## Energy research and development – Survival kit for the future

If Canada is to avoid serious energy shortages, it is essential that long-term research and development programs be undertaken now. Such a program, in the form of the Task Force on Energy Research and Development, is under way and NRC is playing a significant role in it.

Some cynics have been tempted to comment that if the miles of newsprint devoted to the energy crisis were collected and burned in a steam generating plant, the amount of oil saved would be sufficient to meet Canada's needs for many years to come. While this may be an exaggeration, it is certainly true to say that there is no other recent social issue that has so caught the attention of the public as that of energy. It should be added that the subject of the environment has become inextricably tangled with the "energy question" so that the two are seldom discussed separately since the exploitation of energy resources inevitably causes environmental change to a greater or lesser degree.

What is the "energy question"? Stripped of all qualification, it may be summed up in the following way: the world's conventional energy resources (coal, oil, gas, uranium) are not infinite. They are being consumed at an increasingly rapid rate. Energy consumption is the foundation of our existence — this has been the case since man first discovered fire and harnessed animals.

It is obvious then that as a society it is necessary for us to begin to conserve our remaining non-renewable energy resources through both technological improvement of existing systems to make them more efficient energy users, and through modification of our life style to at least retard, if not halt, our increasing energy demands. In addition, we must seek to develop and exploit renewable energy resources, such as the winds, the tides and the sun. It is in recognition of this that the Federal Government has set up, under the aegis of the Department of Energy, Mines and Resources, a Task Force of deputy ministers on Energy Research and Development. It is indicative of the profound social implications of a coordinated long-term approach to energy research and development that the Task Force includes such agencies as the Ministry of State for Urban Affairs, the Department of Regional Economic Expansion and the Department of External Affairs, as well as those more directly related to the subject of energy resource development, such as the Atomic Energy Control Board, Atomic Energy of Canada Ltd., and the National Energy Board. The role of the National Research Council in this Task Force is of particular significance since, by its very nature, NRC can bring to bear a very broad range of scientific and technical expertise on all aspects of energy utilization and conservation, and resource development.

The National Research Council's input to the Task Force is under the broad direction of Dr. Paul Redhead, Group Director of NRC's Physical/Chemical Science Laboratories, and the detailed management is under Dr. Philip Cockshutt, formerly head of the Division of Mechanical Engineering's Engine Laboratory, and now head of the NRC "Energy Project". Dr. Cockshutt sees his job as "a sort of post office, or perhaps rather a telephone exchange," he explains, "in that I try to keep the various NRC teams working on energyrelated topics in touch with each other and, of course, in touch with groups working in other agencies. For example, the people working in the Division of Building Research on the possibility of using solar energy to supplement home heating need to know about the work going on in the Division of Physics, where they are investigating the spectral distribution of solar energy. In other words, exactly what sort of energy does the earth's surface receive from the sun's

rays? What are the proportions of ultra-violet, infrared and visible light energy? This is a very important question if we are going to effectively utilize solar power."

It is this interdisciplinary approach that Dr. Cockshutt regards as the most important feature both of the Task Force's work generally and of the NRC activities in particular. He explains that it is impractical to study individual energy sources in isolation - a systems approach is vital. "We have to look at the total energy flow in our society as a system," he explains, "and then examine the way in which our existing energy subsystems function within that system, and how new energy options can be most efficiently incorporated into that system." The widespread public debate on the energy question has, unfortunately, given rise to the situation where advocates of any particular energy system are often seen as supporting their system to the exclusion of all others — whether the systems under discussion be nuclear power, solar energy or oil from the tar sands. "This is very counterproductive," points out Dr. Cockshutt. "It is important that society realize that no single system can provide all the answers. Now, as long as our society remains highly centralized and industrialized we are going to require large 'blocks' of electrical energy and this is where the CANDU nuclear power system can make a major contribution. At the same time, there exists a strong possibility that the large energy demand of domestic heating could be at least partially met by using solar heating, and that certain geographical locations in Canada could profitably exploit wind power (assuming that a satisfactory answer to the storage question is found).'

A similar approach is necessary when considering the impact of different energy systems on the environment. Dr. Cockshutt points out that the concept of zero environmental impact is, and always has been, unrealisable. "From the time humans ceased to be nomadic hunters and settled down in caves, they started to have an effect on the environment. Our aim has to be minimal environmental impact, concordant with the maintenance of a sufficient energy flow to support our society. Inevitably, there are going to be 'trade-offs'.

What we have to do in the exploitation of any energy resource is to make sure that we have a very clear idea of what the effects of that exploitation are going to be, so that we can anticipate any undesirable environmental change and, hopefully, take appropriate action."

Dr. Cockshutt warns that it is easy to forget that many of the renewable energy options could well have far-reaching environmental effects, and a major part of investigations of such options must be the careful examination of such possible effects. "For example," he says, "take the case of solar energy. Certainly, a few houses with solar collection panels built into their roofs are going to have no significant environmental effect, but if you cover several square miles of land with such panels, then you are creating a major local perturbation in that the amount of solar energy reflected back to the atmosphere is going to be radically reduced with the result that meteorological and geographical effects could be quite far reaching."