain an important global energy source in developing countries well into the next century. A number of developed countries also use biomass quite substantially, e.g., the United States of America, which derives 4 per cent of its total energy from biomass (nearly as much as it derives from nuclear power), Sweden, 14 per cent and Austria, 10 per cent. Biomass is generally and wrongly regarded as a low-status fuel and rarely finds its way into energy statistics. Nevertheless, biomass can lay claim to being considered as a renewable equivalent to fossil fuels. It offers considerable flexibility of fuel supply, owing to the range and diversity of fuels which can be produced. It can be converted into liquid and gaseous fuels and to electricity via gas turbines; it can also serve as a feedstock for direct combustion in modern devices, ranging from very small-scale domestic boilers to multi-megawatt size power plants.

25. Biomass energy systems can increase the energy available for economic development without contributing to the greenhouse effect since biomass is not a net emitter of carbon dioxide to the atmosphere when it is produced and used sustainably. It also has other benign environmental attributes such as lower sulphur and nitric oxide emissions and can help rehabilitate degraded lands. There is a growing recognition that the use of biomass energy in larger commercial systems based on sustainable, already accumulated resources and residues can help improve natural resource management. Integrating biomass energy into national energy planning and policy-making on an equal footing with other energy sources will not be easy and will require concerted action at national and subnational levels. A reliable information base will have to be developed on the supply and utilization of biomass energy in the country; the policy environment must be made responsive to the needs of the biomass-energy sector; research, development and engineering efforts will have to be stepped up in required areas; and the commercialization of biomass technologies will have to be promoted through selective and well-targeted subsidies and fiscal and other forms of incentives.

V. Linking energy with water and sanitation service provision

26. Quite often, upwards of 50 per cent of the total costs of small-scale water utility operations goes towards the running costs of providing electricity to power water pumps. This burden could be reduced by supplementing power provision through appropriate renewable energy technologies such as wind and solar power, or by implementing cross-subsidy arrangements through municipally owned and operated water, sewerage and power companies through cost-sharing mechanisms. At the same time, energy generation (and often electricity) can be implemented through the use of so-called "energy-to-waste" schemes.

27. Poor management of urban waste is often due primarily to the lack of sufficient resources for the collection and proper disposal of municipal waste. The generation of energy from this waste could

transform the situation. The income generated from the sale of energy produced from municipal waste would lead to a reduction in the net financial costs of waste disposal in most cities within developing countries and might actually make the whole venture economically self-sustaining. Municipal wastes, being linked to the size of the urban population, will increase proportionally, thereby providing more raw material for the energy production processes. On the other hand the exploitation of energy from wastes will greatly reduce (by over 60 per cent) the quantities of urban wastes which will need to be disposed.

VI. Development constraints created by urban energy consumption patterns

28. In general, cities throughout the world are growing increasingly dependent on petroleum resources which are imported from a small number of regions. A number of oil-exporting countries have achieved impressive levels of economic growth on the basis of this trade. Cities, however, are exposing themselves to severe economic risks by becoming ever more reliant on imported oil supplies. Urban planners need to recognize that the world's production of oil is likely to reach its apex some time in the next decade or two and, once this occurs, petroleum prices will become increasingly volatile. It would be short-sighted to construct urban infrastructures that are predicated on false assumptions about the availability of cheap and secure oil imports, given these widely acknowledged resource constraints.

29. While many people in the developing world struggle to gain access to modern energy and technologies, urban residents in the global north are generally consuming energy resources at an unsustainable rate. The high levels of energy use in wealthy countries are the source of most greenhouse gases emitted into the atmosphere today. In contrast, most residents of cities in developing countries produce relatively few greenhouse gas emissions. Since these gases remain in the atmosphere for long periods of time, it should also be noted that countries in the developed North have emitted most of the total greenhouse gases accumulated in the atmosphere over the last two centuries.

30. While the environmental problems of conventional patterns of energy consumption are becoming manifest, there is at the same time a growing need for modern forms of energy in the developing world. To put the challenge in perspective, consider that during the period 1970–1990 approximately 40 million people per year gained access to modern energy services. Given the number of people currently in need of services, combined with the expected population growth, almost 100 million people would have to be connected to modern energy systems each year in order to achieve universal access by around 2020. This is certainly a daunting task, especially given tightening resource and environmental constraints.

