



Energy, Mines and
Resources Canada

Énergie, Mines et
Ressources Canada

CANMET

Canada Centre
for Mineral
and Energy
Technology

Centre canadien
de la technologie
des minéraux
et de l'énergie

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CANMET 1978/79 PERFORMANCE PROJECTION

by

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CANMET ENERGY RESEARCH PROGRAM

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CANMET 1978/79 PERFORMANCE PROJECTION

3.0 ENERGY PROGRAM

Resource Summary

3.0	Energy Program	\$15,154,000	MY 331
.1	Sources: Supply, Demand	\$1,185,700	MY 39
.3	Technology Development	\$13,968,300	MY 292



CPUB

INTRODUCTION

The CANMET Energy Research Program contributes to the Departmental Energy Program through the following two Activities: 3.1 Energy Sources; Supply, Demand and Substitution (\$1185.7K, 39 man years including 2 unfunded) and 3.3. Energy Research and Technology Development (\$13968.3K, 292 man years, including 9 unfunded).

This report gives the major operational program goals by Sub-Activity as agreed between the Energy Research Program Office and the operating Divisions at the beginning of fiscal year 1978/79. The anticipated outputs listed will be in the form of a report, or set of reports, unless otherwise stated.

3.1 SOURCES: DEMAND, SUPPLY AND SUBSTITUTION

3.1.1 Oil and Gas

RESOURCES: \$200,800	Man years: 8
(Contracts: \$50,000)	Unfunded: 1

MAJOR OPERATIONAL GOALS:

3.1.1.1 RESOURCE, RESERVE AND PRODUCT ASSESSMENT

GOAL: To provide basic descriptions of the chemical and physical properties of oil-sand bitumens, heavy-oils and black oil conversion products for use in new process design. A major problem preventing development of more efficient heavy oil processing plants is the high rate of catalyst fouling in conventional refinery processes.

OUTPUTS:

- a) Essential analyses to outside agencies - approximately 3000 determinations (Mine gases - Nfld., Que.; Crudes and gases - Ont.; fuel oils - N.B.; DPW; hospitals; others - NRC, DND).
- b) Descriptions of sulphur, nitrogen and hydrocarbon types in products from bitumen and heavy-oil hydrocracking. (3 reports)
(\$50K)
- c) Descriptions of methods for analysis of liquefied coal products. (1 report)

Time Frame: Continuing, long term support service requirement.

3.1.2 Coal and Peat

RESOURCES: \$446.1	Man years: 10
(Contracts: - \$220K)	Unfunded: 1

MAJOR OPERATIONAL GOALS:

3.1.2.1 RESOURCE AND RESERVE ASSESSMENT

GOALS: 1. Assessment of Coal Quality - to determine the quality of Canadian coal (and peat) resources and reserves, on an annual and demand basis, for the National Coal Inventory and for commercial and provincial inventories so as to stimulate regional resource developments and increase reliance on indigenous coals for domestic use and export. Of necessity, this involves the development of improved and specialized chemical and analytical methods and the development of test and quality standards consistent with Canadian interests.

CANMET, historically, is the only source and generator of national coal quality data. The newly perceived EMR priority on development of a National Coal Inventory means that this role is more important than ever.

2. Economically Mineable Coal Reserves - to develop the necessary methodologies and capabilities to model mining systems; and, then to determine the economically recoverable reserves in selected areas of Canada in support of the National Coal Inventory and exploitation of indigenous resources.

Geological reserves must be further qualified as to economic mineability and recoverability.

OUTPUTS:

1. Assessment of coal samples from the Federal-Nova Scotia inventory programs.
- (\$50K) 2. Volume I, Methodology of the Federal-Saskatchewan coal quality program (contract).
3. Assessment of the quality of coal samples from producing mines and from federal field programs.
4. Development of analytical methods and standards for undesirable trace elements in coal.
- (\$20K) 5. Correlation of geophysical logs with Saskatchewan coal quality data to permit inference of coal quality from geophysical logs (contract).
- (\$50K) 6. Canadianization of the ERDA surface mining simulation models (contract).
7. Application of mine simulator models to Saskatchewan and perhaps Nova Scotia.
8. Study of reserve assessment in the coal industry, inventory models and a contribution of quality and mineability data to the National Coal Inventory.
- (\$100K) 9. First principles engineering design of a 50 MW thermal plant fueled with peat. This is Phase III of a serious contract evaluation of the potential of peat for power. Results to date are very encouraging.

