THE ETHICS OF ENERGY : A FRAMEWORK FOR ACTION

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World Commission on the Ethics of Scientific Knowledge and Technology (COMEST)

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on the Ethics of Energy

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FOREWORD

According to the ancient Greek myth, civilization began when Prometheus stole Zeus' precious fire from heaven and gave it to mortals, teaching them how to use it to warm, cook, make tools and create the rudiments of social life. For this, he was severely punished, for the fire and skills which were his gift to humankind were a mixed blessing, since they were also the source of work and war.

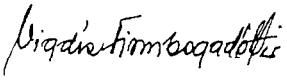
Such ambiguity about harnessing and transforming energy persists to this day: on the one hand, almost every aspect of human endeavour is related to energy and, more than ever, inequalities in access to affordable energy have become intimately linked to inequalities in security and standards of living; on the other, by ceaselessly drawing resources from nature, we have produced the most significant environmental impact that a single species has ever imposed on our planet. Intensively industrialized nations, whose lifestyles are heavily based on non-renewable resources, are today the prime producers of greenhouse gasses, with effects on global warming and climate change that are no longer in dispute.

Environmental issues raise a whole set of fundamental questions about what we as human beings value, how we conceive a meaningful life, how we perceive our place in nature, and the kind of world we wish to bequeath to our children. The principle of *sustainable development*, as defined by the Brundtland Report, *Our Common Future*, implies that the present consumption of energy be examined in the light of the foreseeable needs of future generations. These problems require answers that are essentially ethical and philosophical.

As George Bernard Shaw so succinctly put it, 'We are made wise not by the recollection of our past, but by the responsibility for our future.' Now, as never before, we understand clearly the possible impact of the decisions we take today on the lives of those who will follow us. At the same time, we possess the right information and the proper tools to act to ensure that economic growth and improved quality of life do not necessarily result in increased resource use and pollution. We thus have the opportunity to exercise our responsibility and assess the need to redefine human development in terms that go beyond the strictly economic, so as to establish a genuine vision of sustainability that is viable for decision-makers and clear for all.

In other words, to quote from the immortal Louis Armstrong, we have the choice to make a world where all will be able to say:

'I see trees of green, red roses too
I see them bloom for me and you...
I see skies of blue and clouds of white
The bright blessed day, the dark sacred night
And I think to myself, what a wonderful world.'



Vigdís Finnbogadóttir

Reykjavik, 15 May 2001

INTRODUCTION

'The current energy system is not sufficiently reliable or affordable to support widespread economic growth. The productivity of one-third of the world's people is compromised by lack of access to commercial energy, and perhaps another third suffer economic hardship and insecurity due to unreliable energy supplies.'[1]

This preoccupation was at the heart of the study carried out by a group of experts headed by Jean Audouze, then Director of Research at France's National Centre for Scientific Research (CNRS) and currently Director of the *Palais de la découverte* in Paris, that culminated in the report 'The Ethics of Energy'. Stating at the outset that 'The twentieth century has been marked by the development of techniques capable of liberating larger and larger quantities of energy, in order to meet power requirements and levels of consumption that have increased exponentially' and that the 'production and the use of energy conditions, therefore, our daily lives and changes in the environment on both a local and a global scale...',[2] the report took a major step in analysing and discussing the ethical issues relating to the supply and consumption of energy, taking stock of the current situation with respect to the various forms of energy, their advantages and drawbacks and the management of the risks they entailed; it set out a number of points that could serve as a basis for policy decisions grounded in strong ethical considerations.

The work was undertaken in view of the creation by UNESCO in 1997 of the World Commission on the Ethics of Scientific Knowledge and

1. World Energy Assessment, quoted in *The Economist*, 10 – 16 February 2001.
2. UNESCO, Paris, 1997, Jean Audouze, *The Ethics of Energy*.

Technology (COMEST), whose primary task was to identify situations that could present risks to society as a result of advances in science and technology and to formulate principles that could guide decision-makers and scientists in building the ethical dimension into their efforts. In the words of COMEST Chairperson, Vigdís Finnbogadóttir, President of the Republic of Iceland (1980 - 1996), ethics was a tool enabling situations to be assessed according to human values, and if electricity, for example, was one of life's basic necessities for a large number of people, it nonetheless created difficult ethical dilemmas and affected both those who used it and those who had to do without.[3]

The role of COMEST with regard to the ethics of energy was thus spelled out: it would concentrate on making good the enormous deficit in the ethical field by clearly posing the problems, by promoting the essential balance between economic needs and human and environmental necessities and by fostering a dialogue between producers and consumers. To do so, it would have to bear in mind several salient factors: the 'power hungry' nature of the modern world, the high inertia affecting the adaptability of current systems, the scale of capital investment involved and the length of time over which capital is immobilized, the increasing complexity of new practices and the pressing need to base energy policies on economic realities.

Underpinning these views was the notion of sustainable development as spelled out in the Bruntland report:

> 'Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:
>
> - the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and
> - the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.
>
> 'Thus the goals of economic and social development must be defined in terms of sustainability in all countries - developed or developing, market-oriented or centrally planned. Interpretations will vary, but must share certain

3. Proceedings of the First Session of COMEST, Oslo, Norway, 28 - 30 April 1999.

general features and must flow from a consensus on the basic concept of sustainable development and on a broad strategic framework for achieving it.

'Development involves a progressive transformation of economy and society. A development path that is sustainable in a physical sense could theoretically be pursued even in a rigid social and political setting. But physical sustainability cannot be secured unless development policies pay attention to such considerations as changes in access to resources and in the distribution of costs and benefits. Even the narrow notion of physical sustainability implies a concern for social equity between generations, a concern that must logically be extended to equity within each generation.' [4]

To deal with these manifold issues a COMEST Sub-Commission on the Ethics of Energy was established, chaired by James Peter Kimmins, Professor of Forestry at the University of British Columbia (Canada). It met in Paris on 2 - 3 November 2000 and had before it the Audouze report and a considerable body of research undertaken by its members.[5] Mindful as well of the important work already accomplished by such bodies as the World Energy Council (an umbrella body for various energy interests), the Commission viewed its deliberations as a work in progress, that is to say, as part of an ongoing process that would seek to integrate the energy debate into an overall framework for an ethical approach to the major scientific and technological issues of our time.[6]

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4. *Our Common Future*, Report of the World Commission on Environment and Development, Oxford University Press, 1987.

5. 'Strengths and Weaknesses of the Different Sources of Energy Supply' by Jean Audouze, 'How to Harness Hydro Power as a Renewable Form of Energy With Minimum Negative Consequences?' by Daniel B. Botkin, 'How to Make Renewable Energy Universally Available Without Negative Consequences of the Use of Energy' by Michael Epstein, 'How to Harness Prospects for Future Energy Technologies and for Equitable Distribution of These Around the World Without Possible Negative Side Effects?' by Ayodele A. Esan, 'How to Provide Biomass Energy in a Sustainable Way that Minimizes Negative Environmental and Social (including Ethical) Consequences?', by Paul Fung, 'The Ethics of Energy - Introductory Remarks' by James Peter Kimmins, 'The Dilemma of Energy Demands for Development and an Ecological Conscience in Developing Nations: a Chance for an Ethical Approach?' by José Sarukhan.

6. Meeting of the COMEST Sub-Commission on the Ethics of Energy - Final Report, UNESCO, 2001.

The present publication reflects the Sub-Commission's intention to foster broad public awareness and dialogue on these questions and to contribute to the free and open exchange of experience and ideas between scientists, decision-makers and civil society in all its diversity.

ENERGY TODAY AND TOMORROW

Until humans harnessed energy, they were essentially no different from any other animals. Social organization and the use of tools to increase speed, strength and combativeness certainly improved their competitive status and survival: however, the major divergence in the evolutionary path taken by *Homo sapiens* awaited the exploitation of external energy sources.

The earliest was fire, which enabled people to modify or remove forests and alter vegetation in a way that human strength on its own could not. Later, the power and rapidity of animals such as oxen and horses greatly extended the ability to do work, while the flight of birds was employed to hasten communication. The use of fire and water promoted early agriculture, while capturing the energy of wind facilitated travel across water and provided a power source on land.

