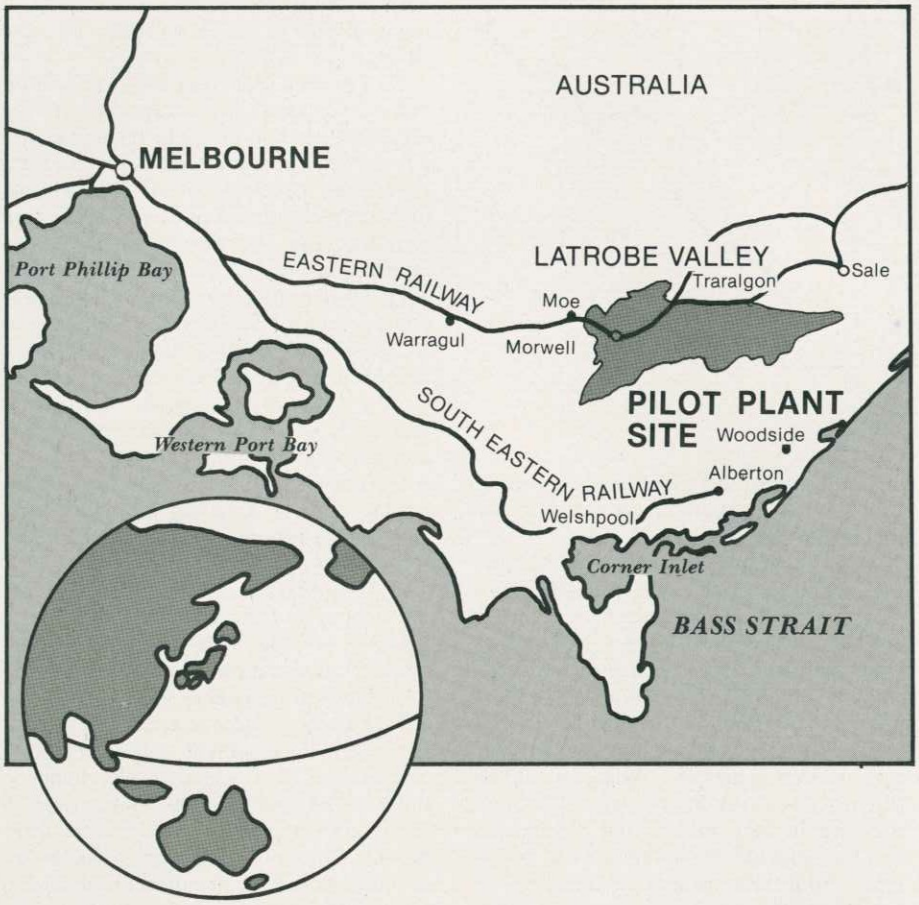
Japan's Brown Coal Liquefaction Projects in Australia

By Ikuya Takase

Ikuya Takase, executive director of the New Energy Development Organization, was born in 1930. He joined the Ministry of International Trade and Industry in 1953 after graduating from the department of technology of Hokkaido University where he majored in mining. He served as director general of the Coal Mining Department of MITI's Natural Resources and Energy Agency before assuming his current post.



Ceremony in a Coal Field

An important ceremony took place on March 5, 1982, at Morwell in the western end of the Latrobe Valley, 150 kilometers east of Melbourne, Australia. The ceremony marked the beginning of a cooperative brown coal liquefaction project by Japan and Australia.

The extensive brown coal fields in this part of the Latrobe Valley are considered among the largest in the world. The purpose of the project is to develop coal liquefaction technology which will make it possible to derive gasoline and other fuel oils from brown coal. A pilot plant with

Coal Liquefaction within the Sunshine Project

The Sunshine project is a series of alternative energy technology development projects being carried out under the auspices of the Ministry of International Trade and Industry's Industrial Science and Technology Agency. Projects are focused on coal liquefaction and gasification, solar energy, geothermal energy, hydrogen energy, and wind energy.

There are four coal liquefaction projects: brown coal liquefaction, explained in the accompanying article, and three other projects.

Direct Hydro-liquefaction

This process involves liquefying coal in one step by ferrous-catalyst hydrogenation at temperatures of 400-500°C and pressures of 200-300kg/cm^2. The process is currently being applied at a Process Development Unit (PDU) built in Kawasaki in April 1982. The Kawasaki PDU treats 2.4 tons of coal per day under experimental operating conditions.

