

from time to time, for oil and gas exploration and development. In addition, applicants for leases on 12.5 million hectares of land have been given three land-tenure options.

Petro-Canada has been given first option for exploration agreements in frontier and offshore oil and gas areas over the next seven years to build up its holdings. Canadian content in frontier oil and gas exploration and development will be strengthened by Petro-Canada's option to acquire up to 25% working interest on lands where no significant discoveries have been made. This option is based on the amount of Canadian ownership in exploration ventures and cannot be exercised if more than 35% is already Canadian-owned.

Panarctic Oils Ltd., in which the federal government has invested \$92 million, has had major successes in finding natural gas in the Arctic.

The full effect of recent exploration activity on reserves cannot yet be assessed.

## Reserves

### 13.4.4

At the end of 1977 Canada's proven liquid hydrocarbon reserves, including conventional crude oil and natural gas liquids, amounted to 1.26 billion cubic metres made up of 0.95 billion  $m^3$  of crude oil and 0.30 billion  $m^3$  of natural gas liquids. These estimates do not include oil in the Athabasca bituminous sands. At the 1977 annual production level of 93.9 million  $m^3$  the life index (reserves-to-production ratio) for conventional crude oil and natural gas liquids was 13.4 years, the same as in 1976.

The reserve position of most provinces declined except in Alberta where total reserves including natural gas liquids increased by 21 million  $m^3$ . The rise is not because of an increase in proven reserves of crude oil, but rather because ethane reserves have been included for the first time. The Canadian Petroleum Association (CPA) estimated Alberta's remaining recoverable reserves of crude oil at 0.81 billion  $m^3$  and natural gas liquids at 0.29 billion  $m^3$ . Together, these represent about 88% of Canada's proven reserves. Saskatchewan's reserves of liquid hydrocarbons declined from 102 million  $m^3$  to 97 million  $m^3$  and accounted for 7.8% of the national total.

Natural gas liquids from the recently discovered, but as yet unproduced, gas fields in the Mackenzie Delta are included in the estimates but oil from the frontier regions is not, because discovered reserves of crude oil in the territories are negligible and currently well beyond economic reach.

At the end of 1977 the CPA estimated Canada's proven reserves of marketable gas at 1 684 057 million  $m^3$ , 42 022 million  $m^3$  more than in 1976. Using the 1977 level of production of 23 422 million  $m^3$  the life index increased to 22.95 years in 1977 from 21.85 years in 1976. Gross additions to reserves amounted to 102 965 million  $m^3$ , including 52 451 million  $m^3$  due to extensions to existing fields, 9 939 million  $m^3$  to new discoveries and 40 574 million  $m^3$  to previously-estimated field reserves. Almost all of the increase was accounted for by increases in reserves in Alberta and the territories. Gross additions of marketable gas in Alberta amounted to 77 296 million  $m^3$ , most of it from extensions to existing fields. Gas reserves in the territories, which include the Mackenzie Delta and the Arctic islands, increased 15 508 million  $m^3$ , primarily by revisions for fields in the Arctic islands.

Alberta, with 1 310 035 million  $m^3$  of marketable gas reserves, accounted for 78.0% of Canadian reserves at the end of 1977, British Columbia 11.2% and the territories 9.0%.

According to an appraisal of Alberta's oil sands completed in 1973 by Alberta's energy resources conservation board, ultimate recoverable reserves of synthetic crude oil from all of Alberta's bituminous deposits amount to 39.7 billion  $m^3$ . Of this, approximately 4.2 billion  $m^3$  is considered recoverable by open-pit mining methods similar to those now in use at the Great Canadian Oil Sands Ltd. plant near Fort McMurray. Most of the oil from the deeper formations will only be recoverable by on-site thermal or other techniques still being developed.

In addition to these known resources, the Geological Survey of Canada estimated in 1975 that between 2.5 and 5.4 billion  $m^3$  of combined crude oil and natural gas liquids remain to be discovered at the high (90%) and low (10%) probabilities respectively, about 80% of which will be found in frontier areas. For natural gas, between 4.1 and 8.3