The sophistication of energy sources has increased steadily over the past century but the fundamentals have changed little. Organic food is still the source of metabolic energy for humans, as it always has been. Animal power is still widely used in agriculture in developing countries. Most of our extra-human energy sources remain based on fire, water and wind; only the means of using them and the fuel for the fire have changed. Wood has largely been replaced by the fossil fuels of coal, oil and gas. Storing the force of wind and water as electrical power has superseded converting it to mechanical energy. The transformation of solar energy into electricity constitutes a variation on the process of photosynthesis by which plants store solar energy as biomass. The development of nuclear power and the use of geothermal and tidal energy represent new departures from traditional energy sources.

Today, slightly more than one billion people in the industrialized countries (about 20 per cent of the world's population) consume nearly 60 per cent of the total energy supply whereas just under five billion people in developing countries consume the other 40 per cent . Even taking into account such factors as colder temperatures in some industrialized countries, this imbalance is significant. The two billion poorest people ($1,000 annual income per capita or less), a small but growing share of whom live in shanty towns with most still scattered in rural areas, use only 0.2 tOE (tonnes of oil equivalent) of energy per capita annually whereas the billion richest people ($22,000 annual income per capita or more) use nearly 25 times more at 5 tOE per capita annually.

We are living in a world that can no longer do without energy - so much so that some people are calling for a declaration of the universal 'right to energy'. At the same time, an analysis of the different sources of energy (fossil fuels, nuclear and renewable energy) demonstrates that each of them has incontrovertible weaknesses to which attention must be drawn.

Fossil fuels will remain the most widely used form of energy throughout the world for the next 100 years. They offer considerable advantages, the most obvious of which is ease of use, for they are simple to process. This is particularly the case with coal, which is readily exploited in many developing countries although its emissions could cause serious environmental problems. Oil is also easy to use and for the time being is offered at a relatively low price. As regards natural gas, which is destined to develop, large fields have been discovered in the Russian Federation, Iran, the Middle East, Algeria and Norway. Its main advantage is that it releases less carbon dioxide (CO_2) per unit of energy than oil.

However, a major drawback of fossil fuels is their finite nature. Produced a billion years ago, they will inevitably run out. The period of grace available to humanity before they are exhausted is estimated at 1,000 years. This may seem long compared with a human lifetime but is extremely short in astrophysical terms. As regards oil, operators foresee no problems for the next 50 years. After that date, it is to be feared that the only remaining deposits would be those in the Caspian Sea or the Middle East. The risks of conflicts resulting from such a concentration are clear.

Equally if not more important are climatic risks, for fossil fuels release CO_2, a gas which, it is now recognised, contributes significantly to unprecedented climatic change. The report prepared for the United Nations Affiliated Intergovernmental Panel on Climate Change in Shanghai in January 2001 showed that global temperatures are rising faster and higher than most experts feared only a short time ago - faster

than at any time during the past 10,000 years. Scientists say the cause of the warming is clear: the inexorable increase of carbon gases that act as an atmospheric greenhouse and trap heat close to the earth's surface. The consequences of this are increasingly severe weather, such as storms, droughts and floods, which will have major impacts on human settlements, food production, disease patterns and natural ecosystems. These are likely to be greatest for those most vulnerable, i.e. the poor in developing countries. The 1997 Kyoto Protocol, which set legally binding targets for reducing greenhouse gas emissions in industrialized countries, has yet to be implemented; indeed, a follow-up meeting in The Hague in 2000 ended in failure and acrimony, pitting the United States of America, the world's leading polluter, against the European Union, which was demanding that Washington clean up the dirty industries that account for a quarter of all greenhouse gases.[7] The recent decision of the United States of America Government not to adhere to the Protocol is seen by many as a major setback to progress in this area.

At the same time as oil professionals grapple with the question of global warming, they are now confronted with issues of air pollution as concerns about environmental harm, and particularly the negative effects on human health, of burning fossil fuels have risen to the forefront of national agendas in many countries. Accidents such as oil spills or leakage from gas pipelines are another drawback and their extensive environmental damage is well known. Finally, the world's economies are particularly sensitive to the price of oil (and gas), and sound management of this resource is therefore becoming imperative and cannot be left to the sole responsibility of the producer countries and distributing companies.

Fuel cells, those big batteries that generate energy from hydrogen and oxygen much more efficiently than a conventional automobile engine does from petrol, are seen by many as a solution as they are silent and produce only harmless water vapour as a by-product. However they have yet to be put to use on a massive scale in the automobile industry where the primary obstacle is the existing infrastructure: the world is not organized to deliver hydrogen on demand and may not be for many years to come.[8]

As to *nuclear energy*, the three major difficulties encountered in its use are significant: firstly, its acceptability to the public; secondly, its particularly drastic security criteria, which require exceptionally well-trained

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7. 'Warming of Earth Raises New Alarm', Barry James, *International Herald Tribune*, 23 January 2001.

8. *The Economist*, op. cit.

personnel and compliance with draconian procedures, and last, but far from least, the disposal of the final waste products. Although nuclear power is often suggested as a partial solution to climate change, these difficulties make it prone to serious risks: it can be used to produce material for nuclear weapons and thus lead to major security problems; the disposal of radioactive waste is still an unresolved environmental issue, and ensuring complete reactor safety is a formidable challenge, especially in countries without effective legal controls.

There is a strong call for *renewable energy sources* to be increasingly used and enhanced in terms of both quality and quantity. Renewable energy is based on numerous substances, the most important of which is water (hydroelectric power) and biomass (wood, agricultural fuels), which provides the heat for cooking, home heating and power generation for countless millions throughout the world. Wind and solar energy are still little-used techniques. By definition, these energies do not play a part in the build-up of carbon dioxide in the atmosphere, however, the extent of the environmental damage which they cause should not be underestimated. The construction of wind-power installations and the conversion of farm land for energy purposes limits the area that could be used for traditional agriculture. Hydroelectric energy, with its development of extensive dams, has led to major ecological changes and the perception of hydropower has gone from an environmental good (renewable, clean, fostering an aesthetically pleasing landscape) to an environmental bad (destroying native habitats and ecosystems, extinguishing or threatening species, eliminating beautiful landscapes, preventing natural variations). Solar thermal power has yet to penetrate the market on any appreciable scale. It must also be pointed out that the costs of solar energy, wind power and biomass currently are higher than those of coal, oil, gas and nuclear power, putting them well beyond the reach of most people.

Although every form of energy has advantages and disadvantages, energy demand is becoming increasingly insistent. Because the industrialized countries have monopolised two thirds of the world's energy up to now, the developing countries are rightly demanding that the former pay for the disorder they have created. If energy consumption continues its existing trend, the world's carbon emissions will reach prohibitive levels, the rate of energy consumption will be extremely high and the disparities between industrialized and developing countries will intensify.

Three main trends will significantly influence the challenges confronting the different sources of energy in future:

- The first is the overall increase in world population. Initial estimates of ten billion by around the year 2020 have now been scaled down considerably, with the latest projections indicating 7.4 billion by that time, no doubt because of the policies pursued in many countries to control the birth rate. This factor must be stressed, as it may have a considerable influence on all aspects of the ethics of energy.
- The second is the increasing trend towards urban development. In 1900, only 14 per cent of the world's population lived in towns. By 2020, this number will exceed 62 per cent , half of them in towns with more than one million inhabitants. This effect too will result in an increase in the pressure on energy because the rapid spread of urban development is accompanied by an intensification of infrastructure and transport claims, which make the energy factor still harder to deal with.
- The third trend is a relative increase in the number of inhabitants who have not yet achieved an adequate level of energy supplies. The principle of equity stipulates that all persons, regardless of their geographical origins and social status, must have access to energy. It would therefore be desirable for this type of consumption to increase rapidly.

This does not mean that the poor do not already use energy but that they often use the least convenient forms (for example, charcoal, crop residues, cow dung) and frequently in ways that are damaging to both human health and the environment. Such inferior fuels comprise nearly a quarter of the world's total energy consumption and three-quarters of all energy used by households in developing countries. 'According to a recent analysis by Richard Ackermann of the World Bank, the costs of using inferior fuels can be staggering: he found that the urban areas of China alone lose some 20 per cent of potential economic output because of the effect on human health of dirty energy use. In India, indoor air pollution from dirty fuels causes as many as 2 million premature deaths a year, particularly among women and girls, who do most of the cooking.'[9]

We therefore find ourselves confronted with a somewhat critical energy supply situation because demand is unlikely to fall and it would be morally questionable not to satisfy it. While we would all like to see a drop in energy intensity (i.e. the consumption of energy per unit of GDP), such a necessary development cannot be painless.

