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ECONOMIC IMPACTS OF THE REGULATION OF WASTE HEAT DISCHARGES TO THE GREAT LAKES

Prepared for

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March 1974

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I INTRODUCTION

This study was commissioned by the Canada Centre for Inland Waters, Department of the Environment and was carried out under a contract with the Department of Supply and Services.

Industrial standards resulting from regulations or legislation could require industry to manage their waste heat discharges into the Great Lakes. The resulting management of the industrial and power plant waste heat discharges could have a direct effect on the price structure of these industries. The purpose of this study is to evaluate the price increases resulting directly from waste heat standards and to assess the economic impacts of these price changes. Two types of economic impacts are studied:

(i) The potential impacts on industry groups;

(ii) The effect of price changes on ultimate consumer costs in Canada.

Section III of the main report reviews the sources of waste heat and sets out the direct effects of two alternative standards: one requiring cooling towers on both existing and future plants and the other requiring cooling towers on future plants only. Details of the calculations of the direct effects are contained in Appendixes A and B.

Section IV of the main report sets out the findings of the economic impact analysis, structured under two topics:

(i) The direct and indirect effects on industries, including an assessment of selected industries' ability to pass on or absorb cost increases;

(ii) Distribution of costs in final demand sectors, including the overall impact on consumer costs.

Statistical data, descriptions of the methodology employed and detailed numerical work are provided in Appendixes C, D and E.

The results of the economic impact analysis are presented for the most costly case identified in Section III. Regulations different from those analysed here might be considered at a later date. If so, the methodology set out in Appendix A can be used to estimate the direct effects. The economic impacts can then be assessed either by adapting the given results or by recalculating the results using the methodology set out in Appendix D.

II SUMMARY AND CONCLUSIONS

1. DIRECT COSTS OF WASTE HEAT MANAGEMENT

Sources of Industrial Heat

Thermal power plants including both utility and industry owned, account for the bulk of the waste heat discharges to the Great Lakes; the only source of process heat considered in this study is that from iron and steel plants. For analysis purposes, industrial waste heat contributors were divided into two groups, as follows:

(i) Electric utilities: the Ontario Hydro system (thermal plants);

(ii) Other industries: motor vehicles, chemicals, pulp and paper, distilleries (thermal plants); iron and steel (thermal plants and process heat).

Potential Regulation of Waste Heat Discharges

To estimate direct costs, it is necessary to know how regulations will translate into specific facilities for waste heat management. So far, there have been no definitive recommendations concerning alternative regulations which might be appropriate for the Canadian section of the Great Lakes. In view of this, it was assumed for study purposes that regulations would lead to utilization of wet cooling towers for heat rejection, and two cases were selected for study:

Case A: assumes that regulations would apply retroactively such that cooling towers would have to be fitted to existing, as well as new plants.

Case B: assumes that cooling towers would be required only for plants scheduled to commence operation after 1975.

Annual Costs of Cooling Towers

The annual direct costs of cooling towers, for the two cases under consideration, are estimated as follows:

Annual Direct Costs* - million 1972 $

	1975	1980	1990	2000
Case A				
Ontario Hydro	56.9	70.5	131.1	230.3
Other industries	1.3	1.2	1.1	1.0
Total	58.2	71.7	132.2	231.3
Case B				
Ontario Hydro	0	19.7	90.0	196.3
Other industries	0	0	0.1	0.2
Total	0	19.7	90.1	196.5

* *Annual costs cover operating expenses, depreciation and return on net asset value.*

Price Increases

The annual direct costs listed above for Ontario Hydro represent the additional revenues that Hydro would collect to recover the capital and operating costs of cooling towers. These additional revenues would increase the price of electricity by the following incremental amounts:

Average Electricity Price Increases

	mills/kwh (1972 $ values)	
	Case A	Case B
1975	.7	0
1980	.6	.2
1990	.5	.4
2000	.5	.4

2. ECONOMIC IMPACT ANALYSIS

Methodology

In the economic impact analysis, the direct effects of waste heat regulations are considered to be the increased costs of purchased electricity and the annual costs of cooling facilities incurred by industries other than electric utilities. Input-output analysis was used to trace the propagation of these direct effects through the economy to final demands. The 1965 Ontario input-output table was used for the principle analyses, and the 1966 Canadian table was used as a check on the results.

Direct and Indirect Effects on Industries

The most severe direct effects are those corresponding to Case A, 1975, for which the estimated electricity price increase is 0.7 mills per kwh and other direct effects total $1.3 million, in 1972 constant dollars. These direct effects were adjusted downward to reflect 1970 dollar values and 1970 levels of activity. The direct and indirect effects, as determined from the Ontario input-output table, were then related to value of shipments and gross profit margins* for some 44 industry groups in Ontario for the year 1970.

It was found that the direct plus indirect effects as a per cent of value of shipments ranged from approximately 0.1 to 0.8 per cent. Expressed as a per cent of gross profit margin, the direct plus indirect effects ranged from approximately 0.1 to 4.0 per cent: in 12 industry

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** Value added less wages and salaries is referred to in this report as the gross profit margin.*

groups the ratio was in the 1.0 to 4.0 per cent range, while in the other 32 industry groups it was in the 0.1 to 1.0 per cent range.

An assessment was made of the ability of ten industry groups to either pass on or absorb cost increases; the industries selected were those having the highest direct plus indirect costs expressed as a per cent of gross profit margin. Of these, it was concluded that the impacts of increased costs could be serious in the following industry groups: smelting and refining; cotton yarn and cloth mills; pulp and paper mills; synthetic textiles; and iron and steel mills.

Impacts on Final Demand Sectors

When related to 1970 levels of activity and dollar values, the most severe direct effects total some $40.4 million per year.* The initial distribution of these direct costs would be $26.1 million to intermediate demands (industries and commercial operations) and $14.3 million to final demands. The Ontario input-output table was then used to determine the ultimate distribution of the $26.1 million amongst final demand sectors, assuming all of the direct

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* *Equivalent of Case A, 1975 direct costs of $58.2 million.*

cost increases would be passed on by industries. The results of this analysis were as follows:

Impact on Final Demand Sectors

million $ per year (1970 dollars)

Sector	Direct Cost	Indirect Cost *	Total
Consumption	10.8	16.7	27.5
Investment	-	4.6	4.6
Inventory changes	-	0.9	0.9
Governments	3.5	1.7	5.2
Net Exports	-	2.0	2.0
Total	14.3	25.9	40.2

* *After 9 rounds of activity; $0.2 million still remains in the intermediate demands.*

The analysis indicates that less than 5 per cent of the total costs will go out of Ontario as net exports and that the majority of the costs (68 per cent) will be borne by Ontario consumers. The amount of the increase in consumer costs represents 0.14 per cent of the total consumer expenditures in 1970. Thus, the inflationary effect of Case A regulations on consumer costs in Ontario is indicated to be in the order of 0.14 per cent.

3. CONCLUSIONS

In a benefit-cost sense, the costs of regulations requiring cooling towers can be considered to include all of the direct costs identified in Section III: for Case A, these would range from $58.2 million in 1975 to $231.3 million in the year 2000; while for Case B, they would range from zero in 1975 to $196.5 million in the year 2000.* There could also be some indirect costs attributable to waste heat regulation: for example, the impact on industries could result in some loss of opportunities for industrial expansion. However, the industrial impacts analyzed in this study are not sufficiently large to draw any definite conclusions in this regard.

Comparison of the results for Case A and Case B points out the importance of the decision as to whether or not the regulations will be made retroactive to include existing plants. Firstly, if the regulations were to be made retroactive (Case A), the present value of the direct costs over the 1975-2000 period would be about 80 per cent greater than the alternative of making the regulations apply only to future plants (Case B). Secondly, the most severe economic impacts will occur

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* *In 1972 constant dollars.*

under Case A regulations immediately following implementation; on the other hand, under Case B the economic impacts will be zero initially and then build up gradually over a long period of time.

III DIRECT COSTS OF WASTE HEAT MANAGEMENT

1.0 SOURCES OF INDUSTRIAL HEAT

A previous study* identified the following as sources of significant heat inputs to the Great Lakes:

(i) Thermal generating stations;

(ii) Iron and steel plants;

(iii) Municipal sewage works.

An indication of the relative importance of these sources can be seen in the following estimate and forecast of heat inputs:

Canadian Heat Inputs to the Great Lakes

Trillion Btu's per hour (%)

	1968		2000**	
Thermal generation	8.30	(65.5)	346.5	(98.0)
Iron and steel plants	1.47	(11.6)	3.0	(0.8)
Municipal sewage	2.90	(22.9)	4.3	(1.2)
Total	12.67	(100.0)	353.8	(100.0)

** Forecast based on continuation of direct discharge of all waste heat to the Lakes.

Source: Acres

* *H.G. Acres Limited, Thermal Inputs to the Great Lakes 1968-2000, February, 1970.*

The Acres study also considered petroleum refineries and chemical plants as potential sources, but concluded that the heat inputs from these industries are negligible and will remain so through the year 2000.

This study is concerned with the economic impacts of industrial waste heat management. It is thought that the bulk of the heat discharged through municipal sewage works is contributed by residential and commercial water heating, although specific information is not available on industrial contributions. In view of this, it was agreed that no further consideration would be given to industrial heat discharged through municipal sewage disposal systems.

For analysis purposes, industrial waste heat contributors were divided into two groups - electric utilities and privately-owned industries. This distinction is made because it is clear that electric utilities will be able to pass on higher costs to their customers, whereas the other industries may or may not be able to pass on increased costs. Specifically, the following industries have been selected as those which could potentially be affected by waste heat management regulations:

(a) Electric utilities:

- The Ontario Hydro system* (thermal generation)

(b) Privately-owned industries:

- Motor vehicles (thermal generation)
- Chemicals (thermal generation)
- Pulp and paper (thermal generation)
- Iron and steel (thermal generation and process heat)
- Distilleries (thermal generation)

2.0 POTENTIAL REGULATION OF WASTE HEAT DISCHARGES

2.1 Options

Waste heat discharges result when water used for cooling or other industrial processes is withdrawn from a lake and returned at a higher temperature. For instance, almost all of the existing thermal plants on the Great Lakes employ conventional, "once-through" cooling: water is withdrawn from the lakes, passed through the condensers and returned directly to the lakes at a higher temperature. These waste heat discharges may be undesirable for one or both of the following reasons:

(i) Potentially adverse effects of the Btu input on the heat balance of the water body as a whole;

** By our own definition, this includes the Municipal Electrical Utilities which purchase power from Ontario Hydro and Atomic Energy of Canada Ltd which supplies power to Hydro. This system includes all of the existing utility-owned thermal plants with installed capacities of 5 MW or more which discharge waste heat to the Great Lakes.*

(ii) Potentially adverse effects of local concentrations of high temperature water.

Waste heat management regulations might be aimed at one or the other of these potentially adverse effects. In the first case, cooling ponds or cooling towers could be employed to reject the waste heat directly to the atmosphere, rather than directly to the lakes; this would eliminate both the Btu input and the temperature concentrations. Alternatively, regulations might relate only to temperature concentrations - without any constraint on Btu inputs. In this case, a plant might opt for dilution of the cooling water effluent before discharging it to the lakes, or it might employ diffusers to disperse the high temperature water over a larger volume of the lake.

To date, there have been no specific recommendations concerning alternative regulations which might be appropriate for the Canadian section of the Great Lakes. Different standards or regulations could lead to different types of waste heat rejection systems, including various types of cooling towers, partial cooling, dilution, diffusers, etc. Some possible applications of these alternative systems to the Great Lakes are being researched at the present time; however, the results are not yet definitive to the extent of suggesting specific regulations.

2.2 Alternatives Selected for Detailed Study

Two cases were selected for detailed study, both of which involve the utilization of wet cooling towers for heat rejection:

Case A: assumes that regulations would apply retroactively, such that cooling towers would have to be fitted to existing, as well as future plants;

Case B: assumes that regulations would not apply retroactively, such that cooling towers would be required only for plants scheduled to commence operation after 1975.

The rationale for this selection is as follows:

(i) Wet cooling towers are the most costly system that is liable to be utilized on the Great Lakes;*

(ii) Capital and operating costs of wet cooling towers can be estimated with a reasonable degree of confidence from available data;

(iii) As shown in subsequent sections of the report, the

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* *Dry (non-evaporative) cooling towers are much more costly than wet towers, but their main application is in situations where it is necessary to reduce the consumptive use of water.*

question of whether or not regulations are to be applied retroactively has an important effect on the economic impacts.

3.0 THE ONTARIO HYDRO SYSTEM

3.1 Definition of the System

The Hydro-Electric Power Commission of Ontario (Ontario Hydro) "is a corporate entity, a self-sustaining public enterprise endowed with broad powers with respect to electricity supply throughout the Province of Ontario."* The Commission is responsible for the generation and purchase of electric power, and for its transmission and disposal to the following classes of customers (figures in brackets are percentages of total 1971 energy sales):

(i) Delivery in bulk for resale, for the most part by the 353 associated municipal electrical utilities (68 per cent);

(ii) Bulk sales to some 91 direct, and generally industrial customers (20 per cent);

(iii) Sales to retail customers in rural areas or in certain communities not served by municipal electrical utilities (12 per cent).

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* *Ontario Hydro Statistical Yearbook, 1972.*

The Commission, in addition to supplying power, exercises certain regulatory functions with respect to the municipal electrical utilities served, as provided for in the Power Commission Act and the Public Utilities Act. These municipal utilities are considered to be part of the Ontario Hydro system in the context of this study.

Ontario Hydro purchases power from several sources, including Quebec and U.S. utilities. Among the sources of purchased power is the Douglas Point nuclear plant, which is owned by Atomic Energy of Canada Ltd and operated by Ontario Hydro. Since the Douglas Point plant would be affected by Case A waste heat standards, it is convenient to include it as part of the Ontario Hydro system, as defined for this study.

3.2 Electricity Supply in Ontario

Ontario's total electrical energy requirement in 1971 was 72.9 billion kwh, including energy losses in transmission and distribution systems; the sources of supply were as follows:

Ontario Electrical Energy Supply, 1971

	billion kwh
Ontario Hydro system	64.1 *
Other Ontario utilities	1.8
Ontario industrial plants	2.7
Total generated in Ontario	68.6
Net imports (imports less exports)	4.3
Total Ontario Supply	72.9

* includes 1.0 billion kwh purchased from AECL

Source: Appendix A, Table A-1

As shown above, Ontario Hydro is the predominant supplier of electricity in Ontario: some 93 per cent of the total electrical energy produced in the province during 1971 was generated in the Ontario Hydro system. It also accounts for most of the imports and exports of electrical energy into and out of the province.

The relative importance of the Ontario Hydro system has been increasing over the years, and this trend is expected to continue in the future. By the year 2000, Ontario's electrical energy requirements are forecast at 506 billion kwh.* It has been assumed that the Ontario Hydro system will generate 502 billion kwh in the year 2000, and that other provincial utilities and industrial plants will contribute just 4 billion kwh, or about the same as their 1971 production.

Prior to 1960, Ontario Hydro had a predominantly hydro-electric system. But most of the new capacity added during the 1960's was in fossil-fueled thermal plants; and by 1971, over half of their generating capacity was in thermal stations. It is expected that essentially all future additions to the system will be thermal, and that the bulk of these plants will be nuclear. For purposes of this study, the following system capacities have been projected:

* *Based on an annual growth rate of about 7 per cent; for details of forecast see Appendix A, Table A-2.*

Ontario Hydro System,* Installed Capacities 1971-2000

	Megawatts (MW) Hydro & Misc.	Fossil (Steam)	Nuclear	Total
1971	6,630	5,914	1,204	13,748
1975	6,600	10,100	3,000	19,700
1980	6,600	12,200	8,200	27,000
1990	6,600	17,200	30,700	54,500
2000	6,600	28,900	66,700	102,200

* Includes Douglas Point nuclear plant (182 MW)

Source: Appendix A, Table A-2

3.3 Costs of Cooling Towers

Table 1 shows the incremental capital and operating costs that would be incurred by Ontario Hydro, over the 1975-2000 period, as a direct result of utilizing wet, natural-draft cooling towers. On future plants, these estimates represent the difference between the costs of cooling towers and the costs of a conventional once-through cooling system; on existing plants (Case A only) they represent the total costs of retrofitting towers to replace an existing cooling system. Details of the estimates, including sources of information and assumptions, are

TABLE 1

ONTARIO HYDRO SYSTEM: CAPITAL AND OPERATING COSTS OF COOLING TOWERS

(Millions of 1972 constant $)

Year	Case A: Cooling Towers on Existing and New Plants		Case B: Cooling Towers on New Plants only	
	Accumulated Capital Costs	Annual Operating Costs	Accumulated Capital Costs	Annual Operating Costs
1975	380	16.0	0	0
1980	531	20.5	151	4.5
1990	1,136	37.5	756	21.5
2000	2,147	67.0	1,767	51.0

All costs are incremental values, representing the differences between wet cooling towers and conventional once-through cooling systems.

Source: Appendix A, Tables A-4(a) and (b).

provided in Appendix A; but the following points are thought to be noteworthy:

(i) Cooling towers reduce the power output from a given plant; hence, the estimates include provision for the costs of replacing the power reduction;

(ii) The estimates are in 1972 constant dollars;

(iii) Operating costs cover operation and maintenance expenses; they do not include any allowance for interest or depreciation charges;

(iv) The cutoff between existing and future plants is assumed to be 1975: that is, the higher unit costs for existing plants (Case A) are applied to units scheduled for commissioning through 1975. Similarly, the Case B estimates, for future plants only, apply to plant capacity scheduled to commence operation after 1975.

Ontario Hydro's total expenditure on cooling towers over the 1975-2000 period will be in excess of $3 billion, if the regulations are applied retroactively, as shown below:

Total Expenditures on Cooling Towers
Ontario Hydro System, 1975-2000

millions of 1972 $

	Case A (existing & new plants)	Case B (new plants only)
Accumulated capital costs	2,147	1,767
Accumulated operating costs	921	505
Total expenditures (1975-2000)	3,068	2,272

Source: Appendix A, Table A-5

The decision as to whether or not regulations will be retroactive to include existing plants will have significant economic consequences. As shown above for cooling towers, the total expenditure by Ontario Hydro over the 1975-2000 period will be $3.07 billion if the regulations are made retroactive, and $2.27 billion if regulations apply only to new plants. But the difference is more pronounced if the comparison is made on the basis of present values, as illustrated below:

Present Values* of Ontario Hydro Expenditures 1975-2000

	million 1972 $
Case A:	1,198
Case B:	673

* Calculated at a discount rate of 8 per cent

Source: Appendix A, Table A-5

3.4 Revenues and Price Increases

Ontario Hydro is a public utility, charged with supplying power "at cost": if it incurs an incremental cost, it will increase the price of electricity to recover that cost. Table 2 shows the annual revenues that Ontario Hydro will have to collect, over the 1975-2000 period, in order to recover the estimated expenditures for cooling towers. These revenues would recover the incremental operating costs and depreciation of the cooling towers, and provide an annual return of 8 per cent of the net asset value. Details of the estimates are provided in Appendix A.

Ontario Hydro would collect these additional revenues through higher rates on the sale of electricity to their retail and direct industrial customers and to the Municipal Electrical Utilities which purchase power for resale. The municipal utilities, in turn, would pass on the increased costs to their customers. Hence, the additional revenues shown in Table 2 would be paid by the ultimate users of electricity in the province.

Table 2 also shows: (i) the forecast net sales to ultimate users, after deducting transmission and

TABLE 2

ONTARIO HYDRO SYSTEM: INCREMENTAL REVENUES REQUIRED AND AVERAGE ELECTRICITY PRICE INCREASES

(1972 constant $)

Year	Net Sales to Ultimate Users	Case A		Case B	
		Annual Incremental Revenues	Average Price Increase	Annual Incremental Revenues	Average Price Increase
	Gwh	million $	mills/kwh	million $	mills/kwh
1975	83,000	56.9	0.69	0	0
1980	119,000	70.5	0.59	19.7	0.17
1990	241,000	131.1	0.54	90.0	0.37
2000	462,000	230.3	0.50	196.3	0.43

Annual revenues and price increases are incremental values, representing the differences between wet cooling towers and conventional once-through cooling systems. Revenues cover operating costs, depreciation and rate of return on net asset value.

