



# THE OIL SANDS

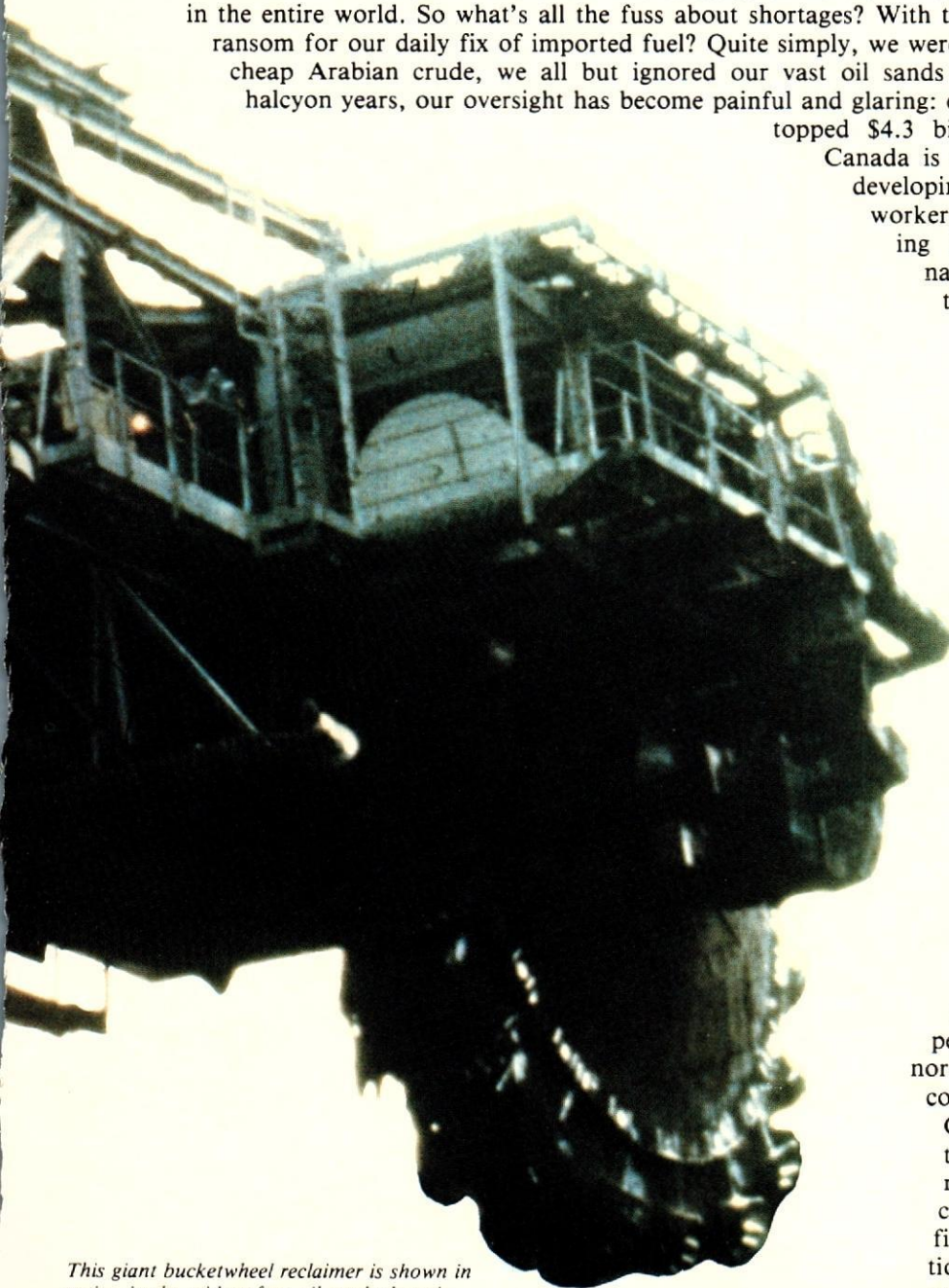
by Allan Bailey

Contrary to today's fashionable pessimism, Canada is not running on 'empty.' The gas tank is far from dry. In fact we are sitting on an ocean of petroleum — much more oil than the combined Middle East reserves. Experts estimate that there is almost twice as much crude in the oil sands of northern Alberta as could be pumped from all the oil fields in the entire world. So what's all the fuss about shortages? With this embarrassment of riches, why pay a king's ransom for our daily fix of imported fuel? Quite simply, we were seduced. Lured for decades by a glut of dirt-cheap Arabian crude, we all but ignored our vast oil sands deposits. Following the abrupt end of those halcyon years, our oversight has become painful and glaring: energy security apart, last year's foreign oil bill topped \$4.3 billion. To reduce this crippling dependence,

Canada is set to launch an Apollo-like effort aimed at developing our forgotten resources. Soon an army of workers, backed by billions of dollars, will be pouring into Alberta's north in quest of the new national dream — energy self-sufficiency through the oil sands.

But energy self-sufficiency is a new idea that was impressed forcibly on the mind of the average Canadian by the threat of oil shortages in 1973-74 and the rapid escalation of oil prices in the last six years. The Canadian consumer is now faced with the problem of evaluating the cost/efficiency of energy sources. Because of the high price of energy, people are now forced to look at the economics of oil versus coal versus hydrogen versus etc. The result is that consumer thinking will have to change — all fossil fuels are part of a finite energy supply that could be depleted by the early 21st century.

Slaking or slowing the national thirst for hydrocarbons, however, won't be easy. With the oil sands it's not simply a matter of drilling a few wells, plunking down a pipeline, and pumping fuel to the masses. Getting this oil out of the ground calls for the construction of gigantic petrochemical installations right in the middle of northern wilderness. There are already two such complexes, Syncrude and