important is the fact that water is a renewable resource. The thermal station on the other hand can be located close to the demand area, with a consequent saving in transmission costs. However, with the current trend to large steam stations a certain amount of the flexibility of location of thermal stations is lost because such units require considerable quantities of water for cooling purposes, making it essential that they be sited close to an adequate water supply.

The marked trend to thermal development which became apparent in the 1950s can be explained in part by the fact that most of the hydro-electric sites in many parts of Canada within economic transmission distance of load centres had been developed by that time and planners had to turn to other sources of electrical energy. More recently, however, advances in extra-high-voltage transmission techniques have provided a renewed impetus to the development of hydro power sites once considered too remote.

Thermal power generation may use fossil fuels or nuclear fuels as the source of energy. The fossil fuels – coal, gas or oil – can be obtained economically from domestic sources in some parts of Canada. In other regions the cost of transportation leads to the use of imported fossil fuels. Nuclear fuels are providing an increasingly important source of energy for thermal power plants and will be especially attractive for regions where fossil fuel costs are relatively high and where the power system permits the use of very large generating units which show the best economic advantage for nuclear plants. The CANDU reactor system, which provides the heat source for Canadian nuclear plants, allows the use of natural uranium mined and processed in Canada.

Because of the relatively long starting-up time required by large thermal units, such stations tend to lack flexibility of operation and can be used most efficiently to meet continuous load conditions. Hydro stations, on the other hand, can put generating units on line with minimum delay and hence are admirably suited to supply power to meet peak loads which may occur several times each day. This applies mainly to hydro plants located close to load centres where peaking operation does not involve substantial extra transmission costs. By combining the advantages of both hydro and thermal stations in integrated supply systems power producers are now achieving much greater flexibility of operation.

Another development trend designed to meet the problem of varying daily loads is the use of pumped storage. An example is the Sir Adam Beck hydro development at Niagara Falls where water taken from the Niagara River above the Falls is carried by tunnel and power canal to penstocks which supply the main generating station on the bank of the Niagara River some distance below the Falls. In off-peak hours, power from the main station is used to pump water from the power canal into a reservoir maintained at a higher level; during peak-load hours, the dual-purpose pumps operate as generators and are driven by water released from the reservoir. The pumping-generating units at this development make available an extra 176,700 kw of generating capacity. A pumping-generating station using the same general principle has been constructed on the Brazeau River in Alberta as part of the 305,500-kw Big Bend hydro development.

Perhaps the most promising application of the pumping-generating principle is its use in conjunction with nuclear power stations. Nuclear units, in common with the larger conventional thermal units, can be used most efficiently under conditions of continuous operation. Off-peak nuclear power can be used to operate pump-turbine units and the hydro-electric power derived from operating the units as generators is available for use during periods of peak demand.

Details of research activities now being carried on into the many aspects of electric power generation and distribution in the broad sense may be found in Chapter 9.

13.3.3 Utilization of electrical energy

In 1971, Canada's generating facilities produced 215,064 million kilowatt-hours of electrical energy, after allowing for the energy used in the power stations themselves. Of this total, 74.6% was produced in hydro-electric stations and the remainder in thermal stations. Electric power exported to the United States exceeded imports by 3,737 million kwh during 1971, so that the total energy available in Canada amounted to 211,327 million kwh.

As indicated in Table 13.10, total electrical energy consumed in Canada during 1971, after deducting about 8% for losses, was divided among commercial users (15%), domestic and farm consumption (21%) and industrial loads (56%). The energy distribution for this latter group can be subdivided approximately as follows: one third to the mineral industry (including smelting