Source: Appendix A, Tables A-6(a) and (b).

distribution losses - including those in the municipal systems; and (ii) the average electrical energy price increases to the ultimate users for the two cases analysed. The annual revenues and price increases to the ultimate users are plotted on Figure 1 for the 1975-2000 period.

Figure 1 illustrates the considerable difference in the price effects of the two cases analysed. If the regulations are made retroactive to include existing plants (Case A), the maximum price increase will occur in the years immediately following implementation of the regulations: in the case of cooling towers, the maximum price increase would be approximately 0.7 mills per kwh in 1975, declining to approximately 0.5 mills per kwh in 2000.* On the other hand, if the regulations apply only to future plants (Case B), there will be no immediate increase: the price increase will build up gradually from zero in 1975 to approximately 0.4 mills per kwh in the year 2000.

The greatest price increase occurs under Case A because the unit costs of fitting cooling towers to existing plants

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* *These estimates are all in 1972 constant dollar values.*

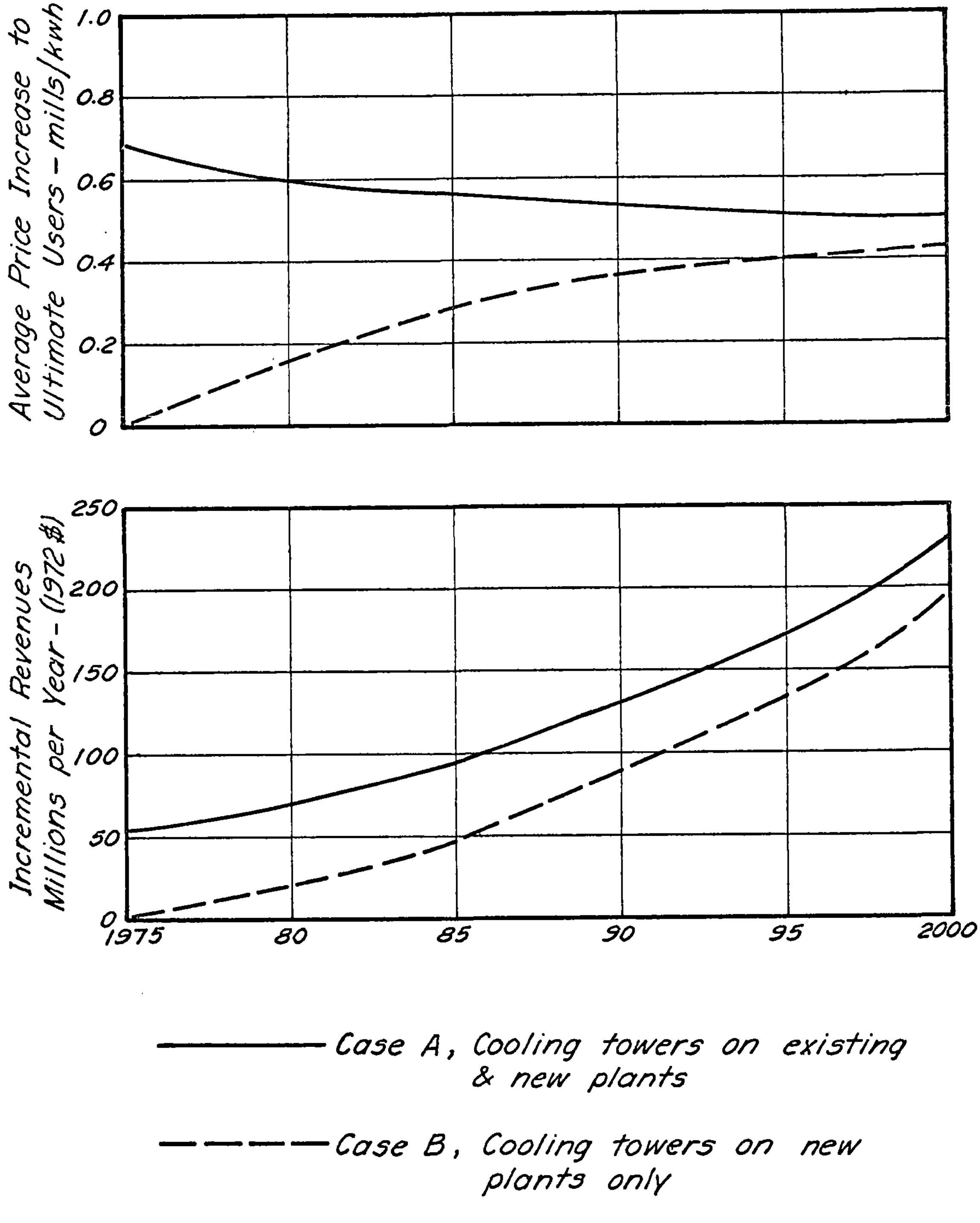

FIGURE 1

ONTARIO HYDRO SYSTEM INCREASE IN ELECTRICITY PRICES WITH COOLING TOWERS are about twice the differential unit costs for new plants. The cost curves for the two cases would converge around the year 2008, when the facilities for existing plants would be fully depreciated.

In a benefit-cost sense, the costs of regulations requiring cooling towers in the Ontario Hydro system are the annual revenues required from the electricity users, which are shown in Table 2 and Figure 1. With Case A regulations, these costs would range from approximately $57 million per year in 1975 to $230 million per year in 2000; with Case B regulations, the annual costs would go from zero in 1975 to $196 million in the year 2000.

4.0 OTHER INDUSTRIES

4.1 Existing and Future Sources

There are two general sources of waste heat from industries other than electric utility: waste heat from industry-owned thermal electric plants and process heat from iron and steel mills. As noted in the preceding discussion, process heat wasted from other industrial operations is thought to be negligible.

At present there are eight privately-owned thermal plants, in five industry groups, which discharge waste heat to the Great Lakes;* the combined capacity of these plants is 190 MW. The rate of discharge of waste process heat from iron and steel plants is the equivalent of approximately 170 MW of thermal capacity.

It has been assumed that there will be no future additions to privately-owned thermal capacity: this is consistent with the earlier assumption that all new electricity requirements in the province will be supplied from thermal plants in the Ontario Hydro system. Process heat from iron and steel plants will increase over time as the capacity of mills on the Great Lakes expands to meet growing demands in Canada.**

4.2 Costs of Cooling Towers

Table 3 shows the estimated annual costs of providing cooling towers to manage the waste heat from privately-owned industries. These annual costs cover operating expenses, depreciation and the opportunity cost of capital, which is estimated at 15 per cent of the net asset value. The power loss in the thermal plants is assumed to be replaced by purchased power, the cost of

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* *Includes plants with installed capacities of 5 MW and greater.*

** *The process heat is associated almost exclusively with the blast furnace operations; and it is assumed that iron-making will continue to be in blast furnaces. The forecasts would not be affected by a trend towards electric furnaces in the steel-making operations.*

TABLE 3

ANNUAL COSTS OF COOLING TOWERS FOR PRIVATELY-OWNED INDUSTRIES

Industry	Year	Annual Costs of Cooling Towers million $/year*	
		Case A	Case B
Motor vehicles	1975	0.29	0
	2000	0.19	0
Chemicals	1975	0.19	0
	2000	0.12	0
Pulp and paper	1975	0.19	0
	2000	0.12	0
Iron and steel	1975	0.64	0
	2000	0.52	0.21
Distilleries	1975	0.02	0
	2000	0.01	0
Totals	1975	1.33	0
	2000	0.96	0.21

* *1972 $. Includes operation, replacement of thermal power loss, depreciation and the cost of capital.*

Source: Appendix B, Table B-3.

which is included in the operating expenses. (For details of the estimates see Appendix B.)

With Case A regulations, the total annual costs to the five industry groups will be approximately $1.3 million in 1975, declining to approximately $1.0 million in the year 2000.* These costs are relatively small in comparison with the costs in the Ontario Hydro system; but they are still potentially important to the individual industries affected. With Case B regulations, iron and steel would be the only industry significantly affected: its annual costs would go from zero in 1975 to approximately $0.2 million in the year 2000. Here again, the decision as to whether or not regulations will be made retroactive is shown to have an important effect on the costs.

** All these cost figures are in 1972 dollar values.*

IV ECONOMIC IMPACT ANALYSIS

1.0 INTRODUCTION

1.1 Purpose of Analysis

In broad terms, the purpose of the analysis is to determine how the increased costs resulting from thermal pollution standards will flow through the economy to the final demand sectors and to assess the impacts along the way, namely:

(i) The direct and indirect impacts on Ontario industries;

(ii) The effects on ultimate consumer costs in Canada.

The costs used in the impact analysis are consistent with standards requiring cooling towers on existing as well as new plants - in other words, the most costly case identified in Section III.

1.2 Approach

Assuming that regulations will be made retroactive to include existing plants, six industries will be significantly affected in the first instance, in that they will be required to make capital investments in cooling facilities. These industries are as follows - in declining order of incremental costs incurred: electric utility (the Ontario Hydro system), iron and steel, automobile manufacturing, pulp and paper, chemicals, and distilleries.

The great majority of the cooling tower costs will be borne by the Ontario Hydro system; but as noted in Section III, it is clear that Hydro, and associated Municipal Electrical Utilities, will increase their prices to recover any incremental costs. Hence, the incremental costs incurred by the electric utility sector can be treated more logically by considering electricity price increases as direct cost effects on their customers. For example, consider that portion of the electricity which is purchased by commercial and industrial enterprises: an increase in electricity price is treated as a direct increase in the cost of the inputs used in their operations.

There is a second category of direct effects: the costs that would be incurred by the five industries, other than electric utility, which discharge significant quantities of waste heat to the lakes. For example, if the iron and steel industry constructs cooling towers to meet waste heat regulations, the incremental costs of the facilities are considered as direct effects on the annual cost of inputs used in their manufacturing operation - the same way that purchased electricity is treated.

By definition then, the direct effects of waste heat regulations are considered to be the increased costs of purchased electricity and the annual costs of cooling facilities incurred by industries other than electric utilities.

Some of the direct effects attributable to increased electricity costs go immediately to final demand categories - for example, electricity sales to the residential sector, apartments, government buildings and street lighting. The rest of the direct effects are distributed amongst primary industries, manufacturing and commercial enterprises; the problem is to analyse how these direct effects flow through the economy to final demands. Consider a hypothetical Industry A, which purchases electricity for a manufacturing process: because of the nature of the industry, it is able to increase the price of its products - which it sells to Industry B - to recover an increase in the cost of purchased electricity. The increased electricity price now has an indirect effect on Industry B - through the increased cost of intermediate goods which it purchases from Industry A. Hence, the analysis is concerned with the potential impacts of both direct and indirect cost effects on industries.

1.3 Methodology

The current transactions in an economy may be summarized by an input-output table which shows the supply of commodities (from both domestic industries and imports) and the disposition of those commodities to industries as current inputs and to consumers, governments, capital formation and exports as final users. In this study, two available input-output tables were used as price models to analyse the propagation of price increases throughout the economy. The inputs are the direct effects of the increased costs of purchased electricity and the annual costs of cooling facilities incurred by industries other than electric utilities. The tables were used to analyse a cost push type of price propagation; that is, all increases in costs are passed on in the sense that output prices are assumed to rise when an industry is faced with an increase in input costs.

In this way, the tables were used to determine the indirect effects of intermediate price increases on each industry and to trace price increases through to final users.

The two input-output tables used were the 1965 Ontario Table and the 1966 Canadian Table. The main applications of the results from each table are as follows:

1965 Ontario Table: analysis of the direct and indirect effects of cost increases on industry groups and the distribution of costs amongst final use categories.

1966 Canadian Table: analysis of the inflationary effects of cost increases on consumer prices and a check on industry impacts derived from the Ontario table.

Details of the analyses are provided in Appendix D.

2.0 DIRECT AND INDIRECT IMPACTS ON INDUSTRIES

2.1 Input Data

As discussed in the preceding section, a particular standard will result in a set of direct effects comprising a general increase in the price of electricity and some additional annual costs to a few specific industries. The dominant effect is the increase in the price of electricity, which varies over time for each standard. The most severe case identified in Section III is an electricity price increase of approximately 0.7 mills per kwh, accompanied by additional direct costs of $1.3

million spread over five industry groups.* These direct effects correspond to the Case A regulations and costs derived for the year 1975, or more generally, for the years immediately following implementation of the regulations.

The numerical analysis presented here is based on the electricity price increase of 0.7 mills per kwh, in 1972 dollar values. The input-output analysis is completely linear; hence, the results can be simply factored by a constant to conform with any different price increase.

Some adjustments had to be made to get a consistent set of input data for purposes of analysis. This was done as follows:

(i) The most recent detailed statistics available on industrial electricity consumption, value of shipments, value added, etc, are for 1970 (see Appendix C). This data was adopted for the analysis and everything else was adjusted accordingly;

(ii) Since the available data on value of shipments, value added, etc, are in 1970 dollars, the

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* *In 1972 constant dollars.*

electricity price increase was reduced from 0.7 to 0.65 mills per kwh to reflect 1970 dollar values instead of 1972 dollars.

(iii) The other direct effects were reduced by 15 per cent to adjust for both 1970 dollar values and 1970 production levels.

As a result of these adjustments, the actual input data used in the analysis are as follows:

(a) An electricity price increase of 0.65 mills per kwh, applied to 1970 electricity purchases;

(b) An additional direct cost of $1.1 million divided amongst five industry groups.

Statistical data are provided in Appendix C and a detailed breakdown of the input data is provided in Appendix D.

2.2 Results Using the Ontario Input-Output Table

The Ontario Input-Output table was used to determine the indirect cost increase industries would experience as a result of the direct (initial) cost increase. Details of the methodology used to determine these indirect cost increases appear in Appendix D. The indirect effects result from the direct cost increases being passed on to other industries and to final demands.

Each of the 49 industrial and commercial sectors experiences the direct increase in cost and passes this increase on by increasing the price of their outputs. Hence in the next "round" of economic activity each of the 49 sectors finds that their input prices have increased and that they in turn must increase the price of their outputs. As each round of economic activity takes place, a portion of the output is sold directly to final demand (i.e. to some final consumer) and there are no further price increases on that portion. Over a number of rounds of activity virtually all the initial direct cost increase is passed on to final demand.

Table 4 shows for 14 aggregated industrial groups the results of pushing the direct cost increase through the economy round by round. (See Table D-4, Appendix D for a

TABLE 4

ROUND BY ROUND IMPACT OF INCREASED COSTS ON INDUSTRIAL SECTORS ($,000,000)

Industry	Direct Costs	Indirect Costs						Total Direct Plus Indirect
		Round 1	Round 2	Round 3	Round 4	Round 5-9	Total	
1. Agriculture	.3	.5	.4	.2	.1	.2	1.4	1.7
2. Mining	2.1	.4	.2	.1	.1	.1	.9	3.0
3. Food, beverage & tobacco industries	.8	.9	.9	.7	.4	.5	3.4	4.2
4. Leather, textile, knitting & clothing industries	.5	.6	.5	.3	.2	.2	1.8	2.3
5. Wood, furniture and fixture ind.	.2	.2	.2	.1	.1	.1	.7	.9
6. Paper, printing, publishing and allied industries	3.1	1.6	.7	.4	.1	.2	3.0	6.1
7. Primary metal, metal fabricating and machinery industries	4.8	4.0	2.0	.9	.5	.6	8.0	12.8
8. Transportation equipment and electrical products industries	1.7	3.0	2.1	1.2	.7	.8	7.8	9.5
9. Petroleum, coal products, chemical products & rubber products ind.	3.6	2.6	1.2	.6	.3	.4	5.1	8.7
10. Non metallic mineral prod., misc. mfg. ind. and unallocated	1.4	1.8	1.1	.7	.4	.5	4.5	5.9
11. Construction maintenance & repair	.2	1.5	1.0	.6	.3	.3	3.7	3.9
12. Transportation, storage and trade	4.8	.6	.6	.3	.2	.2	1.9	6.7
13. Utilities	.7	.2	.1	.1	.0	.0	.4	1.1
14. Communication & other services	1.9	.5	.6	.4	.3	.3	2.1	4.0
Total	26.1	18.4	11.6	6.6	3.7	4.4	44.7	70.8

Source: Appendix D, Tables D-1, D-2, D-3 and D-4

See Table D-4 for results broken down for 49 industrial and commercial sectors

49 industrial sector breakdown of the results). For instance, the table shows that agriculture experiences a direct (initial) cost increase of $0.3 million and as the entire direct cost increase is pushed through the economy agriculture experiences $1.4 million of indirect cost increases. Each of the 14 rows can be interpreted in this manner.

Note that after three rounds $19.5 million (75 per cent) of the direct cost increase has been passed to final demand categories and only $6.6 million remains to be passed on in subsequent rounds.

The total direct cost is $26.1 million and the total indirect cost amounts to $44.7 million. Hence, if the inflationary process works perfectly and each industry passes on all cost increases, the total of all goods sold will increase by $70.8 million. This does not mean, however, that $26.1 million of direct costs to industries end up costing society $70.8 million. Real costs to society only occur when goods or services are purchased by some final consumer: i.e. by personal consumption, capital formation or governments. In fact the $26.1 million direct cost to industries leads to the same amount of ultimate cost increase to final consumers, according to the methodology used.

Consider an incremental $10 of direct electrical energy cost imposed on a steel mill: the steel mill passes on the $10 to a metal fabricator who in turn passes the $10 to an automobile manufacturer. The auto manufacturer sells the car and a consumer pays an extra $10 for the car. In this situation the $10 of direct cost is ultimately charged to the consumer; the steel industry experiences a $10 direct cost increase and there is a total $20 of indirect costs imposed on the fabricator and the auto manufacturer. The $44.7 million of indirect costs is the sum of this double counting process that occurs as industries sell to other industries.

Clearly, the indirect cost increases borne by industries are of no consequence to final consumers; however, they are important to individual industries and individual firms. If an industry finds that it is not able to pass on costs of this magnitude, because its customers will either substitute other goods or purchase imports, then the $44.7 million of indirect costs can effect the viability of that industry. An analysis of the relative impact of waste heat regulation on individual industries follows in section 2.3.

2.3 The Ability of Selected Ontario Industries to Accommodate Cost Increases

(a) Introduction

The significance to industry of cost increases induced by compliance with thermal pollution regulations is evaluated by considering the cost increase as a proportion of (a) value added minus wages and salaries in Ontario, and of (b) value of shipments in Ontario. The value added minus wages and salaries figure is sometimes referred to as the "gross profit margin" and is felt to be the best readily available figure to measure cost increases against in determining the potential seriousness of the cost increases; basically it is equal to value of production less costs of factor inputs i.e. less costs of labor and materials and supplies used. The major components of the "gross profit margin" figure then are profits, depreciation, interest payments, and taxes.

Table 5 shows industry groups ranked according to the importance of the cost increase when measured as a proportion of value added minus wages and salaries. A comparison of this ranking to that which would have been obtained using value of shipments as the denominator can be seen by comparing the last two columns. In general of course, may not be possible in all cases and to the extent that some industries have to absorb increased costs the direct plus indirect cost increases as calculated in column 5 of Table 5 will be overstated. These totals should be viewed as the maximum cost increases which would result from the institution of the Case A thermal pollution standard.

(b) Indicators of Industries' Ability to Accommodate Cost Increases

The ability of each Ontario industry to pass on cost increases is evaluated by considering the following indicators of industry structure or performance:

(i) Concentration

Consideration is given to the degree to which the industry is concentrated in the hands of the few largest enterprises. It may be assumed that, everything else equal, the higher the industry concentration the greater the ability to increase prices. Concentration should of course be considered in relation to the market area served; for example the degree of concentration of the industry in Canada may not be particularly relevant if export markets account for a large part of the industry demand.