Suncor (formerly Great Canadian Oil Sands Ltd.) operating just outside the town of Fort McMurray, 432 kilometres north of Edmonton. Altogether, the two plants cost about \$3 billion and each of them took five years to build. Still, after years of operation, they have yet to realize their scheduled output capacity of 179 000 barrels per day (combined). Even if the oil flow had not been choked by numerous snags and breakdowns, the two companies could supply less than seven per cent of Canada's current needs.



*This giant bucketwheel reclaimer is shown in action in the midst of an oil sands deposit. This 2 300 tonne machine follows the huge 5 500 tonne draglines that dig the sand out in bungalow-sized mouthfuls, gobble up the heaps of oil sand and spit it out onto speeding conveyor belts. Suncor*

Not only is output below expectations, but the oil that they do produce is the most expensive in the world. The choice for Canadians is simply that of no oil or expensive oil and the consumers seem to be willing to pay the price. As a result, two even larger oil sands plants are in the works. The Al sands and Cold Lake projects might be on stream producing 140 000 barrels per day each by the middle of this decade. Some oilmen believe that Canada's entire oil supply base could be replaced by 15 such plants by the turn of the century. Before such dreams come to pass, however, some impressive technological, economic, and political hurdles must be overcome.

Sprawling over thousands of square kilometres of north-central and north-western Alberta, the four major deposits — Athabasca, Peace River, Wabasca, and Cold Lake — contain a staggering 1 350 billion barrels of oil. What makes it so expensive and rules it out as an overnight energy salvation is that this crude exists as a thick, mucky impersonation of what oil should look like. In fact, oil sand bears a closer resemblance to asphalt than, say, crankcase oil. It is a frustrating mish-mash of sand, water, and a tarry form of crude called bitumen. Each sand grain is coated by a thin film of water which, in turn, is surrounded by bitumen. It is this water film that ultimately provided the key to unlock this enormous wealth of crude.