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9. Ibid.

Regulatory reforms, aimed at promoting competition, transparent regulation and cost reflective pricing, are considered by many as an important driver of economic growth and energy efficiency. They have spread rapidly in most market economies, with sometimes unforeseen difficulties, as, for example, the massive power outages in parts of California where utilities were recently brought to the verge of bankruptcy by an ill-conceived deregulation of the power industry. Their implementation in transition economies and the way the reform process unfolds in many developing countries have also posed problems.

According to the World Energy Council's most recent statement,[10] the current scale and extent of energy liberalization was not foreseen in its 1993 study, and the main issues to emerge since then may be summarized as follows:

- There are considerable benefits to be derived from greater reliance on market mechanisms, the breaking of monopolies, and the introduction of greater competition; experience demonstrates that appropriate regulation is required.
- Conditions in different countries vary widely. Mature markets may sustain greater competition and reliance on decentralized decision-making, while infant networks may well require the co-ordinated effort of a vertically integrated single decision maker... Greater reliance on market mechanisms should be viewed pragmatically and, in some cases, even international co-operation among different governments may be required for the success of certain ambitious energy ventures.
- There are market failures: the need to serve the poor is one. The need to cover political (or non-commercial) risk is another. Political difficulties can upset markets and prevent them from operating successfully.
- Markets tend to be short-sighted. Today's price reflects today's view about the equilibrium of demand and supply, but this may change rapidly, especially from the supply side. Shareholder value, favourable comment from analysts, and customer satisfaction are all key ingredients for commercial success, but they can be quickly dissipated and may not be consistent with key requirements for sustainable development.

10. *Energy for Tomorrow's World - Acting Now*, World Energy Council, 2000.

In other words, according to the Council, 'energy resources are plentiful and not expected to be the limiting factor in global economic growth, but their regional endowment and the pace at which they are developed and distributed may not be entirely satisfactory. Increasingly energy companies rely on market mechanisms and decentralized decision-making to channel investment and technology into developing energy resources. However, market signals are not always efficient in ensuring that all energy needs are met and environmental priorities are respected.

Some WEC Members believe that the energy sector is not currently on a sustainable path while others believe that, if the energy sector is evolving on a sustainable path, it could move along it more quickly. Both opinions converge in a strong consensus that new policy departures and remedial action are needed. Although we expect no major problem in providing the energy that will be necessary to sustain the rates of economic growth that one might realistically expect in the coming decades, the current situation is characterized by distributional inequalities and detrimental impacts on the global, regional and local environment and on human health.'[11]

The main factors that have come together to shape the future of the energy industry are market forces, environmental consciousness and technological innovation. Although none of them are new, it is the strength of their combined forces that is exerting pressure for change. 'Yet the industry's incumbents tend to resist change because they have much to lose from it; and given the sector's enormous and long-lived stock of fixed assets, a turnaround is bound to take time. And, confusingly, some of the forces for change pull in opposite directions: rising environmental standards may favour renewable energy, for example, but market reforms may choke off subsidies for it at the same time...However, whether the world realizes the full potential of these prospects depends crucially on one factor: government...during the transition to liberalized energy markets the role of regulators and officials is vitally important. And as California's sad example shows, governments can make a big difference by getting it wrong.'[12]

In the final analysis, the attitudes and policies that will determine our energy future are as important as the resources themselves. As one expert put it, 'The basic ethical question which must be asked first of any

11. Ibid.

12. *The Economist,* op. cit.

energy proposal is, will it provide sufficient energy to do the work necessary to not only maintain but advance the health, well-being, safety and socio-economic progress of all people, poor as well as rich? Any answer to this question which does not come up a resounding "yes", represents an irresponsible and unethical toying with the lives and fortunes of people rather than a legitimate and ethical path of future energy development.'[13]

13. 'Energy Ethics: A Positive Response' by James A. Weber; presentation at the conference 'Energy Crossroads', November 18 - 19, 1980, Chicago.

ENERGY THROUGHOUT THE WORLD

In its groundbreaking 1993 report, 'Energy for Tomorrow's World', the World Energy Council provided a seminal study of energy development which, according to its latest statement, has largely stood the test of time. Thus, the following overview offers a useful look at the distinctive regional variations and problems that still weigh in the balance today.[14]

THE WAY IT WAS

Sub-Saharan Africa, which comprises 47 countries, most of which have low incomes and are mainly rural, contains 9 per cent of world population and contributes to 2.5 per cent of the world's economic activity. The region consumes 2.7 per cent of all so-called 'commercial' primary energy. It contains 6 per cent of the world's oil reserves, 3 per cent of its natural gas resources and 6 per cent of all coal deposits. It has a high hydroelectric potential, relatively high solar irradiance and large uranium deposits. The consumption in energy per inhabitant is one of the lowest in the world. In addition, the region is constantly threatened by the desertification of an increasing part of its territories.

The procurement of energy is a crucial problem in this region where earnings are very low and population is growing quite rapidly. This is compounded by the fact that arbitrary price fixing (via subsidies) prevents the cost of the services supplied from being reimbursed, which leads to the inefficient use of resources and the financial collapse of the utility companies operating in the energy sector. The means must therefore be found to improve the use of energy and supply the region with technical

14. As cited in Audouze, op. cit.

assistance to enhance the performance of its facilities and above all to ensure they are correctly maintained. Increased economic aid has to be allocated to this region, which is bearing the full brunt of the negative effects of market globalization.

Latin America and the Caribbean account for 8 per cent of world population and contribute to 8.7 per cent of the global economy. This is a region of high population increase, meaning that it is going to need at least double the quantity of energy it currently consumes, or 6 per cent of the total. It contains 12 per cent of the world's oil reserves, 6 per cent of its natural gas resources and 2 per cent of all coal deposits, or 7 per cent of the world's energy reserves.

The region is obviously concerned by economic development, since there is a tendency for poverty to increase in the majority of the countries. Some of these, such as Mexico and Brazil, are undergoing uncontrolled urban expansion, which is becoming a source of serious problems, not only in terms of energy procurement but also in relation to environmental protection and health. Certain practices involving specific grants have also destabilized the financial position of a number of the energy industries in these countries. It should be recalled that the region demands that the industrialized countries accept the principle of joint responsibility, according to which the cost of environmental protection should be shared between those who have created the damage in the past (the industrialized countries) and those who are likely to cause harm in the future (the countries of the South).

North America is the most developed and the richest region in the world: with 5 per cent of world population it is the source of 25 per cent of the world's economy, and consumes 27 per cent of the available energy. It has 4 per cent of the world's oil reserves, 6 per cent of its natural gas and 25 per cent of its coal.[15]

The inhabitants of this region obviously wish to keep their highly privileged standard of living, all the more so since the cost of energy is abnormally low. To maintain their growth and their competitiveness the United States of America and Canada function within a legislative, regulatory and legal framework that is increasingly restrictive and complicated. Despite the rise of environmental concerns, there is every reason to fear there may

15. It should also be pointed out that the gas deposits (methane hydrate) located at the bottom of the Atlantic Ocean off the shores of the southern states of the United States of America appear to be sufficient to satisfy American demand for the next 100 years, provided that the requisite heavy capital expenditure is allocated.

be a steep increase in energy consumption rates. Current international negotiations also provide an opportunity for United States of America diplomacy to defend positions whose protectionism in terms of energy and environmental issues contrasts sharply with the standpoints of most other countries. Nonetheless, a growing segment of public opinion in these countries feels that the global balances upon which world peace depends require that the problems and hopes of the underprivileged regions be taken into account.

South Asia contains 22 per cent of world population and contributes to 4.5 per cent of global economic activity. The countries here have low incomes, are mainly agricultural, and feature high economic growth and population expansion rates. Half of the region's 1.2 billion inhabitants, mainly in India and Bangladesh, live in a state of extreme poverty. The region consumes less than 4 per cent of global energy and its resources are limited: 1 per cent of the world's oil, 2 per cent of its natural gas and 6 per cent of all coal.

The priorities for the region are first and foremost to strive to eradicate poverty through economic growth. Expansion for the region represents a necessity which is considerably more important than environmental protection. CO_2 emissions are set to double between now and the year 2010. It is considered that the economic performance and well-being of the populations must at all costs rapidly become comparable with those reached elsewhere if trade between countries or regions is finally to stabilize. In addition to poverty and uncontrolled demographic growth, the region is encountering serious difficulties stemming from the relative inefficiency of the power system, a very limited volume of natural resources and difficult access to new technologies because of their cost. The future of the region from the energy standpoint is, therefore, not very optimistic.

