The current research efforts of the NRC can be usefully discussed under three headings: resource assessment, small to medium size windmills, and large windmills.

The first area of research involves assessing the wind energy resource in Canada. The Atmospheric Environment Service (AES) of the Department of Environment has done much of the work in this area to date, using archival material to derive a standard set of data for the purpose of identifying areas which deserve detailed evaluation. The NRC has established a set of technical specifications for wind speed monitoring equipment to promote the development of standard testing procedures. In addition, the NRC is working with provincial utilities on detailed evaluations of a number of promising sites across Canada which were identified in the AES study. Canada is also taking part in an international evaluation of computer models for wind energy siting under the auspices of the International Energy Agency's Program of Research and Development on Wind Energy Conversion Systems.

The small and medium sized wind turbines which NRC has examined are being developed with three distinct applications in mind. The first is special purpose applications in which turbines of 1 kW (DC) provide on-demand power at a remote site. Storage is required in these applications as the wind system is the sole power source. These units are expensive as they must meet very rigid demands for reliability and the provision of storage capacity adds to the total cost. Such systems are designed primarily to power remote communications networks and navigational aids, where high costs can be justified. Six installations of this type are now being made across Canada. Five of them — in Alberta, Saskatchewan, Ontario, New Brunswick and Newfoundland — will supply energy for telecommunications networks. The sixth installation will provide cathodic protection for an oil pipeline in Alberta.

The second area of application is in small- and medium- sized wind energy systems which can be used for electrical generation in remote communities. Many settlements in Canada depend entirely on diesel generation for their electricity. The NRC has been working on a wind/diesel hybrid system with the Ontario government and a 10 kW(AC) VAWT has been coupled with a diesel generator at an experimental test site on Toronto Island. Two years of operation have demonstrated that significant savings in diesel fuel can be achieved on a site with an average wind speed in excess of 13 mph (21 km/h) and at a diesel fuel cost greater than $1.00/gallon. Many northern communities satisfy both of these conditions and the NRC, the Ontario Ministry of Energy and Ontario Hydro are arranging to finance the installation of a 50 kW VAWT wind/diesel hybrid system in Sudbury, Ontario.

Medium-sized turbines (around 50 kW in output) are also being tested while linked into electrical grids. Four 50 kW units with no storage are already installed and coupled to major grids, one each in British Columbia, Saskatchewan, Manitoba and Newfoundland. These systems are the forerunners of larger wind turbines and are being monitored to determine what problems may arise from feeding the variable wind-generated electricity into an electrical grid which has traditionally relied on steady energy inputs from large facilities.

Concerning large windmills, the NRC and Hydro Quebec in a joint project have constructed a 230 kW VAWT on the Magdalen Islands. The machine was first erected in 1977 and early tests showed that this version of the VAWT performed as expected. Unfortunately, a procedural error in the operation of the machine led to its destruction in July 1978. An identical machine was erected on the same site in January 1980 and subsequent testing has shown this wind turbine to perform as expected, reaching full power operation ahead of schedule. The original plans called for the operation of the facility to be turned over completely to Hydro Quebec at the end of 1980 with the installation generating a part of the electricity supply for the Magdalen Islands. Hydro Quebec and the NRC agreed, however, that the instrumentation collecting operational data should remain in place so that experiments can continue while the wind turbine is contributing power to the Islands' grid.

Following the success of the Magdalen Islands experiments, scientists at the NRC proposed the construction of a megawatt-size VAWT, seeing this as the next logical step in the wind energy program. Running a vertical axis wind machine of this size would give Canada unique operating experience and consolidate its position as a world leader in vertical axis wind turbine research and development. "Project Aeolus" involves the design and construction of a VAWT which can generate up to 3.8 megawatts of electricity (enough electricity to supply the non-heating requirements of 600-700 homes) and which is expected to cost $23 million to complete. It is believed that such a system could operate at sites with average wind speeds of approximately 30 mph (48 km/h) and deliver energy which is cost competitive with conventional electricity. Hydro Quebec has agreed to participate in this program on a cost-shared basis with the Federal Government and the wind turbine will be erected at a suitable site in eastern Quebec with operation expected in 1983.

The market for wind turbines in Canada may not prove to be large, given other options available to us for the production of electricity. However, in certain regions of the country such large-scale wind conversion systems could be very important in replacing fossil fuels currently used for electrical generation. In addition to the domes-