Time Frame: Annual and near-term to 1983.

3.1.3 Radioactive Minerals

RESOURCES: \$177,800 Man years: 7
 (Contracts: -) Unfunded: -

MAJOR OPERATIONAL GOALS:

3.1.3.1 RESOURCE AND RESERVE ASSESSMENT

GOAL: To determine on a continuing basis and to report annually on the economically recoverable uranium ore reserves in Canada, the productive capacity of the Canadian uranium industry; and the technical feasibility of bringing known ore bodies into production.

The assessments are reported to the Uranium Resource Appraisal Group (URAG) as a basis for a rational uranium policy. Of necessity, the work involves the development of computerized assessment methodologies.

OUTPUTS:

1. Annual assessment of uranium reserves and resources in the major deposits of Canada.
2. Validation of reserves for new deposits, necessary to the acquisition of production permits.
3. Annual assessment of the productive capacity of uranium mines and upgrading facilities.
4. Development of geostatistical modelling and computer software for assessment of resources and reserves.

Time Frame: Annual and short term to 1983.

3.1.6 Support Services

RESOURCES: \$184,000 Man years: 12
 (Contracts: -) Unfunded: -

3.3 TECHNOLOGY DEVELOPMENT

3.3.2 Conservation Technology

RESOURCES: \$2,150,000 Man years: 30
 (Contracts: \$1,300,000) Unfunded: 2

MAJOR OPERATIONAL GOALS:

3.3.2.1 CONVENTIONAL FUEL COMBUSTION

GOAL: Development of new or improved techniques for utilizing known fuels or substitutes for oil and gas with minimal environmental impact.

The projected supplies of domestic oil and gas and oil imports necessitate an increasing requirement for substitution of other fuels for oil and gas with minimum penalties in combustion efficiency and for conservation of oil and gas by developing methods for increasing combustion efficiencies.

OUTPUTS:

1. Use of coals to replace oil and natural gas fuels in cement and lime kilns and other industrial processes: characterization of ignition and combustion performance of a fine coal reject as a substitute for No. 2 heating oil and a study of combustion and emission characteristics of GCOS by-product coke.
2. Installation of a pilot-scale research boiler for low-grade coal utilization studies. Study of ignition and combustion characteristics of a low-grade coal for central electricity generation.
3. Continuing study of fuel economy and pollutant emissions of new model automobiles and trucks for service in Canada, specifically with respect to the influence of climatic variations, fuel combustion technology innovations, and the efficacy of a "lead trap" in minimizing lead emissions.
(\$60K)
4. Improved combustion efficiency of oil and gas space heating by development of conservation strategy for residential space heating (2 reports); 2 evaluations of operating efficiencies and cycle performance of new and retrofit equipment; monitoring of 2 contracts for construction of prototype low BTU and dual rate oil burners; and continuing evaluation of effect on combustion efficiency of fuel oil additives (3 reports).
(\$130K)
5. Characterization of coal and coal blend combustion product emissions (2 reports) and evaluation of plume dispersion data with subsequent technology transfer.

Time Frame: continuation to March, 1983.

3.3.2.2 DEVELOPING ENERGY TECHNOLOGY

GOAL: To optimize the utilization of reserves of available fuels, one requirement is the development of new or advanced technology directed towards the increase in both fuel efficiency and capability of burning substances available in Canada but not presently used as fuels.

In response to the requirement for substitution of other fuels for oil and gas, and in recognition of the reduced environmental emission characteristics of fluid-bed coal combustors, a significant effort is indicated in this direction towards the goal of a demonstration plant, which was listed as one requirement following the Federal-Provincial Conference of First Ministers (Ottawa, Feb. 13-15, 1978).

OUTPUTS:

- ((\$1000K)
1. Completion of two conceptual design studies and placing of orders for detailed design of the demonstration boiler and heating plant for the atmospheric fluid-bed heating plant at Summerside, P.E.I.
 2. Completion of combustion trials of 5 Canadian coals of varying sulphur levels and initiation of a program to study sulphur neutralization of high-sulphur Maritime coals in the pilot scale fluid bed.
 3. Design of a larger, more flexible pilot-scale fluid-bed combustor.
 4. Optimization of fluid-bed combustion using differential temperature and ratio pressure probes to control agglomeration and segregation of coal and coal ash.
 5. Provision of technical expertise and funding for joint projects aimed at conserving energy by improving cycle efficiency by co-generation.