The Commonwealth of Independent States (CIS) and the Baltic States (the former Soviet Union), which have recently undergone major political changes, comprise 5.5 per cent of world population and in 1990 represented 8 per cent of the global economy, a proportion which has no doubt seriously declined since that date. Together the countries of the region possess 6 per cent of the world's oil reserves, 38 per cent of its natural gas deposits and 22 per cent of its coal resources. These resources, however, are mainly concentrated in the Russian Federation and, to a minor extent, in Kazakhstan, Turkmenistan and Azerbaijan.

Although the region is not the least privileged, it faces many problems. The first, of course, is adaptation to political and economic change: the future remains highly uncertain and it is still impossible to foresee how the region will strike a balance between a market economy and effective governmental organization. Secondly, the various countries also have to succeed in balancing their energy exchanges on an equitable basis, since some, such as the Russian Federation, have satisfactory resources, others, such as the Ukraine, are capable of meeting part of their requirements, while a third series, such as Georgia and the Baltic states, have no energy resources of their own whatsoever. Thirdly, the region has to make significant progress in terms of energy wastage control and environmental protection. Finally, mention should be made of the scale of concerns about nuclear safety which, as is common knowledge, is far from being satisfactory.

Central and Eastern Europe, which comprises Bulgaria, the Czech Republic, Slovakia, Hungary, Poland and Romania, accounts for 2 per cent of world population and represents 2 per cent of global economic activity. It consumes 4 per cent of so-called 'commercial' power and the consumption rate per inhabitant is comparable to that of the rest of Europe. It has less than 1 per cent of the world's oil and natural gas reserves and 6 per cent of all coal deposits.

The region has had to face a major industrial recession during the transition from a centralized to a market economy. It is seeking to catch up with the standard of living of Western Europe and wishes to boost its electricity production and increase the use of gas. It considers that improving energy efficiency requires the complete pricing of every cost and service. Central and Eastern Europe is reputed to be the most polluted region in Europe, and is also that in which the risks of nuclear accidents are the highest. For these various reasons related to energy and environmental issues, it is a region which has need of considerable financial support.

Western Europe accounts for 9 per cent of world population and represents 22 per cent of world trade. The economic situation of the region is currently satisfactory, although there are a number of causes for concern for the future: the region consumes 18 per cent of the world's energy supply, although it has only 2 per cent of its oil reserves, 5 per cent of its natural gas deposits and 7 per cent of all coal. Western Europe is therefore an energy-importing region, even though the situation has led certain countries such as France and Belgium to have broad recourse to nuclear power.

The region is particularly sensitive to environmental considerations and would like to see a significant global reduction in the level of CO_2 emissions. It is prepared to take an active role towards achieving this end, but wishes efforts to be made by other regions as well, and would like measures taken to contribute to further objectives, such as greater security of supply, reduced import costs and improved conservation of natural resources. Western Europe has indicated on several occasions (such as in Rio de Janeiro in June 1992) that its power industries should provide support for the countries of the South to help them develop their strategies, invest in this area and maintain efficient technologies. The region at present has greater confidence in market forces than in governments to make energy policy more effective: the role of taxes on energy or on greenhouse gas emissions is still the subject of heated debate. Finally, the region also feels, as do many others, that economic growth is a condition strictly necessary for efficiency and equity in terms of energy as well as for environmental protection.

The Middle East and North Africa counts 5 per cent of world population and contributes 4 per cent of its economic activity. The region consumes 3.4 per cent of the available energy. It contains 70 per cent of all oil deposits and 35 per cent of the world's gas reserves, but the distribution of the deposits among the different countries in the region is very uneven.

A major problem encountered here is a population growth rate that is as high as that of sub-Saharan Africa. The lack of water and the resulting desertification have affected several countries in the area, but preserving the environment is not their foremost concern. The region is more preoccupied with energy prices, yields, and financial and technological issues. Better co-ordination on a regional level with respect to electricity and gas supplies would be desirable. The area is highly dependent on future market prices for hydrocarbons, which is why it insists on a dialogue between oil producers and distributors.

The Pacific comprises countries as disparate as China, Australia and Japan. China has a pre-eminent place because of its population, but also for its production and consumption of energy. As a whole, the region forms a vast, highly diverse entity from both the economic and cultural points of view, since it includes countries in all categories, from the wealthiest to the most poverty-stricken. It contains 34 per cent of world population and contributes to 23.5 per cent of global economic activity. Together with South Asia it is the region where the economic growth rate is the highest but is also the one where energy consumption per inhabitant is still low. The Pacific consumes 18 per cent of available energy. It has 4 per cent of

the world's oil reserves, 5 per cent of its natural gas fields and 24 per cent of all coal deposits, with highly uneven distribution of the resources among the different countries in the area.

The main priority is economic development and the satisfaction of basic energy requirements, even to the detriment of environmental protection. This is particularly true of China, and especially of its rural areas. Stabilization and decrease of greenhouse gas emissions seem to be objectives incompatible with economic growth. The policies to be adopted in China in this respect will have a major impact on the way in which humanity as a whole tackles the problem. The unusual situation in which Japan finds itself is also worthy of mention: the country is both highly industrialized and at the same time extremely poor in raw energy materials, and has opted for restrained energy development (its energy intensity - the quantity of energy required to produce a unit of gross domestic product (GDP) - is less than half that of the United States of America) and for the simultaneous use of all forms of primary energy (coal, oil, gas, nuclear power and renewable energies). It represents, as do certain European countries, an example of a country adopting a 'wise energy policy' demonstrating its concern for sustainable development.

In this region, which seeks a powerful, competitive economy and gives great emphasis to the eradication of poverty as well as to education, technological progress and the construction of appropriate infrastructures, nuclear power is thought likely to play a greater role than renewable energies. Several countries would like to have wide-ranging options open to them in terms of energy and thus be capable of adapting rather than succumbing to radical changes. In their opinion, their independence and competitiveness depend upon the degree to which they can improve energy efficiency and allow for all the costs related to it.

WHAT HAS CHANGED[16]

The energy demand projections and analysis of trends in the 1993 report (cited above) have remained valid over time. However, in several key areas the context of this analysis and some of the drivers of economic growth and energy consumption have changed.

- World population growth is now slower than previously assumed, but urbanisation, especially in developing countries, has accelerated. In the early 1990's world population estimates

16. World Energy Council, op. cit.

suggested that, by 2020, the total population would be nearly 8.1 billion. By the mid-1990's the United Nations medium-term projection for 2020 had been reduced to 7.9 billion people, and today it is 7.4 billion.

- Economic growth has been slower in the last eight years than initially foreseen. The ongoing economic problems in economies in transition and subsequent crises in parts of Asia and Latin America could not have been predicted in 1993 and have had a downward impact on energy consumption. The range in the various 1993 scenarios was 3.3 per cent to 3.8 per cent average annual growth, but the overall average annual growth rate for the world economy reached only 2.8 per cent during the last eight years (2.5 per cent in market economies alone) and could be somewhat lower in the longer term. Energy intensity has also not fallen as rapidly as anticipated.
- Financial co-operation between industrialized and developing countries has not improved since 1993. According to recent World Bank data, OECD countries have failed not only to fulfil their international commitments of Official Development Aid (slightly more than 0.2 per cent of their GDP in 1998, compared to the 0.7 per cent they promised), but also have failed to create the appropriate institutional tools to promote a larger amount of Foreign Direct Investment. The basic problem is not lack of money since global capital resources in principle are more than adequate to meet any potential demands coming from the energy sector. While earlier estimated energy investment requirements have been reduced, the key for many countries is still to establish the legal, financial, and market reforms which will attract the necessary domestic and foreign capital for new energy projects. It is still generally more expensive to invest in a developing than an industrialized country today because the risks and transaction costs are higher in the former.
- One of the most fundamental shifts in context from 1993 to 2000 has been the extent of deregulation and restructuring of energy markets, coupled with a strong trend toward regional integration and energy trade. WEC has studied the changes in market structure, regulatory regimes, and energy trade in sixteen countries and published 'The Benefits and Deficiencies of Energy Sector Liberalisation' in 1998. This work has now been extended to cover more than 100 countries.