Solvent Extraction Liquefaction

Coal is processed into slurry with a solvent having a high hydrogen content and then liquefied at temperatures of 400-450°C and pressures of 100-150kg/cm^2. Study is also being given to the use of a ferrous catalyst. An experimental PDU in Kashima processes 1 ton of coal per day using this procedure.

Solvolysis Liquefaction

In this process, coal slurry is exposed to temperatures of 380-430°C and pressures of up to 50kg/cm^2 for a short time to dissolve the solution components. After this, ash is removed and a highly active catalyst is added for secondary hydrogenation, which liquefies the coal. Known as SCT-TSL, this process is currently being used by a PDU in Hiroshima to process 0.1 tons of coal per day.

All three of these coal liquefaction processes are designed to use various varieties of coal available all over the world. When experiments at the three PDUs are completed and their results studied, a large-scale pilot plant based on the most suitable process will be built with a 250-500 tons/day capacity.

the capacity to process 50 tons of brown coal per day is now under construction at Morwell.

The opening ceremony was held by Japan's New Energy Development Organization (NEDO). NEDO's chief director, Tsutomu Watamori, stressed that the project was a joint venture between Japan and Australia, and that the development of brown coal liquefaction technology would have great significance for both countries.

Among the many dignitaries at the opening ceremony were MITI Vice Minister for International Affairs, Shohei Kurihara; president of the Nihon Brown Coal Liquefaction Co. (NBCL), Kokichi Takahashi; Secretary of the Department for National Development and Energy, A.J. Woods; and chairman of the Victorian Brown Coal Council (VBCC), E. Falk. All of these men expressed the hope that the project would serve to strengthen the ties between Japan and Australia in the field of energy.

A Star in the Sunshine Project's Cluster

Today Japan is actively developing the technology for petroleum-alternative energy sources.

MITI's Agency of Industrial Science and Technology inaugurated the Sunshine project in April 1974 to develop the technologies for coal liquefaction and gasification, solar energy, geothermal energy, and hydrogen energy. All of the Sunshine projects are long-term, high-cost, and high-risk undertakings. Accordingly, they are being funded by the Japanese Government and carried out by NEDO, which was founded in October 1980.

One of the most important of the Sunshine projects, the brown coal liquefaction project has a budget for fiscal 1982 of approximately ¥12.3 billion or 30% of total funding for all Sunshine projects.

Coal liquefaction is a technology which converts solid coal into liquid fuel which is cleaner and easier to use. Because coal is one of the most plentiful resources in the world, and is more widely distributed than petroleum, coal liquefaction will provide a major source of petroleum-alternative liquid fuels. The United States, West Germany, and many other countries are currently working on similar coal liquefaction projects.

Yet coal liquefaction is especially important for Japan, a major energy consuming country and one which must depend upon imports for virtually all of its petroleum supplies. The Sunshine project includes four coal liquefaction projects studying various technologies for different types of coal. This brown coal liquefaction project, set up for the purpose of processing the brown coal deposits in Australia, is one of the most advanced of the projects.

Development of a "Sleeper" Natural Resource

Among the important factors in selecting a coal for liquefaction are its liquefaction properties, size of deposits, and availability.

By any criterion, Victorian brown coal is ideal for liquefaction. Brown coal has a low carbonization temperature and its high reactivity makes it burn spontaneously when dried. While these properties make brown coal largely unsaleable in world coal markets, the very same properties make it extremely good for liquefaction. Brown coal's high reactivity makes it easy to break down, and its low carbonization temperature simplifies its conversion into light oil. Victorian brown coal also has low ash and sulphur levels, which is another factor in its favor in liquefaction.

The Victorian brown coal fields are both extensive and easy to mine. Deposits are estimated at 120 billion tons of brown coal, with 35 billion tons immediately accessible for mining. While some of this brown coal is used for thermal power generation and made into briquettes, the rest is left idle, sleeping in the earth. With a thick layer of coal under a relatively thin layer of topsoil, conditions are ideal for strip mining.

The establishment of a brown coal liquefaction industry is seen as the key to developing this natural wealth into a major energy source.