Time Frame: Goal re-evaluation July, 1982.

3.3.2.3 ENERGY RECOVERY

GOAL: To develop and implement existing and new technology for waste heat recovery from garbage disposal units, thermal power stations and various industrial processes.

Waste heat recovery measures can contribute significantly towards energy conservation by increasing overall energy efficiencies of power stations and industrial plants and by provision of source energy for district heating systems.

OUTPUTS:

- ((\$25K)
- ((\$40K)
1. A feasibility study of waste heat recovery of exhaust steam from a thermomechanical pulping mill by vapour recompression.
 2. A conceptual design study of the upgrading of low temperature waste water by heat pumps for district heating systems.

Time Frame: Ongoing.

3.3.2.4 ENERGY STORAGE

GOAL: To contribute to the development of technology for energy storage in association with other national agencies.

Advances in technology of energy storage are required for the implementation of solar and wind power generation systems for residential and remote applications.

OUTPUTS:

- ((\$30K)
1. Development of a fused-salt heat storage cell for residential application.
 2. Development of technology, in cooperation with NRC, for flywheel energy storage compatible with wind power generation.

Time Frame: Goal re-evaluation March 1979.

3.3.3 Oil and Gas

RESOURCES: \$2,230,000
(Contracts: \$1,037,000)

Man years: 53½
Unfunded: -

MAJOR OPERATIONAL GOALS:

3.3.3.1 OIL SANDS MINING

GOAL: To monitor current developments with respect to oil sands exploitation and to identify research, which should be supported to optimize exploitation of the oil sands by the application of surface and underground mining technology, consistent with efforts of AOSTRA, private industry and PetroCanada.

The unique properties of the oil sands deposits justifies study of the applicability of their recovery by underground mining technology. CANMET's expertise in mining can play a vital role.

OUTPUTS:

1. An assessment of bucket bed and dragline mining methods for oil sands extraction, with recommendations.
- (\$20K) 2. A field study, assisted by contract, to determine the zone of deconsolidation of oil sand caused by the Saline Creek diversion tunnel.
- (\$30K) 3. A contracted study of the geotechnical and mining characteristics of Waterways limestone underlying the Athabasca oil sands.
- (\$45K) 4. Development of a non-linear finite element model of the engineering behaviour of oil sands and application to a case study of an underground mining system (contract).
- (\$10K) 5. Field tests of hydraulic cutting of oil sands to corroborate laboratory studies by AOSTRA and to provide slurry samples for characterization (contract).
6. Characterization of oil sand slurries as a precursor for studies of hydraulic mining of oil sands. The work is to be shared by CANMET and Alberta Research Council at Clover Bar, Edmonton.

Time Frame: Annual and medium term to 1985.

3.3.3.2 OIL-SAND SEPARATION

GOAL: To aid in developing alternative commercial methods of separating oil sands and oil-sand-water emulsions.

Major problems with the present commercial hot water separation are the volumes of water needing heat and storage, the long settling times for entrained colloidal clays, and the amount of mechanical energy required in milling.

Major problems are expected with oil-sand-water emulsion breaking for "In Situ" produced bitumen.

OUTPUTS:

1. Data from final cold-water separation tests by Magna International on their pilot plant. (Report)
- (\$200K) 2. Preliminary design study and cost for scale-up of the Magna process to 30 tons/hr. (Report)
3. Preliminary techno-economic study describing the integration of the Magna Process into a "Syncrude" or "GCOS" type of operation. (Report)
- (\$92K) 4. Descriptions of the physical and chemical properties governing the uses of mechanical energy, solvent extraction and solvent recovery in oil-sand separation (3 reports).
- (\$100K) 5. Descriptions of methods for production and testing of bio-surfactants (1 report).

Time Frame: Re-evaluation of industrial needs by April 1980.

3.3.3.3 REFINING OF BITUMEN AND HEAVY-OIL

GOAL: To develop a commercially viable process, with specified operating parameters, for the conversion to lower boiling liquids of tars, pitches and high-boiling bitumenous substances.

One of the major problems confronting GCOS, Petrocan and others in choosing future plant design processes is the lack of commercially proven technology for processing bitumen and heavy oils by hydrocracking. High pressure and temperature regimes, as well as high catalyst consumption are deterrents in the current commercial processes.