31. Many of the people in direst need of access to modern energy systems are located in rapidly growing urban settlements throughout the developing world. With diminishing traditional sources of fuel, the citizens of medium-sized and large cities often face escalating energy prices while being forced to contend with the pollution generated by conventional energy industries.

32. Many of the most severe challenges confronting cities originate from the manner in which energy resources are produced and consumed. While energy is a key input for urban development, virtually every type of power generates varying levels of environmental problems. Some of these impacts are experienced outside city limits. The harvesting of wood for use by impoverished city residents in Asia and Africa, for instance, has led to extensive deforestation around numerous urban areas. Meanwhile, within cities, intensive levels of energy consumption are leading to unprecedented spatially concentrated forms of pollution, particularly along major transportation corridors.

VII. Sustainable urban transport, air quality and land use

33. It has been estimated that more than 1 billion people throughout the world live in urban settlements where air pollution levels exceed health standards. The human consequences of this energy-generated pollution can be quite significant. In the United States, for instance, it is thought that at least 28 per cent of the urban population is exposed to harmful levels of particulates; a level of exposure that causes the premature death of an estimated 40,000 United States residents each year. Meanwhile, 46 per cent of the United States urban population is exposed to unhealthy levels of ozone, which exacerbates respiratory and cardiovascular diseases in more and more people. In European cities conditions are equally bad, with high levels of energy-related pollution causing an increase in the incidence of, and fatalities due to, chronic pulmonary disease.

34. Meanwhile, in the developing world, conditions are even more extreme. In Mexico City, high levels of pollution are estimated to cause over 6,500 deaths each year. Meanwhile, over 52,000 people in 36 Indian cities are thought to have been killed by air pollution in 1995 alone. And in China, air pollution is estimated to cause anywhere from 170,000 to 280,000 deaths each year. On top of the human toll registered in these figures, there are growing financial costs as well. In developed countries, air pollution is estimated to cost around 2 per cent of gross domestic product (GDP); in developing nations such pollution can cost anywhere from 5 to 20 per cent of GDP. On a global scale, the health costs of urban air pollution are thought to approach \$100 billion annually.

35. Though the problems inherent in low-density, car-reliant cities are increasingly in evidence in more developed countries and cities, this model of urbanization is being replicated in many other developed countries. One of the most salient features of life in the twentieth century has been the rise of the private motor vehicle, which has completely reshaped urban life. While exclusively the domain of developed countries for decades, less developed countries have joined the same bandwagon and are suffering from the same grave social and environmental consequences. Annual increases in rates of motorization in many developing countries has approached 10 per cent – rates substantially higher than have ever been found in countries like the United States, considered the bastion of private car ownership and use.

36. Changes in urban land use patterns can have important effects on the viability and popularity of the modes of transport that are most important to the urban poor: non-motorized transport (walking, cycling, animal traction, etc.) and public transport. These forms of transport are vital for providing low-cost mobility and hence access to a range of urban opportunities for the poor, including a wider choice of housing. As cities become more motorized, however, trends in land use change and this tends to undermine these low-cost modes of travel to the detriment of the mobility of the poor.

37. The result has been that in recent years energy efficiency gains have slowed down or even been reversed in some transport and residential sectors in numerous developed nations. As a result of these dynamics, the largest per capita contributors to energy-related environmental problems continue to be affluent citizens living in cities throughout the developed world. The primary responsibility for reducing such impacts therefore should rest on those living in the wealthiest regions of the world economy. Nevertheless, there are also serious energy-related problems emerging in cities in the developing world.

38. While cities in the developed world confront problems originating primarily from over consumption, metropolitan areas in the developing world face a much more complex set of energy dilemmas. On the one hand, the vast majority of urban residents in cities throughout the southern hemisphere suffer from inadequate access to modern energy systems. On the other hand, even at low per capita levels of consumption many of these cities are generating very intense forms of pollution. There are a number of factors that are producing this unfortunate combination of low per capita consumption rates and high aggregate urban emissions throughout the developing world.