(ii) Market Area Served, Tariff Protection

An important factor in determining price flexibility

TABLE 5

DIRECT AND INDIRECT INDUSTRY COST INCREASES DUE TO COMPLIANCE WITH CASE A THERMAL POLLUTION STANDARD [1]

Industry Group [2]	Value Added Total Activity, Ontario, 1970 [3]	Direct Cost Increase		Indirect Cost Increase [6]	Direct plus Indirect Cost Increase	Direct plus Indirect Cost ÷ (Value Added minus Wages and Salaries) [7]	Direct plus Indirect Cost ÷ Value of shipments [8]
		Purchased Electricity Cost Increase [4]	Direct Industry Cost Increase [5]				
	$,000	$,000	$,000	$,000	$,000	%	%
1. Petroleum refineries and coal products	108,379	545.6	-	1600.3	2145.9	3.98	.35
2. Plastics and synthetic resins	36,889	61.8	-	629.6	691.4	3.74	.82
3. Pulp and paper mills	346,406	2573.4	162.0	1405.2	4140.6	2.62	.57
4. Other primary metals industries	409,140	1441.6	-	1542.4	2984.0	1.92	.31
5. Cotton yarn and cloth mills	25,113	52.8	-	96.7	149.5	1.86	.26
6. Meat and poultry processors	153,091	120.6	-	659.2	779.8	1.50	.09
7. Other non-metallic mineral products	181,499	754.1	-	406.7	1160.8	1.41	.38
8. Synthetic textile mills	112,667	281.4	-	444.1	725.5	1.29	.33
9. Other chemical industries	635,871	2575.4	162.0	1837.0	4574.4	1.19	.40
10. Iron and steel mills	695,111	2058.9	544.0	1624.5	4227.4	1.17	.32
11. Knitting mills	49,188	25.8	-	179.8	205.6	1.14	.20
12. Paper products	268,100	166.2	-	1055.7	1221.9	1.11	.21
13. Electrical appliances	148,093	67.1	-	599.4	666.5	.99	.20
14. Communication equipment	375,091	213.1	-	931.8	1144.9	.97	.15

TABLE 5

DIRECT AND INDIRECT INDUSTRY COST INCREASES DUE TO COMPLIANCE WITH CASE A THERMAL POLLUTION STANDARD [1]

Industry Group [2]	Value Added Total Activity, Ontario, 1970 [3]	Direct Cost Increase: Purchased Electricity Cost Increase [4]	Direct Cost Increase: Direct Industry Cost Increase [5]	Indirect Cost Increase [6]	Direct plus Indirect Cost Increase	Direct plus Indirect Cost ÷ (Value Added minus Wages and Salaries) [7]	Direct plus Indirect Cost ÷ Value of shipments [8]
	$,000	$,000	$,000	$,000	$,000	%	%
15. Metal stamping, pressing and coating	255,513	142.8	-	905.8	1048.6	.89	.18
16. Other electrical products	111,660	52.6	-	372.0	424.6	.85	.21
17. Dairy products	136,274	97.4	-	466.4	563.8	.85	.12
18. Motor vehicles and aircraft	1,514,910	940.2	247.0	5142.9	6330.1	.84	.15
19. Leather and leather products	93,655	40.0	-	118.6	228.6	.76	.12
20. Other textile mills	177,478	89.6	-	516.7	606.3	.74	.15
21. Paint and varnish industry	70,543	24.7	-	247.4	272.1	.73	.20
22. Electrical industrial equipment	265,980	129.2	-	594.8	724.0	.73	.17
23. Grain mills	113,443	153.7	-	336.1	489.8	.72	.13
24. Clay, lime and cement manufacturers	201,940	367.1	-	394.4	761.5	.70	.21
25. Rubber products	259.897	242.1	-	647.0	889.1	.66	.19
26. Other wood industries	104,347	62.1	-	181.4	243.5	.64	.11
27. Other metal fabricating ind.	1,175,809	500.6	-	2829.7	3330.3	.64	.16
28. Other food industries	334,837	198.0	-	1065.9	1263.9	.63	.15

TABLE 5

DIRECT AND INDIRECT INDUSTRY COST INCREASES DUE TO COMPLIANCE WITH CASE A THERMAL POLLUTION STANDARD [1]

Industry Group [2]	Value Added Total Activity, Ontario, 1970 [3]	Direct Cost Increase: Purchased Electricity Cost Increase [4]	Direct Cost Increase: Direct Industry Cost Increase [5]	Indirect Cost Increase [6]	Direct plus Indirect Cost Increase	Direct plus Indirect Cost ÷ (Value Added minus Wages and Salaries) [7]	Direct plus Indirect Cost ÷ Value of shipments [8]
	$,000	$,000	$,000	$,000	$,000	%	%
29. Other transportation equipment	91,074	38.4	-	253.9	292.3	.63	.17
30. Fabricated and structural metals	137,009	34.0	-	336.7	370.7	.61	.16
31. Clothing industries	161,702	23.7	-	299.3	323.0	.57	.11
32. Sawmills	47,899	36.8	-	64.4	101.2	.57	.10
33. Biscuits and bakeries	138,924	58.1	-	241.7	299.8	.55	.12
34. Mining	847,561	2121.3	-	789.2	2910.5	.52	.20
35. Furniture and fixtures	195,736	66.1	-	307.8	373.9	.48	.10
36. Agriculture	-	257.8	-	1469.8	1727.6	.41	.12
37. Miscellaneous mfg. industries	603,305	313.3	-	854.0	1167.3	.40	.12
38. Sugar and confectioneries	90,846	43.8	-	146.8	190.6	.36	.10
39. Printing and publishing	541,988	146.9	-	560.8	707.7	.33	.09
40. Tobacco and tobacco products	92,898	37.3	-	168.0	205.3	.30	.07
41. Miscellaneous machinery	470,982	94.7	-	761.8	856.5	.30	.21
42. Soft drinks	72,857	20.1	-	82.0	102.1	.27	.07

TABLE 5

DIRECT AND INDIRECT INDUSTRY COST INCREASES DUE TO COMPLIANCE WITH CASE A THERMAL POLLUTION STANDARD [1]

Industry Group [2]	Value Added Total Activity, Ontario, 1970 [3]	Direct Cost Increase		Indirect Cost Increase [6]	Direct plus Indirect Cost Increase	Direct plus Indirect Cost ÷ (Value Added minus Wages and Salaries) [7]	Direct plus Indirect Cost ÷ Value of shipments [8]
		Purchased Electricity Cost Increase [4]	Direct Industry Cost Increase [5]				
	$,000	$,000	$,000	$,000	$,000	%	%
43. Pharmaceuticals and medicines	153,466	25.9	-	185.8	211.7	.20	.10
44. Distilleries, breweries and wineries	299,886	87.7	17.0	232.5	337.2	.14	.08
45. Construction, maintenance & repair	-	166.3	-	3690.9	3857.2	-	-
46. Transportation, storage and trade	-	4822.3	-	1993.8	6816.1	-	-
47. Utilities	-	687.8	-	274.1	961.9	-	-
48. Communications and other services	-	1882.1	-	2185.3	4067.4	-	-

Footnotes to Table:

1. For a description of Case A, total costs in Ontario, see Section III, 2.2
2. For a definition of industry groups by Standard Industrial Classification Number see Table E-1 Appendix E
3. Source: Statistics Canada 31-203, Resourcecon
4. Source: Table D-2, Appendix D
5. Source: Table D-4, Appendix D
6. Source: Table D-4, Appendix D
7. For values of the statistic, value added minus wages and salaries, see Table C-5, Appendix C
8. For estimates of the Statistic, value of shipments, see Table C-5, Appendix C

the order of ranking is the same but some significant differences are apparent: for example the seriousness of the cost increases to the meat and poultry processing industries ranks high on the value added scale and low on the value of shipments scale.

The direct and indirect cost increases borne by each industry group attributable to the "Case A" type waste heat standards* are a significant proportion of value added minus wages and salaries in the top ranked cases. However some of these industries will be readily able to pass the cost increases on in terms of higher prices and will thus not be significantly affected. The petroleum refineries industry group, for example, which would bear a cost increase of nearly 4 per cent of value added minus wages and salaries, is the most certain of any of the top ranked industry groups to be able to pass the cost increases on** and so will bear no serious effects from the institution of thermal pollution standards (price elasticity of demand effects will be small).

It should be noted that the direct plus indirect cost increases have been calculated for each industry group on the implicit assumption that all of the industries pass the cost increases on in terms of higher prices. This,

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** See Section III, 2.2*

*** See Table 6 and Appendix E for a discussion of the 10 top ranked industries' ability to accommodate cost increases.*

will be the market area served - is it regional, national, export? Also of importance will be the extent to which foreign products compete in the domestic market.

The existence of effective tariff protection allows domestic firms to increase profit margins without losing the market to foreign goods. If protected industries are already pricing up to the tariff level, the existence of the tariff will not allow cost increases to be passed on but it may indicate an ability of the industry to absorb the cost increase.*

Non-tariff trade barriers are extremely important: for example in the oil industry import restrictions ensure the absence of import competition in the Ontario market area.

(iii) Demand Growth Factors

Everything else equal the higher the forecast demand growth for an industry's product the easier it will be for that industry to increase prices.

(iv) Consumer Goods or Producer Goods

A producer of consumer goods (those sold to final

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* *It is important to note that although the nominal tariff governs the price level, it is the existence of "effective" tariff protection that enables domestic producers to earn excess profits. For a discussion of the concept of effective protection and a description of the method used in calculating the measures of effective protection see the Economic Council of Canada Special Study No. 9, "Effective Protection in the Canadian Economy."*

demand sectors) can be expected to increase prices more easily than a producer of goods which are sold in intermediate markets. Intermediate purchasers of goods (i.e. other industries) will have both a greater ability and a greater inclination to shop around. For any given level of industry concentration the industry margin will be lower the greater the concentration on the buyers' side of the market.

(v) Barriers to entry

The ability to increase prices without attracting new entrants is based on advantages which existing firms have over potential entrants. These advantages arise from economies of scale, product differentiation, and absolute cost differences due to the control of scarce resources or patents and/or to the cost of raising the quantity of capital required for successful entry. The greater the barriers to entry the easier for industries to accommodate cost increases. Price flexibility should be greater in industries in which the proportion of the market supplied by a plant of minimum efficient scale is relatively large, in industries where product differentiation is important, and in industries where absolute capital requirements are very large.

(vi) Profit Margins

A review of historical industry profits will give an indication of industries' abilities to maintain profit margins. We have chosen for comparison purposes the profit measure "profit before taxes on capital employed" as reported in the Statistics Canada publication, "Corporation Financial Statistics". Price performance is another possible indicator of market power; however price movements are not necessarily reflective of industry profit. Changing prices may or may not compensate for changing costs of inputs.

It should be pointed out to the reader that this discussion of the ability of Ontario industries to accommodate price increases is undertaken in the context of an "everything else equal" world. The analysis addresses itself to the question: If nothing else changes what will be the possible burden of the cost increases on these industry groups? The analysis does not pretend to evaluate the relative importance of the cost increases vis-a-vis other changing cost factors faced by these industries, or vis-a-vis cost changes in other political jurisdictions. Clearly, for example, if every other country in the world were to impose the same thermal pollution standards the ability of Ontario producers to pass on cost increases would be easier than if the standards were to apply to the Great Lakes only.

(c) Assessment and Conclusions

It was found that the direct plus indirect effects of the waste heat standard induced cost increases, when expressed as a percent of gross profit margin, ranged from 0.1 to 4.0 per cent. In twelve industry groups the cost ratio was in the 1.0 per cent to 4.0 per cent range. This is a significant amount. The direct plus indirect cost effects, when measured as a proportion of value of shipments, ranged from approximately 0.1 to 0.8 per cent.

The ten industry groups most affected by the cost increases are set out in Table 6. Structure and performance characteristics of each of these industries is summarized and a summary statement made of the ability of each to accommodate the cost increases. A more detailed discussion of the characteristics of these 10 industries is presented in Appendix E.

Of the ten industries suffering the greatest increases in cost five will have little or no problem in increasing prices to compensate; these are petroleum refining, plastics and synthetic resins, meat and poultry processors, other non-metallic minerals, and other chemical industries. The other five may suffer varying degrees of difficulty in passing the cost increases on. These are discussed below:

(i) Other primary metals (primarily smelting and refining)

Although Canada is a very large producer of mine products there is much competition from other countries with respect to the location of smelting and refining facilities. The smelting and refining industry would appear to need every advantage possible to encourage the construction of such facilities in this country. Loss of smelting and refining capacity to other countries probably means a corresponding loss of associated metal fabricating industries.

(ii) Cotton Yarn and Cloth

A low forecast demand growth and continuing strong competition from imported materials suggest a limited ability of this group to pass on cost increases.

(iii) Synthetic Textiles

Strong demand growth is forseen for several years. Cost of resins used in the manufacture of textiles (based largely on oil and natural gas products) should be cheap compared to most countries. However cost disadvantages compared to many other producing countries will continue to be experienced with respect to labor costs, construction costs, distribution costs, and scale of operations. Import competition should remain steady.

Some difficulty may be experienced in passing on cost increases.

(iv) Pulp and Paper

Demand and prices for Ontario production should be good over the next 3 or 4 years. In the longer term the continuation of the cyclical price and profit performance of the world industry can be expected to continue. The Canadian industry which competes importantly in world markets may therefore suffer periods of low demand relative to supply making the passing on of cost increases difficult.

(v) Iron and Steel

The world steel industry has gone through cycles of over and under capacity and will probably continue to do so. The outlook for the immediate years ahead is very good however. The steel industry in Ontario is very highly concentrated and with reasonably good demand prospects should be able to pass on cost increases. In periods of low demand (compared to total world capacity) Ontario producers will face import competition from producers in Japan, Europe and the U.S.A.

TABLE 6

SUMMARY STATEMENT OF THE ABILITY OF SELECTED INDUSTRY GROUPS TO ACCOMMODATE THERMAL STANDARD INDUCED COST INCREASES [1]

Industry Group [2]	Indicators of Industry Structure or Performance										
	Degree of Concentration[3] (in market area served)	Market Factors			Forecast Demand[5] Growth Relative to supply		Industry Selling[6] Price Index (1961 = 100)		Profits Compared[7] to Average for all Mfg. Activity 1968-1970	Producer of Consumer Good or Producer Good	Barriers to Entry
		Export Oriented	Import Competition	"Effective"[4] Tariff on Imports	short term	long term	1970	July 1973			
1. Petroleum Refinery	high	no	no	high	high	high	103.1	130.6	below	consumer	high
2. Plastics and synthetic resins	high	no	yes	low	high	high	88.6	92.8	?	producer	med.
3. Pulp and paper	med.-low	yes	no	high	high	ave.	116.9	131.3	much below	producer	med.
4. Other primary metal [8]	med.	yes	no	low	high	cyclical	146.5	179.8	slightly below	producer	high
5. Cotton yarn	high	no	yes	high	low	low	108.4	130.6	much below	producer	med.
6. Meat and poultry	med.	no	no	low	ave.	ave.	(meat) 129.0 (poult.) 106.7	187.6 183.7	meat above average	consumer	low
7. Other non-metallic [9]	high	no	yes	high	ave.	ave.	(glass) 125.4 (abras.) 112.2	144.8 116.5	below	both	med.
8. Synthetic textiles	high	no	yes	high	high	high	91.4	90.9	below	producer	med.
9. Other chemicals [10]	med.	yes	yes	low	high	high	94.7	102.2	below	producer	med.
10. Iron and steel	high	some	some	low	high	ave.	112.6	132.4	slightly below	producer	med.
							all mfg. 119.1	142.8			

bility to Accommodate Cost Increases

1. High demand in short term will allow price increases. Long term outlook good on basis of good availability of petroleum feedstocks relative to other countries.

2. Excellent ability to pass on cost increases. Sales are made only in a protected domestic market.

3. Five year price outlook for industry is good. Industry must be world competitive, however. Domestic market protected by tariffs. Ability to pass on costs fair to good.

4. Smelter economics in Canada are marginal. Higher costs in Canada make location of smelters in other countries more attractive. May have to absorb increased costs.

5. Natural fibre production levels not expected to increase significantly. Most market growth will be accounted for by synthetics. Price increases may be difficult.

6. Cost increases will be passed on to consumer. Price of substitutes increasing as well.

7. Highly concentrated industries supplying construction industry materials. Likely to be able to pass on cost increases.

8. Very strong demand growth foreseen for several years. Import competition will decline somewhat. Maybe some difficulty in passing on cost increases.

9. High price expectations next 5 years. Source of feedstock materials in Canada suggests advantage for domestic producers. Will pass on cost increases.

10. Outlook is good for passing on cost increases. In periods of low demand (vs. supply) will have problems with import competition in coastal areas.

TABLE 6 (contd)

Footnotes:

1. For a fuller description of each industry group and a discussion of its ability to accommodate cost increases see Appendix E.

2. For a definition of industry groups by Standard Industrial Classification number see Table E-1, Appendix E.

3. Main source: "Concentration in the Manufacturing Industries of Canada", Department of Consumer and Corporate Affairs, 1971.

4. "Effective" industry tariff rates from: "Effective Protection in the Canadian Economy", Economic Council of Canada Special Study No 9, 1968.

5. Various sources were consulted regarding demand prospects. Considerable information was obtained from the "Outlook" papers of the National Economic Conference" (November 1973), sponsored by the Economic Council of Canada.

6. Source: SC 62-002, "Prices and Price Indexes".

7. Source: SC 61-207, "Corporation Financial Statistics, 1970". See Appendix E, Table E-4.

8. The "Smelting and Refining" industry is the largest component of this industry group and the comments regarding concentration, market factors, etc. apply specifically to the smelting industry.

9. This industry group includes glass manufacturing (the largest component), abrasives, asbestos, mineral wool and "other".

10. The largest component of this category is the "Industrial Chemicals" industry. The comments regarding concentration, market factors, etc. apply specifically to the industrial chemical industry.

3.0 IMPACTS ON FINAL DEMAND SECTORS

3.1 Results Using the Ontario Input-Output Table

The costs associated with waste heat regulation have to be borne by some sectors within the economy. The five possible candidates to assume these costs are industries which are unable to pass costs on, consumers, capital expenditures, governments and exports. Section 2.3 describes the problems selected industries may encounter in passing on cost increases; however, if we assume that industries are totally successful in passing on costs, then the four final demand categories are left as the repository of the total cost increases.

Table 7 indicates how this process would take place. The total direct costs are $40.4 million,* including both purchased electricity and other direct industrial costs. Of this total, $26.1 million goes to intermediate demands (i.e.industries) in the first instance, with residential customers consuming some $10.8 million and governments (including street lighting) consuming the remaining $3.5 million. The table shows, on a round by round basis, how the $26.1 million of industrial cost increases are further passed on; for instance, in the first round $18.4

** All costs cited here are adjusted to 1970 dollars and 1970 levels of economic activity.*

TABLE 7

ROUND BY ROUND IMPACT OF INCREASED COSTS ON FINAL DEMAND SECTORS

million $ per year *

	Direct Cost Increase	Indirect Effect of Cost Increase						Total Direct Plus Indirect
		Round 1	Round 2	Round 3	Round 4	Round 5-9	Total	
Intermediate Demand	26.1	18.4	11.6	6.6	3.8	4.4	44.8	n.a.
Final Demand								
- consumption	10.8	7.1	3.3	2.6	1.6	2.1	16.7	27.5
- investment		1.0	1.5	1.0	.5	.6	4.6	4.6
- inventory changes		.5	.2	.1	.1	.1	.9	.9
- governments	3.5	.7	.4	.2	.1	.2	1.7	5.2
- net exports		-1.6	1.4	1.1	.5	.6	2.0	2.0
Total	14.3	7.7	6.8	5.0	2.8	3.6	25.9	40.2
Total	40.4	26.1	18.4	11.6	6.6	8.0	n.a.	n.a.

Source: Table D-1, Table D-2, Table D-3, and Table D-4

n.a. - not applicable

* *1970 dollars and 1970 levels of economic activity.*

million is returned to intermediate demands and $7.7 million is passed on to final demands. Note that all final demand categories begin to share the increased costs at this point.

It is interesting to note the net export row* in Table 7 This row shows that in the first round Ontario has a net import position of $1.6 million and it is not until the second and subsequent rounds that Ontario begins to export some of this cost increase.

After nine rounds of economic activity $25.9 million of the initial $26.1 million of cost increase to intermediate demands has been passed on to final demands. This means that 99.2 per cent of the direct cost increase has been pushed on and the inflation is essentially completed.