OUTPUTS:

- (\$100K) 1. To complete 3 test runs and process descriptions for licensing of EMR/CANMET hydrocracking technology to Hydrocarbon Research Inc. and, potentially, Lummus Engineering (16 Patent Applications, 3 Reports).
2. Descriptions of optimum process conditions for hydrocracking PetroCanada's types of feedstocks using one special EMR catalyst under high conversion conditions (+80%). (3 Reports)
3. Preliminary descriptions of the suitability of cheap, "natural" catalysts for bitumen processing.

Time Frame: On-going to 1990.

3.3.3.4 BITUMEN CATALYST DEVELOPMENT

GOAL: To develop hydrocracking catalysts which will have longer reactor life and be of lower net cost per bbl of product.

A major problem with the 3 commercial processes proposed for refining bitumens and heavy oils is the short catalyst life and relatively

high catalyst cost per barrel of product. The short in reactor life of catalyst is caused by external deposits of "coke" and metal poisons.

OUTPUTS:

1. A study to determine the best method for removal of asphaltenes (coke precursors) from bitumen (1 Report).
2. Completion and run-in tests of catalyst-life testing units (1 Report on initial catalysts).
3. Descriptions of methods to improve catalyst life by the control of pore size and the use of coke-suppressing additives (2 Reports).
4. Identification of the main problems associated with the use of REDOX catalysts for pitch gasification.

(\$50K)

Time Frame: On-going to 1988.

3.3.3.5 TRANSFER OF HYDROCRACKING TECHNOLOGY

GOAL: To provide to industry the information necessary for evaluation of EMR/CANMET Hydrocracking as a commercial process.

During 1977/78, three separate and independent evaluations of bitumen processing options indicated that hydrocracking now has economic advantages over 'coking' routes. The EMR/CANMET process is one very attractive option. However, industry needs additional information to do a complete process integration and product-slate study.

OUTPUTS:

1. A comparative economic study of integrated, full-scale processing of oil-sands bitumen via hydrocracking and coking options with coal make-up energy (Final Report).
2. Study of optimum H₂ generation for hydrocracking (1 Report).
3. Studies of thermal conductivities and gas solubilities of bitumens (2 Reports).
4. Evaluation of the commercial 'H-Oil' process proposed by HRI to GCOS (Reports, analyses, samples).
5. Descriptions of probable product slates resulting from hydrocracking bitumen.

(\$50K)

(\$25K)

(\$12K)

(\$300K)

(\$15K)

Time Frame: Peak expected by 1982; continuing for term of licences.

3.3.3.6 MATERIALS FOR OIL AND GAS PROCESSING

GOAL: To develop materials technology in response to critical materials problems identified for significant future Canadian oil and gas processing projects.

The requirement for processing of heavy oils and tar sands to supplement domestic oil supplies is bringing and will continue to bring associated materials problems. CANMET, with its expertise in materials research, can play an important role towards fulfilment of this national strategy.

OUTPUTS:

1. Review of the materials requirements for construction and operation of hydrocracking pressure vessels.
2. Recommendation, by March 1979, for materials research on critical materials problems associated with future processes for upgrading tar sands and heavy oils.

Time Frame: Goal re-evaluation March 1982.

3.3.4 Coal and Peat

RESOURCES: \$4,600,000	Man years: 92
(Contracts: \$2,205,000)	Unfunded: 7

MAJOR OPERATIONAL GOALS:

3.3.4.1 COAL MINING

GOALS: 1. Ground Control - to develop a rationale for monitoring and controlling the stability of underground coal mines in Canada; and to improve productivity, recovery and safety of current and new mines despite difficult geological environments.

Every Canadian underground coal mine is wasting reserves and mining both inefficiently and dangerously because of inadequate strata, pillar, roof and subsidence control.

2. Underground Environment - to determine the factors creating spontaneous combustion, fire and explosion hazards in underground coal mines and, to develop methods of monitoring and control so as to ensure acceptable working environments; and to transfer the technology to industry.

The onus is on EMR to conduct R, D & D to avert mortalities and mine closures due to CH₄/CO/coal dust fires and explosion. The situation is critical in some mines. However, mine operators are concerned with operations and have almost no R & D experience or capabilities.

3. Equipment Safety & Cost Recovery - to establish, on a continuing basis, better means of ensuring safety-rated equipment and its certification for use in underground coal mines.