VIII. Issues and options to meet the urban environmental challenge

A. Household level

39. At the household level, urban dwellers in many cities are exposed to excess levels of indoor air pollution, which results from the lack of proper ventilation and incomplete combustion of biomass, coal, and other fuels used to meet residential cooking or heating needs. Health effects include acute respiratory infections, low birth weight, and eye problems. Impacts vary greatly according to cooking practices, fuel use, type of dwelling and duration of exposure. The groups that are most at risk are women and children because they predominantly remain indoors and in most cultures are responsible for cooking. Short-term options to tackle this environmental health risk include, first, production and dissemination of stoves that are more efficient and clean-burning; second, installation of chimneys to vent smoke from dwellings; and, third, consumer education about the adverse health effects of indoor smoke inhalation. Longer-term approaches include upgrading kitchens and heating systems; formulating pricing policies that result in energy conservation; substituting cleaner fuels for cooking and heating; and tackling other sources of indoor pollution such as cigarette smoke, hazardous chemicals, and radon.

40. Urban poverty strongly reinforces the social and environmental impact of energy use at the household level. A study of low-income groups in Rio de Janeiro suggests that the poor do not have adequate information about, or access to, more efficient and less polluting equipment and fuels. Furthermore, because the distribution network is less effective or altogether non-existent in the poorer

sections of the city, those in poverty are served by a parallel market which forces them to pay more than the wealthy, making it even more difficult to afford other available options. In addition, low-income families often settle in undesirable but affordable sections of the city that may suffer from energy-generated pollution, for example, near major roadways or factories. This increases their exposure to daily doses of pollutants as well as the risk of accidents.

B. Local level

41. There are two important issues to which attention must be given at the local level. First, those concerned with energy and environmental matters in the urban context need to focus on problems where an identifiable population is exposed to a significant threat. For example, when comparing emission rates from a large coal power station with those from smaller, decentralized wood-burning plants, one needs to take into account the total output of pollutants and their impact on the affected population. The large central facility may be located in a remote, underpopulated and well vented air-shed, while the decentralized sources may be both more numerous and much closer to population centres, thus exposing large numbers to the emissions. A recent study carried out in Bombay shows a clear spatial-population nexus for energy-based environmental problems. This issue can best be resolved through an improved understanding of the importance not only of volumetric measurements of pollutants but also their spatial locations, human health effects, and economic and environmental costs.

42. The rapid growth of cities in Latin America, Africa and Asia has generated such high-density populations that even modest levels of energy consumption at the individual level can translate into severe environmental problems. Local municipal agencies in the southern hemisphere, unlike their counterparts in large cities in the northern hemisphere, are rarely able to mobilize sufficient resources to cope with these growth-related challenges. In fact, budgetary pressures have forced many cities throughout the developing world to reduce environmental expenditures in general, and energy management in particular, even as the scale of the problems continues to expand.

43. The fact that certain large cities in the northern hemisphere have had some success in confronting energy-related challenges indicates that population pressures can be managed. High population densities in the southern hemisphere, while certainly posing a significant challenge, are clearly not the sole factor to be considered in this context.

44. At least as important as the population pressures are the severe social inequalities found in cities throughout the developing world. While privileged classes in the southern hemisphere often replicate the modern, energy-intensive lifestyles found in the developed world, substantial numbers of impoverished urban inhabitants are forced to subsist on heavily polluting resources such as wood and coal. Public policy often exacerbates these inequalities. For instance, the limited subsidies for energy products provided in many developing countries have been shown to benefit wealthier residential or industrial groups, while the truly impoverished typically pay high unit costs for resources purchased in informal markets. In short, affluent urban consumers generally contribute disproportionately to pollution problems while poorer residents are again subjected to higher levels of exposure to energy-generated pollution throughout the developing world.

45. A final factor that contributes to energy-related difficulties in less affluent cities has to do with technological inadequacies found in their energy sectors. Electrical power plants currently in operation in the developing world, for instance, are estimated to be between 20 and 40 per cent less efficient than plants typically found in industrial countries. Transmission losses, meanwhile, are thought to lead to losses of another 20 per cent. This means that more than half the energy that is normally put to use in developed countries is often lost in the developing world, although the environmental externalities are still being generated. In the sectors of transport, huge efficiency losses are again incurred because of old vehicles and congested roads. More seriously, the continuing use of leaded petrol in many cities in developing countries is causing neurological, cardiac-related and other health problems in urban residents.

46. Technological upgrading is sorely needed in energy sectors throughout the southern hemisphere; the difficulty lies in determining how this is to be achieved. Some analysts believe that the development process will of itself deal with these issues. For instance, it has recently been suggested that the relationship between local pollution and levels of economic development can be expressed as a bell-shaped Kuznets-type curve. At very low levels of development, poverty appears to limit the ability to pollute and so emission rates tend to be low. As industrialization and urbanization begin to accelerate, however, larger quantities of resources are often consumed in relatively archaic, unregulated conditions

and air quality tends to worsen. It is generally believed that it is only when a city or country has reached higher levels of affluence, and social demands for a better quality of life have been articulated, that resources will be mobilized to improve technological systems and counteract the impact of pollution.