- Another key issue relates to the international environmental agenda, led mainly by the United Nations Framework Convention on Climate Change (UNFCCC) beginning in 1992 and subsequent rounds of the Conference of the Parties (COP) meetings, but also linked to the next United Nations Conference on Sustainable Development which will take place in 2002. Local and regional pollution, as well as greenhouse gas emissions, have received wide political attention, and the contribution of energy development to these problems and to health and well-being in general is under great scrutiny.
- Despite apparently good global progress in reducing energy intensity in the last decade, overall evidence now suggests this was partly the result of economic disruption and slowdown and, more importantly, the impact of restructuring in the economies in transition. Earlier scenarios were too optimistic about the extent of technical progress in energy development. While the application of new technologies will continue at a steady pace in market economies, it is not likely that there will be any major breakthroughs in the energy sector between now and 2020 to decouple the linear relationship between GDP growth and energy consumption at constant prices. This relationship does of course vary for different groups of countries, depending on their level of development.
- With respect to specific energy sources it is helpful to note that:
  - A more rapid penetration of new renewables in meeting energy demand was expected than the actual result to date;
  - The anticipated growth in nuclear power has also not materialized, despite significant cost and maintenance improvements. While public perceptions about safety, waste management and proliferation problems persist, the impact of regulatory reforms dealing with overcapacity has reduced the need for new baseload, including nuclear, investment; and,
  - The economies of combined cycle gas turbines (CCGTs) were underestimated as was the potential strength of natural gas demand based on the cost and environmental advantages of this fuel in meeting total energy demand.
- In 1993 there were nearly 1.8 billion people in the world without access to commercial energy. Despite efforts to connect roughly 300 million people to electricity grids or to provide them with modern biomass and other commercial energy over the last eight

years, there are still an estimated 1.6 billion people in such a situation. Four to five hundred million people out of the 1.4 billion to be born between now and 2020 will join them, most of whom will live in rural areas and shanty towns in developing countries.

What is clear is that there remains a high degree of inequality between different countries in terms of their access to and consumption of energy, and that instruments must be developed that will enable all countries to exchange useful information about energy, and thus to discuss, debate and quickly conclude negotiations on terms that are both objective and equitable. The world at large depends on progress being shared in research and technology, and this represents our final hope of solving the problems that have been described.

ENERGY POVERTY[17]

More than half the world's population lives in rural areas, nearly 90 per cent of them - some 2.8 billion - in the developing countries. The vast majority is dependent on the traditional fuels of wood, dung and crop residue, often using primitive and inefficient technologies. For many, this combination barely allows fulfilment of the basic human needs of nutrition, warmth and light, let alone the possibility of harnessing energy for productive uses, which might begin to permit them to escape from the cycle of poverty.

Demographic trends risk exacerbating the situation. While most of those today without adequate energy services are in rural areas, urban populations are projected to grow more rapidly. Far from easing rural energy poverty, this is likely to reinforce the preoccupation of policy makers with urban issues, while increasing competition for rural energy supplies. Disease, in particular AIDS, will also take its toll on the development capacity of the worst affected countries.

It is calculated that an amount of energy roughly equivalent to 7 per cent of the world's current electricity production could cover basic human needs. In an age of apparently advanced technological and management skills, we have failed in this relatively modest challenge.

Dependence on traditional fuels will long remain a reality, given its level (reaching over 95 per cent in some countries). It is not so much their use that is wrong as the manner in which they are being managed and

17. This chapter is based on the joint report of the World Energy Council and the Food and Agriculture Organization (FAO), 'The Challenge of Rural Energy Poverty in Developing Countries', World Energy Council, London, 1999.

exploited, not always at a sustainable rate. Inefficient technologies and appliances mean that precious woodfuel resources are wasted and high indoor smoke pollution severely impairs health. A gradual transition to modern energy systems (which may utilise traditional energy sources) must be achieved if sustainable economic activity is to be realized in rural areas.

While precision is difficult, most energy in rural areas is used for residential purposes, predominantly for cooking. Energy in itself may not be a basic human need, but it is critical to the alleviation of hunger. Staple foods, on which poor people depend, are often inedible when raw and energy is also needed for food production and preservation. In cold climates it is also essential for adequate warmth.

In addition to household needs, there is an increasing demand for energy in the provision of rural services such as water supply, health care and education, and for productive activities such as agriculture and small industries. Ideally, all these needs should be met in an efficient, cost-effective and environmentally sustainable manner. In many cases, this is possible only through a transition from traditional energy sources and technologies to more efficient ones.

As much traditional energy use occurs outside the commercial sector, data on it is geographically patchy and discontinuous. This statistical invisibility of much rural energy use reinforces its neglect and hampers the development of effective policy. In addition, the enormous variety of energy use patterns, even within quite short distances, makes extrapolation dangerous.

Although some developing countries long ago recognized the importance of energy in rural development, it was only following the so-called energy crisis in the early 1970s that rural development policy makers began to show greater concern for the energy constraints facing them. As the world suddenly entered an era of rising energy prices and unstable petroleum-based fuel supplies, these factors threatened to accelerate the perceived gradual environmental depletion associated with rural people's heavy reliance on woodfuels and agricultural residues to meet their basic energy needs. As supplies of petroleum-based fuels became more costly and unreliable, it was believed that people would have to switch back to traditional energy sources, thus increasing the environmental damage.

Interventions aimed at the traditional sector have thus increased since the 1970s, prompted in particular by the perceived 'woodfuel gap'. Just as the first oil shock seemed to indicate that oil reserves would fall short of ever-rising demand, so there was alarm that woodfuel was being gathered

at an unsustainable rate. The principal response - the promotion of woodfuel forestry - ignored characteristics of woodfuel use that are only now being understood. Most woodfuel is derived from trees cut for other purposes or from branches and other sources collected in non-forest areas. Worse, woodfuel forestry tended to be ignored, or even actively opposed, by its intended beneficiaries, rural people.

With hindsight these interventions were often scaled-down versions of conventional industrial plantation forestry with woodfuel production the sole objective, whereas for rural people, management of trees and shrubs is an integral part of overall land-use. The new approach of participatory forest management, whereby rural people are given regulated responsibility for dealing with existing forests and woodlands, is better attuned to traditional practice and appears more successful in achieving sustainable operations. This advance from worries of deforestation and woodfuel crisis has been brought about not by massive government investments, but by an attitudinal revolution, followed by the creation of new markets, patterns of ownership and institutional environments.

On the demand side of the biomass equation, efforts have focused on improved cooking stoves. With nearly half the world's population cooking with traditional biomass, greater fuel efficiency is attractive. Acceptance by rural populations has not been as high as hoped, however, and, even where improved stoves were adopted, fuel savings are less than anticipated. Too often the stoves do not meet users' needs closely enough and are not sufficiently robust for real-life conditions. They do, however, assist in other important ways, especially in reducing indoor pollution.

In seeking to bring energy supplies to rural areas, one encounters a certain paradox, however. Modern energy sources, although indispensable to the functioning of society, often account for a relatively small percent of total national energy consumption. However, since their exploitation is inseparable from modern technologies of energy transformation and end use, virtually all investments in the energy sectors of developing countries have been made in the modern sector.

Sometimes these promote decentralized electrification, for example, with renewable energy sources. More often they focus on grid extension. Although the number of rural households with access to electricity doubled in the 1970 - 1990 period, this barely kept pace with population increase.

In general, the costs of electrification were underestimated while its benefits were overstated. By itself, electrification does not guarantee economic development and its benefits tend to accrue to the wealthier

groups in electrified areas. It is increasingly recognised that electrification must be part of a much broader development package. Rural electrification contributes to, but is not a substitute for, other interventions. Conversely, although traditional energy sources are dominant in the overall energy balances of many developing countries, they have attracted little or no investment, despite the fact that relatively small sums could make significant differences.

This imbalance between consumption and investments has resulted in an obvious bias of energy development towards the modern sector. In the 1960s it could have been argued that this was valid, given the expectation that economic growth and development would result in a harmonious transition from traditional to modern energy use. However, actual experience has shown quite a different pattern. Low growth and reduced incomes have resulted in widespread stagnation in both urban and rural areas, and these factors are prolonging the intensive use of traditional fuels as the most accessible, although not necessarily the most economical, source of energy for a rapidly growing population. The pressure on biomass resources and arable land in a fragile environment may put at risk the long-term prospects of an entire economy, with the most serious consequences for the poorer strata of the population.