EMR is responsible for certification of all equipment and materials used in Canadian coal mines at the request of the Provincial Inspectorates and must therefore conduct R & D to develop facilities and expertise for certification and development of adequate standards.

OUTPUTS:

1. Systems/Demonstration - to push the exploitation of Canadian coal resources by evaluating, developing, adapting and demonstrating on a shared contract basis where possible, advanced mining systems, technology and equipment which will increase productivity, lower costs of production and increase coal recovery from reserves.

The Canadian coal industry is being challenged to mine high-quality coal deposits economically and safely in difficult geological settings. It lacks expertise and leadership so that risk sharing with technical support by EMR can serve as the needed stimulus to technology transfer via demonstration projects and direct R & D at the production face.

2. Determination of surface subsidence, underground caving patterns, deformation of mine workings and support loads to develop a data base so that extraction panels and mine pillars may be dimensioned for safe operation and high extraction rates in the hydraulic mining of thick seams in mountain regions. The study site is No. 5 Panel of Kaiser's mine at Sparwood, B.C.

(\$30K) 3. Phase I of the development of a numerical model for prediction of ground movements and support loads accompanying high speed panel extraction of coal (contract).

4. Determination of interseam ground movement and stress interactions. The study site is at McIntyre Grande Cache mines where mining in #4 Seam has caused serious problems in #11 seam, which is 400 ft above; and, where the intermediate #10 seam is being readied for mining!

(\$80K) 5. Contract to develop a subsidence measurement and telemetry monitoring system for use over coal mines in mountain regions.

(\$30K) 6. Evaluation of geophysical methods which are or may be applicable to coal (contract).

7. Monitoring of carbon monoxide to allow control of mine fires at Kaisers hydraulic mine; studies of methane emission problems at Kaiser, Canmore and Devco; and characterization of Canadian coals for susceptibility to CH₄/coal dust explosion.

(\$50K) 8. Phase I of a cost/sharing demonstration of methane drainage to allow high production mining in very gassy coal. The study site is the Riverside Mine, Canmore.

(\$15K) 9. Contract for identification of fire hazards associated with use of diesels in methane atmospheres.

10. Research on ignition sensitivity of electrical equipment and instrumentation in coal mines.

11. Research to improve the flameproofness and efficiency of diesel engines to make them more acceptable in coal mines.

12. Development of standards and cost recovery certification of equipment and materials for use in coal mines.

(\$140K) 13. Shared cost demonstration of high speed driving of sub-level headings in coal. The site is provided by Kaiser Resources (contract).

(\$50K) 14. Shared cost engineering feasibility study on equipment and support systems applicable to longwall/shortwall mining of coal in mountains. The site will be Kaiser's Baldy Ridge at Sparwood where a two million ton/year mine is being planned.

(\$30K) 15. Evaluation of sources of rock and systems for backfill to control ground movements in mountain coal mines where massive intermittent caving in thick seams and interseam reactions can be catastrophic.

(\$15K) 16. Phase I of an R & D contract to develop a longwall lighting system for Devco which will later be used to demonstrate that proper lighting increases productivity.

Time Frame: On-going with re-evaluation annually.

3.3.4.2 BENEFICIATION

GOAL: To develop technically improved and environmentally more acceptable coal beneficiation processes for the coal industry specifically adapted to up-grading Canadian coals for metallurgical, thermal and coal conversion markets with minimum waste.

CANMET provides the necessary leadership in R & D and technology transfer. None of the Canadian coal companies conduct coal beneficiation R & D despite the special character of many Canadian coals e.g. high-ash friable mountain coals, high inherent moisture/ash/alkali Prairie coals and the high sulphur Cape Breton coals. The western coals in particular are not 'typical' for conventional processing and pose special problems for the local environments.

OUTPUTS:

(\$50K) 1. Processing of coals having high contents of fine coals and clays will be facilitated by a contract to study fundamentals of the fluidized automedium cyclone bed.

(\$50K) 2. Liberation of thermal coals from fine rejects will be studied by contract.

(\$40K, solids \$70K, effluents) 3. As a basis for development of processes, contractors will analyse solid products and effluents from Canadian coal washeries.

(\$80K) 4. For the treatment of effluents commercially available flocculants will be characterized by contract.

(\$30K) 5. A data acquisition and processing unit will be developed for automated monitoring of flocculated solids from effluents.