47. While the potential existence of this Kuznets curve has led some to assume that development automatically cures underlying environmental problems, the fact that the majority of the world's urban residents are located at the beginning of the curve has troubling implications. Unless concerted efforts are made to bypass the curve, through proactive policies of technology transfer and careful regulation, the human and environmental damage generated by urban energy consumption will escalate dramatically.

IX. Cities and climate change

48. The combined effects of the excessive consumption of energy in affluent cities and inadequate energy sectors in developing cities are clearly producing serious pollution problems on local and regional levels. Though the causal connections are less obvious, it is also known that urban settlements are contributing significantly to the problem of global warming.

49. Cities themselves are thought to be particularly vulnerable to the consequences of climate change. It is expected that infectious diseases will proliferate in a warmer world, especially in dense urban settlements. Regional temperature rises will generate more urban smog. Changes in precipitation will adversely affect urban water supplies. An increase in extreme weather events will cause damage to urban infrastructure, and a rise in sea levels will begin to threaten coastal cities throughout the world.

50. Given the likely consequences of climate change, urban managers throughout the world have a limited time frame in which to undertake proactive damage control strategies. As the financial costs of global warming begin to mount, fewer and fewer cities will have the resources to foster the diffusion of new energy technologies that could reduce environmental impacts. The time for concerted action is clearly upon us. But are there alternative energy technologies that could provide solutions to the energy-related developmental constraints that are emerging in both affluent and impoverished cities? A growing body of evidence suggests that the answer to this question is a tentative "yes".

51. A variety of options exist to reduce municipal outputs of greenhouse gases in the developing world: first, pricing energy products to cover their economic costs, thus encouraging conservation; second, removing market imperfections that impede efficient energy use in households, industries, enterprises, transport, and the public sector; third, reducing losses in the supply of energy, e.g., generation, transmission, and distribution losses to urban electricity consumers; fourth, promoting the substitution of cleaner alternative fuels and technologies, e.g. crop residues for agro-industries and households, and natural gas in industry and transport; fifth, improving transportation systems through pricing, investment, technological options and regulatory measures to reduce urban traffic congestion; and, sixth, managing peri-urban lands to maintain green zones and increase forested areas that, through photosynthesis, are important sinks for carbon dioxide.

X. Sustainable energy technologies appropriate for urban applications

52. Advances in a variety of new energy technologies offer considerable promise for reducing pollution, increasing efficiencies and broadening the resource base of urban energy sectors in countries at all levels of development. The new energy systems that hold the most promise for enhancing sustainability include small-scale hydroelectric, wind, solar modern biomass and fuel cell technologies. While the literature on these new energy systems has generally highlighted the potential for their use in rural areas, it is becoming clear that they can make a significant contribution in urban energy sectors as well.

53. A few of these new energy technologies are restricted as to location, but they could provide power to urban areas via long-distance transmission. Small-scale hydroelectric stations, for instance, offer one of the most benign forms of energy production available to the world. In contrast to disruptive large-scale hydroelectric projects, small-scale systems allow electrical power to be generated without significantly altering the flow of rivers. Wind systems offer similarly benign options for electrical generation in areas surrounding cities and large-scale solar arrays have been shown to be capable of generating electricity that can then be fed into utility grids. If development agencies, Governments and corporations begin supporting such alternative energy systems, a more environmentally sustainable

network of facilities can begin to bring electricity to urban communities throughout the world in the coming decades.

54. Urban areas have long benefited from preferential treatment in terms of energy provision. Indeed, inadequate access to modern energy services in rural areas is one factor prompting migration to cities in many regions of the world. It is therefore important for policy makers to ensure that the benefits of new energy technologies are equitably shared by rural and urban settlements alike. Moreover, it is crucial that cities begin reducing their burdens on rural areas by generating their own power. Urban-based solar, biomass and fuel cell technologies offer opportunities to improve the self-reliance of urban energy sectors.