The international development aid community recognised the importance of traditional energy issues and over the past two decades has devoted substantial resources to the sub-sector. Numerous studies carried out since the Nairobi Conference on Renewable Energy in 1981 have contributed to a build-up of information on the sector and its principal economic agents, notably lower income households and the informal commercial and small industrial sectors, which had never been systematically surveyed before. Nevertheless, it must be noted that much of the assessment and analysis made was more qualitative than quantitative. Exceptions would include a 1980 FAO study for the whole African continent and other FAO and World Bank studies on woodfuel consumption.

The assistance that specifically addressed the needs of the traditional energy sector included the development of, *inter alia*:

- household energy strategies, at the national, urban and rural levels;
- consumer surveys;
- improved stoves dissemination programmes and;
- biomass resource inventories.

In parallel with these programmes, a growing number of other public and private sector agencies have undertaken similar studies. The resulting accumulation of data and reports has been instrumental in increasing the understanding of the sector and of its development problems and opportunities. Nevertheless, more recent efforts to consolidate and integrate this knowledge have highlighted a dominant orientation towards technology and exposed major gaps that remain to be explored.

Most past activity focused on partial solutions to demand - or supply-side problems, or on the inner workings of sector institutions. Now there is a growing perception that traditional energy sector problems are closely linked to population growth and movement, agriculture and forestry, and that they have direct impacts on rural income and employment, quality of life, natural resource management and environmental stability. Indeed, there is a growing awareness that some energy issues may be the by-product of developments in other sectors, and therefore cannot be addressed in isolation. Furthermore, there is a tendency to overlook the critical variables that link both modern and traditional fuels to macro-economic factors such as balance of payments, external debt and reliance on foreign aid. In summary, there is a clearly demonstrated need to address the problems of the energy sector, and particularly the traditional segment, in a more comprehensive and systematic manner.

At the project implementation level, tangible results in terms of well-defined and executed energy policies, strategies and programmes are still hard to find, despite the efforts to date of the many agencies and groups active in the traditional energy sector. This point is most pertinent in Africa, where traditional sources account for up to 90 per cent of energy consumed by households. Here donor agencies have spent large shares of their resources, but only marginal progress in addressing the perceived problems has been made. This situation underlines the need to evaluate the objectives, scope and approach of the efforts made to date, and identify those elements that have determined their success or failure. Such a review would benefit decision-makers in the countries concerned, national non-governmental organizations, and the international donor community in their search for ways to improve their effectiveness in the rural energy sector.

Switching to more efficient, modern energy systems typically entails an initial capital cost that is beyond the means of rural households, although their running costs may be less than the energy sources already in use. Rural micro-credit schemes aim to overcome the initial capital hurdle, typically by utilising the savings resulting from the lower operating

cost of the new systems. They have the added advantage that the poor become clients, rather than recipients of government or donor largesse. Under this relatively new approach, poor rural households represent a potentially significant commercial market.

Specific technologies significantly affect our daily activities and the way in which we interact with both our fellow humans and the wider environment. This is especially obvious for the industrialized countries, where motor vehicles, computers, cash cards, grid electricity, stoves, microwaves, television, telephones, radios and the Internet have transformed lifestyles and daily activities. Technology driven changes in rural areas of developing countries have been less pervasive. Technologies that have application only in these areas receive a relatively small proportion of global research and development expenditure, even though they stand to benefit billions of people. Hence innovation has lagged and products offered to rural people are technically inferior and offer poor value for money.

There are a number of technologies that offer the potential to assist progress in rural areas. They span generation, transmission, storage, metering and billing, and include lower capacity limited-current supplies, Single Wire Earth Return systems, gasifiers, certain hybrid systems and, in the longer term, small gas turbines and fuel cells. In principle, renewable energies, such as solar and wind power, should find good application despite playing a minor role at this time.

Information and communications technologies also offer the promise of helping in rural areas. Potentially they could transform access to credit and product information, as well as providing new possibilities to overcome the difficulties of metering and billing in rural areas, but their penetration is still very limited.

As the scale of continuing rural energy poverty makes clear, little progress has resulted from all the well-intended efforts made to date. A better path must be found for the effective use of scarce development resources. In the re-evaluation taking place several imperatives should be emphasised:

- Rural energy development must be accorded higher priority by policy makers.
- Hoping that improvement will 'trickle down' from more advanced sectors of the economy or that rural energy poverty can be solved by a 'technical fix' is untenable.

- Rural energy development must be decentralized to place rural people themselves at the heart of planning and implementation. Biomass supply and demand is inherently local in nature and is best understood by the local population, which has the clearest insights into rural needs and priorities. Bottom-up, people-led solutions show the most promise of achieving sustainable development.
- Rural energy development must be integrated with other measures dealing with agriculture, education, infrastructure and social and political factors. Experience has clearly demonstrated the limited effect of one-dimensional measures.

A broader range of institutions also has a supportive role to play. The Food and Agriculture Organization's direct experience of agriculture and the rural sector provides an ideal platform to promote sustainable economic and social development through improved rural energy systems. The World Energy Council, with its diverse membership of industrialized and developing countries and all sub-sectors of the energy community, is ideally placed to build productive partnerships, such as that with FAO. Foreign aid should focus on capacity building and on projects that can be developed as longer-term replicable programmes. Non-governmental organizations can assist in articulating and communicating the needs of the people to government and in putting programmes and projects into effect.

THE ETHICAL CHALLENGE OF ENERGY[18]

While it could be argued that food and water are the most fundamental necessities for life, it is equally true that access to these resources is closely connected to the price and availability of energy. In fact, almost every aspect of human endeavour is related to a greater or lesser extent to energy cost and supply and any consideration of the ethical aspects of these efforts will, therefore, involve an analysis of energy.

Likewise, consideration of energy issues has implications for many other aspects of human society. As we have seen, use of fossil fuels has been identified as a major contributor to global climate change, with serious ethical implications. Replacement of fossil fuels by hydroelectricity involves dam construction and flooding, displaces rural populations, destroys forest and wildlife habitats, interferes with fish populations, and changes sediment transport and deposition patterns. The construction of concrete dams releases large amounts of greenhouse gases to the atmosphere, and in many areas dams have a limited life span. Decommissioning dams raises significant environmental questions, is very costly, and will require further substantial releases of greenhouse gases. Development of nuclear power, once seen as the answer to the energy dilemma, has proven to be difficult, a possible health risk, and less reliable and more expensive than initially predicted. Solar energy, geothermal energy and wind have significant potential for generating electricity in some areas, but may involve aesthetic alterations to human environments that are deemed unacceptable. Tidal and wave action as a source of energy have been little

18. This chapter is largely based on the documents prepared by Paul Fung, James Peter Kimmins and José Sarukhan for the meeting of the COMEST Sub-Commission on the Ethics of Energy, UNESCO, Paris, November 2000.

developed, and while they could have local significance, energy storage and distribution issues remain to be solved, and there may be environmental and aesthetic constraints.

We thus face an enormous ethical dilemma. How do we balance short-term social costs borne largely by the poor, the disadvantaged and the developing nations (costs that may in the immediate future increase the disparities between rich and poor) against the longer-term benefits of moving to a more sustainable society and protecting the global environment?

The fact that the extent of accumulation of greenhouse gases and its effect on global warming and climate change is predominantly caused by the wealthy nations raises an important issue. These economies are currently founded on energy intensive industrialization and lifestyles based on non-renewable sources. The targets for greenhouse gas reduction through the Kyoto Protocol would be jeopardised if developing countries significantly increase their emissions. Should they therefore be burdened by restrictions as well? This would severely limit their drive to build up their economies and improve living standards. If the wealthy are the prime producers of present and past greenhouse gases, they must take some responsibility for the sustainable development of the poor. If there were no support, developing countries would be forced to resort to cheap, polluting technologies, following the same road as the Industrial Revolution in Europe, which relied heavily on fossil fuels. This course would compound the pressures on greenhouse gas emissions with even greater risk of global climate change. The industrialized world should therefore take greater responsibility in developing renewable energy and help advance the rural sectors of the poorer countries without jeopardizing their ecosystems. Achieving this goal would be equivalent to a new, green industrial revolution. The feeling that the problem is geographically and temporally displaced from specific societies is a formidable barrier to break. However, at the same time it constitutes the most serious ethical dilemma for our generation, not only for those who will follow us, but for those present now in extremely unprivileged conditions.