Since the first attempts to extract the bitumen more than 60 years ago, the oil sands have alternately inspired, exasperated, and thwarted generations of oilmen. Standard drilling techniques are pointless: the bitumen simply will not flow. In its natural form, no amount of pressure will coax it out of the ground. Some early investigators shook their heads in despair, lamenting that this sea of oil would remain in nature's clutches for eternity.

Syncrude and Suncor, of course, have proved them wrong. Yet, those first plants have barely scratched the surface — literally. Their successes are based on skimming off the easy stuff — that small fraction of the oil sands that lie close to the surface in the Athabasca river valley. For Canada and the other oil sands countries (Venezuela, Malagasy, the

United States, and the Soviet Union also have significant deposits), the real hope lies in new techniques to recover the huge portions buried so deeply that they are beyond reach of present technology.

To the visitor, the first sight of Syncrude is a shocker. After driving north from Fort McMurray for about 20 minutes, the forests and rolling bush country abruptly give way to a flat, barren moonscape. In place of the greenery, a black desert sprawls off in the distance about as far as the eye can see. Dwarfed by the vastness of it all, heavy machinery and earth-moving equipment can be seen crawling around against a backdrop of haunting desolation.

This Orwellian scene is really the world's largest open pit mining operation that is the setting for the mechanical drama of oil sands recovery. Employees of Syncrude refer to the plant as a 'minery' because the mine is linked directly to a refinery. Through this set-up, the oil sand is first excavated and then the bitumen is separated from the sand after which, it is processed — or upgraded — in the refinery. The refined crude is then pumped through a pipeline to Edmonton. Sound simple? Far from it.

It takes two tonnes of oil sand to produce just one barrel of product, called synthetic crude. To reach the daily output of 129 000 barrels, therefore, Syncrude workers must process a 225 000 tonne mountain of oil sand every day. This feat is a sight to behold.

At the mine site, the sticky sand is excavated from a yawning pit about 7.5 km long by 4.2 km wide. Perched along the edge of this black canyon are four of the largest machines in existence — the 5 500 tonne draglines. Vivid red against the bleak terrain, they dip and swivel like demented monsters from some far-off planet. In a well-rehearsed ritual they stoop over the pit, chomp a bungalow-sized mouthful of sand, swing it around and then dump it in neat piles behind them. These awesome draglines are nine stories high and as wide as a superhighway. The cavernous interior resembles an aircraft hangar and houses not only the mechanical innards of the dragline, but also the lunchroom, lockers and showers of the operators.

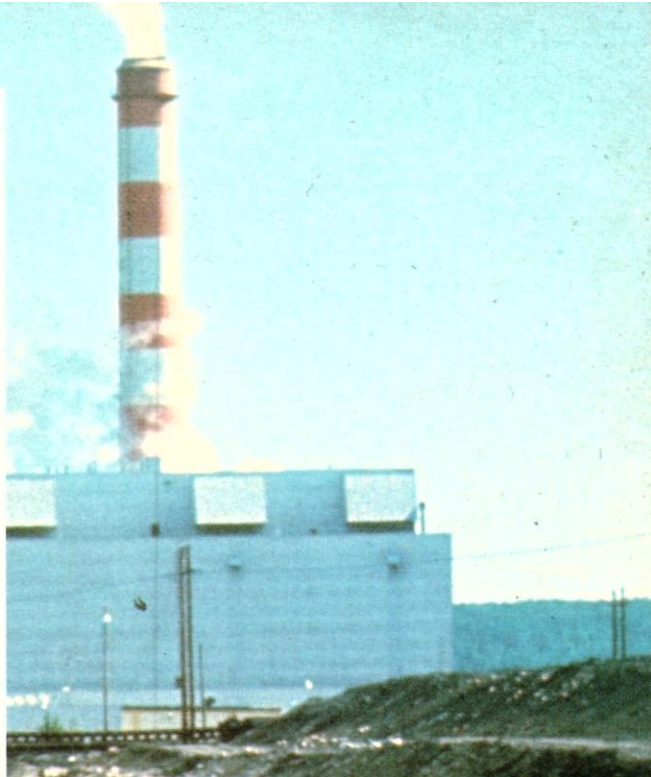
The neck-line boom is as long as a football field and is used to cast the 60 cubic metre reclaiming bucket into the mine pit. According to one expert, the 10 000 kilowatt surge of electricity required to haul a loaded bucket can ripple throughout the entire Alberta power grid and may be detected hundreds of kilometres from the source. Syncrude does have its own natural gas-fired power plant that could provide enough electricity for a city of 300 000.