55. Solar thermal and photovoltaic systems designed for use in metropolitan areas have received increasing attention in the last decade. In part, this continued growth is the result of public support. In the United States of America, for instance, the Million Solar Roofs programme has helped to foster the diffusion of solar thermal and photovoltaic systems in numerous cities. In Japan, the New Earth 21 programme has vigorously promoted solar system construction in urban areas. In Western Europe, publicly funded programmes have supported the proliferation of photovoltaic roofs and building façades. Smaller government programmes in Brazil, China, India, Mexico and the Republic of Korea have promoted solar systems for both domestic use and export.

56. Meanwhile, the recent growth in private investments in solar systems has been of crucial importance. Even the major multi-national energy corporations are increasing their participation in solar power sectors. While there are still many small manufacturing companies in solar sectors, the trend is towards greater involvement by sophisticated, high-technology companies with access to the capital required for the full commercialization of solar technologies. All these initiatives are increasing the usable electricity and heat generated by buildings in cities throughout the world.

57. Another strategy for expanding city-based energy production involves the use of modern biomass technologies to turn waste materials into sources of useful power. The huge volumes of solid and liquid waste generated by metropolitan areas throughout the world are replete with combustible resources. Urban waste contains large amounts of organic material, while landfills and sewage tailings spontaneously generate methane gas: a powerful greenhouse gas. These solid and gaseous materials can be fed into a variety of incineration systems, thereby simultaneously reducing the volume of wastes while generating heat and electricity from inexpensive, plentiful urban resources. Given this combination of advantages, waste-to-energy projects have proliferated throughout North America, Western Europe and Japan. Similar projects are under way in developing countries such as Brazil, Chile, China, Indonesia and South Africa.

58. Greater use of urban-based solar and biomass technologies provides options to increase the efficiency and reliability of local electrical grids that supply power to residential and commercial locations. But these systems cannot directly serve the energy-intensive transport sector, which generates a great deal of pollution. The fuel cell, however, can be used to power motor vehicles, and also residential, commercial and energy-to-waste systems. Given its remarkable flexibility, the fuel cell is emerging as a new energy technology with tremendous potential for use in urban settings.

59. A variety of new energy technologies have clearly attained the engineering maturity required for use in many different urban settings. Researchers at the World Bank, the World Energy Council, the International Energy Agency and the United States Department of Energy have also gathered evidence indicating that numerous alternative energy systems are approaching the price competitiveness required for large-scale commercialization. Comparative cost information gathered on different kinds of electrical generation systems reveals a narrowing price gap between conventional and new energy systems.

60. It should be noted that, for a variety of reasons, these data on electrical generation costs must be treated with caution. To begin with, these cost estimates are averages from many regions of the world and they are based on facilities with widely varying technologies and operating histories. Second, it is difficult to account for the effects of subsidies on generation costs. Since it has been well documented that conventional power sectors receive extensive subsidies throughout the world, it is likely that the generation costs shown for these sectors underestimate the true costs. Similarly, it is hard to factor in externality costs for conventional energy systems, again resulting in an underestimation of true conventional energy costs. Even given these price distortions, however, it is clear that wind, biomass, solar and fuel cell systems are approaching commercial viability in many markets throughout the developed and developing worlds.

61. The world commercial environment appears set at last to foster the expansion of new energy systems. Although it is impossible to predict how quickly new energy technologies can spread, it nevertheless appears that they are in a strong position to begin the process of rapid diffusion in the coming decades. Indeed, in a recent analysis published by the World Bank, it was argued that, given relatively moderate levels of public support, alternative energy systems could be providing 20 per cent of the world's energy by the year 2100.

XI. Strategies for achieving reform in urban energy sectors: some best practices

62. As the world moves further into the twenty-first century, the long-term viability of urban energy sectors around the globe is increasingly being called into question. If new generations of city residents are to be provided with access to vital energy systems and urban environments are to be simultaneously improved, at least three underlying developmental challenges must be met. First, existing urban energy systems must be reorganized in order to enhance their efficiency. Second, new energy technologies, which minimize urban pollution, must be made widely available to cities throughout the world. And third, the inequalities embedded in the world energy system must be reduced.

