Electricity and the environment: The basis for choices

Many countries face a dilemma, but options exist

by Dr Hans Blix

There is a tremendous tension — locally, regionally, and globally — between the demands for more energy, notably electricity, and the demands for the protection of life, health, and the environment.

Developing countries generally use a fraction of the energy per capita consumed by industrialized countries. To take electricity specifically, Bangladesh, for instance, uses less than 100 kilowatt-hours (kWh) per capita per year, while Norway uses more than 25 000 kWh. It cannot be doubted that developing countries will seek to expand their energy production and use, in particular their use of electricity. Indeed, we can also expect industrialized countries to do so. France, which is known for its rapid expansion of electricity generation through nuclear power, is now using some 6500 kWh per capita per year and is presently exporting some electricity. Can we doubt, however, that in due time the French will increase their reliance on electricity as the Norwegians have done?

Despite this reality, there is awareness that increased electricity generation in some areas may call for the construction of dams and the flooding of large areas of land. Or it may require the construction of nuclear power stations or the burning of fossil fuels at a time when 25% of the carbon dioxide contribution to the atmosphere is already caused by electricity generation in fossil–powered plants.

At the national level, many governments are familiar with the dilemma. They see a need for greater electricity generation. Yet, both hydro schemes and nuclear projects may be blocked by popular referenda, and greater use of fossil fuels may be vigorously opposed. In developing countries, concern is concentrated usually on negative local consequences, such as loss of farm land, and less on future global effects.

At the regional level, we see discussions about the environmental impact of emissions of sulphur dioxide and nitrogen oxide on forests and lakes. In Europe, 60% of sulphur dioxide emissions and 30% of nitrogen oxide emissions come from electricity generation. It is not surprising that the recent proposal for an energy charter to be adopted by all European countries, including the USSR, emphasizes environmental protection as one of its objectives.

At the global level, concerns are focused on the risk of global warming, which is linked to carbon dioxide emissions from burning fossil fuels.

In such uncomfortable situations, countries tend to call conferences for discussions and possible action. The problem of transfrontier pollution from the burning of fossil fuels — sulphur dioxide and nitrogen oxide — can be tackled technically. It is a question of capital and time. The problem of carbon dioxide and other greenhouse gases is more intractable. The Intergovernmental Panel on Climate Change (IPCC) has examined this problem for some time and the United Nations Conference on Environment and Development will have to address it in Brazil in 1992.

Conferences are one consideration. Answers are another. The World Commission on Environment and Development (WCED), in 1987, while advocating what it termed to be a low energy path and urging the development of renewable sources of energy, honestly admitted that it had no satisfactory solution to the dilemma.

Others have been less modest and have suggested that we can eliminate both nuclear power and reduce our reliance on fossil fuels, if we are simply less wasteful in our use of energy and rely more on renewable sources such as solar power and wind power. They point to the use of the best available technology, such as new types of light bulbs and refrigerators that use much less electricity than the more common types in present use. Much of this discussion relies on anecdotal evidence. It does not mean, however,

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Nogent-sur-Seine nuclear plant, France. (Credit: EdF)

that it is without influence. As individuals, our attitudes are often formed by the evidence we happen to see with our own eyes or encounter in the media: the accident at Chernobyl, the burning of oil wells in Kuwait, an explosion in a coal mine, brownouts in Florida, the demonstration of an electric car, an airplane partially fuelled by hydrogen, discussions among scientists about cold fusion, a wind power plant in some country, and so on.

However, if as individuals we allow ourselves to be impressionistic when we form our opinions, because we as individuals cannot systematically study all problems that affect us, we still want society as a whole to have the fullest and best possible basis for rational action.

No doubt, we reserve to ourselves the right to continue forming our views on the basis of anecdotal evidence and impressions, even when the most systematic data have been compiled. Moreover, different political groupings can usually be relied on to draw different conclusions from the same data. Nevertheless, I think the common man and woman are much wiser than the story which had him and her say, "I don't need nuclear power. I need electricity." I think the common man and woman know that all electricity generation has some impact on life, health, and the environment and that it is meaningful for governmental and intergovernmental authorities to try to bring objective assessments and data into the discussions.

Examining the key issues

Let me highlight a few points from key issue papers at this symposium that I find particularly interesting:

First, more electricity will need to be generated, particularly in developing countries. Efficiency gains, although very substantial and necessary, will not neutralize increased demand. Let us note from the outset that the availability of electricity offers a highly significant improvement in the standard of living and the quality of life.