6. A mobile water treatment plant for field demonstration processing of coal washery effluents will be assembled.

7. Annual reports on automation and development of pilot facilities, pilot plant testing of problem coals, (including Hat Creek), flotation research, flocculation research, characterization of mineral matter in coals, inventory of coal washability data and development of a dry beneficiation process using high-gradient magnetic separation.

(DSS: 10K,
Beeckmans
100K Incullet)

8. Unsolicited proposal research to develop novel dry beneficiation processes using fluidized beds and electrostatic separation.

Time Frame: Annual and short term to 1983.

3.3.4.3 CARBONIZATION

GOALS: To provide assistance to the Canadian Coal and Steel industries by: i) determining the coke-making properties of new coals; ii) determining the chemical and physical properties of new coals; iii) improving the efficiency of coke-making and developing new coke-making technology; and iv) contributing carbonization data to the National Coal Inventory.

For the export market (Japan and Europe), unbiased assessments of the coking propensities of Canadian coals are required. Such assessments are also required to achieve self-sufficiency by the use of more indigenous coals in coke-oven blends in the domestic steel industry. New coking methods will allow the use of non-coking coals in coke-making. These goals are supported (cost-shared) through the Government-Industry Canadian Carbonization Research Association.

OUTPUTS:

1. Descriptions for the steel industry of the conventional coke-making properties of coals from 10 seams.

(\$25K) 2. Elaboration of the mechanism of coke formation (4 reports, 1 patent).

3. Continued contribution to the inventory of the quality of Canadian coking coals (2 reports).

4. Impact of new coking technologies (partial briquetting, selective pulverization and preheating on Canadian coking coal self-sufficiency (1 Report).

Time Frame: Annual and medium term to 1990.

3.3.4.4 GASIFICATION

GOAL: To construct, test and operate a gasification reactor in order to determine the gasification characteristics of Hat Creek (B.C.) and Shaunovon (Sask.) coals for production of low-to-medium BTU gas.

Major problems associated with the substitution and use of coal gasification products in Canadian industry are assessments of the reactivities, product qualities, material balances and energy balances of specific processes applied to specific Canadian goals.

OUTPUTS:

1. A preliminary report on the gasification properties of Hat Creek and Shaunovon coals.

Time Frame: Near-term coal-to-electricity. Long term with review bi-annually.

3.3.4.5 LIQUEFACTION

GOAL: To construct, test and operate a coal liquefaction unit for the determination of the liquefaction characteristics of coal/bitumen slurries.

Major problems in the economics of coal liquefaction are the supply and recovery of an effective solvent, the solubility of specific coals, and the filtering of undissolved solids.

OUTPUT:

(\$50K) 1. A preliminary report on the liquefaction characteristics of one Canadian coal.

Time Frame: Medium and long term to 2000.

3.3.4.6 COAL CONVERSION/TECHNO-ECONOMIC STUDIES (50/50 Contract Funding)

GOAL: To stimulate and aide industrial and utility companies in the evaluation of various coal conversion processes as alternative sources of fuels and feedstocks and their inclusion in integrated power plants.

A major problem is the lack of a broad industrial infrastructure, and a base of knowledge and experience for the assessment of coal conversion technology under explicit Canadian constraints. Incentive is necessary for the implementation of advanced coal-to-electricity processes by Canadian electrical utility companies.

OUTPUTS:

(\$780K) 1. A series of up to 8 reports on various aspects of coal drying, combustion and liquefaction processes.

Contractors: Saskatchewan Power New Brunswick Power and Light
 Manalta Coal Nova Scotia Research
 B.C. Research STELCO
 Union Carbide Ontario Research Foundation

Time Frame: Near term; review annually.

3.3.4.7 COAL CONVERSION R AND D CONTRACTS (100% Funding)

GOAL: To aide in the development of R and D facilities and expertise in Canadian industrial, utility and research agencies, and to broaden the currently narrow in-house R and D data bases, expertise and process evaluation capabilities.

As coal conversion becomes more important in the Canadian economy it will be essential to have available a trained pool of engineering and technical-support human resources. Reliable Canadian commercial major-project design studies can only be obtained from sound Canadian data and experience bases.

OUTPUTS:

(\\$405K) 1. A series of up to 8 reports describing problems and solutions for a range of equipment, design, process and properties studies.

Time Frame: Near to medium term. Annual review.