Lumbering along behind each dragline is a 2 300 tonne bucketwheel reclaimer. This machine gobbles up the heaps of oil sand deposited by the draglines and spits it out in a constant stream onto speeding conveyor belts. More than 20 kilometres of conveyor belts rush the freshly mined sand to a central stockpile.

This stockpile is fed into the extraction plant. It is here that the valuable bitumen is "wrung" from the oil sand. Following a process patented in 1928 by a Canadian scientist, Dr. Karl Clark, hot water and steam are added to the sand. As the temperature rises, the mixture is constantly agitated. At 80°C the water film, sandwiched between the sand and the bitumen, expands and ruptures. The result is a hot, fluid slurry of water, sand and bitumen. The slurry is pumped into a separation tank where the heavier sand settles to the bottom and the lighter oil floats to the top to be skimmed off. The skimmed bitumen is stored in holding tanks to await further processing. The sand and the water, which contains a suspension of fine particles and minute oil droplets, is pumped to a 30 square kilometre tailings pond for permanent storage.

*Inset: This aerial view of the Suncor oil mine and plant north of Fort McMurray, Alberta illustrates the scale of the undertaking. NFB Photothèque ONF photo by George Hunter*

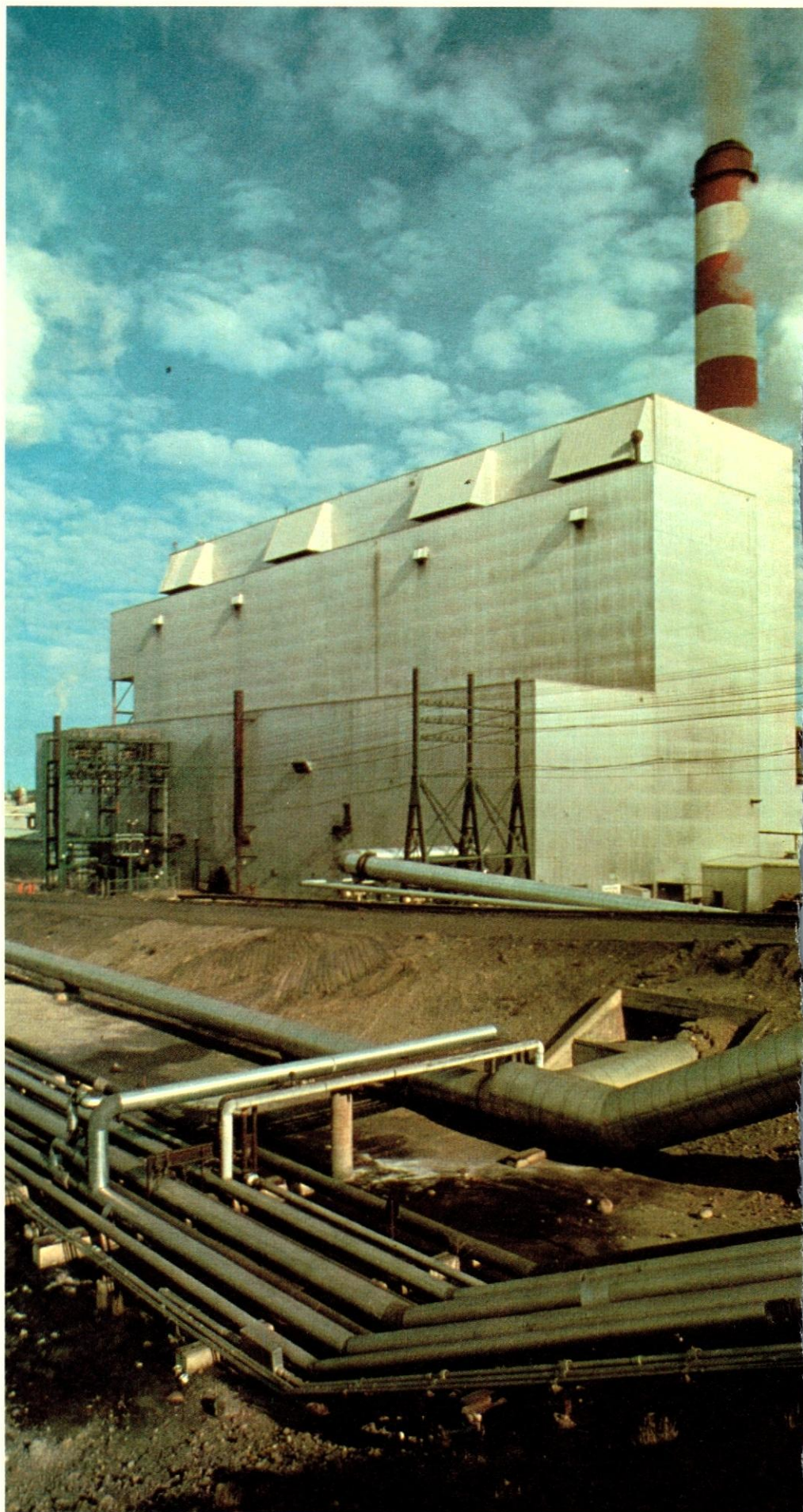
*Full Page: More than 20 kilometres of conveyor belts rush the freshly mined sand to a central stockpile and then into the extraction plant. NFB Photothèque ONF photo by George Hunter*