In summary, the direct cost increase would be passed on in the following way to final demands:

	$ million	% of total
consumption	27.5	68.5
investment	4.6	11.4
inventory change	.9	2.2
governments	5.2	12.9
net exports	2.0	5.0
	40.2	100.0

* *The net trade row is derived as a residual item and includes the trade balance and federal government expenditures.*

It is useful to look at how quickly the cost increases are passed on in order to make a judgement on the amount of time that would elapse between the initiation of the price increase and their impact on manufacturers and consumers. The following table indicates the cumulative percentage of the indirect cost (i.e. the $26.1 million initially borne by industries) that has been passed at each round to the final demand categories:

	Round 1	Round 2	Round 3	Round 9
Final Demands				
- consumption	42.6	62.4	77.9	100.0
- investment	22.1	53.7	75.1	100.0
- inventory change	46.9	71.3	84.6	100.0
- governments	44.8	68.5	82.8	100.0
- net exports	-78.1	- 6.4	44.2	100.0

The table indicates that within three rounds 75 per cent to 85 per cent of cost increases have been passed to the final demand categories. Net exports are the one exception: most of the export of cost increases takes more than three rounds. If we assume a round takes 3 to 6 months then the inflation will be essentially complete within one to two years. Also this is a one time only inflationary process; i.e. the introduction of waste heat regulation pushes electric energy cost to a higher level and this cost is pushed through the economy until an equilibrium is achieved at this new price level.

By comparing these price increases by final demands to the total expenditures by these final demand categories in 1970, the magnitude of the inflation can be calculated:

	Total 1970* Expenditure ($ millions)	Cost Increase ($ millions)	% Increase
consumption	19,424	27.5	.14
investment	7,240	4.6	.06
inventory change	476	.9	.19
governments	4,289	5.2	.12
net exports	4,193	2.0	.05

Consumer expenditures would be .14 per cent higher with Case A waste heat regulations: this indicates the inflationary impact that waste heat regulation could be expected to produce on consumer costs in Ontario. Note that virtually the entire impact of these increased costs takes place in Ontario: only 5 per cent of the increased costs are exported beyond Ontario's boundaries.

* *Ontario Statistical Review, 1972.*

4.0 COMMENTARY ON THE POSSIBLE EFFECTS OF CAPITAL SPENDING

The economic impacts studied in the preceding sections are those arising from a cost-push type of price propagation: the analysis traces the inflationary effects resulting from incremental direct costs being passed on to final demand categories. Another type of impact is worth mentioning, namely: the possible effects that capital expenditures for cooling towers might produce through increasing the demand for capital and for goods and services. A perspective of the potential importance of this can be gained by examining the expenditure forecasts for cooling towers in relation to total capital spending forecasts for Canada.

The most severe case would be the spending in the early years under Case A regulations, when large expenditures would be required on the existing plants, as well as new plants under construction. In this case, the total capital expenditures over the 1975-1980 period will be $531 million, including $380 million on existing plants. If we assume that spending on the existing plants will be spread more or less uniformly over the six-year period, the average annual expenditure on cooling towers will be roughly $90 million per year in 1972 constant dollars; in current dollar values, this would be the equivalent of about $110 million in 1975, rising to $140 million in 1980.* Alternatively, if Case B regulations were adopted, spending over the 1975-1980 period would be in the order of $35 to $50 million per year, in current dollars.*

These figures can be compared with forecasts of gross fixed capital formation (private and government); one such forecast indicates total Canadian capital expenditures of $28.4 billion in 1975, rising to $46.9 billion in 1980 (in current dollars).** Thus, the Case A capital requirements would represent about 0.3 to 0.4 per cent of the forecast capital expenditures in Canada over the 1975-1980 period; this would be slightly less than one per cent of the capital expenditures in Ontario. This is a relatively small increment: too small to attempt an evaluation of its specific impact. Nevertheless, this spending could come at a time of strong demand for capital, labour and material to construct a number of large-scale energy projects in Canada, such as a Mackenzie Valley pipeline, several tar sands plants, James Bay hydro development

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** 1972 $ inflated at 6 per cent per annum.*

*** Clifford B. Jutlah, "A Long-Term Economic Forecast for Canada and Ontario," Ontario Economic Review, July/August 1973, p.17.*

and large new thermal plants in Ontario.*

In short, even a high level of spending on cooling towers would be small in comparison with other projects being considered, but it could aggravate an already difficult situation. Also, the Case A capital spending over the 1975-1980 period would represent a large increment on Ontario Hydro's borrowing requirements, at a time of strong demand for capital.

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* *For example, see: R.G. Fletcher, "The Economic Impact of the Mackenzie Valley Gas Pipeline Project,"* Ontario Economic Review, *November/December 1973.*

APPENDIX A

ELECTRICITY PRICE INCREASES IN THE ONTARIO HYDRO SYSTEM

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APPENDIX A

ELECTRICITY PRICE INCREASES IN THE ONTARIO HYDRO SYSTEM

1.0 SCOPE

This appendix provides details of the methodology used to calculate differential costs and price increases associated with waste heat management by Ontario Hydro. The actual dollar figures apply to the utilization of wet, natural draft cooling towers; but the methodology can be used for estimating price increases associated with other waste heat facilities, given the appropriate capital and operating costs.

The price increases have been calculated for the Ontario Hydro system, including the Municipal Electric Utilities supplied by Hydro, for the period 1975-2000. Two alternative cases have been examined, as follows:

Case A: assumes that cooling towers will be fitted to existing thermal plants, as well as future plants.

Case B: assumes that cooling towers will be fitted only to plant capacities scheduled for commissioning after 1975.

2.0 ELECTRICITY SUPPLY IN ONTARIO

2.1 Historical Supply

Ontario's total electrical energy requirements and sources of supply for 1961 and 1971 are shown in Table A-1. In 1971, Ontario Hydro plants* generated 88 per cent of the total electrical energy requirements of the province, up from 81 per cent in 1961. Annual generation by other Ontario utilities and industrial plants has increased slightly in absolute terms, but has declined on a percentage basis. Ontario was not self-sufficient in electrical energy over the 1961-71 period: annual net imports varied randomly between 3,400 and 5,800 million kwh.

Since 1961, most of the increase in generation has come from new thermal plants, as shown in the following comparison:

Ontario Generation by Source
million kwh

	1961		1971	
Hydro	33,737	(97%)	38,111	(56%)
Thermal	1,217	(3%)	30,529	(44%)
Total	34,954	(100%)	68,640	(100%)

Source: Statistics Canada 57-202

* *In this and subsequent discussions, the Douglas Point nuclear plant, which is owned by Atomic Energy Co. Ltd, is included in the Ontario Hydro figures.*

TABLE A-1

ONTARIO ELECTRICAL ENERGY REQUIREMENTS AND SOURCES OF SUPPLY, 1961 and 1971

(Gwh, or million kwh)

Source of Supply	1961		1971	
Generated in Ontario	34,954		68,640	
Ontario Hydro*	31,100	(81%)	64,111	(88%)
Other utilities (public and private)	1,695	(4%)	1,816	(2%)
Industrial plants	2,159	(6%)	2,713	(4%)
Ex-Provincial (Net) **	+ 3,323	(9%)	+ 4,312	(6%)
Total Requirements	38,277	(100%)	72,952	(100%)
Transmission and distribution losses	4,328		6,098	
Net Requirements	33,949		66,854	

* *Includes the Douglas Point nuclear plant which is owned by AECL*

** *Net of inter-provincial transfers, imports and exports*

Sources: Statistics Canada, 57-202

Ontario Hydro Statistical Yearbooks

2.2 Supply Forecast 1971-2000

Table A-2 shows a forecast to the year 2000 of total provincial requirements for electrical energy, the annual generation assumed from the Ontario Hydro system and the expected division of installed capacities in the Ontario Hydro system. The forecast is a composite, in that it is derived from several different sources, which are outlined in the notes accompanying the table.

The information obtained from the various sources was found to be quite consistent, but certain basic assumptions had to be made. First, it was assumed that the combined capacity of hydro, gas turbine and diesel plants would remain the same as in 1971 over the entire forecast period; in effect, any future additions are assumed to be offset by retirements from service. Secondly, it was assumed that Ontario would become self-sufficient in electrical energy supply by 1975; this would require an annual growth of about 9 per cent in Ontario Hydro's generation over the 1971-75 period. Finally it was assumed that generation from other Ontario utilities and industrial plants will stabilize at approximately 4,000 million kwh per year. This last assumption is thought to be reasonable since there hasn't been any significant increase of installed capacity in this category over the last ten years or so.

TABLE A-2

ONTARIO HYDRO SYSTEM *: INSTALLED CAPACITIES AND TOTAL GENERATION, 1971-2000

Year	Installed Capacities - MW (Ontario Hydro Plants) Hydro & Misc.**	Fossil (Steam)	Nuclear	Total	Ontario Hydro Generation Gwh	Total Provincial Require-ments Gwh
1971	6,630	5,914	1,204	13,748	64,111	72,952
1975	6,600	10,100	3,000	19,700	91,000	95,000
1980	6,600	12,200	8,200	27,000	129,000	133,000
1985	6,600	14,700	16,700	38,000	181,000	185,000
1990	6,600	17,200	30,700	54,500	262,000	266,000
1995	6,600	23,000	45,000	74,600	363,000	367,000
2000	6,600	28,900	66,700	102,200	502,000	506,000

* *Includes Douglas Point nuclear plant owned by AECL (182 MW)*

** *Includes gas turbines and diesel (372 MW in 1971)*

*** *Total provincial requirements includes generation by other Ontario utilities and industrial plants and purchased ex-provincial energy which were as follows in 1971:*

Other Ontario utilities and industries:	*+ 4,529*	*Gwh*
Net, inter-provincial transfers, imports and exports:	*+ 4,312*	*Gwh*

TABLE A-2 (cont'd)

Notes on Sources

Total Provincial Requirements

1971 : Statistics Canada, 57-202

1990 : Forecast by Ontario Advisory Committee on Energy, in Energy in Ontario, The Outlook and Policy Implications, Volume Two

2000 : estimated on basis of 6.6% annual load growth 1990-2000

Intermediate years : interpolated using average annual growth rates

Ontario Hydro Generation

1971 : Ontario Hydro Statistical Yearbook 1971

1975-2000 : Total provincial requirements less 4,000 Gwh generation from other utilities and industrial plants (assumed)

Installed Capacities (Ontario Hydro System)

1971 : Ontario Hydro Statistical Yearbook 1971

1975 : Proposed plant additions from: Department of Energy, Mines and Resources, Electric Power in Canada, 1971

2000 : Thermal plants from: Acres, Thermal Inputs to the Great Lakes 1968-2000, February 1970. Thermal plant forecast supplied by Ontario Hydro. Hydro, gas turbine and diesel plant capacities assumed the same as in 1971.

Intermediate years : estimated

The foregoing assumptions are such that subsequent estimates of Ontario Hydro price increases due to waste heat management will err on the high side, if at all - provided that the forecast of total electrical energy requirements is acceptable. This is so for the following reasons:

(i) The proportion of total provincial requirements supplied from Ontario Hydro plants is the maximum that can be expected;

(ii) The steam thermal component of total system capacity is about the maximum that can be expected;

(iii) The split of steam thermal capacity between fossil and nuclear plants represents a high nuclear configuration.

3.0 COSTS OF WET, NATURAL-DRAFT COOLING TOWERS

3.1 Definition of Costs

All costs given here are incremental values; they represent the increases in capital and operating costs that would be incurred if wet, natural-draft cooling towers were installed on thermal plants, instead of the conventional, once-through cooling systems now in use.

Capital costs are assumed to include all costs associated with construction, including engineering and contractors' overhead costs. Operating costs cover such items as operating labour and supplies, maintenance, fuel, and the like; they do not include any allowance for interest or depreciation charges.

3.2 Unit Costs

Table A-3 summarizes capital and operating unit cost differentials between wet cooling towers and conventional once-through cooling systems. These figures were adapted from Ontario Hydro estimates,* although some restructuring has been made as noted below.

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* *Ontario Hydro, Report Number 177-61*

Table A-3

UNIT COST DIFFERENTIALS: WET COOLING TOWERS VS. CONVENTIONAL ONCE-THROUGH COOLING

$ per KW of installed capacity (1972 $)

	Fossil Plants		Nuclear Plants	
	Capital Costs $/KW	Operating Costs $/KW/yr	Capital Costs $/KW	Operating Costs $/KW/yr
New Plants				
Cooling facilities	6.90	0.13	11.60	0.19
Power reduction	4.70	0.48	12.70	0.43
Total	11.60	0.61	24.30	0.62
Existing Plants with Once-Through Cooling Installed				
Total	23.20	1.22	48.60	1.24

All values represent additional capital and operating costs of wet, natural draft cooling towers relative to conventional, once-through cooling systems.

The estimated capital and operating costs of the cooling facilities for new plants were obtained directly from Ontario Hydro figures. However, Hydro presented the power reduction* costs for new plants on a mills per kwh basis, including allowances for interest and amortization of capital costs. The Hydro figures were separated into capital and operating components as follows:

(i) Per cent reductions in power output were taken from Hydro's figures: 2.34 per cent for fossil plants and 3.18 per cent for nuclear plants;

(ii) Capital costs of fossil and nuclear plant capacity, required to make up the power reduction, were estimated at $200 and $400 per KW of power reduction respectively;

(iii) Operating costs, required to make up the power reduction, were estimated on the basis of 4.7 mills per kwh for fossil plants operating at 50 per cent plant factor, and 2.2 mills per kwh for nuclear plants operating at 70 per cent plant factor.

The values derived by the above procedures, and shown in Table A-3, are identical to Ontario Hydro's mills per

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* *The cooling towers require additional pumping power and reduce the turbine output.*

kwh figures if capital costs are converted to annual costs on the basis of 8 per cent interest and amortization over 30 years.

Ontario Hydro did not give specific estimates of differential costs applicable to existing plants. Hydro noted that "retrofit of cooling towers to a station

> designed to operate on a once-through cooling system would cost considerably more and incur significantly higher loss of plant output. Although a thorough analysis of the cost of such an installation has not been made it is believed that Total Evaluated Costs could be double those shown for new plant."

In the absence of more specific information, the capital and operating costs of fitting cooling towers to existing plants have been assumed to be double the corresponding costs for new plants.

3.3 Capital and Operating Cost Schedules

Tables A-4(a) and A-4(b) show the incremental capital and operating costs that would be incurred by Ontario Hydro, over the 1975-2000 period, as a result of adopting wet cooling towers.

Two alternative cases are examined:

Case A (Table A-4(a)): gives the costs that would be incurred if cooling towers were fitted to existing as well as future thermal plants;

Case B (Table A-4(b)): gives the costs that would be incurred if cooling towers were fitted only to future plants.

In these schedules, capital expenditures are assumed to be made at the same rate as new capacity is added to the system. For example, between 1975 and 1980 the estimated increase in fossil capacity is 2,100 MW (Table A-2); the corresponding incremental capital cost of cooling towers during the period is estimated at $24 million - 2.1 million KW times $11.60 per KW. All capacity added to the system after 1975 is estimated at the unit costs for new plants; all capacity which is either now on line or scheduled for commissioning through 1975 is estimated at the higher unit costs for existing plants.

Total cash flows over the 1975-2000 period are shown in Table A-5, for Cases A and B; also shown are the present values of the cash flows, discounted at 8 per cent per annum.

TABLE A-4(a)

CAPITAL AND OPERATING COST SCHEDULES: ONTARIO HYDRO PLANTS

CASE A: Cooling Towers on Existing and New Plants

(All $ figures are millions of 1972 constant $)

	Fossil Plants			Nuclear Plants			Total, All Plants		
	Capital Costs - $		Oper. Costs	Capital Costs - $		Oper. Costs	Capital Costs - $		Oper. Costs
	During Period	Accumul. Total	$/yr	During Period	Accumul. Total	$/yr	During Period	Accumul. Total	$/yr
	234			146			380		
1975		234	12.3		146	3.7		380	16.0
	24			127			151		
1980		258	13.6		273	6.9		531	20.5
	29			207			236		
1985		287	15.1		480	12.2		767	27.3
	29			340			369		
1990		316	16.6		820	20.9		1,136	37.5
	67			348			415		
1995		383	20.1		1,168	29.8		1,551	49.9
	69			527			596		
2000		452	23.7		1,695	43.3		2,147	67.0

Notes:

1. See Table A-2 for plant capacities and Table A-3 for unit capital and operating costs.
2. All costs are incremental values representing the differences between wet cooling towers and conventional once-through cooling systems.

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TABLE A-4(b)

CAPITAL AND OPERATING COST SCHEDULES: ONTARIO HYDRO PLANTS

CASE B: Cooling Towers on New Plants Only

(All $ figures are millions of 1972 constant $)

Year	Fossil Plants: Capital Costs - $ Increment	Fossil Plants: Capital Costs - $ Total	Fossil Plants: Oper. Costs $/yr	Nuclear Plants: Capital Costs - $ Increment	Nuclear Plants: Capital Costs - $ Total	Nuclear Plants: Oper. Costs $/yr	Total, All Plants: Capital Costs - $ Increment	Total, All Plants: Capital Costs - $ Total	Total, All Plants: Oper. Costs $/yr
1975		0	0		0	0		0	0
	24			127			151		
1980		24	1.3		127	3.2		151	4.5
	29			207			236		
1985		53	2.8		334	8.5		387	11.3
	29			340			369		
1990		82	4.3		674	17.2		756	21.5
	67			348			415		
1995		149	7.8		1,022	26.1		1,171	33.9
	69			527			596		
2000		218	11.4		1,549	39.6		1,767	51.0

See Notes Table A-4(a)

TABLE A-5

CASH FLOW AND PRESENT VALUES 1975-2000: ONTARIO HYDRO PLANTS

(Millions of 1972 $)

	Case A: Existing and New Plants				Case B: New Plants Only			
	Cash Flow			Present Value *	Cash Flow			Present Value *
	Capital	Operat.	Total		Capital	Operat.	Total	
1975	380	16	396	367	0	0	0	0
1976-1980	151	94	245	180	151	14	165	121
1981-1985	236	122	358	179	236	42	278	139
1986-1990	369	164	533	181	369	84	453	154
1991-1995	415	225	640	149	415	145	560	130
1996-2000	596	300	896	142	596	220	816	129
Total 1975-2000	2,147	921	3,068	1,198	1,767	505	2,272	673

* *Present values calculated at a discount rate of 8% per annum.*

4.0 ELECTRICITY PRICE INCREASES

4.1 Introduction

If Ontario Hydro were to make incremental expenditures for cooling facilities, as outlined in the preceding section, they would have to collect additional revenues to recover their increased operating costs and capital expenditures. Ontario Hydro would collect these additional revenues through higher rates on the sale of electricity to their direct customers and to the Municipal Electrical Utilities which purchase wholesale power from Hydro. The Municipal Utilities, in turn, would pass on the increased costs to their customers. Hence, any increased costs borne by Ontario Hydro will be translated into higher electricity prices to the ultimate users of the electricity.

Tables A-6(a) and A-6(b) show the additional revenues that would be required by Ontario Hydro, over the 1975-2000 period, to recover the incremental capital and operating costs of cooling towers. The tables also show the average increases in electricity prices to the ultimate users. Details of the methodology used to calculate revenues and price increases are discussed in the following sections.

TABLE A-6(a)

CALCULATION OF AVERAGE PRICE INCREASES, 1975-2000

CASE A: Cooling Towers On Existing and New Plants

Rate of Return = 8% per annum; 1972 constant $

Year	Accum. Capital Costs million $	Deprec. Value Assets @ Year-end million $	Annual Incremental Revenues million $ per year				Gross Generation by Ontario Hydro Gwh	Net Sales to Ultimate Customers Gwh	Average Price Increase Mills /kwh
			Oper. Costs	Deprec.	Return on Net Assets	Total			
1975	380	369	16.0	11.4	29.5	56.9	91,000	83,000	0.69
1980	531	451	20.5	13.9	36.1	70.5	129,000	119,000	0.59
1985	767	598	27.3	18.5	47.8	93.6	181,000	167,000	0.56
1990	1,136	844	37.5	26.1	67.5	131.1	262,000	241,000	0.54
1995	1,551	1,095	49.9	33.8	87.6	171.3	363,000	334,000	0.51
2000	2,147	1,473	67.0	45.5	117.8	230.3	502,000	462,000	0.50

Note: All costs and prices are incremental values representing the differences between wet cooling towers and conventional once-through cooling systems.