3.3.4.7 MATERIALS FOR COAL PROCESSING

GOAL: To develop Canadian technology, both through contract and in-house research, on materials for construction of coal processing and conversion plants.

Whilst a considerable research thrust has been directed in the United States towards the study of materials for coal conversion, there is little expertise of this type presently available in Canada. In view of projected coal utilization strategies, Canada must develop its own expertise in anticipation of the particular material-environment problems indicated by its specific coal strategies.

OUTPUTS:

Contract
\$75K

1. Recommendations for the most suitable materials to be specified for boiler tubes in the atmospheric fluid bed heating plant at Summerside, P.E.I.

Time Frame: Goal re-evaluation March 1984.

3.3.5 Nuclear Energy

RESOURCES: \$424,000
(Contracts: \$50,000)

Man years: 16½
Unfunded: -

MAJOR OPERATIONAL GOALS:

3.3.5.1 URANIUM EXTRACTION

GOALS: To improve conventional extraction technology and to develop new technology for recoveries from low-grade ores.

Present uranium extraction processes suffer from losses of economy in operating costs, losses of values in unappreciated metals important to the electronics industry, waste-water treatment, and environmental protection.

OUTPUTS:

1. A comparative cost study for sulphuric acid leaching of low and (\$30K) high grade ores (1 Report).
2. Ranking of a series of ion-exchange resins for concentrating thorium and other metals (1 Report).
3. Development of expertise in processing complex ores by pressurized leaching (1 Report).

Time Frame: Near term. Assessments by April 1980.

3.3.5.3 MATERIALS FOR HEAVY WATER PLANTS

GOAL: In support of the AECB, to formulate an opinion concerning the resistance of heavy water pressure vessels to in-situ flow initiation and growth and subsequent failure under specific, proposed operating conditions.

As an integral part of the nuclear industry, and because of the catastrophic implications of fracture in the pressure envelope, heavy water plants must guarantee high reliability. CANMET, in its unique role as an impartial body with expertise in environmental degradation of materials, can contribute significantly to this requirement.

OUTPUTS:

1. Regulatory and operator acceptance of proposed use of a laboratory atmospheric test environment to simulate pressurized H₂S pressure vessel environment.
2. Assembly and operation of an advanced hydrogen-in-steel analysis apparatus.
3. Determination of the effects of temperature and hydrogen delaminations on the degree of embrittlement of the pressure vessel steel by the process environment.

Time Frame: Goal re-evaluation March 1980.

3.3.5.9 COST RECOVERY WORK-FEDERAL

GOAL: Provision of metallurgical consultation and technical support to AECB concerning plant safety. CANMET's role as a neutral body with extensive materials expertise make it uniquely suited to this requirement.

OUTPUTS: Not applicable.

Time Frame: Ongoing.

3.3.6 Electricity

RESOURCES: \$10,000
(Contracts: \$50,000)

Man years: $\frac{1}{2}$
Unfunded: -

MAJOR OPERATIONAL GOALS:

3.3.6.1 HYDROGEN PRODUCTION

GOAL: To assess the application of molybdenum and tungsten sulfides as electrodes in photo-chemically assisted electrolysis of water to hydrogen and oxygen. Utilization of solar energy to produce a photo-chemical current in the electrodes, and thus reduce the net "electric" power consumption, may improve the economics of hydrogen production.

OUTPUTS:

- (\$50K)
1. Complete, operational testing apparatus.
 2. Fabricated samples of electrodes.

Time Frame: initiated Jan. 1978 - completion and reassessment in March 1980.

3.3.7 Renewable Resources

RESOURCES: \$329,000
(Contracts: \$200,000)

Man years: 5
Unfunded: -

MAJOR OPERATIONAL GOALS:

3.3.7.1 BIOMASS CONVERSION

GOAL: To evaluate several prototype wood-waste conversion processes and to determine the mass balance for the wood-to-alcohol route.

Two independent B.C. wood-waste conversion processes have been developed and these need to be proven or evaluated for scale-up. As well, no comprehensive wood-gasification to methanol mass balance is available for process evaluation.

OUTPUTS:

- (\$100K)
1. A critical evaluation of the "Westwood-Polygas" wood-waste gasifier process. (1 Report)
 2. A preliminary study of the scale-up feasibility of the B.C. Research wood-waste gasifier. (1 Report)
 3. Mass balances for wood to methanol conversion. (1 Report)

Time Frame: Immediate to near term. Annual review.