63. It is only when local civic organizations and business interests participate in designing and implementing reform agendas that efforts to achieve sustainability have a reasonable chance of success. Fortunately, it would appear that policy reformers are taking these lessons to heart. Indeed, in the field of urban management there has been a proliferation of programmes intended to foster public-private coalitions and enhance cooperation between local, national and international organizations. Given innovative efforts such as the "Cities for Climate Protection" campaign mounted by the International Council on Local Environmental Initiatives (ICLEI), the Clean Cities Programme and the Local Agenda 21, among others, it appears that the institutional environment is at last favouring participatory approaches to reform. The achievements of some of these coalitions will be highlighted as we turn to a review of contemporary initiatives that are under way to improve urban energy sectors.

64. Although new energy technologies can play a part in improving urban sustainability, energy efficiency can also be enhanced at the city level by reorganizing urban services and directing growth in specific directions. Perhaps the best example of this strategy can be found in the city of Curitiba, Brazil. Urban planners, working in close consultation with local residents and businesses, began by designating a number of transport corridors that ran along the axes of the city for use by authorized buses only. These corridors substantially improved the efficiency and reliability of public transport, resulting in a very high level of usage. Furthermore, this coordinated planning allowed real estate developers to build new properties in specified locations, with the confidence that the public would have easy access to their commercial and residential areas on the transit lines. These low-cost strategies have resulted in improved transport efficiency and lower rates of urban pollution in Curitiba. Many other cities, including Copenhagen, Portland, Singapore, Surabaya, Toronto and Zurich, have pursued similar strategies of reorganizing existing urban areas in order to improve transport efficiency.

65. It is also possible to upgrade energy systems, thereby achieving higher efficiency and lower environmental impacts. For instance, emissions from urban transport sectors can often be reduced by shifting to alternative fuels such as compressed natural gas, liquefied petroleum gas and ethanol. This is precisely the strategy that will be pursued in Hong Kong, where extremely high levels of ground-level pollution prompted taxi and truck drivers to organize a protest in which they demanded that city officials accelerate conversion to liquefied petroleum gas. In another example of system upgrading, existing electrical power plants can often be transformed into co-generation systems that make more effective use of the large amounts of heat generated in the process of producing electricity.

66. Many cars already on the road in the world's cities can burn advanced biofuels. Brazil has already vastly reduced its imports of oil and three quarters of Brazil's new cars can burn either pure ethanol or pure gasoline. Other countries are following their lead. For example, Sweden plans to be oil-independent by 2020, chiefly via ethanol made from forest wastes.

67. UN-Habitat remains committed to exploring the economic, social and environmental impacts of more sustainable biomass use, including ethanol and other bio-fuels. The Programme looks forward to working with Brazil, one of the world's leading proponents and users of the various ethanol-related technologies to ensure their wider adoption, particularly in more developing countries and cities.

68. The virtue of these system-upgrading strategies is that they can often be carried out by local municipalities, at quite moderate cost. Consider, for instance, the achievements of ICLEI. ICLEI

consists of over 300 cities in all regions of the world that are committed to reducing their carbon dioxide emissions. At the 1997 Kyoto Climate Change Summit, ICLEI reported that these cities had together succeeded in reducing carbon emissions by more than 41 million tons. Moreover, it was shown that in nearly every case these reductions were associated with an improvement in the local economy. Many other urban coalitions, including the United States Clean Cities Programme and the European Energie-Cités project, are having similar success in improving efficiency and reducing energy-related pollution at little or no cost.

69. In addition to upgrading existing energy systems, it will also be necessary to accelerate the diffusion of new energy technologies to urban areas throughout the world. As discussed in the previous chapter, a variety of innovative energy systems have reached the engineering maturity required for successful use in metropolitan regions. The challenge now is to foster commercial expansion in new energy sectors.

70. To accomplish this, equitable market conditions must first be introduced into energy industries. Currently, decentralized energy providers are generally prevented from connecting to power grids. Opening utility grids to small-scale electricity producers would reduce one institutional barrier that has inhibited the expansion of alternative energy sectors in many countries.

71. More important, the massive subsidies provided to conventional fossil fuel and nuclear power sectors must be substantially reduced. While removing subsidies is often politically difficult, it is important to note that these subsidies tend to benefit large industrial producers and consumers rather than the truly impoverished. Once the commercial playing field is levelled in these ways, private sector dynamics can begin to foster the expansion of new energy systems in cities throughout the world.