The bitumen in the holding tank is still too heavy, too thick for commercial use and needs further refinement. For this it is drawn from the tank and taken on an incredible voyage through kilometres of twisting and turning pipes; into and out of a bewildering jungle of pumps, tanks and chambers. It is compressed, heated, sprayed, vaporized and condensed. At a breathtaking pace, it is sped through a dizzying succession of chemical calisthenics. It is diluted, cracked, fractionated, separated; then it is cleaned, hydrotreated, scrubbed and blended. After this gauntlet of abuse, this appropriately-named synthetic crude must still be piped to other Canadian refineries for more of the same before it is ready for the gas tank or the home furnace.

Although the two existing mineries will soon be joined by a third, Alsands, the technique is useful only for recovering that portion of the oil sands (74 billion barrels) buried under less than 60 metres of overburden in the Athabasca deposit. The greatest excitement, therefore, is reserved for In Situ recovery, a technique that, it is hoped, will open up the huge bulk of the oil sands (more than 90 per cent) that lies beyond the reach of surface mining operations. The idea is to separate the bitumen from the sand in situ (in place) and then pump it to the surface as in a conventional oil well. The major obstacle has been to overcome the bitumen's reluctance to flow, its viscosity. Through the years, a plethora of schemes have been proposed which involve adding solvents, heat, or some combination of both. Strategies have included heating with steam or electricity, setting the formation on fire, and even exploding an underground nuclear device to liberate the bitumen.

In the Cold Lake deposit, where most of the oil sand lies at a depth of about 450 metres, Esso Resources Canada Ltd., hopes to be recovering commercial quantities of bitumen by the middle of the decade using in situ techniques. Esso plans to pump superhot steam down into the formation to raise the temperature of the oil sand to 150°C. At this point the



*Right: This close-up of the Suncor extraction plant shows the complex piping through which the synthetic crude oil is routed. NFB Photothèque ONF photo by Hans Blohm*



bitumen becomes thin enough to separate from the sand and to be drawn to the surface in a normal manner. After several weeks of steam injection the steam flow will be stopped and the hot oil will be pumped back up the same shaft. This scheme, called 'huff-and-puff,' will require drilling about 320 wells a year, or some 8 000 wells over the life of the project.