TABLE A-6(b)

CALCULATION OF AVERAGE PRICE INCREASES, 1975-2000

CASE B: Cooling Towers on New Plants Only

Rate of Return = 8% per annum; 1972 constant $

Year	Accum. Capital Costs million $	Deprec. Value of Assets @ Year-end million $	Annual Incremental Revenues million $ per year				Gross Generation by Ontario Hydro	Net Sales to Ultimate Customers Gwh	Average Price Increase Mills /kwh
			Oper. Costs	Deprec.	Return on Net	Total			
1975	0	0	0	0	0	0	91,000	83,000	0
1980	151	137	4.5	4.2	11.0	19.7	129,000	119,000	0.17
1985	387	332	11.3	10.2	26.5	48.0	181,000	167,000	0.29
1990	756	618	21.5	19.1	49.4	90.0	262,000	241,000	0.37
1995	1,171	903	33.9	27.9	72.2	134.0	363,000	334,000	0.40
2000	1,767	1,310	51.0	40.5	104.8	196.3	502,000	462,000	0.43

Note: All costs and prices are incremental values representing the differences between wet cooling towers and conventional once-through cooling systems.

TABLES A-6(a) and A-6(b) (cont'd)

Notes:

1. Capital expenditures are assumed to be made at the beginning of the year.

2. Depreciation is calculated using the straight line method and an average rate of 3% per annum.

3. Capital and operating costs are from Table A-4(a) and (b).

4. Return on assets calculated at 8% of the depreciated value at year-end.

5. Gross generation is from Table A-2.

6. Net sales to ultimate customers calculated at 92% of gross generation by Ontario Hydro; based on 8% losses in transmission and distribution.

4.2 Financial Parameters Used to Calculate Incremental Revenues

Annual incremental revenues are shown in Tables A-6(a) and A-6(b) as the sum of three components - operating costs, depreciation and return on net assets. The method of calculating these revenue requirements generally conforms with the financial policy recommendations of Task Force Hydro,* although certain specific assumptions were made as noted below.

Depreciation was calculated using the "straight-line" method, at a rate of 3.0 per cent per annum. Hydro has used the straight-line method of depreciation since January 1971 for all new power supply facilities, and this decision has been supported by Task Force Hydro. The 3.0 per cent rate is our estimated figure: it is a typical rate for thermal-electric facilities.

Residual revenues are required, after recovery of operating costs and depreciation, to provide a suitable rate of return on the net asset value of the cooling facilities; these were calculated in the following manner:

(i) Depreciation was calculated on the assumption that capital expenditures were made at the beginning of

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* *Task Force Hydro, Hydro in Ontario - Financial Policy and Rates, Report Number Four, April 1973.*

each year;

(ii) Net value of assets at year-end are the accumulated capital costs less the accumulated depreciation, including depreciation for the year in question;

(iii) Revenues required to make up the return on net assets were calculated at 8 per cent of the depreciated value of assets at year-end.

Task Force Hydro did not recommend a specific long term rate of return for Ontario Hydro; rather it was recommended that "Hydro take the initiative with Government in undertaking a periodic review of Hydro's financial performance, using rate of return on net assets as a principal criterion."* It was further recommended that "Hydro take whatever steps are necessary to prevent any further increase in its debt/equity ratio."** Rates of return required over the short term to achieve a stabilized debt/equity ratio were estimated by Task Force Hydro as follows: ***

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* *Task Force Hydro, Report Number Four, p. 28.*

** *Ibid, p. 20.*

*** *Ibid, p. 23.*

	Rate of Return for Stabilized Debt/Equity Ratio (79:21)
	%
1974	7.8
1975	8.1
1976	7.7
1977	8.3

Hence, the 8 per cent rate of return on net assets, as used in the calculation of incremental revenues, is consistent with Task Force Hydro recommendations over the near term.

4.3 Average Electricity Price Increases

Average price increases to the ultimate customers, listed in Tables A-6(a) and A-6(b), were estimated by dividing Ontario Hydro's annual incremental revenues by the estimated annual net sales to ultimate customers. Net sales were estimated at 92 per cent of Ontario Hydro's forecast gross generation; the remaining 8 per cent is an allowance for transmission and distribution losses by Hydro and the municipal utilities, and corresponds to the actual 1971 value.

APPENDIX B

COSTS OF OTHER INDUSTRIAL WASTE HEAT MANAGEMENT

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APPENDIX B

COSTS OF OTHER INDUSTRIAL WASTE HEAT MANAGEMENT

1.0 SCOPE

This appendix provides details of the methodology used to calculate differential costs associated with waste heat management by industrial enterprises other than Ontario Hydro. Two sources of industrial waste heat are examined - discharges from privately-owned thermal-electric plants and process heat rejected from steel plants.

As in Appendix A, the cost analysis is made for wet cooling towers; and two alternative cases have been examined, as follows:

Case A: assumes that cooling towers will be fitted to existing plants, as well as future plants;

Case B: assumes that cooling towers will be fitted only to plant capacities scheduled to commence operation after 1975.

2.0 HISTORICAL AND FORECAST PRODUCTION

2.1 Privately-Owned Thermal-Electric Plants

In 1970, there were eight privately-owned thermal-electric plants* discharging waste heat to the Great Lakes. As shown in Table B-1, these plants have a total capacity of 190 MW, spread over five industry classifications - motor vehicles, chemicals, pulp and paper, iron and steel, and distilleries.

It has been assumed that there will not be any future additions to privately-owned thermal-electric generation. This assumption is thought to be reasonable because there has not been any capacity increase since 1963, and so far as is publicly known, none is scheduled over the next five years.** Also, this assumption is consistent with cost forecasts developed for the Ontario Hydro system,*** where it was assumed generation from other Ontario utilities and industrial plants would remain at or below 1971 levels through to the year 2000.

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* *Includes all plants 5 MW and larger*

** *For example, see Energy, Mines and Resources, Electric Power in Canada, 1971*

*** *Appendix A*

2.2 Iron and Steel Process Heat

In 1970, iron and steel plants located on the Great Lakes produced approximately 9.3 million tons of crude steel.* Using Acres' heat rejection rates,** the waste process heat from this level of production would amount to 620 million Btu per hour, which is the equivalent of a 160 MW fossil-fueled thermal-electric plant operating at rated capacity.

Acres' forecast of 16.5 million tons of crude steel production in the year 2000 was adopted for the Great Lakes plants. It was assumed that steel production will increase linearly from 9.3 million tons in 1970 to 16.5 million tons in the year 2000.

3.0 ESTIMATED COSTS OF COOLING TOWERS

3.1 Thermal-Electric Plants

Table B-1 shows the estimated annual costs, on an industry by industry basis, of fitting cooling towers to the existing, privately-owned thermal plants. These annual

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* *Energy, Mines and Resources, Canadian Minerals Yearbook, 1970*

** *H.G. Acres Ltd, Thermal Inputs to the Great Lakes, 1968-2000, February 1970*

TABLE B-1

PRIVATELY-OWNED THERMAL PLANTS: 1970 INSTALLED CAPACITIES AND ANNUAL COSTS OF COOLING TOWERS

Industry	1970 Installed Capacity* MW	Annual Cost of Cooling Towers** million $/year	
		1975	2000
Motor Vehicles	64	0.29	0.19
Chemicals	43	0.19	0.12
Pulp and Paper	42	0.19	0.12
Iron and Steel	36	0.16	0.11
Distilleries	5	0.02	0.01
Totals	190	0.85	0.55

* *Privately-owned thermal plants discharging waste heat to the Great Lakes; includes all plants 5 MW or larger.*

Capacities from Energy, Mines and Resources, Electric Power in Canada, 1970

** *Annual costs include operation, replacement of power reduction, depreciation and the cost of capital (for derivation see attached notes). All costs are in constant 1972 $. Variation between 1975 and 2000 is linear.*

TABLE B-1 (cont'd)

Calculation of Costs

1. Capital costs of cooling facilities

   Unit cost: $14 per installed KW (1972 $)

2. Annual costs: $ per installed KW per year (1972 $)

	1975	2000
(i) Cooling facilities, operation and maintenance:	0.25	0.25
(ii) Replacement of power reduction with purchased power: (4% power reduction 50% plant factors 10 mills per kwh)	1.75	1.75
(iii) Depreciation (3% p.a.):	0.42	0.42
(iv) Opportunity cost of capital (15% of net asset value)	2.04	0.46
Total, Annual Costs	4.46	2.88

costs include operation, replacement of power reduction with purchased electricity, depreciation, and the cost of capital.

The unit cost and other financial parameters used in estimating annual costs are set out in the notes accompanying the table. It should be noted that the true cost to individual plant owners, of regulations that would make cooling towers mandatory, is very difficult to estimate with any certainty. All of the plants are old: the first units were installed between 1928 and 1948 and the most recent unit was added in 1963; hence some of the companies might choose to retire plants, rather than comply with new standards. Also, data on annual generation from individual plants are not publicly available; the 50 per cent plant factor assumed in the analysis is, at best, a reasonable estimate of the average for all plants. In view of these uncertainties, we have assumed a relatively high opportunity cost of capital - 15 per cent of the net asset value of the cooling facilities.

3.2 Iron and Steel Process Heat

Table B-2 shows the estimated annual costs of cooling towers associated with a crude steel production of ten million tons per year. These costs include operation,

TABLE B-2

ESTIMATED COSTS OF COOLING TOWERS FOR IRON AND STEEL PROCESS HEAT*

For annual production of 10 million tons from Great Lakes plants.

1. Heat rejection

Heat rejection rate: 670 million Btu/hr

(Source: Acres, Thermal Inputs to the Great Lakes, 1968-2000, Appendix G, February 1970)

Fossil thermal heat rejection rate: 3,900 Btu/hr

Hence, steel plant process heat is equivalent to 170 MW fossil-fueled thermal plant.

2. Capital costs of cooling facilities

$14 per KW, 170 MW: $2.4 million

3. Annual costs

$ million per year

		1975	2000
(i)	Operation and maintenance:	0.04	0.04
(ii)	Depreciation (3% p.a.):	0.07	0.07
(iii)	Opportunity cost of capital: (15% of net asset value)	0.35	0.08
	Total, Annual Costs (the costs decline linearly between 1975 and 2000)	0.46	0.19

* *All costs are 1972 $. Heat rejection from thermal-electric plants is excluded (see Table B-1)*

depreciation and the cost of capital, and can be applied to future as well as existing plants. The estimates are based on unit costs for equivalent thermal-electric plants; procedures used in calculating costs are set out in the table.

3.3 Total Costs of Other Industrial Waste Heat Management

Table B-3 shows the total annual costs to industries of regulations requiring cooling towers for waste heat management. These costs are in 1972 dollars, and include operating expenses, replacement of thermal power reduction where applicable, depreciation and the cost of capital.

The industrial cost estimates are of a very preliminary nature: they are considered to be indicative of the order of magnitude, but little better.

TABLE B-3

ANNUAL COSTS* OF COOLING TOWERS FOR OTHER INDUSTRIAL WASTE HEAT

Million $ per year (1972 $)

Industry	Year	Case A: Existing and New Plants			Case B: New Plants only		
		Thermal-Electric	Process Heat	Total	Thermal-Electric	Process Heat	Total
Motor Vehicles	1975	0.29	-	0.29	-	-	-
	2000	0.19	-	0.19	-	-	-
Chemicals	1975	0.19	-	0.19	-	-	-
	2000	0.12	-	0.12	-	-	-
Pulp and Paper	1975	0.19	-	0.19	-	-	-
	2000	0.12	-	0.12	-	-	-
Iron and Steel	1975	0.16	0.48	0.64	-	-	-
	2000	0.11	0.41	0.52	-	0.21	0.21
Distilleries	1975	0.02	-	0.02	-	-	-
	2000	0.01	-	0.01	-	-	-
Totals	1975	0.85	0.48	1.33	-	-	-
	2000	0.55	0.41	0.96	-	0.21	0.21

* *Annual costs include operation, replacement of thermal power reduction, depreciation and the cost of capital*

TABLE B-3 (cont'd)

Notes:

Case A:

- thermal-electric costs are from Table B-1
- process heat unit costs are from Table B-2, adjusted for an annual steel production of 10.5 million tons in 1975, increasing to 16.5 million tons in 2000

Case B:

- thermal-electric costs are zero on assumption that there will be no new industry-owned thermal plants
- process heat unit costs are from Table B-2, adjusted for the following schedule of additional steel production after 1975

Year	Total Production	Added after 1975
	million tons/year	
1975	10.5	-
1980	11.7	1.2
1985	12.9	2.4
1990	14.1	3.6
1995	15.3	4.8
2000	16.5	6.0

APPENDIX C

MINING AND MANUFACTURING STATISTICS FOR ONTARIO

Table C-1: Value of Shipments, Quantity and Value of Purchased Electrical Energy Used in Mining and Manufacturing, Ontario, 1966 and 1970

Table C-2: Industries Purchasing the Largest Quantity of Electrical Energy, Ontario, 1966 and 1970

Table C-3: Quantity of Purchased Electrical Energy Used per Dollar Value of Shipments in Mining and Manufacturing, Ontario, 1966 and 1970

Table C-4: Industries Purchasing the Largest Quantity of Electrical Energy per Dollar Value of Shipments, Ontario, 1966 and 1970

Table C-5: Value of Shipments, Value Added Minus Wages and Salaries, and Quantity and Value of Purchased Electricity in Mining and Manufacturing, Ontario, 1970

TABLE C-1

VALUE OF SHIPMENTS,[1] QUANTITY AND VALUE OF PURCHASED ELECTRICAL ENERGY[2] USED IN MINING AND MANUFACTURING, ONTARIO, 1966 and 1970

65 Industry Aggregation Number	Industry[3]	1966			1970		
		Value of Shipments $,000	Electricity Purchased Quantity ,000 kwh	Electricity Purchased Value $,000	Value of Shipments $,000	Electricity Purchased Quantity ,000 kwh	Electricity Purchased Value $,000
4-7	Mining	1,437,384	2,084,837	12,604	1,492,647	3,263,562	21,549
8	Meat and Poultry Processors	688,279	162,254	1,582	838,209	185,518	1,856
9	Dairy Factories	450,772 *	137,365	1,658	482,912	149,901	1,891
10	Fruit and Vegetable Canners and Preservers	288,522	72,520	941	329,076	98,231	1,109
11	Feed, Flour, Cereal Manufacturing	323,622	148,765	1,651	369,433	236,420	2,036
12	Biscuit and Bakery Industries	228,614	71,383	762	256,037	89,389	968
13	Sugar, Confectionery Manufacturing	148,211 *	61,949	563	183,439 *	67,376	681
14	Other Food Industries	383,630 *	165,091	1,328	489,178 *	206,353	1,822
15	Soft Drink Manufacturing	91,550	20,359	269	137,065	30,918	410
16	Alcoholic Beverage Manufacturing	324,779	111,827	833	400,001	134,994	1,203
17	Tobacco Products Industries	212,271	35,907	370	292,787	57,432	570
18	Rubber Products Manufacturing	407,506	353,210	2,704	461,531	372,396	3,405
19	Leather Products Manufacturing	180,053	50,879	653	188,552	61,471	786
20	Synthetic Textile Mills	174,688 *	333,739	1,924	219,819 *	432,912	2,931

TABLE C-1 (cont'd)

VALUE OF SHIPMENTS,[1] QUANTITY AND VALUE OF PURCHASED ELECTRICAL ENERGY[2] USED IN MINING AND MANUFACTURING, ONTARIO, 1966 and 1970

65 Industry Aggregation Number	Industry[3]	1966			1970		
		Value of Shipments $,000	Electricity Purchased Quantity ,000 kwh	Electricity Purchased Value $,000	Value of Shipments $,000	Electricity Purchased Quantity ,000 kwh	Electricity Purchased Value $,000
21	Cotton, Yarn and Cloth	58,995 *	79,935	595	56,648 *	81,194	694
22	Knitting Mills	110,742	33,135	386	105,259	39,760	478
23	Clothing Industries	283,002	34,416	518	308,328	36,405	587
24	Other Textile Industries	328,082 *	135,548	1,220	404,412 *	137,840	1,508
25	Sawmills	90,446	35,835	558	99,022	56,583	941
26	Furniture and Fixture Industries	294,291	73,255	1,092	361,445	101,714	1,589
27	Other Wood Industries	183,205	87,115	1,049	217,899	95,472	1,321
28	Pulp and Paper Millsl	622,102	3,824,797	18,904	732,424	3,959,071	26,076
29	Other Paper Industries	479,715	231,265	2,004	581,487	255,707	2,589
30	Printing and Publishing	638,592	182,827	1,990	800,600	225,977	2,626
31	Iron and Steel Mills	1,017,974	2,648,304	15,870	1,317,165	3,167,497	22,972
32	Smelting and Refining	157,378	1,265,909	6,725	212,184	1,571,782	10,041
33	Other Primary Metal Industries	610,235	501,499	4,678	754,023	645,997	6,925
34	Fabricated Structural Metal	210,233	52,447	599	232,252	52,334	728

TABLE C-1 (cont'd)

VALUE OF SHIPMENTS,[1] QUANTITY AND VALUE OF PURCHASED ELECTRICAL ENERGY[2] USED IN MINING AND MANUFACTURING, ONTÁRIO, 1966 and 1970

65 Industry Aggregation Number	Industry[3]	1966			1970		
		Value of Shipments $,000	Electricity Purchased Quantity ,000 kwh	Electricity Purchased Value $,000	Value of Shipments $,000	Electricity Purchased Quantity ,000 kwh	Electricity Purchased Value $,000
35	Metal Stamping, Pressing and Coating Industries	437,770	170,277	1,795	573,378	219,710	2,760
36	Other Metal Working Industries	989,370	420,386	4,528	1,241,943	504,368	6,244
37	Manufacturers of Machinery	1,073,080	326,403	3,213	1,317,722	411,548	4,670
38	Aircraft and Parts Manufacturing	278,288	90,604	822	256,803	105,025	1,049
39	Motor Vehicle and Trailer Manufacturing	2,131,973	488,111	3,622	2,779,818	618,967	5,466
40	Motor Vehicle Parts Manufacturing	839,854	479,908	4,329	1,243,019	722,466	7,327
41	Other Transportation Equipment Manufacturing	155,310	61,724	569	170,937	59,145	681
42	Electrical Appliance Manufacturing	331,961	140,894	1,334	325,963	103,164	1,277
43	Manufacturing of Electric Industrial Equipment	355,251	183,846	1,533	417,163	198,769	2,021
44	Mfg. of Communication Equipment including Wire	483,574	265,442	1,699	601,890	291,166	2,819
45	Other Electrical Products Manufacturing	332,955	96,508	960	394,085	117,531	1,325
46	Manufacturing of Clay, Lime and Cement	312,749 *	570,526	4,137	361,352 *	564,721	4,859
47	Manufacturing of other Non-Metal Mineral Products	238,713 *	1,153,115	6,281	305,007 *	1,160,196	7,960
48	Petroleum and Coal Products Industries	525,150	585,576	3,607	618,658	839,417	6,031

TABLE C-1 (cont'd)

VALUE OF SHIPMENTS,[1] QUANTITY AND VALUE OF PURCHASED ELECTRICAL ENERGY[2] USED IN MINING AND MANUFACTURING, ONTARIO, 1966 and 1970

65 Industry Aggregation Number	Industry[3]	1966			1970		
		Value of Shipments $,000	Electricity Purchased Quantity ,000 kwh	Electricity Purchased Value $,000	Value of Shipments $,000	Electricity Purchased Quantity ,000 kwh	Electricity Purchased Value $,000
49	Plastic Manufacturing and Synthetic Resins	74,040 *	64,217	489	84,571	95,050	817
50	Paint and Varnish Manufacturing	117,355	30,877	320	138,346	38,047	486
51	Pharmaceutical, Soap and Toiletry Products Mfg.	395,696	92,409	851	510,528	124,847	1,261
52	Other Chemical Industries	727,839 *	3,143,461	18,622	844,045	3,877,171	24,952
53	Miscellaneous Manufacturing Industries	664,157	270,323	3,051	993,220	482,019	5,438

Notes on Sources

1. Source: Statistics Canada 31-203, 31-206, Resourcecon

In order to satsify the confidentiality requirements of the Statistics Act, value of shipments information was unavailable for those Ontario-based industries or component sectors of industries marked with an asterisk (*) in the preceding table. Where this deficiency occurred, estimates of the value of shipments were calculated taking into consideration statistics published for the industry or component sectors for other provinces and for the activity on a nationwide basis.

