value in upgrading heavy fuels to middle distillates which have been in relatively short supply.

While petrochemical plants are distributed widely across Canada — Sarnia, Montreal and Edmonton are the principal centres. At Sarnia three refineries are closely integrated with nine petrochemical companies. The oil refineries supply petroleum gases, naphtha, aromatics, etc. to the chemical companies who convert them to a large number of intermediates as well as final products. Western Canadian natural gas is also pipelined into this complex. The intermediate products produced in these chemical plants include ethylene, propylene, butadiene, aromatics, ethylene oxide, etc. Final products include carbon black, synthetic rubbers, detergent alkylates, polyethylene, polystyrene, polyvinylchloride, ammonia, fertilizers, petroleum additives, and many others. Many of the joint products from the petrochemical plants are sold back directly to the refineries for blending into fuel products. Fuels are also piped directly to the petrochemical plants for process heat and power requirements.

Of major importance to the industry today are the developments aimed at improving the environment. All Canadian refineries have been investing a large percentage of their capital expenditures in conservation equipment to meet stringent new standards. The use of process cooling water is minimized or abandoned entirely in favour of air cooling. What remaining water effluent exists is generally treated not only by gravity separation but by secondary processes such as air flotation, biological oxidation or filtration. The discharge of sulphur dioxide from process heaters is minimized where possible by the use of low sulphur fuels and dispersion aided by very high smoke stacks. The refineries also have the responsibility of producing products designed to minimize pollution by the consumer. The most important aspects of this are the treatment of fuels for sulphur removal and the manufacture of motor gasolines that will minimize automotive emissions.

The pioneer oil sands recovery plant at Fort McMurray includes refining equipment to semi-process the recovered bitumen to a synthetic crude oil. New oil sands plants planned for construction over the next decade will represent a major refinery growth.

Table 13.8 gives details of existing and planned oil refinery capacity in Canada in 1973 with scheduled completion dates for new facilities. In addition, some expansion of existing refineries is already in progress.

13.4 Natural gas

Raw natural gas may vary widely in composition. In addition to the usually predominant methane, varying proportions of ethane, propane, butanes and pentanes plus may be present. Hydrogen sulphide may be so abundant as to be an important source of sulphur. After processing has removed the water content, hydrogen sulphide, pentanes plus and other petroleum gases, the marketable gas consists mainly of methane, some ethane and small amounts of propane and butanes. The heating value of the marketed gas averages about 1000 Btu per cu ft of gas.

The most important use of natural gas is as a fuel for space and water heating. Domestically, it is finding increasing use as fuel in the larger home appliances. In the industrial sector natural gas is being used by the automobile, steel, metal working, glass and food-processing industries and in metallurgical processing where the clean, easily controlled flow of this fuel makes it possible to attain precise desired temperatures for the rolling, shaping, drawing and tempering of steel.

The constituents of natural gas have become major sources of feedstock for the petrochemical industry. Natural gas supplies the basic raw material for ammonia, plastics, synthetic rubber, insecticides, detergents, dyes and synthetic fibres such as nylon, orlon and terylene.

13.4.1 Reserves

Canada's proven reserves of natural gas have been estimated at 119.6 MMMMcf of gas in place, most of it in the western provinces of Alberta and British Columbia. After deducting reservoir losses and processing shrinkage (much of the gas has a hydrogen sulphide content and therefore a high processing shrinkage), 74.1 MMMMcf is estimated as ultimately to be recoverable. Cumulative production to the end of 1973 was 21.6 MMMMcf, leaving 52.5 MMMMcf available to meet future demand. On the basis of 1973 production of marketable gas, the reserves-to-production ratio has declined to 17 years from 23 years in 1970. However, there are very large potential resources yet to be developed in the frontier regions.