In spite of the fact that they are now producing 6 500 barrels per day in an in situ pilot project, Esso officials glumly expect that escalation to commercial operations will expose them to the devastating growing pains that wracked Syncrude and Suncor in their early years.

The unco-operative weather and the balky terrain of Alberta's north, for example, quickly turned Suncor's brave dreams into a nightmare. The saga of frustration began with the mundane task of removing the blanket of muskeg that covers the oil sand formation. Plans called for first draining the soggy soil and then hauling it away after the spring freeze.

That's what should have happened. In the event, the surface dried forming a crust, while underneath, the muskeg remained mushy. Heavy excavating equipment, attempting the spring removal, would often break through the crust and sink into the sodden darkness. "Early operations," as one veteran wryly recalls, "tended to concentrate more on the retrieval of sunken equipment than on muskeg."

Near arctic winds of  $-45^{\circ}\text{C}$  turned the soft, pliant bitumen into a frozen mass of rock-hard ore. The giant bucketwheel reclaimers, after a few futile hours of mining, were reduced to broken toys. Glowing red with friction, their huge 45 kilogram teeth were filed to the gums and occasionally ripped from their sockets. Sub-zero temperatures caused a plague of calamities: smashed equipment, shredded conveyor belts, frozen process units, and parking lots choked with stalled vehicles.

For oil sands developers, frigid weather is only part of a string of misfortunes that have driven construction and operating costs through

the ceiling. This galloping inflation, fuelled by an interminable series of breakdowns, kept Suncor in the red for years. Although the picture is improving for its owners, Sun Oil Co. of Philadelphia, the shaky beginning casts a shadow of trepidation and uncertainty over those who will follow. The grim lesson for potential investors is that technological upsets may be overcome; it is the economic vicissitudes that jeopardize future ventures. This stark fact will make or break Canada's drive for energy security from the oil sands.

The staggering escalation of costs hints at the financial mine-field ahead. In 1968 Suncor cost around \$300 million to build. Syncrude, by the time it had delivered its first barrel in 1978, had spent \$2.4 billion. It is now expected that sponsors of the Alsands (Shell Canada Resources Ltd.) and Cold Lake projects, will have to pay out six or seven billion dollars apiece. Operating costs, too, have gone slightly berserk. Back in 1973, planners estimated that Syncrude's cash operating costs would be

*Below: This aerial view of Fort McMurray shows a boom town in the making. The city is located on the Athabasca River 432 kilometres north of Edmonton. NFB Photothèque ONF photo by Kryn Taconis*



about \$100 million annually by 1980. In fact they are now at around \$500 million, according to a senior official.

To assuage the fears of potential investors, the Federal government now allows operators of oil sands plants to charge world prices for their synthetic crude. Since producers of conventional oil get only \$15 per barrel, this concession is a monumental inducement for development, considering the current world price has passed \$35 per barrel. It is also a contentious issue for critics of big oil. Does this price truly reflect the costs? Are Canadian consumers really getting their money's worth? As we move towards greater reliance on the oil sands, these questions assume national dimensions and, in the end, could profoundly affect Canada's economic future.

Granting world price was only part of an extraordinary package hastily arranged in 1975 to bail the Syncrude project out of financial trouble. The key points of the deal, agreed to by the federal, Ontario and Alberta governments, are: lower than normal provincial royalties (8% rate instead of 20%); the royalties, paid to Alberta, are exempt from federal taxation; and a joint venture concession allowing participating companies to write off Syncrude expenses against their other profitable operations. (Syncrude is a consortium comprising Esso Resources (17.6 per cent), Canada-Cities Service (17.6 per cent), Gulf Canada Resources (13.4 per cent), plus Petro-Canada, Alberta Energy Company, the Alberta government, Petrofina, Hudson's Bay Oil and Gas, and PanCanadian Petroleum.) Effectively, those companies could now get immediate investment write-offs without waiting until Syncrude turns a profit.