In the majority of instances where value of shipments information was not provided for an Ontario-based activity, data was available for one or more other provinces, most commonly Quebec. For purposes of explanation consider the example of the synthetic textile industry. Based on statistics published in Statistics Canada 31-203, the value of shipments of synthetic textile mills for all of Canada during 1970 was $481.8 million and of this total $241.5 million was produced by establishments based in Quebec. The residual ($240.3 million) was produced by mills located in four other provinces including Ontario. The industry is comprised of 101 establishments, 54 being located in Quebec, 43 in Ontario and 4 distributed among three other provinces. For purposes of estimation it was assumed that the value of shipments per plant in Ontario would equal the average value of shipments per establishment of plants located outside Quebec. This average was calculated to be $5.1 million and when multiplied by 43, the number of synthetic textile mills located in Ontario, the result, $219.8 million, represented an approximation of the value of shipments of Ontario based firms in this activity.

In the case of the food and beverage and non metallic mineral industries data deficiencies within some sub-sectors required that the method outlined above be used to arrive at approximations for the value of shipments.

2. Source: Statistics Canada

3. The industries designated in this table conform to those identified in the 65 industry aggregation of the Canadian Input-Output Model.

TABLE C-2

INDUSTRIES PURCHASING THE LARGEST QUANTITY OF ELECTRICAL ENERGY, ONTARIO, 1966 and 1970

1966			1970		
Rank	Industry	Quantity ,000 Kwh	Rank	Industry	Quantity ,000 Kwh
1	Pulp and Paper Mills	3,824,797	1	Pulp and Paper Mills	3,959,071
2	Other Chemical Industries	3,143,461	2	Other Chemical Industries	3,877,171
3	Iron and Steel Mills	2,648,304	3	Mining	3,263,562
4	Mining	2,084,837	4	Iron and Steel Mills	3,167,497
5	Smelting and Refining	1,265,909	5	Smelting and Refining	1,571,782
6	Other Non Metallic Mineral Pr.	1,153,115	6	Other Non Metallic Mineral Pr.	1,160,196
7	Petroleum and Coal Products	585,576	7	Petroleum and Coal Products	839,417
8	Clay, Lime and Cement Mfg.	570,526	8	Motor Vehicle Parts Mfg.	722,466
9	Other Primary Metal Industries	501,499	9	Motor Vehicle and Trailer Mfg.	618,967
10	Motor Vehicle and Trailer Mfg.	488,111	10	Other Primary Metal Industries	645,997
11	Motor Vehicle Parts Mfg.	479,908	11	Clay, Lime and Cement Mfg.	564,721
12	Other Metal Working Industries	420,386	12	Other Metal Working Industries	504,368
13	Rubber Products Mfg.	353,210	13	Miscellaneous Mfg. Industries	482,019
14	Synthetic Textile Mills	333,739	14	Synthetic Textile Mills	432,912
15	Mfrs. of Machinery	326,403	15	Mfrs. of Machinery	411,548

Source: Table C-1

TABLE C-3

QUANTITY OF PURCHASED ELECTRICAL ENERGY USED PER DOLLAR VALUE OF SHIPMENTS IN MINING AND MANUFACTURING, ONTARIO, 1966 and 1970

65 Industry Aggregation Number	Industry	Quantity of Electrical Energy Purchased per Dollar Value of Shipments (Kwh)	
		1966	1970
4-7	Mining	1.45	2.19
8	Meat and Poultry Processors	.24	.22
9	Dairy Factories	.30	.31
10	Fruit and Vegetable Canners and Preservers	.25	.30
11	Feed, Flour, Cereal Manufacturing	.46	.64
12	Biscuit and Bakery Industries	.31	.35
13	Sugar, Confectionery Manufacturing	.42	.37
14	Other Food Industries	.43	.42
15	Soft Drink Manufacturing	.22	.23
16	Alcoholic Beverage Manufacturing	.34	.34
17	Tobacco Products Industries	.17	.20
18	Rubber Products Manufacturing	.87	.81
19	Leather Products Manufacturing	.28	.33
20	Synthetic Textile Mills	1.91	1.97

TABLE C-3 (cont'd)

QUANTITY OF PURCHASED ELECTRICAL ENERGY USED PER DOLLAR VALUE OF SHIPMENTS IN MINING AND MANUFACTURING, ONTARIO, 1966 and 1970

65 Industry Aggregation Number	Industry	Quantity of Electrical Energy Purchased per Dollar Value of Shipments (Kwh)	
		1966	1970
21	Cotton, Yarn and Cloth Mills	1.36	1.43
22	Knitting Mills	.30	.38
23	Clothing Industries	.12	.12
24	Other Textile Industries	.41	.34
25	Sawmills	.40	.57
26	Furniture and Fixture Industries	.25	.28
27	Other Wood Industries	.48	.44
28	Pulp and Paper Mills	6.15	5.41
29	Other Paper Industries	.48	.44
30	Printing and Publishing	.29	.28
31	Iron and Steel Mills	2.60	2.40
32	Smelting and Refining	8.04	7.41
33	Other Primary Metal Industries	.82	.86
34	Fabricated Structural Metal Industries	.25	.23

TABLE C-3 (cont'd)

QUANTITY OF PURCHASED ELECTRICAL ENERGY USED PER DOLLAR VALUE OF SHIPMENTS IN MINING AND MANUFACTURING, ONTARIO, 1966 and 1970

65 Industry Aggregation Number	Industry	Quantity of Electrical Energy Purchased per Dollar Value of Shipments (Kwh)	
		1966	1970
35	Metal Stamping, Pressing and Coating Industries	.39	.38
36	Other Metal Working Industries	.42	.41
37	Manufacturers of Machinery	.30	.31
38	Aircraft and Parts Manufacturing	.33	.41
39	Motor Vehicle and Trailer Manufacturing	.23	.22
40	Motor Vehicle Parts Manufacturing	.57	.58
41	Other Transportation Equipment Manufacturing	.40	.35
42	Electrical Appliance Manufacturing	.42	.32
43	Manufacturing of Electric Industrial Equipment	.52	.48
44	Mfg. of Communication Equipment including Wire	.55	.48
45	Other Electrical Products Manufacturing	.29	.30
46	Manufacturing of Clay, Lime and Cement	1.82	1.56
47	Manufacturing of other Non-Metal Mineral Products	4.83	3.80
48	Petroleum and Coal Products Industries	1.12	1.36

TABLE C-3 (cont'd)

QUANTITY OF PURCHASED ELECTRICAL ENERGY USED PER DOLLAR VALUE OF SHIPMENTS IN MINING AND MANUFACTURING, ONTARIO, 1966 and 1970

65 Industry Aggregation Number	Industry	Quantity of Electrical Energy Purchased per Dollar Value of Shipments (Kwh)	
		1966	1970
49	Plastic Manufacturing and Synthetic Resins	.87	1.12
50	Paint and Varnish Manufacturing	.26	.28
51	Pharmaceutical, Soap and Toiletry Products Mfg.	.23	.24
52	Other Chemical Industries	4.32	4.59
53	Miscellaneous Manufacturing Industries	.41	.49

Source: Table C-1

TABLE C-4

INDUSTRIES PURCHASING THE LARGEST QUANTITY OF ELECTRICAL ENERGY PER DOLLAR VALUE OF SHIPMENTS, ONTARIO, 1966 and 1970

1966			1970		
Rank	Industry	Quantity/$ Value of Shipments Kwh/$	Rank	Industry	Quantity/$ Value of Shipments Kwh/$
1	Smelting and Refining	8.04	1	Smelting and Refining	7.41
2	Pulp and Paper Mills	6.15	2	Pulp and Paper Mills	5.41
3	Other non Metallic Mineral Products	4.83	3	Other Chemical Industries	4.59
4	Other Chemical Industries	4.32	4	Other non Metallic Mineral Products	3.80
5	Iron and Steel Mills	2.60	5	Iron and Steel Mills	2.40
6	Synthetic Textile Mills	1.91	6	Mining	2.19
7	Clay, Lime and Cement Manufacturing	1.82	7	Synthetic Textile Mills	1.97
8	Mining	1.45	8	Clay, Lime and Cement Manufacturing	1.56
9	Cotton Yarn and Cloth Mills	1.36	9	Cotton Yarn and Cloth Mills	1.43
10	Petroleum and Coal Products	1.12	10	Petroleum and Coal Products	1.36
11	Plastics Mfg and Synthetic Resins	.87	11	Plastics Mfg and Synthetic Resins	1.12
12	Rubber Products Manufacturing	.87	12	Other Primary Metal Industries	.86
13	Other Primary Metal Industries	.82	13	Rubber Products Manufacturing	.81
14	Motor Vehicle Parts Manufacturing	.57	14	Feed, Flour and Cereal Mfg	.64
15	Mfg of Communications Equipment	.55	15	Motor Vehicle Parts Manufacturing	.58

Source: Table C-3

TABLE C-5

VALUE OF SHIPMENTS, VALUE ADDED MINUS WAGES AND SALARIES, AND QUANTITY AND VALUE OF PURCHASED ELECTRICITY IN MINING AND MANUFACTURING, ONTARIO, 1970

Industry Group[1]	Value of Shipments[2]	Value Added Minus Wages & Salaries (actual)[3]	Value Added Minus Wages & Salaries (adjusted)[4]	Purchased Electricity[5]	
				Quantity	Value
	$,000	$,000	$,000	,000 kwh	$,000
1. Mining	1,492,647	563.018	-	3,263,562	21,549
2. Meat and Poultry Processors	838,209	52,063	-	185,518	1,856
3. Dairy Products	482,912	59,012	66,638	149,901	1,891
4. Grain Mills	369,433	67,712	-	236,420	2,036
5. Biscuits and Bakeries	256,037	54,700	-	89,389	968
6. Sugar and Confectioneries	183,439	53,287	-	67,376	681
7. Other Food Industries	818,254	199,527	-	304,584 *	2,931 *
8. Soft Drinks	137,065	38,284	-	30,918	410
9. Distilleries, Breweries, Wineries	400,001	237,104	-	134,994	1,203
10. Tobacco and Tobacco Products	292,787	69,084	-	57,432	570
11. Rubber Products	461,531	134,797	-	372,396	3,405
12. Leather Products	188,552	30,018	-	61,471	786
13. Cotton Yarn and Cloth	56,648	8,033	-	81,194	694
14. Synthetic Textiles	219,819	56,477	-	432,912	2,931

TABLE C-5 (cont'd)

VALUE OF SHIPMENTS, VALUE ADDED MINUS WAGES AND SALARIES, AND QUANTITY AND VALUE OF PURCHASED ELECTRICITY IN MINING AND MANUFACTURING, ONTARIO, 1970

Industry Group[1]	Value of Shipments[2]	Value Added Minus Wages & Salaries (actual)[3]	Value Added Minus Wages & Salaries (adjusted)[4]	Purchased Electricity[5]	
				Quantity	Value
	$,000	$,000	$,000	,000 kwh	$,000
15. Knitting Mills	105,259	56,477	17,974	39,760	478
16. Clothing Industries	308,328	56,250	-	36,405	587
17. Other Textile Mills	404,412	81,743	-	137,840	1,508
18. Sawmills	99,022	17,776	-	56,583	941
19. Furniture and Fixtures	361,445	78,382	-	101,714	1,589
20. Other Wood Industries	217,899	38,189	-	95,472	1,321
21. Pulp and Paper Mills	732,424	158,217	-	3,959,071	26,076
22. Paper Products	581,487	109,861	-	255,707	2,589
23. Printing and Publishing	800,600	213,875	-	225,977	2,636
24. Iron and Steel Mills	1,317,165	359,994	-	3,167,497	22,972
25. Other Primary Metals	966,207	139,943	155,410	2,217,779 *	16,966 *
26. Fabricated Structural Metals	232,252	61,316	-	52,334	728
27. Metal Stamping, Pressing and Coating	573,378	117,556	-	219,710	2,760
28. Other Metal Working Industries	2,145,150	521,989	-	770,228 *	9,261 *
29. Miscellaneous Machinery	414,515	290,466	-	145,688 *	1,653 *

TABLE C-5 (cont'd)

VALUE OF SHIPMENTS, VALUE ADDED MINUS WAGES AND SALARIES, AND QUANTITY AND VALUE OF PURCHASED ELECTRICITY IN MINING AND MANUFACTURING, ONTARIO, 1970

Industry Group[1]	Value of Shipments[2]	Value Added Minus Wages & Salaries (actual)[3]	Value Added Minus Wages & Salaries (adjusted)[4]	Purchased Electricity[5]	
				Quantity	Value
	$,000	$,000	$,000	,000 kwh	$,000
30. Motor Vehicles and Aircraft	4,279,640	752,291	-	1,446,458 *	13,842 *
31. Other Transportation Equipment	170,937	46,497	-	59,145	681
32. Electrical Appliances	325,963	67,516	-	103,164	1,277
33. Electrical Ind. Equipment	417,163	99,278	-	198,769	2,021
34. Communication Equipment	789,098	134,693	118,209	327,836 *	3,232 *
35. Other Electrical Products	206,877	49,974	-	80,861 *	912 *
36. Clay, Lime and Cement	361,352	108,122	-	564,721	4,859
37. Non-Metallic Mineral Products	305,007	82,242	-	1,160,196	7,960
38. Petroleum Refineries and Coal Products	616,658	16,457	53,865	839,417	6,031
39. Plastics and Synthetic Resins	84,571	18,475	-	95,050	817
40. Paint and Varnish	138,346	37,336	-	38,047	486
41. Pharmaceuticals and Medicines	204,486	105,306	-	39,827 *	402 *
42. Other Chemical Industries	1,150,087	384,174	-	3,962,191 *	25,811 *
43. Miscellaneous Mfg. Industries	993,220	293,751	-	482,019	5,438

Notes on Sources

1. The industry groups referred to in this table are those identified in the Ontario Input-Output Model.

2. Source: Statistics Canada 31-203, Resourcecon. Refer to the notes following Table C-1 for a discussion of the method used to estimate value of shipments for industries where statistical data was deficient.

3. Source: Statistics Canada 31-203, Resourcecon. The gross profit parameter (value added minus wages and salaries) was derived by subtracting total wages and salaries (production wages plus administrative wages and salaries) of an industry group from the total activity value added figure for the industry.

4. In the case of five industry groups (dairy, knitting mills, other primary metals, communication equipment and petroleum and coal products), it was necessary to make an adjustment in the value of the gross profit parameter. In comparison to establishments in the same industry located in other provinces, Ontario-based establishments were found to have a disproportionate share of wages and salaries when related to their share of value of shipments. In the petroleum and coal products industry for instance, the value of shipments of establishments located in Ontario represented approximately 34 per cent of the Canadian total. The production wages of employees of these plants were also equivalent to 34 per cent of the total wages for the industry as a whole. In contrast, administrative wages and salaries for Ontario were estimated to be on the order of 73 per cent of the Canadian total. By combining production and administrative wages and salaries, Ontario-based activity in this industry accounted for 57 per cent of the industry total.

This observation indicates that the majority of administrative functions in this industry are centralized in Ontario, even though a significant portion of the productive capacity is located in other provinces. The petroleum refining industry exemplifies this situation, insofar as the head offices of major oil companies are located in Ontario, but the production facilities of these corporations are distributed throughout the nation. As administrative personnel are providing services to company operations based in Ontario, as well as other provinces, we are lead to conclude that the administrative wages and salaries estimate provided in SC31-203 is not indicative of the level of production activity of that industry in Ontario. Therefore, an alternative estimate of the administrative component within total wages and salaries was derived for the five industries in question. The estimate was based on the assumption that Ontario's share of an industry's administrative wages and salaries would be equivalent to its share of total value of shipments.

Having calculated an estimate of administrative wages and salaries for the five industries, this new figure was added to the recorded value of production wages and the new sum was then subtracted from the industry's value added to arrive at the adjusted measure of gross profit.

5. Source: Table C-1, Resourcecon. The industries in this table are those identified in the Ontario Input-Output Model. As statistical information regarding the quantity and value of electrical energy purchases presented in Table C-1 was based on the Canadian Input-Output Model industry designation, it was necessary to amend the data to conform to the Ontario industry groups. Where changes have been made in transforming the data, the industries have been noted with an asterisk(*). In some cases adjusting the data was a simple process. For example, in the motor vehicle and aircraft industry, to obtain the appropriate figure for use in the Ontario model it was necessary to add together the totals for industries 38 through 40 in Table C-1. In other instances the adjustment process was considerably more complex. Consider, for example, the "Other Metal Working" and "Miscellaneous Machinery" industries. For the purposes of the Ontario model, "Miscellaneous Machinery and Equipment Manufacturers" (S.I.C. 315) was transferred from the machinery to the other metal working sector. As measures of the quantity and value of electrical energy purchased by "Miscellaneous Machinery and Equipment Manufacturers" located in Ontario were unavailable, estimates were developed using published information pertaining to fuel and electricity purchases as contained in Statistics Canada 31-203. During 1970, "Miscellaneous Machinery and Equipment Manufacturers" purchased fuel and electricity valued at $6.027 million, or approximately 65 per cent of the total fuel and electricity purchases ($9.332 million) of the machinery industry. Assuming that the electricity purchases of "Miscellaneous Machinery and Equipment Manufacturers" represent 65 per cent of total electrical energy purchases by the machinery industry, it was possible to calculate the value of purchased electricity as follows:

value of purchased electricity = $4,670,000 x .646 = $3,017,000

The estimated value of purchased electricity for "Miscellaneous Machinery and Equipment Manufacturers" was then added to the total for the "Other Metal Working Industries" ($6.244 million - see Industry 36, Table C-1) to arrive at an estimate for the industry as defined in the Ontario Model.

Similar basic assumptions were applied when estimating the value of purchased electricity in the electrical and chemical products industries.

APPENDIX D

INPUT-OUTPUT ANALYSIS

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APPENDIX D

INPUT-OUTPUT ANALYSIS

1.0 INTRODUCTION

Two types of economic impacts have been analysed on the basis of input-output tables:

(i) the identification of industries most affected by price changes;

(ii) the effect of price changes on ultimate consumers.

The current transactions in an economy for a particular year may be summarized by an input-output table which shows the supply of goods and services (from both domestic industries and imports) and the disposition of these goods and services to industries as current inputs and to consumers, governments, capital formation and exports as final users. An input-output table typically has these relationships worked out for some 30 to 300 industrial and commercial sectors.

Traditionally, input-output tables have been used as "output models" where the industrial output necessary to achieve some expenditure pattern by final demands is calculated. This is the type of analysis which answers the questions: "What will this government expenditure program do to the economy? Which industries will have to expand their output and by how much?"

Alternatively, an input-output table can be used as a price model and an analysis can be made of the propagation of direct cost increases throughout the economy. This is the type of analysis undertaken in this study.

2.0 THE COST PUSH MODEL

2.1 Use of Available Tables

There are two input-output tables available - the 1966 Canadian Table* and the 1965 Ontario** Table. The Ontario table was used for the main analysis and the Canadian table was used as a check on the information obtained from the Ontario table. The Ontario table was chosen for the main analysis because the direct effects of waste heat regulation (mainly increased

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* *The 1966 Canadian table is available directly from Statistics Canada.*

** *R.H. Frank, S.M. Batrik, and D. Haronitis, "The Input-Output Structure of the Ontario Economy,"* Ontario Economic Review, *Jan-Feb. 1970.*

electrical energy prices by Ontario Hydro) will apply to the Province of Ontario and not just the Great Lakes watershed area. Hence the area to which waste heat regulation would apply is best described in an economic sense by the Ontario input-output table.

2.2 Constraints

In using any input-output table as a cost-push model there are a number of problems and constraints which should be recognized:

(i) An input-output table represents transactions that take place in an economy in a particular year. In the case of the Ontario table, it represents the transactions for 1965. In a cost-push model, the main use of the table is as a means of determining to whom each industry sells its output in order to know to whom the price increases are successively passed.

(ii) All changes in costs are entirely passed on. An industry faced with an increase in costs passes them on by increasing its output prices. Only increases in input costs are passed on: there is no mark up of profits.