3.3.7.2 WOOD COMBUSTION TECHNOLOGY

GOAL: To contribute to the technology of renewable resource exploitation and utilization in cooperation with other national agencies.

Technology transfer is required to increase Canadian manufacture of efficient wood stoves.

OUTPUTS:

1. Determination of extent of creosote formation and establishment of a method to quantify wood stove efficiency.
2. Provision of expertise and supporting experimental work for a Federal/Provincial project at Kemptville, Ontario, involving fluid-bed combustion of wood from poplar plantations.

Time Frame: Goal re-evaluation March 1983.

3.3.8 ENERGY TRANSPORTATION

RESOURCES: \$673,000	Man years: 23
(Contracts: \$150,000)	Unfunded: -

MAJOR OPERATIONAL GOALS:

3.3.8.1 COAL SLURRY TECHNOLOGY

GOAL: Supply of scientific and engineering support for analysis of the problems of transporting coal in the form of slurries in oil and water.

Techno-economic studies have indicated certain advantages in coal slurry transportation. If there are no insurmountable technical problems revealed in development of this technology, coal slurry transportation must be considered in overall energy transportation policies.

OUTPUTS:

1. Successful separation of coal-oil slurries to minimize residual oil on coal.
2. Determination of the effects of residual oil on the coking properties of metallurgical coal.

Time Frame: Goal re-evaluation March 1979.

3.3.8.2 LIQUID NATURAL GAS TRANSPORTATION

GOAL: To determine scientific and engineering data required to analyse the problems of transporting gas in the liquefied form by pipeline. Conceptual design studies have indicated potential advantages of internally

insulated LNG pipelines over conventional gas pipelines for short to intermediate distance transmission. Potential benefits warrant further development of this technology.

OUTPUTS:

(\$50K)

1. Investigation of specific engineering and scientific problems associated with internally insulated transmission of liquefied natural gas.

Time Frame: Goal re-evaluation March 1980.

3.3.8.3 MATERIALS FOR NATURAL GAS AND OIL TRANSMISSION

GOAL: To evaluate by December 1981, the mechanical and metallurgical properties of candidate line-pipe materials for large gas lines in the North and to respond to demands for advances in technology for the purpose of increasing reliability of materials for oil transmission.

The Dempster link to the Alaska Highway pipeline system and the recent N.E.B. decision favouring 56" diam. pipe for transmission has greatly increased the importance of CANMET's materials research contribution to this major engineering undertaking. The scope of coordinated expertise in line-pipe steels available within CANMET is not only unique in its ability to assess candidate line pipe but also in its capability to respond to technological problems encountered during the construction phase. This research effort, to date, has received international recognition for its contribution to the technology of materials testing of line-pipe steels, by necessity an integral part of the program.

OUTPUTS:

1. Determination of residual stress distribution across weldments in candidate line-pipe steels will be completed, microstructural variations in weld HAZ's will be evaluated for 2 Canadian produced line-pipes, and the effects of thermal cycling and submerged-arc welding on mechanical properties of candidate line-pipe steels will be analyzed.

2. Investigation of the effects of aqueous environments on fatigue crack propagation rates on candidate pipe materials.

3. Familiarization and initiation of studies to investigate strain amplification and rate of displacement occurring during "pop out" of dents, representative of typical mechanical damage.

4. Characterization and evaluation of the uniformity of the chemical, microstructural and mechanical properties of Canadian produced candidate line pipe steels.

5. Evaluation of current specification tests for line-pipe steel toughness by comparison with results obtained for Canadian produced line-pipe steels using a newly developed large scale instrumental drop-weight test.

6. Determination of the susceptibility to failure by sulphide stress cracking and stress corrosion cracking for 2 Canadian produced line-pipe steels.

7. Completion of preliminary familiarization investigations into corrosion of crude oil transmission pipelines by bacteria.

(\$25K) 8. Determination of the effects of micro-alloying elements in high strength low alloy steel on recrystallization kinetics as related to hot working of line-pipe steels.

(\$40K) 9. Determination of line-pipe steel toughness by instrumented dynamic toughness testing.

Time Frame: Goal re-evaluation Dec. 1981

3.3.9 Support Services

RESOURCES: \$1,705,000

Contracts: -

Man years: 62½

Unfunded: -