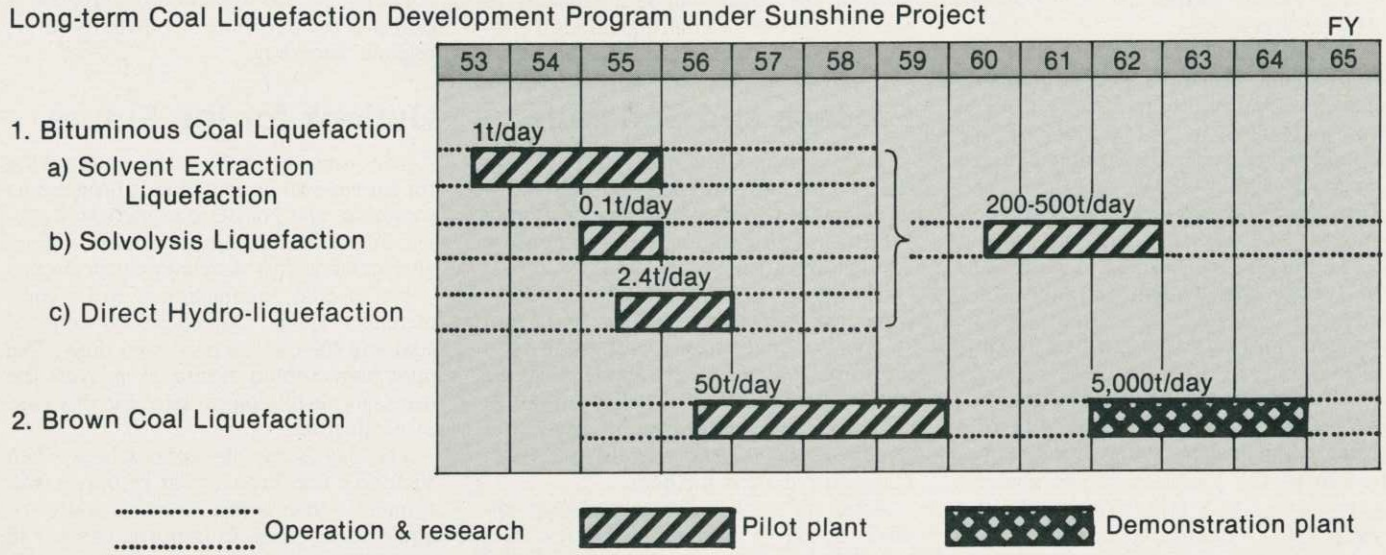
History of the Brown Coal Liquefaction Project

There is a long history of research behind the building of the brown coal liquefaction pilot plant in Australia. Its beginnings go back to 1962, when Nissho Iwai submitted a proposal to the government of Victoria for the use of brown coal resources for the commercial production of briquettes.

In 1972 KOMINIC (a joint venture among Kobe Steel, Mitsubishi Chemicals, and Nissho Iwai) proposed using the brown coal to make SRC. Accordingly, the Victoria Government supplied KOMINIC with brown coal samples for testing.

In the course of the SRC research at autoclave and small-scale bench plants, it

Long-term Coal Liquefaction Development Program under Sunshine Project



Coal Liquefaction Plans and the Long-Term Energy Supply-Demand Outlook

The long-term energy supply-demand outlook compiled by the Advisory Committee for Energy, an advisory organ to the Minister of International Trade and Industry, and disclosed on April 21 forecasts that the utilization of liquefied coal and other new energy sources will reach 1.5 million kiloliters in crude oil equivalent in fiscal 1990 (2.5% of Japan's total energy needs) and 6.5 million kiloliters in crude oil equivalent in fiscal 2000 (8% of total energy needs). The report also says that technical development in the 1990s will make possible full-scale utilization of new alternative energy sources to petroleum. As regards coal liquefaction, the report predicts that 1.4 million kiloliters of liquefied coal will be produced in fiscal 1990 and 20-25 million kiloliters in fiscal 2000. The report thus anticipates that coal liquefaction will advance at an accelerated pace in the 1990s.

Positioning of New Energy Sources in Long-Term Energy Supply-Demand Outlook

	FY 1980 (Actual)	FY 1990	FY 2000
Synthetic fuel oil, alternative energy, others of which	66	1,500	6,500
Liquefied oil	0	140	2000-2500
Solar energy	34	650	1500-2000
Oil sand, shale	0	350	1000-1500
Others (Charcoal, alcohol, biomass, etc.)	32	360	500-1500

10,000kl

found that SRC could be rehydrogenated in a two-stage hydrogenation process to produce liquid fuel.