At the time the deal was struck, it provoked a great deal of indignation. Critics still argue that it was an excessive giveaway inspired by Ottawa's naivete and desire to increase Canada's oil output. University of Alberta political economist, Larry Pratt, argues that the development risks simply did not justify such massive support of the multinational oil companies. Pratt, author of the book *The Tar Sands* (1975), believes the oil firms manoeuvred the government into carrying more of the risk than they would ordinarily.

What Pratt and others fear most is that by making these "invisible investments", the Canadian public is, in effect, subsidizing outside control over its own resources. Today it seems that only the multinationals have the technology, expertise, and capital to run these megaprojects. If Canada is heading for full-scale development of the oil sands, Pratt reasons, it is essential that we maintain control — through public ownership, if necessary — to provide a practicable alternative to the terms of the oil companies. Says Pratt, "I argue that public ownership is not a question of ideology or philosophy, it is essentially a question of bargaining power." Without such power, he says, the companies have a free hand to negotiate lucrative tax, royalty, and pricing terms. Wilbert Hopper, chairman of Petro-Canada agrees: "Nobody else is going to develop the oil sands for us, unless we pay an exorbitant price for them. Somehow, we have to marshal the expertise that we have in Canada in terms of scientific expertise and the money to get the job done by Canadians, for Canadians."

Regardless who builds and operates them, the thought of these mammoth projects springing up all over the countryside does not elicit universal glee among Albertans. True, the inflow of big money and jobs is welcome, but the Alberta government is worried that the fallout from this explosive development — inflation, housing shortages, social dislocation, crime — might plague the province through the end of this century. Since Alberta has the final say on these projects, the ultimate pace of oil sands development depends upon the province's willingness to suffer disruption.

Since the construction of each oil sands project requires a work force of about 10 000, Alberta has become a sort of mecca for tradesmen, the unemployed, and a mixed grab-bag of drifters and camp followers. In the building of Suncor and Syncrude, this influx necessitated erecting an instant town. In 15 frenetic years Fort McMurray ballooned from a village of 1 200 souls to a city of 27 000. The housing shortage became so severe that at one point some 2 000 workers were living in a hastily-built tent city. A few kilometres north of Fort McMurray, a completely new

town is planned for the Alsands project. In the Cold Lake region, 400 kilometres south, many of the 20 000 residents fear that the coming of this boom-town mentality will drive up land and housing prices and change their rural ways forever.

The inevitable air, water and soil pollution that these projects bring also concerns many Albertans. A major hazard of oil sands operations is that they belch out large quantities of sulphur dioxide into the atmosphere. Although each new project installs tighter emission controls than its predecessor, some environmentalists worry that the cumulative output from many operations could threaten the forests and lakes of northern Alberta and Saskatchewan. They contend that without even stricter controls Western Canada may inherit the alarming problem of acid rain that has ravaged Eastern Canada.

If development of the oil sands is to be the main highway to energy security, it seems clear that it will not be an entirely smooth one. How swiftly we travel it depends upon Alberta's willingness to endure the migraines of big development. It depends also on the price Albertans and Canadians are prepared to pay — in economic, social and environmental terms.

Whether oil sands development paves the way for more foreign control of our energy industries or whether it stimulates a new ethos of technological and industrial self-reliance, is probably a question of national will. In a world lurching from oil crisis to oil crisis, however, this ocean of awkward crude offers Canadians some compelling grounds for optimism. This sentiment is perhaps best expressed by Esso Resources vice president in charge of oil sands operations, Robert Peterson: "Oil sands to me are a romantic notion. There are going to be a lot of great things that have to be done. They are kind of like the last frontier in Canada."

*Allan Bailey has written material for CBC's The Nature of Things and his numerous science articles have appeared in several Canadian and American journals.*