(iii) The change in prices of inputs does not lead to a substitution of other inputs (i.e. the technical coefficients are fixed). This is a somewhat restrictive assumption, but in view of the relatively small increases in prices involved it does not seem unrealistic.

(iv) Because of the structure of the Ontario table (imports and exports are not treated separately but are treated as net export demand) the price of imported goods increases when the price of domestically produced goods increases. This assumption seems reasonable as import prices should follow the prices of domestically produced goods.

3.0 ANALYSIS USING THE ONTARIO INPUT-OUTPUT TABLE

3.1 Use of the Table

The public version of the Ontario input-output table identifies 49 industrial and commercial sectors, 2 primary inputs and 7 final demands. Unfortunately, the electric energy industry is not identified separately and so it is not simply a case of increasing the prices in that sector. The specific steps in the model then are:

(i) Calculate for 1970 the amount of electrical energy (kwh's) used by each of the 49 industrial and commercial sectors and the 7 final demands. The kilowatt hour use by sector is multiplied by the increased cost per kwh to determine the total direct cost increases.

(ii) Each of the 49 sectors and 7 final demands experiences a direct increase in costs as determined above. They will also experience an indirect increase in costs. Each of the 49 industrial and commercial sectors experiences the direct increase in cost and passes this increase on by increasing the price of their outputs. Hence in the next "round" of economic activity each of the 49 sectors finds that their input prices have increased and that they in turn must increase the price of their outputs. As each round of economic activity takes place, a portion of the output is sold directly to final demand (i.e. to some final consumer) and there are no further price increases on that portion. Over a number of rounds of activity virtually all the initial direct cost increase is passed on to final demand. Each of the 49 sectors is faced with an indirect cost increase as the direct costs are passed from round to round; the magnitude of these indirect costs compared to the direct costs varies greatly from sector to sector. A computer program was written to calculate the "round" by "round" price effects using the Ontario table.

(iii) Having calculated the round by round propagation of price increases it is possible to answer the following questions:

(a) how important the indirect effects are compared to the direct effects?

(b) how quickly the direct cost increase is passed on to final demands and which final demands must bear the increases?

(c) how quickly costs are passed on i.e. how many "rounds" are required before most of the direct cost increase is passed on to final demands?

(iv) Once the direct and indirect effects have been calculated for each of the 49 sectors, these effects are compared to the value of shipments and the gross profit margin (value added less wages and salaries) for each sector to establish the relative impact of these price increases. (See Section IV, 2.3 and Appendix E).

3.2 Input Data

The cost push model using the Ontario table uses 1970 as the base year: the most recent year for which information is available on value of shipments, value added, and wages and salaries by industrial sector. Hence the mills per kwh price increase was reduced to $1970 (using the consumer price index) and all calculations and comparisons are performed in $1970.* Also the allocation of electrical energy consumption to the 49 sectors and to final demand is based on 1970 Ontario electrical energy consumption. Table D-1 gives the direct consumption of purchased electrical energy in Ontario in 1970. Table D-2 shows the purchased electrical energy consumption broken down by the 49 industrial and commercial sectors and 7 final demand categories of the Ontario Input-Output Table and gives the direct cost increase each of these sectors can expect as a result of thermal pollution regulation. Table D-3 indicates the direct cost increase that can be expected by those industries with their own thermal electric generation facilities.

** See IV, 2.1 for detailed explanation why 1970 is used as the base year.*

TABLE D-1

DISTRIBUTION OF PURCHASED ELECTRICAL ENERGY IN ONTARIO, 1970

Sector	Consumption (,000 kwh)	Per Cent of Total
Agriculture	396,681	0.7
Mining	3,263,562	5.4
Manufacturing	23,083,970	38.2
Commercial (including street lighting)	17,025,458	28.1
Residential	16,685,652	27.6
Total	60,455,323	100.0

Source: SC 57-202
Ontario Hydro 1970 Annual Report

TABLE D-1 (cont'd)

Notes on Sources

Agriculture: calculated as 25 per cent of farm category in Ontario Hydro 1970 Annual Report. Average monthly consumption for a rural residential customer is approximately 75 per cent of the average monthly consumption of a farm customer during the 1966-1972 and hence 25 per cent of the farm category is considered as being used for agricultural production.

Mining and Manufacturing: Appendix C, Table C-5.

Commercial: street lighting 481,473,000 kwh as per Ontario Hydro 1970 Annual Report, remainder of commercial calculated as a residual from total of 60,455,323,000 kwh. Total taken from SC 57-202 as total consumption of purchased electrical energy. Residual corresponds very closely to commercial category shown in SC 57-202.

Residential: as per Ontario Hydro 1970 Annual Report plus 75 per cent of the farm category as per the same report.

TABLE D-2

DIRECT COSTS OF PURCHASED ELECTRICAL ENERGY BY INDUSTRIAL SECTOR, 1970

I-O Row and Column No.	Industries and Final Demands	Power Consumption 1970 (,000 kwh)	Direct Cost Increase (,000 $ 1970)
1	Agriculture	396,681	257.8
2	Mining	3,263,562	2,121.3
3	Meat and poultry	185,518	120.6
4	Dairy	149,901	97.4
5	Grain mills	236,420	153.7
6	Biscuits and bakeries	89,389	58.1
7	Sugar and confectionery	67,376	43.8
8	Other food industries	304,584	198.0
9	Soft drink	30,918	20.1
10	Distilleries, breweries, wineries	134,994	87.7
11	Tobacco	57,432	37.3
12	Rubber	372,396	242.1
13	Leather	61,471	40.0
14	Cotton yarn and cloth	81,194	52.8
15	Synthetic textiles	432,912	281.4
16	Knitting	39,760	25.8
17	Clothing	36,405	23.7
18	Other textile	137,840	89.6
19	Sawmills	56,583	36.8
20	Furniture and fixtures	101,714	66.1
21	Other wood	95,472	62.1
22	Pulp and paper	3,959,071	2,573.4
23	Paper products	255,707	166.2
24	Printing and publishing	225,977	146.9
25	Iron and steel	3,167,497	2,058.9
26	Other primary metals	2,217,779	1,441.6

TABLE D-2 (cont'd)

DIRECT COSTS OF PURCHASED ELECTRICAL ENERGY BY INDUSTRIAL SECTOR, 1970

I-O Row and Column No.	Industries and Final Demands	Power Consumption 1970 (,000 kwh)	Direct Cost Increase (,000 $ 1970)
27	Fab. and str. metals	52,334	34.0
28	Metal stamp. press, etc.	219,710	142.8
29	Other metal working	770,228	500.6
30	Miscellaneous machinery	145,687	94.7
31	Motor vehicles and aircraft	1,446,458	940.2
32	Other transport equipment	59,145	38.4
33	Electrical appliances	103,164	67.1
34	Electrical ind. equipment	198,769	129.2
35	Communication equipment	327,836	213.1
36	Other electrical equipment	80,861	52.6
37	Clay, lime, cement	564,721	367.1
38	Other non metallic minerals	1,160,196	754.1
39	Petroleum and coal	839,417	545.6
40	Plastics and synthetic resins	95,050	61.8
41	Paint and varnish	38,047	24.7
42	Pharmaceuticals	39,827	25.9
43	Other chemical	3,962,191	2,575.4
44	Miscellaneous manufacturing ind.	482,019	313.3
45	Construction, main. and repair	255,824	166.3
46	Transportation, storage and trade	7,418,912	4,822.3
47	Utilities	1,058,183	687.8
48	Communication and other services	2,895,469	1,882.1
49	Unallocated sector	-	-
51	Personal consumption	16,685,652	10,845.7
55,56	Government expenditure	5,397,070	3,508.1
	Total	60,455,323	39,296.1

TABLE D-2 (cont'd)

Notes

1. Distribution of electric energy consumption to industries and final demand as per Table D-1.

2. Detailed breakdown of manufacturing sector as shown in this table is from Appendix C, Table C-5.

3. Allocation of commercial electrical energy consumption based on 1966 Canadian Input-Output Table. No Ontario information is available on specific end users of commercial electric energy.

4. Price increase is 0.65 mills per kwh in 1970 $ (equivalent of 0.7 mills per kwh in 1972 $).

5. Note that this table includes only the purchased electrical energy used in Ontario. The direct cost increases for self generated electrical energy are shown in Table D-3.

TABLE D-3

DIRECT COSTS OF OTHER INDUSTRIAL WASTE HEAT MANAGEMENT

I-O Row and Column No.	Industries	Direct Cost (,000 $ 1970)
10	Distilleries	17
22	Pulp and paper	162
25	Iron and steel	544
31	Motor vehicles	247
43	Other chemcials	162
	Total	1,132

Source: Table B-1, Appendix B; 1975 values reduced by 15 per cent to account for lower production levels in 1970 and to reduce 1972 $ to 1970 $.

3.3 The Calculation of the Indirect Effects

The indirect impact of a price increase is probably best illustrated by working through a simple hypothetical input-output table. Suppose the following table represents some hypothetical economy with three industry groups, two final demand, and one primary input:

		Industries				Final Demands			Total Exp.
		A	B	C	Total	Con-sumers	Govt.	Total	
Industries	A	5	4	2	11	5	2	7	18
	B	2	6	4	12	3	3	6	18
	C	3	2	7	12	8	1	9	21
	Total	10	12	13	35				
Primary Input		5	8	7			2	22	
Total Inputs		15	20	20			2		57

Since we are interested in how cost increases would be pushed through this economy it is necessary that the market shares matrix be calculated so that we can follow the sale of goods through the economy. The market shares are calculated as the per cent of an industry's output which is sold to each industrial sector and to final demands. The market share matrix for our hypothetical economy is:

Portion of output purchased by:

		Industries			Final Demands		Total Exp.
		A	B	C	Con-sumers	Govt.	
Industries	A	.28	.22	.11	.28	.11	1.00
Selling	B	.11	.33	.22	.17	.17	1.00
Output	C	.14	.10	.33	.38	.05	1.00

If prices increase it is possible to trace the propagation of prices through the economy. For instance if in our hypothetical economy Industry A and C experience a $1 increase in the cost of electrical energy and Industry B experiences a $2 increase then those costs would be passed on in the first round as follows:

		Direct Increase	First Round		
Industry	A	$1	.28(1) + .11(2) + .14(1)	=	.64
	B	$2	.22(1) + .33(2) + .10(1)	=	.98
	C	$1	.11(1) + .22(2) + .33(1)	=	.88
Consumers			.28(1) + .17(2) + .38(1)	=	1.00
Govts.			.11(1) + .17(2) + .05(1)	=	.50
		$4			$4.00

Of the initial $4 direct increase $2.50 has been passed on to industries, $1.50 to final demands. The $2.50 increase experienced by the industries requires a price increase of that amount and is passed on in a further round of production. Note, however, that as prices are passed "round by round" to final demand the price increase which is passed on is reduced. This is the procedure used to determine the effect of the price increases shown in Table D-2 and Table D-3. Table D-4 presents the direct and indirect effects of the increased cost of purchased electrical energy and increased annual costs of those industries with their own thermal generating facilities.

TABLE D-4

ROUND BY ROUND EFFECTS ON INDUSTRIES(NO. 1 TO 49) AND FINAL DEMANDS(NO. 51 TO 57) OF INCREASED PRICES (000 $ 1970)

	DIRECT	ROUND1	ROUND2	ROUND3	ROUND4	ROUND5	ROUND6	ROUND7	ROUND8	ROUND9	INDIRECT	TOTAL	TOTAL/DIRECT
1	257.8	519.1	416.1	227.5	136.4	78.4	44.9	25.3	14.2	7.9	1469.8	1727.6	6.7
2	2121.3	365.1	189.4	103.1	60.3	33.4	18.7	10.3	5.7	3.2	789.2	2910.5	1.4
3	120.6	129.2	171.5	143.9	91.6	55.5	32.4	13.6	10.6	5.9	659.2	779.8	6.5
4	97.4	91.5	126.3	101.6	63.5	37.9	22.0	12.6	7.1	4.0	466.4	563.8	5.8
5	153.7	94.9	84.2	65.0	40.0	23.7	13.6	7.8	4.4	2.4	336.1	489.8	3.2
6	58.1	61.9	65.8	45.4	30.0	17.6	10.1	5.7	3.2	1.8	241.7	299.8	5.2
7	43.8	45.0	37.0	26.1	16.8	10.0	5.8	3.3	1.8	1.0	146.8	190.6	4.4
8	198.0	302.7	288.3	198.8	121.6	79.8	40.6	23.0	12.9	7.2	1065.9	1263.9	6.4
9	20.1	19.6	26.2	15.6	9.3	5.2	2.9	1.6	0.9	0.5	82.0	102.1	5.1
10	104.7	75.7	63.8	39.3	24.1	13.5	7.6	4.2	2.4	1.3	232.5	337.2	3.2
11	37.3	36.7	47.4	35.8	21.3	12.3	7.0	3.9	2.2	1.2	168.0	205.3	5.5
12	242.1	199.1	202.2	110.6	62.3	34.3	19.0	10.5	5.8	3.2	647.0	889.1	3.7
13	40.0	51.6	45.5	35.0	23.9	14.6	8.6	4.9	2.8	1.6	188.6	228.6	5.7
14	52.8	36.0	25.3	15.3	9.0	5.1	2.9	1.6	0.9	0.5	96.7	149.5	2.8
15	281.4	224.7	121.2	54.3	29.4	16.2	9.0	5.0	2.8	1.5	444.1	725.5	2.6
16	25.8	57.3	50.9	31.2	18.2	10.3	5.8	3.2	1.8	1.0	179.8	205.6	8.0
17	23.7	90.7	79.3	55.5	33.1	19.0	10.7	6.0	3.3	1.9	299.3	323.0	13.6
18	89.6	169.3	147.0	88.2	51.0	28.6	16.0	8.9	5.0	2.8	516.7	606.3	6.8
19	36.8	24.6	16.2	9.8	6.0	3.5	2.0	1.2	0.6	0.4	64.4	101.2	2.7
20	66.1	84.9	100.6	55.9	30.7	16.8	9.3	5.2	2.9	1.6	307.8	373.9	5.7
21	62.1	77.9	43.8	26.1	15.0	8.6	4.9	2.8	1.5	0.9	181.4	243.5	3.9
22	2735.4	876.8	299.2	117.9	54.3	27.5	14.7	8.0	4.4	2.4	1405.2	4140.6	1.5
23	166.2	473.6	293.8	143.1	70.8	36.1	19.1	10.3	5.7	3.1	1055.7	1221.9	7.4
24	146.9	244.0	147.5	74.2	43.9	24.0	13.4	7.4	4.1	2.3	560.8	707.7	4.8
25	2602.9	943.9	345.1	155.0	83.0	45.7	25.5	14.1	7.9	4.4	1624.5	4227.4	1.6
26	1441.6	734.4	387.2	200.1	104.7	55.7	30.0	16.4	9.0	4.9	1542.4	2984.0	2.1
27	34.0	189.6	79.8	32.7	16.1	8.7	4.8	2.7	1.5	0.8	336.7	370.7	10.9
28	142.8	496.4	217.0	94.3	46.1	24.7	13.6	7.5	4.2	2.3	905.8	1048.6	7.3
29	500.6	1276.4	753.1	378.1	198.4	106.3	58.1	31.9	17.6	9.7	2829.7	3330.3	6.7
30	94.7	387.9	138.3	38.9	45.4	24.4	13.3	7.3	4.0	2.2	761.8	856.5	9.0
31	1187.2	1831.9	1368.7	855.4	495.0	278.1	154.6	85.6	47.4	26.2	5142.9	6330.1	5.3
32	38.4	100.3	69.9	39.2	20.8	11.3	6.1	3.4	1.9	1.0	253.9	292.3	7.6
33	67.1	270.3	162.7	79.2	41.1	21.9	12.0	6.6	3.6	2.0	599.4	666.5	9.9
34	129.2	269.6	154.1	80.4	42.5	22.9	12.5	6.8	3.8	2.1	594.8	724.0	5.6
35	213.1	378.8	254.9	139.1	75.1	40.2	21.8	11.9	6.5	3.6	931.8	1144.9	5.4
36	52.6	154.7	101.8	53.6	29.1	15.6	8.5	4.7	2.6	1.4	372.0	424.6	8.1
37	367.1	201.0	91.0	45.8	25.8	14.4	8.1	4.5	2.5	1.4	394.4	761.5	2.1
38	754.1	217.5	92.2	44.9	24.2	13.2	7.3	4.0	2.2	1.2	406.7	1160.8	1.5
39	545.6	1037.4	282.5	129.6	68.1	38.7	21.5	12.0	6.7	3.7	1600.3	2145.9	3.9
40	61.8	329.0	134.3	76.9	41.2	22.7	12.5	7.0	3.9	2.1	629.6	691.4	11.2
41	24.7	103.1	65.5	35.6	19.9	11.0	6.1	3.4	1.9	1.0	247.4	272.1	11.0
42	25.9	72.1	50.1	28.1	16.4	9.0	5.0	2.8	1.5	0.8	185.8	211.7	8.2
43	2737.4	832.1	468.9	243.6	134.4	74.1	41.3	22.9	12.8	7.1	1837.0	4574.4	1.7
44	313.3	229.7	281.1	154.8	87.4	47.7	26.3	14.5	8.1	4.5	854.0	1167.3	3.7
45	166.3	1523.7	1028.6	553.6	287.3	157.3	86.4	47.8	26.5	14.7	3690.9	3857.2	23.2
46	4822.3	648.4	585.0	326.[illegible]	196.8	110.4	62.4	34.7	19.3	10.7	1993.8	6816.1	1.4
47	687.8	150.1	58.7	29.3	16.5	9.1	5.1	2.8	1.6	0.9	274.1	961.9	1.4
48	1882.1	497.5	631.2	435.7	278.3	158.4	90.0	50.4	28.2	15.7	2185.3	4067.4	2.2
49	0.0	1184.3	655.4	471.2	258.3	148.4	81.9	45.6	25.3	14.1	2884.4	2884.4	
50	26074.2	18397.2	11555.8	6590.2	3714.4	2073.0	1155.6	642.7	357.3	198.5	44684.6	70758.8	2.7
51	10845.7	7075.1	3287.0	2577.0	1597.1	954.4	542.3	306.2	171.3	95.6	16605.9	27451.6	
52	0.0	1022.5	1464.1	939.5	540.8	289.6	158.7	87.4	48.3	26.8	4627.8	4627.8	
53	0.0	204.5	114.7	66.5	35.1	19.5	10.7	5.9	3.3	1.8	462.0	462.0	
54	0.0	234.2	114.7	58.0	31.3	17.2	9.5	5.3	2.9	1.6	474.7	474.7	
55	3508.1	188.8	103.9	57.3	36.7	20.5	11.4	6.4	3.5	2.0	440.5	3948.6	
56	0.0	552.0	288.2	170.0	92.3	52.4	29.1	16.2	9.0	5.0	1214.1	1214.1	
57	0.0	-1600.1	1468.8	1037.4	542.4	287.8	155.8	85.4	47.1	26.0	2050.6	2050.6	
58	14353.8	7677.0	6841.4	4965.6	2875.8	1641.4	917.4	512.8	285.5	158.8	25875.6	40229.4	
59	40428.0	26074.2	18397.2	11555.8	6590.2	3714.4	2073.0	1155.6	642.7	357.3	70560.1	110988.1	

Notes to Table D-4

1. Numbers at the extreme left of table identifies the industries and final demands. See Table D-2 for a listing of what the numbers 1 to 49 identify. Numbers 50 to 59 are identified as follows:

50	total intermediate demand
51	personal consumption expenditure
52	investment
53	changes in inventories, finished goods and goods in process
54	changes in inventories, raw materials
55	provincial government expenditures
56	municipal government expenditures
57	trade balance and other final demand
58	total final demand
59	total output

2. Column at the extreme right (headed: Total/Direct) is the ratio of the total direct plus indirect effects divided by the direct effects and indicates for that industry how important the indirect effects are relative to the direct effects.