As a result of the dramatically uneven distribution of energy and the disparate rates of its consumption, the World Energy Council at its 17th World Congress (1998) concluded that the number one priority in sustainable energy development today for decision-makers in all countries is to extend access to commercial energy services to the people who do not now have it and to those who will come into the world in the next two decades, largely in developing countries.

Otherwise, their opportunity for education, good health and individual dignity will be in doubt. Meeting the requirements of these people will be the first test of the sustainability of the world's energy development path.

For most people in Western society, especially for policy-makers, science and technology offer the only hope for solving environmental problems, which often involve very technical matters. As science normally provides objective and factual answers in an area dominated by diverse interests, it seems an obvious avenue to turn to. However, environmental challenges are neither exclusively nor primarily problems in the realm of science and technology. They raise basic issues about human values and goals, and require answers to questions that are essentially ethical and philosophical.

Many environmental scientists are convinced that solutions are to be found in the application of more environmentally sensitive technologies. But it is also quite clear that this will not be enough on its own if a stricter regulation of population size - mostly in developing regions - and especially a very different behaviour towards energy demands on the part of affluent societies is not exercised. The latter means, in many cases, a serious change in the levels of comfort enjoyed, as well as more sober expectations of the future standards of well-being sought by developing nations. These two issues represent fundamental ethical choices.

In consequence, it makes little sense merely to look at how developing countries must transform their technologies and sources of energy for the future (which they obviously should do) as a way of solving the environmental problems we are facing globally. It makes even less sense to discuss how they will have to draw limits to their needs and expectations in isolation of what is, or should be, occurring in the rest of the world.

Ethics play an important role in issues of development for the future by clarifying values at stake in policy decisions and giving moral reasons for alternative courses of action. Environmental and development questions are loaded with moral implications that need to be understood and carefully weighed before intelligent choices are made. This should help resolve value conflicts that thwart ecological conservation and development projects. With the help of ethics, a new social paradigm should evolve that would promote sustainable development with the maintenance of cultural diversity, social justice and equity.

Many of the problems caused by development - as we have envisaged it until now - are the result of our vision of nature from the 'outside', as if we human beings were onlookers on a bountiful realm of goods and processes on which we depend for our existence and which we very poorly understand. We are in need of a new vision, one that situates us as a species, the product of a process of hundreds of millions of years of evolution that has created nature as we now know it. We must start thinking of a future for ourselves on this planet not as individuals, societies, nations or regions, but as one specific biological entity: *Homo sapiens*. We should look for the well being of all the individuals who comprise our species and for the conditions that will maximise each one's potential creativity, preserving the diversity that every genetic make-up represents. But equally or even more important than the moral significance of ethics is that its practicability - the effect that it may have on changing human behaviours - depends totally on how to convert theoretical principles and concepts into politically and socially accepted norms of action.

Fortunately, there are examples that prove that this is what is happening in a number of places today. Again according to *The Economist*; 'The United Nations foundation's AREED (African Rural Energy Enterprise Development) project is helping on two levels: by supporting local enterprises with business development services and seed capital, and by training its local partners in developing countries to apply market principles. Another example is the Renewable Energy and Energy Efficiency Fund, a commercial equity fund sponsored by the International Finance Corporation (the World Bank's private-sector arm), which provides the investment-stage capital for renewable energy projects in developing countries. With the help of big western utilities, insurance companies and banks, the fund has raised some $65m so far to boost renewable energy, with a focus on innovative village power schemes.'[19]

In the long run, what is needed is a view in tune with the rapid pace of change in the modern world. One such approach was put forward recently by Jean-François Rischard, vice president for Europe of the World Bank, in an address to the 2001 World Economic Forum at Davos.[20] Noting that despite the 1992 Rio Earth Summit and the 1997 Kyoto Protocol the problem of global warming is getting worse and that virtually nothing is being done about it, he pointed out the futility of further treaties and

19. *The Economist,* op. cit.

20. 'Try a Network Approach to Global Problem-Solving', David Ignatius, *International Herald Tribune*, 29 January 2001.

conventions: a study by the Worldwatch Institute counts nearly 240 environmental treaties enacted in the past eighty years, but many of these agreements remain unratified or unenforced. He went on to emphasize that '19th century methods and the glacial pace of global treaty-making and ratification' are unable to deal with 21st century problems, and expressed scepticism about the capacity of existing organizations, such as the United Nations, the International Monetary Fund or even his own World Bank, to cope with the major global problems on their own.

What, then, is the solution? According to Mr Rischard, the only models that have a chance to work in the 21st century will be ones that share the network effects of the new economy. They will be coalitions of interested nations, private companies and non-governmental organizations who will use online polling to speed their work along and who will focus on setting standards or norms. These 'global issues networks' will, over time, be able to bring out ratings that measure how well countries and private businesses are doing in meeting specified criteria on the environment and other issues that effect the welfare of the planet. The process can be quick and non-bureaucratic, based on the premise that if you don't meet the agreed-upon norms, you will be exposed as a rogue player in the global economy.

Linking ethics inextricably to energy requires this type of universal vision, one that seeks to arrive at practical action that is responsive, flexible and participatory. The complexity of energy issues, and their interconnectedness to every other issue that COMEST is concerned with, shows that all potential solutions to individual energy questions involve a social cost, an ethical dilemma and an impact on the way other problems are resolved. Thus, they can only be looked at within a broader consideration of the functioning of the world system of which energy is but one intimately woven component.

THE WAY FORWARD

Many ethical issues arise as a result of unequal access to energy and of the environmental repercussions of the various ways of meeting energy demands. They require that we consider the consequences for future generations of satisfying the energy needs of the present and that we carefully evaluate the implications for the functioning of the environment on which we and other species depend. We cannot resign ourselves to the fact that nearly one human being out of every four today does not have access to adequate energy resources. The actors in world energy policy (government, industry, research and development teams) must ultimately ensure the availability and upkeep of vital resources at a cost sufficiently low so that each country, whatever its geographical location and economic situation, has access to them. It is, therefore, essential that the industrialized countries consider themselves responsible for those that are still developing and that true co-operation in the energy field be established between North and South.

That spirit of co-operation must also be the guiding light for the development of bonds between individuals in the same society or country, between rich and poor. We cannot, therefore, merely allow market forces alone to take care of balancing the relations involving the supply and consumption of energy, from national down to individual levels. Government inevitably has a vital role to play in ensuring equity and justice and in encouraging solidarity in these areas. There can be no pretext for unduly maintaining the countries of the South in a state of forced 'energy restraint' when they so urgently need adequate infrastructures, and the governments of the industrialized countries should step up efforts to help the developing world meet its energy requirements by 'leapfrogging' to clean technologies.

In the long-term, there is no question that energy supplies will have to come from renewable sources since we know that the non-renewable fossil carbon fuels will eventually be exhausted. The only question is how rapidly we should move to such sources and what mix should be used in various parts of the world over time. This is an extremely complex question and the answer depends on careful analysis of the costs and benefits at local, national and global levels, and must take into account the implications for land, air, water, other organisms, food, human security and health, economics and trade, culture and other social and environmental considerations. In short, the ethics of energy must concern the whole energy cycle, from extraction and distribution to consumption and waste disposal.

The World Commission on the Ethics of Scientific Knowledge and Technology has, through its Sub-Commission on the Ethics of Energy, sought to explore the ethical dimensions of these issues. The following key considerations have emerged from its work and are meant to point the way towards framing policies and actions that will have long-term and equitable benefits.[21]

ACCESSIBILITY

Energy should be available to individuals at a level that permits them to achieve their personal security, aspirations and social responsibilities, while not compromising the environment and the rights of others. To make energy affordable for the poor, governments should accept responsibility to absorb part or all of the costs of energy infrastructures needed to serve them, favour decentralized renewable energy systems for rural areas where their lifecycle cost is comparable to or lower than the extension of the grid, and build the capacity of local energy enterprises by training managers and other personnel.