A friend of mine told me that his father, who was 105 years old, had recently been asked what he thought was the most important change he had experienced in the world during his long life. Without hesitating, the father — a professor — answered, "The introduction of electricity." Voices are sometimes heard urging a return to lifestyles with minimal reliance on electricity. The reality is that electricity transports energy to our doorsteps and houses. Ample lighting prolongs our days and makes our streets light at night. Electric pumps bring water to fields and houses. Refrigerators and deep freezers keep our food fresh and reduce spoilage. Television allows us to meet the whole world at home. Electric stoves, irons, vacuum cleaners, and innumerable other items make our lives more comfortable.

A basic factor that leads to an increasing demand for electricity — apart from the wishes for higher standards of living — is, globally, the population increase. It is fundamental not only for the use of electricity but for the whole question of the environment, and I cannot pass the population issue in silence. In the last 10 years of this century, the human population is increasing roughly as much as it did during the *preceding 1900 years*. No meaningful discussion can be pursued about the future of global environment without an examination of the population issue.

It is not surprising that the use of electricity increases faster than the use of energy in general. In many industrial processes, switching to electricity permits the saving of primary energy, because electricity is more efficient and flexible in end use. Moreover, there are often significant environmental gains, as the end use of electricity is very clean. The use of electric trolley buses instead of diesel buses is an example. If I were allowed two wishes for the environment, the first would be for an economically viable electric car and the second for a system of fast electric trains linking countries and continents and reducing the need to lift people to 10 000 metres altitude at high energy cost for travelling even moderate distances.

Efficiency improvement is not really an issue. What is an issue is how much savings can be achieved and how fast. It is interesting to note that increased efficiency in electricity use will by no means neutralize the greater demand that flows from an increased reliance on electricity services. Each new refrigerator will consume less electricity, yes, but there will be so many more refrigerators that the increased number of refrigerators will use a greater total amount of electricity. For example, China has the ambition to ensure that each household has a refrigerator. Even if these appliances were the most current and efficient models and were modest in size, they would call for a base load electric capacity of some 20 000 megawatts-electric (MWe) — or 20 large nuclear power reactors of 1000 MWe each.

The second point I should like to highlight is that all energy sources have *some* impact upon life, health, and the environment, that all sources will be needed, and that the real question before us will not be the inclusion or exclusion of some options, but rather what is the optimal mix — nationally and internationally.

It seems most sensible to examine the risks and consequences that relate to the whole fuel cycle of an energy source, ranging from extraction of gas or the mining of coal or uranium, through transportation, to burning and waste disposal and emissions. What we want to measure, after all, are the total consequences for health and environment of the use of a given quantity of electricity.

Other important distinctions are those between risks in routine operations and in accidents. For example, the emissions from a coal-fired plant in routine operation are very substantial, while there are no emissions from the routine operation of a hydropower station and a very small amount of emissions from a nuclear power station in routine operation. By contrast, an accident in a nuclear power plant could result in important emissions, and accidents in hydro dams might have catastrophic effects.

The differentiation urged between local, regional, and global impacts and between direct and indirect health effects also seems necessary. Comparisons between the global impact of one energy source with a local impact of another are not meaningful. For indirect health effects, we learn that, while these are estimated in the case of radiation, they are not assessed in the case of, say, emissions from the burning of fossil fuel causing the release of metals such as mercury or aluminium because estimates are not available in the latter cases. Such facts must be kept in mind.

The last point I should like to cite is both reassuring and disconcerting. The reassuring statement is that "all the major fuel cycles in the electricity generation systems, when fitted to state-of-the-art technology, are able to deliver electricity at relatively low risks to health and the environment."* The ominous statement is "an exception is carbon dioxide emissions from fossil fuels." Indeed, it is submitted that "the most ambitious feasible global target for carbon emissions from the total energy sources in the year 2010 would involve emissions above those released in 1990."

This seems far from the famous 1988 Toronto target of a 20% reduction of carbon dioxide emissions by the year 2005.

I think you will forgive me if I end my quotations by another line: "Nuclear energy has the potential to make a significant contribution towards the reduction in carbon emissions." I am obliged also to quote the end of that same sentence, ". . . but its social acceptability remains in question."

I am convinced that the scientific and dispassionate examination of the relation between electricity and the environment is a wise approach that may have positive long-term effects and may contribute to rational discussion.

* This and the following quotes are from key issues papers discussed at the Senior Expert Symposium on Electricity and the Environment in Helsinki in May 1991.