72. There are other, market-based mechanisms that are likely to provide additional support to environmentally friendly energy systems. For instance, emissions-trading schemes are already encouraging private companies to invest in domestic acid rain-reduction technologies in North America. Similar agreements show promise on the international level. The Prototype Carbon Fund, an emissions-trading system administered by the World Bank that focuses on renewable energy systems, attracted more private investments in its first six months of operation than had been expected for its entire first year of operations. The joint implementation and clean development mechanisms, meanwhile, should facilitate the international transfer of new energy systems; under the provisions of these agreements companies with headquarters in developed countries will be able to get credit for the emission reductions they achieve by investing in new energy ventures in developing countries.

73. While these market-based strategies are certain to be important components of any global effort to accelerate the diffusion of new energy technologies, by themselves they are not likely to represent a sufficiently robust policy response. In part this is because emissions-trading mechanisms may allow cities that are currently over-consuming resources to purchase relatively inexpensive permits and thereby continue such behaviour. What is also needed is an influx of public and private investments to finance the construction of new energy infrastructures. Unfortunately, at present, the level of funding for new energy projects does not appear to be adequate to the task.

74. Since the economic crisis of 1997–1999, Governments throughout the world have sharply scaled back public funding for energy infrastructure development. In place of public financing, it has been hoped that energy sector restructuring would prompt private companies to increase their investments in energy projects. While a few countries in Latin America have seen modest growth in private investments, the vast majority of cities throughout the world have been forced to contend with declining public and private energy sector investments.

75. Given this difficult context, an increasing number of countries have turned to multilateral development agencies such as the World Bank Group for assistance in upgrading existing energy sectors and expanding new energy systems. While the World Bank, however, has publicly acknowledged the need to increase financing for new energy projects, reforming its own investment practices has proved to be difficult. For instance, during the period 1995–1999 the World Bank Group's total portfolio of lending commitments to energy projects amounted to \$13.5 billion. Just over \$1 billion of this financing, or about 7 per cent of the total, went to renewable energy projects. In comparison, over \$3.6 billion, or 27 per cent of the total, went directly to oil, gas and coal projects. The remainder went to large-scale hydroelectric and utility grid development. Though the World Bank has made great strides in publicizing the potential benefits of new energy technologies, its lending portfolio clearly still favours conventional, environmentally problematic energy technologies. Moreover, during the period 1995–1999 annual World Bank lending for energy projects has actually declined, even as its own studies highlight the need for greater commitments to improving energy systems across the world.

76. While a decline in energy-related investments by national Governments, private companies and multilateral development agencies has been occurring in recent years, it is expected that this trend will eventually reverse itself and a new round of financing will become available for energy-development projects. Once this occurs, it is likely that a substantial portion of these new resources will be used to expand sustainable energy systems. A variety of international mechanisms, such as the Global Environment Facility and the Clean Development Mechanism, are now available to make more effective use of capital resources. National Governments, under moderate pressure from the Kyoto Protocol to the United Nations Framework Convention on Climate Change, are also committing themselves to pursuing emissions-reduction strategies that favour new energy technologies.

77. City-level coalitions such as ICLEI and Local Agenda 21 have proved to be capable of spearheading innovative energy reforms in many metropolitan regions. In short, the policy environment appears to be at last set to favour true changes in urban energy industries in urban centres throughout the world.

78. There still remains, of course, uncertainty regarding how to reform the severe inequalities in energy consumption that are embedded in the contemporary world energy system. As demonstrated, high-income nations consume a disproportionate share of the energy resources available for human use. These consumption practices cannot be made universal without causing rapid environmental crises at regional and global levels.

XII. Conclusions and recommendations

79. Most of the commercial and non-commercial energy produced today is used in and for human settlements and a substantial percentage of it is used by the household sector. Developing country cities are at present faced with the need to increase their energy production to accelerate development and raise the living standards of their populations, while at the same time reducing energy production costs and energy-related pollution. Increasing the efficiency of energy use to reduce its polluting effects and to promote the use of renewable energies must be a priority in any action taken to protect the urban environment. The urban sector, being the dominant sector of commercial energy use and a major sector in the use of biomass fuels, will have to take a leading role in increasing energy efficiency. This will require a major policy change away from a business-as-usual approach to imaginative innovations in lifestyle, energy use and energy policy planning to reorient the current focus on energy supply to a focus on end-use, thus contributing to the sustainable human settlements development goals.