SUSTAINABILITY

Energy sources should be renewable in order to be sustainable. We must develop and deliver renewable sources of energy and find combinations of renewable energy strategies to facilitate the transition from non-sustainable to sustainable energy supply. We have specific duties towards future generations: the resources must be exploited in as economical and rational a manner as possible, above all when we know

21. The specific Principles and Recommendations adopted by the Sub-Commission will be found in its Final Report, op. cit.

full well that a large part of the non-renewable energy resources may be depleted within one or two centuries. There is, therefore, a duty at every level to limit energy wastage. The exploitation of a resource whose disappearance could threaten the existence of entire industries requires that governments view energy control policies as a major aspect of their development programmes.

PRECAUTION

We must avoid creating irreversible situations with regard to the environment and the management of energy and apply the principle of precaution to avoid an increase in the CO_2 content of the atmosphere. Feedback from experience should permit the rational production and consumption of energy and prevent, insofar as possible, the occurrence of any event with irreparable consequences. Precaution requires that the social and environmental benefits and costs of shifts in the balance of energy sources, the rate of energy use, and the financial framework for energy be carefully evaluated before changes are instituted.

ENVIRONMENTAL RESPONSIBILITY

The production and use of energy can be a threat to the environment, hence the urgent need to take all appropriate measures as quickly and as efficiently as possible. This involves reductions in the negative environmental consequences of energy exploration, production, and storage and distribution. Particular emphasis should be on limiting releases of greenhouse gases to the atmosphere, on the problem of storage of nuclear power waste products, and on the environmental impacts of unmanaged biomass use.

The energy sector is one area in which new and readily available technologies have already reduced emissions and hold out prospects for future improvement. But these environmentally friendly technologies have to be developed, distributed, maintained and expanded in all parts of the world. Hence, there is a need to foster adequate local capacity to ensure that the technologies can be used and kept up by local people. Although a 'zero risk' level is unattainable, the various actors in the energy sector are duty-bound to lay down appropriate safety regulations and make sure they are obeyed, particularly with regard to the operation of nuclear power plants or large-scale hydroelectric installations, to cite but two examples.

INNOVATION, ADAPTATION AND RESEARCH

Research, development and capacity building in the energy field are vital, particularly with regard to harnessing renewable energy sources. We must foster a strategic view of research and development activities and not just a tactical approach based on cost reduction and the prospect of abundant short-term resources.

The duty to carry out energy-related research in the production and consumption chains seems occasionally to have been neglected or even sacrificed. This downturn must be reversed and we must continue to seek new sources and uses of energy which are even more economical. Against this background, the exploitation of natural gas, the rationalization of the energy produced by biomass, the development of fuel cells and the use of solar energy in photovoltaic and thermal form are all vast areas for research, both fundamental and technological. Research should also be continued into the relations between climate change and CO_2 emissions, on nuclear power (breeder reactors, 'energy amplifiers', thermonuclear power plants, etc.) and the management of nuclear waste. Industrialized countries must provide effective aid for research in developing countries and train them to maintain their utility plants.

It is also crucially important to keep all energy options open so that there is room for the development of new forms that would compensate for the finite nature of some types of existing energy supplies or would use technologies in innovative ways to reduce harmful side-effects of current energy production or utilisation. Energy diversification, regional integration of energy systems, and enhanced trade in energy services are relevant strategies.

EDUCATION AND PUBLIC INFORMATION

Education and public information need an open, transparent, independent, lively and provocative debate. Hence, there is a vital need for governments and business to support national and international energy institutions so as to provide a forum and context for such discussion to take place. The focus in energy education needs to be global and long term. It needs to foster regional and local decision-making and to allow for a meaningful dialogue between those who have commercial energy services and those who do not, between those who compete and those who determine energy policy or set the rules. The emphasis should be on calling attention to the models and best practices that have proven effective.

INTERNATIONAL CO-OPERATION

In a globalized society, companies operating internationally should act as world citizens. They should not only respect national laws and regulations, but also move the overall energy and environment agenda forward. Fundamental business ethics, including honesty and the avoidance of corrupt practices, are essential, but the need for ethics goes beyond these. Voluntary energy and/or environment audits, their widespread publication in civil society, common standards for safety, performance, best industrial practices, and respect of energy workers should be fostered in all plants in all countries in which a company operates.

It is evident that global thinking with regard to the ethics of energy is indispensable and that consensus and agreement must underpin action programmes in co-operation with the industrial sector. National and international decision makers thus have the responsibility not merely to react to energy crises but to demonstrate leadership and statesmanship in the transition to sustainable, affordable and environmentally acceptable energy policies. In other words, they must never lose sight of the inescapable paradigm of life today that was so clearly summarized by Alexander Solzhenitsyn, Nobel Prize-winning Russian writer: 'On our crowded planet there are no longer any internal affairs.'

AFTERWORD

Life is a manifestation of energy and cannot exist at all, and certainly not as we know it in contemporary society, without a constant supply of new energy. Chemicals, and therefore most inanimate physical objects used by humans, can be recycled. In contrast, one of the most fundamental laws of physics, the second law of thermodynamics, asserts that energy cannot be recycled. Whenever energy is transformed from one state to another (i.e. when energy is 'used'), a portion of it is degraded to heat which is lost from the ecosystem and is unavailable for most human uses. Energy is the source of organization in both living and non-living systems, and because it is steadily being lost, a continuing input is required if system integrity is to be maintained and system function is to last.

This fundamental tenet lies behind the need for a perpetual supply of energy by individuals, societies and social structures; the higher the degree of social organization and the more complex the society, the greater the requirement for energy to sustain them. As human societies aspire to higher levels of economic, material and technical organization, and as world population continues to increase, the demand for energy to support improved security, food availability (energy and nutrition), supply of clean water, health, education, technical and material standards of living, leisure time and other human desires can also be expected to rise.

Energy is intimately connected to every aspect of human life and endeavour. Consequently, making changes in human conduct and in the global economic system to satisfy the basic energy needs of all people and produce a more equitable distribution of global energy wealth is extremely complex. Such changes are fraught with uncertainty and risk,

and rife with the possibility of 'nasty surprises' - unexpected and unintended negative consequences. The comprehensive energy analyses and interactions that have been referred to in this brochure give insight into the high degree of inter-linkage between energy and all other environmental and social issues. However, we have not yet undertaken a global analysis of the energy issue at appropriate spatial and temporal scales and in sufficient detail to identify the possible consequences of changes in energy policy and technology change. Before we are able to make choices between alternative courses of action that will have ethical consequences and be environmentally sound and economically sustainable, such a comprehensive analysis must be undertaken.

The Club of Rome's project on the 'predicament of mankind', initiated in 1968, produced 'The Limits to Growth' report,[22] which asserted that while any individual problem (such as the supply of energy or metals, or the provision of food and water, or the prevention of pollution) is technically capable of being solved, the inter-linkages between the components of the global ecosystem and between the sectors of human society pose fundamental constraints on our ability to do so. For example, the use of water to solve food production issues limits our ability to maintain river navigation, manufacturing, freshwater fisheries and hydropower production. Similarly, the use of energy to maintain cities limits the supply of energy for agriculture, manufacturing and pollution control. The single most important message from the Club of Rome is that it is the inter-linkages between sectors that pose limits to growth, rather than the details of any one individual sector.

A problem is an issue that does not get resolved. An issue that gets resolved is not a problem. Problems persist in many cases because they are complex and connected to other questions, but the solutions offered are often simplistic and fail to address these ties. Before human society can decide how best to act to address the energy problem and related ethical concerns, there is an urgent need to revisit and improve the type of global analysis that was pioneered by the Club of Rome. The ethics of energy can only be comprehended in the context of a better understanding of how energy is woven into the fabric of human society.

If we are to solve the energy dilemma - how to provide all people with sufficient energy to sustain their human dignity and health, and to achieve their individual potential without damaging the ability of the environment to

22. Meadows, D.H., Meadows, D.L., Randers, J. and Behrens III, W.H.. 1972. The Limits to Growth. Pan Books, London. 205 pp.

sustain humans and other species - we must objectively examine all possible sources of energy. We must accept that different solutions will be appropriate in different places and that they will change over time. It must be accepted that ultimately we will move to renewable, non-polluting energy sources, and that we should speed the transition to such sources. Technically, there is no reason why we should not achieve this before we further damage global ecological processes and exacerbate existing disparities in energy availability. That we have thus far been unable to do so reflects the extraordinary complexity of the issue of energy and emphasizes the need to consider the full range of social, cultural, economic, technical, political and environmental barriers to making progress.

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Achevé d'imprimer
SCIPP Vincennes
Juillet 2001