This discovery soon drew the attention of the Japan-Australia Energy Research and Development Council. The Council was organized in recognition of the mutual benefits of cooperation between Japan, a major energy consumer, and Australia, a country rich in energy resources. The Council's first meeting, in Tokyo in 1978, was devoted to discussions on brown coal liquefaction and solar energy.

Later, the Council decided at its June 1980 meeting to run a feasibility study on the Victorian brown coal liquefaction project. A study was also conducted to find the most suitable technology for the liquefaction of the Victorian brown coal reserves, and NBCL (formerly KOMINIC) was selected to carry out the project.

At the November 1980 meeting of the Council, it was decided with the full support of the Australian Government, to include the brown coal liquefaction project as one of Japan's Sunshine projects.

Process and Schedule

The liquefaction process employed at the 50 tons/day pilot plant was chosen for its suitability for processing Victorian brown coal in light of its high moisture content and strong reactivity.

The first step in the process is to dehydrate the brown coal and turn it into slurry. Victorian brown coal has a 60% moisture content, such that finding the most effective means of dehydrating this coal was a major project in itself. Research is still underway to discover even better dehydration methods.

After the coal is dehydrated and solvents added to turn it into slurry, it is liquefied and hydrogenated in a primary hydrogenation process.

The primary hydrogenation process, using a ferrous catalyst at temperatures of 430-460°C and pressures of 150-250 kg/cm^2, is one of the most important parts of the whole liquefaction procedure.

In the next step, gas is removed from the hydrogenated liquid. The solution is then broken down into SRC, naphtha, and solvents. The solvents are recycled for repeated use.

Ash residue and the ferrous catalyst used in the primary hydrogenation process are then removed from the SRC to prepare it for secondary hydrogenation.

In the secondary hydrogenation process, a highly active catalyst is used at temperatures of 380-450°C and pressures of 100-250kg/cm^2 to dissolve the SRC, rehydrogenate the solution, and convert it into light oil.

The 50 tons/day pilot plant is being built in two stages. The facilities required for the primary hydrogenation process are being constructed first, and they are expected to be completed by 1983. Experimental primary hydrogenation will be carried out while the second-stage construction is done for the secondary hydrogenation process. The plant is expected to be in full operation by 1985.

Funded by the Japanese Government and administered by NEDO, the pilot plant is being built and operated by NBCL. NBCL has the same membership as its predecessor, KOMINIC, with the addition of the Idemitsu Oil Co. and Asia Sekiyu.

The Australia Federal Government is cooperating in the project in a variety of ways, including facilitating the import of the necessary equipment and entry visas for technicians. The Victoria State Government and the Victorian Brown Coal Council are supplying the brown coal, land, electricity, and water facilities for the project. The involvement of local construction companies and technicians in the construction and operation of the plant is expected to contribute significantly to the regional economy.

Outlook for the Future

The joint Japan-Australia undertaking for brown coal liquefaction is progressing smoothly, and NEDO considers this project one of the most important of its many alternative energy development projects.

Yet, if coal liquefaction is to be commercially viable, 20,000-30,000 tons of coal will have to be processed daily. The pilot plant should eventually provide the necessary technological base for this kind of production.

The day is rapidly approaching when Victoria's idle brown coal resources will come into their own as a major source of liquid fuel and as an important factor in the global economy. ●

Brown coal fields at Morwell in the western end of the Latrobe Valley, 150km east of Melbourne, Australia

What the BCLV Pilot Plant Means to Victoria and Australia

The BCLV Pilot Plant, which is expected to be operative by 1984, is being constructed on Victorian Brown Coal Council land at Morwell in the Latrobe Valley at a cost of approximately $110 million.

Thus immediate direct benefits will occur through employment and the multiplied effect on the regional and State economies of construction and operation of the Pilot Plant and indirect benefits through the acquisition of specialist skills and knowledge by Australians working in both phases.

This Pilot Plant is also valuable for the excellent opportunity it offers to check occupational health and safety aspects related to coal developments.

The potential is enormous; the opportunity exists in the long term to significantly supplement known oil reserves to meet future needs for liquid fuels and in the short term to strengthen the Victorian and Australian economies through a diversification of our industrial base.

E. Eugene Falk
Chairman,
Victorian Brown Coal Council

Victorian Brown Coal Liquefaction Project

This is a very significant project which is important not only to Japan, but also to Australia and it will continue to receive the full support of the Australian Government.

Sir John Leslie Carrick
Minister for National Development and Energy