80. Recognizing the need for a comprehensive approach to the promotion of sustainable energy development and use and for efforts to extend the provision of more energy-efficient technology and alternative or renewable energy for human settlements and to confront the negative impacts of energy production and use on human health and the environment (including promoting efficient and environmentally sound transport systems), UN-Habitat has identified three key prerequisites which are crucial to the successful implementation of energy-related action plans. These are:

- (a) *Understanding the problem*, with a view to improving policy making and building capacity to plan and implement responses to the urban environmental challenge;
- (b) *Establishing an enabling policy environment*, that takes into account the full range of issues and options, the special needs and abilities of those affected and the key actors, and provides the best possible mix of regulatory and incentive-based actions in the appropriate urban context;
- (c) *Capacity-building*, based on an institutional strategy that mobilizes public support and broadens the decision-making processes, and develops the managerial, technical and financial capacities of those responsible for the planning and implementation of actions.

81. To improve policy-making so as to ensure better management of urban energy-use-related environmental problems, planners and policymakers need informed analysis based on adequate data. For example, it is not enough to know simply the quality of the energy-related environmental impacts in the urban sector. The magnitude and the significance of these impacts must also be assessed and physical impacts will have to be converted into economic costs to assess which ones require the most urgent attention.

82. Urban energy policy-making will require a multidisciplinary approach, incorporating urban, transportation, and health planning. Urban planning needs to incorporate the environmental dimensions

of energy use in its analyses. How this is done in practice will vary depending on the municipal, regional, and national configuration of actors and institutional responsibilities. Regardless in which sector planning initiatives are being mounted, decision-makers should be clear about the environmental trade-offs that are involved in policies and programmes that involve urban energy use.

83. Policies and programmes that permit improved energy efficiency will be an important first step in dealing with environmental problems stemming from urban energy use. By investing in efficiency, developing countries can stretch the energy services from existing supply capacity to free up capital for necessary investment in the sector, and reduce carbon dioxide emissions.

84. A serious obstacle to improving energy efficiency in the urban sector lies in the institutional structure of energy decision-making. Access to information and access to capital are not concentrated in the hands of energy users, but in the supply side of the energy equation. Utilities make supply-side investment decisions, builders determine the appropriate level of building insulation, appliance manufacturers determine the energy efficiency of their products, and none of them pay the energy bill. Energy and product markets also fail to capture externalities, which are borne by others. This is a challenge that must be met by new and innovative policy initiatives.

85. Pricing, as a policy instrument, has been used successfully in some developing countries to promote environmentally cleaner fuels like liquefied petroleum gas (LPG) in household use and unleaded petrol in cars. At the same time, such subsidies have often been criticized for breeding inefficiency. Nevertheless, there is a growing recognition of the efficacy of incentive-based economic instruments for policy implementation. They can reduce excessive reliance on regulation and investment programmes to control pollution and stimulate innovation.

86. Concerted action will be required at all levels to put renewable energy strategies into the national energy matrix, but success will primarily depend on the abilities of developing countries to support private renewable-energy investors through selective and well-targeted subsidies, fiscal and other forms of incentives and innovative venture-capital schemes to speed up the commercialization of renewable energy technologies. The private sector has been and will remain a key driving force behind the successful diffusion of clean energy-related technologies. UN-Habitat must work with private sector companies and government regulators to ensure an open and level playing field in terms of market-entry into the sustainable energy field.

87. Implementing urban environmental strategies to tackle energy-use-related problems will require integrating environmental considerations into existing responsibilities, initiating new environmental actions or programmes that address critical problem areas and mobilizing financial resources to perform the related tasks. UN-Habitat will be working with a variety of United Nations partners, including – but not limited to – UNDP, WHO, UNIDO and UNEP, in the development and implementation of plans, programmes and projects in the area of improving access to clean modern energy for the urban poor.

88. It will be expedient for most cities to build on existing structures and capacities to meet new environmental responsibilities rather than to develop new institutions or authorities. The principal capacity-building tools include training, technical assistance, private sector participation, public information and outreach programmes. A participatory approach involving the end-users will be crucial to the successful formulation, implementation and follow-up of projects and programmes.

89. For most cities in developing countries, capacity-building will be a long-term and dynamic process, refining and strengthening existing strategies, skills and capabilities. External assistance will be crucial in building the necessary capacity to plan and implement environmental strategies at local level. Principal areas where such support should be considered are, first, the environmental research and policy analysis needed to formulate urban environmental strategies and action plans at the local level; second, policy reform, institutional development and resource mobilization; and, third, financial support for improving the efficiency of urban energy services and for the promotion of renewable energy technologies.