APPENDIX E

INDUSTRY GROUPS MOST AFFECTED BY THERMAL POLLUTION REGULATIONS

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APPENDIX E

Industry Groups Most Affected by Thermal Pollution Regulations

The direct and indirect cost increases borne by each industry group in Ontario, attributable to "Case A" type waste heat standards, have been calculated and are shown in Section IV, Table 5. The ten industries most affected by the institution of waste heat standards are analyzed below in an attempt to determine the ability of each of these industries to pass on the cost increases in terms of higher prices. Each industry's ability to pass on cost increases is evaluated by a consideration of various indicators of industry structure or performance such as concentration ratios, tariff protection, product demand growth, profitability, etc.

1. Petroleum Refining

The petroleum refining industry as defined for purposes of the Ontario Input-Output model comprises the following Standard Industrial Classification (SIC) industry groups:

SIC 365 - petroleum refining

SIC 369 - other petroleum and coal products industries

The SIC 369 category is a very small proportion of the total value added of these two categories.

(a) Industry Structure or Performance:

(i) Concentration

Table E-2 following shows the industry to be highly concentrated on a national basis with the top four enterprises responsible for over 83 per cent of value-added. The refining industry is similarly concentrated on a regional basis.

(ii) Market Area Served, Tariff Protection

Since 1961 Canada has exercised import controls on oil products to that part of Canada west of the Ottawa Valley. To the extent that refined products can be produced in Ontario, the product can only be supplied by Ontario refineries. Ontario refineries have operated and probably will continue to operate in a protected market. It is possible that the Canadian price of crude feed-stocks will be lower than crude prices in most other countries; this would put Canadian refiners in a very strong competitive position, even without import controls.

(iii) Demand Growth Factors

About two-thirds of Canada's demand for primary energy is supplied by oil and gas. The forecast of energy consumption in Canada made by the Department of Energy, Mines and Resources in their recent study "An Energy Policy for Canada"* predicts oil and gas will maintain this approximate proportion to the year 2000. On the basis of EMR's standard energy forecast (assuming the low oil forecast alternative) oil consumption in the year 2000 will increase some three times from 1970 levels to approximately 1.7 billion barrels per year.

Sharply higher crude oil prices (to a wellhead level of $6.00/bbl or higher) are forecast for Canada (the East Coast has already experienced much higher prices) but even so Canadian prices will likely remain lower than those in most other world areas. Demand will remain strong for petroleum products due to the probability that other energy types will be priced competitively with oil, e.g. gas, coal, and that in the large transportation market no alternative energy source will be available for many years.

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* *Volume II, pp. 4 to 30.*

(iv) Type of Good

A large proportion of refining products are delivered to final demand sectors - for retail space heating or transportation uses.

(v) Barriers to Entry

The economies of plant scale in the petroleum refining industry are large in relation to the size of provincial, and even national markets. The fact results in a significant barrier to the entry of new plants. Product differentiation is also important in the marketing of oil products and constitutes another barrier to entry. A third results from very high capital cost requirements for refineries, from $100 million to $200 million for a 100,000 b/d plant.

(vi) Industry Profit

Profits in the refining industry for the years 1968 to 1970 were somewhat less than the average for all manufacturing activity in Canada, and about the same as the average rate for the category "all non-financial industries". (see Table E-4 following).

(b) Ability to Accommodate Cost Increases

The Ontario refining industry will continue to market its product in protected Canadian markets. Crude oil feedstock prices will be lower than in most other countries. Demand for the product in Canada will remain high relative to refinery capacity as competing energy forms are priced upwards to an oil competitive level. These factors plus high industry concentration and large barriers to entry should ensure the ability of the industry to pass on cost increases incurred as a result of Great Lakes waste water heat standards.

2. Plastics and Synthetic Resins

This industry is that as defined by SIC category 373. Principal products are resins of various kinds and film manufactured from synthetic resins including cellulose film, polyethylene film, etc. Oil and natural gas products are very important feedstock items in the manufacture of these products.

(a) Industry Structure or Performance

(i) Concentration

The production of these products is highly concentrated in Canada, with 12 enterprises supplying over 90 per cent of the Canadian output (Table E-2).

(ii) Market Area Served, Tariff Protection

Canadian producers manufacture mainly for domestic consumption. Of total value of shipments of nearly $200 million in 1970 less than $25 million* was exported. Imports are very significant: between $150 million and $200 million in 1970.

The average tariff level on products in this industry group is low (Table E-3).

(iii) Demand Growth Factors

Demand and prices which have been depressed over the 1966-72 period have recovered strongly over the past year. Of the chemicals and chemical products industries prices have recently been rising most quickly for plastics and synthetic resins. The index for these items was 104.7 in December 1973, up 18.2 per cent from 88.6 in December 1972.*

In the medium term (3 to 5 years) demand will remain strong for products from Canadian plants as both the Canadian and world industries are working at capacity. Imports will be at lower

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* *SC65-201, 202, 203, Trade of Canada*

** *Globe and Mail, February 19, 1974, p.B5.*

levels as other countries strive to supply their domestic markets. In the longer term the Canadian industry should remain in a strong competitive position, assuming Canadian energy policies which will lead to relatively low oil and gas prices in Canada compared to other parts of the world.

(iv) Type of Good

The output of the industry is primarily sold to intermediate sectors of demand.

(v) Barriers to Entry

Barriers to entry are present through significant economies of scale in the manufacture of many of the commodities in this group and through high capital costs necessary to build plants of minimum efficient size.

(vi) Industry Profit

Figures for industry profit on the basis shown in Table E-4 not available for this industry group.

(b) Ability to Accommodate Cost Increases

The long term outlook for this industry is good assuming Canadian oil and gas policies which will make oil and gas feedstock costs for these manufacturers lower than in most other countries. This fact plus a high degree of concentration in the Canadian industry should enable cost increases to be passed on in higher prices.

Everything else equal the increase in producing costs in Ontario due to Great Lakes standards will make Alberta (the source of the lowest cost oil and gas in Canada) comparatively more attractive as a location for this class of industry.

3. Pulp and Paper

The pulp and paper mill category is defined as that group of manufacturing activity covered by SIC 271.

(a) Industry Structure or Performance

(i) Concentration

The top 12 enterprises in Canada supplied about two-thirds of the value of production in Canada. Because pulp and newsprint are bulky commodities freight cost considerations lead to regional markets; therefore Canadian concentration ratios are not particularly relevant. However we conclude that the pulp and paper mill industry is not highly concentrated in the markets it serves having in mind the large proportion of sales in export markets.

(ii) Market Area Served, Tariff Protection

Export sales are a very important part of industry activity. Some 60 per cent* of Ontario's pulp and

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* *Ontario Department of Lands and Forests, "The Ontario Forest Industry" 1969, pp. 63, 64.*

below specifically in terms of the smelting and refining industry.

(a) Industry Structure or Performance

(i) Concentration

The smelting and refining industry in Ontario is highly concentrated in the hands of INCO, Falconbridge, and Ecstall whose primary output is copper, nickel, lead and zinc.

(ii) Market Area Served, Tariff Protection

By value it is expected that 86 per cent of Canada's mine production will be exported in 1980, about the same proportion as in 1970.* During the 60's there was a marked increase in the proportion of copper, lead, and zinc production exported in concentrate form; this relates to Canada's international competitive situation in smelting and refining which is faced with the following factors:

(1) Smelting and refining capacity is highly capital intensive and Canada's construction costs continue to be substantially higher than in Europe or Japan where most of the added capacity to treat Canada's concentrates has been installed.

(2) Smelters located close to large sulphuric acid

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* *National Economic Outlook Conference, 1973. See the paper "Mining" prepared by the Mining Committee, p. 12.*

have been a recurring feature of the world industry and a period of over-supply prevailed during the latter 1960's and early 70's.

(b) Ability to Accommodate Cost Increases

Demand and prices for Ontario production should be good over the next 3 or 4 years. In the longer term the continuation of the cyclical price and profit performance of the world industry can be expected to continue. The Canadian industry which competes importantly in world markets may therefore suffer periods of low demand relative to supply making the passing on of cost increases difficult.

4. Other Primary Metal Industries

This category includes the following industry categories:

	1970 Ontario value added ($ million)	Ontario Cost Fuel & Electricity ($ million)
SIC 292 - Steel pipe	50	2.6
294 - Iron Foundries	88	4.9
295 - Smelting and Refining	137	29.9
296 - Aluminum Rolling	59	2.7
297 - Copper Rolling	34	1.6
298 - Metal Rolling, n.e.s.	39	1.8

The smelting and refining industry which is the largest part of this category is by far the most important user of purchased electricity. As a result this industry group's ability to accommodate cost increases is discussed paper production was exported to foreign countries in 1966.

Imports of pulp and paper mill products into Ontario are small. The effective tariff on imported products is high at approximately 75 per cent (Table E-3).

(iii) Demand Growth Factors

Canada's pulp and paper industry is forecast to operate at full capacity for the short and medium term.*

World demand is forecast to continue growing strongly at an average rate of 5 per cent per year, but some uncertainty exists as to the effect of higher prices on paper demand. Continental Europe and Japan are emerging as important markets for Canadian output - this trend is forecast to continue based on gradually increasing wood fibre deficits in those areas. U.S. demand, the most important by far to Canada, is expected to continue to grow strongly.

Canada's producers seem reasonably well placed in terms of supply costs compared to their world competitors. Most specifically the gap in wood

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* *See the paper "Forest Products" presented at the National Economic Outlook Conference in September 1973 by the Forest Products Committee. This conference was sponsored by the Economic Council of Canada.*

costs between Eastern Canada and the Southern U.S. which has been a major disadvantage to Canadian producers selling in Eastern U.S. markets is seemingly being closed.

Over the long term the outlook for Canadian producers is good but they will continue to operate in a competitive world market.

(iv) Type of Good

The pulp and paper industry manufactures a "producer" good for sale to customers in the intermediate sector. A considerable amount of industry sales of newsprint are made to publishers on long term contract basis. Publishers own a significant portion of producing capacity* and may be able to pass on paper cost increases through higher prices charged for advertising.

(v) Barriers to Entry

The most significant barrier to entry seems to be the large capital requirements to establish a mill.

(vi) Industry Profits

The industry profit performance over the 1968 to 1970 period studied (Table E-4) was very poor compared to the average for all manufacturing industries. Periods of excess productive capacity

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* *H. Eastman and S. Stykolt, The Tariff and Competition in Canada, MacMillan, Toronto, 1967, p.267.*

markets (which Canada lacks) have a competitive advantage.

(3) Freight rates are generally structured to make the transport of metal in concentrate cheaper than in pure form.

(4) Canadian wage rates are higher than in many competing countries.

(5) The tariff structure of many countries discriminates in favour of concentrates as opposed to metal imports.

(iii) Demand Growth Factors

The Mining Committee of the National Economic Outlook Conference forecast that international demand for mine products will remain strong through 1980.* Prices are forecast to increase over 1970 levels, in constant dollar terms.

(iv) Type of Good

Product is sold to the intermediate sector of demand.

(v) Barriers to Entry

Barriers to entry are high in terms of capital costs required to build a facility of minimum efficient size.

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* *Ibid., pp. 6, 7, 8.*

(vi) Industry Profit

Profits of the smelting and refining industry were above the total manufacturing industries' average in 1968 and below in 1969 and 1970 (Table E-4).

(b) Ability to Accommodate Cost Increases

Although Canada is a very large producer of mine products there is much competition from other countries regarding the location of smelting and refining facilities and attendant metal fabricating facilities. The necessity of burdening the Canadian industry with any cost increases which would weaken its world competitive situation should be carefully considered.

5. Cotton Yarn and Cloth

The cotton yarn and cloth industry conforms to SIC 183.* The value added of this activity in Ontario in 1970 was the smallest of all the industry sectors studied (Table 5, Section IV, 2.3).

(a) Industry Structure or Performance

(i) Concentration

Concentration in this industry in Canada is very high with the top 8 enterprises accounting for over 95 per cent of the industry output (Table E-2).

** Changed to SIC 181 under the 1970 classification code.*

(ii) Market Area Served, Tariff Protection

Canada is a small exporter and large importer of textiles (both natural and synthetic) and clothing. In 1970 imports of textiles and clothing amounted to $730 million, exports to $181 million.* Though the manufacture of cotton yarn and cloth is only a small fraction of the total textile and clothing category we assume the pattern of exports and imports to be similar to that of the total.

Total value of shipments of textiles (1,558 million) and clothing ($1,335 million) was nearly $2.9 billion in 1970.** The value of shipments of cotton cloth and yarn was $282 million.

The effective tariff on products of the cotton yarn and cloth industry is 38 per cent (Table E-3).

(iii) Demand Growth Factors

The Textiles and Clothing Committee of the National Economic Outlook Conference predicted that synthetic fibres will take up the vast majority of anticipated demand growth for fibres, with natural fibre production levels not expected to increase significantly. Man-made fibres and

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* *National Economic Conference, 1973, "Textiles and Clothing."*

** *SC 31-203 General Review of Manufacturing Industries in Canada, 1970.*

yarn now supply over half the domestic fibre requirements and this proportion is expected to rise to about three quarters by 1977.*

(iv) Type of Good

Produces good for purchase by intermediate sectors of demand. Concentration in the clothing industries, the principal buyers of cotton cloth and yarn, is not high.

(v) Barriers to Entry

No obvious barriers to entry exist but the high concentration ratio in this industry group suggests some important barriers may exist.

(vi) Industry Profit

Industry profit figures on a consistent basis with other industry groups were only available for the category "cotton and woollen mills." This combined classification showed profits lower than that in all manufacturing in 1968 and 1969, but higher in 1970 (Table E-4).

(b) Ability to Accommodate Cost Increases

Low forecast demand growth for the product and continuing strong competition from imported materials suggest a limited ability of this group to pass on cost increases.

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* *Textiles and Clothing*, p.6.

6. Meat and Poultry

Industry group includes SIC's 101 and 103.* Establishments primarily engaged in abattoir operations and/or meat packing. Also killing, dressing, packing and canning poultry.

Value added of "slaughtering and meat processors" in Ontario was by far the major part of this category at $129 million in 1970, compared to some $20 million for "poultry processors."

(a) Industry Structure or Performance

(i) Concentration

There is a fair degree of concentration in the Canadian meat processing industry with the top 8 enterprises producing two-thirds of total Canadian output.

(ii) Market Area Served, Tariff Protection

The market in meat and poultry is a national market with meat shipped from surplus areas to areas in which the production of animals falls below the requirements of consumption. The market in livestock is not a national market because of the higher cost of transporting animals than meat. Meat production is chiefly for Canadian consumption with only a small import or export trade.

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* *Both categories are included under SIC 101 under the 1970 SIC code changes.*

Tariffs on products of meat processors are low at some 5 per cent to 6 per cent (Table E-3).

(iii) Demand Growth Factors

Steady growth in demand for beef and poultry products can be expected.

(iv) Type of Good

The product is primarily sold to the consumer category of demand; or at least only one step removed to the retail sector.

(v) Barriers to Entry

Barriers to entry appear low.

(vi) Industry Profit

Profits for the meat processing industry group were above the average for all manufacturing industries in 1969 and 1970; in 1968 they were somewhat below the average (Table E-4).

(b) Ability to Absorb Cost Increases

Continuing strong demand for meat products will enable cost increases to be passed on. Prices of meat and poultry products have increased sharply but the price of substitutes (fish and other food products) have increased as well.

7. Other Non-Metallic Minerals

This category of industries includes the following:

	Ontario Value added 1970 ($ million)	Ontario Cost of Fuel and Electricity ($ million)
SIC 354 - Mineral wool*		
355 - Asbestos*		
356 - Glass products	$96	6.5
357 - Abrasives	$26	5.1
359 - Other non-metallics	$52 +	3.5 +

Glass products and abrasives are the largest part of this category and use the majority of the purchased electricity consumed.

(a) Industry Structure or Performance

(i) Concentration

Glass products manufactures and abrasives manufacturers are highly concentrated industries (Table E-2).

(ii) Market Area Served, Tariff Protection

Exports of glass products and abrasives in 1970 was approximately $50 million compared to total value of shipments of over $300 million. Imports of these products was approximately $75 million. Effective tariffs on glass imports were moderate at 11.5 per cent and for abrasives high at over

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** SIC 354 and 355 reclassified to be included in SIC 359 under 1970 SIC reclassification. Value added and cost of fuel and electricity totals are included with SIC 359 category.*

44 per cent (Table E-3).

(iii) Demand Growth Factors

Demand for these largely construction industry related goods will be somewhat cyclical.

(iv) Type of Good

Sold to intermediate sectors of demand. The construction industry buys a large part of output.

(v) Barriers to Entry

Very large economies of scale in glass manufacturing. Perhaps in the production of abrasives too as evidenced by high degree of industry concentration.

(vi) Industry Profits

Profit ratios for glass and glass products manufacturers were lower than the average for all manufacturing industries over the 1968 to 1970 period (Table E-4). Profit figures for abrasive manufacturers were not available on a comparable basis.

(b) Ability to Accommodate Cost Increases

Highly concentrated industries supplying largely construction industry materials will stand good chance of passing on cost increases.

8. Synthetic Textiles

This category comprises those industries in SIC 201.*

** Changed to SIC 183 under the 1970 classification code.*

Products manufactured include man-made fibre, yarn and cloth, including establishments engaged in the extrusion of man-made textile filaments from purchased resins.

(a) Industry Structure or Performance

(i) Concentration

Concentration in the Canadian market is high with 8 enterprises producing about 75 per cent of total output (Table E-2).

(ii) Market Area Served, Tariff Protection

As discussed under category 6 above, Cotton Yarn and Cloth Mills, exports of textiles are small and imports large. The primary market served by Canadian synthetic textile manufacturers is the domestic one under stiff competition from imported goods.

Synthetic textiles are protected by an effective tariff of nearly 60 per cent (Table E-3)

(iii) Demand Growth Factors

Strong demand growth was forecast for synthetic fibres over the 1973-78 period by the Textiles and Clothing Committee of the National Economic Outlook Conference.* Fibres, largely manufactured from oil and gas based resins should be much more competitive, assuming greater oil and gas price increases in most countries than will be

* "*Textiles and Clothing*," p.1 and 15.

experienced in Canada. This should increase both domestic and export demand.

(iv) Type of Good

The industry produces goods for the intermediate demand sector. Buyers of the good, mainly in the clothing industries, are not highly concentrated.

(v) Barriers to Entry

Barriers to entry are not obvious yet industry concentration is high. Economies of scale may be very important.

(vi) Industry Profits

Industry profits in 1968 and 1969 were slightly below the average for all manufacturing and much below in 1970 (Table E-4).

(b) Ability to Accommodate Cost Increases

Strong demand growth is forseen for several years. Cost of resins used in the manufacture of textiles should be cheap compared to most countries. However cost disadvantages compared to many other producing countries will continue to be experienced with respect to labor costs, construction costs, distribution costs, and scale of operations. Import competition should remain steady. Some difficulty may be experienced in passing on cost increases.

9. Other Chemicals

Includes the following SIC groups:

	1970 Ontario Value added ($ million)	1970 Ontario Fuel and Electricity ($ million)
SIC 371 - Explosives		
372 - Fertilizers	14.7	0.4
376 - Soaps	128.9	1.9
377 - Toilet preparations	55.1	0.3
378 - Industrial Chemicals	313.3	52.0
379 - Misc. chemicals	123.9	2.8

The industrial chemical industry is the largest component of this group and much the most important in terms of purchased electricity costs. The discussion below will concentrate on the manufacture of industrial chemicals. Included in the industrial chemical category are acids, alkalis, chemical fertilizers, pigments, synthetic rubber, etc. Oil and natural gas products are an important feedstock item for many of these products.

(a) Industry Structure or Performance

(i) Concentration

Concentration in the industrial chemical industry in total is only moderate. However the calculation of a concentration ratio for the whole category is of limited value as many of the manufactured items producing 70 to 80 per cent of Canadian output (Table E-2). Industry concentration is even higher than this in the Ontario market area.

(ii) Market Area Served, Tariff Protection

There is a significant import and export trade in iron and steel products. Canadian crude steel production in 1970 was 12.3 million tons, imports 2.2 million tons, and exports 2.3 million tons.* Export sales are nearly all to the U.S. with import competition mainly from U.S.A. and Japan but to some degree from European countries as well.

Canadian tariffs on imported iron and steel products are low (Table E-3).

(iii) Market Demand Factors

Canadian and world demand for steel is at high levels relative to supply capacity. Plants are working at capacity. An increase of 5 per cent per year in Canadian steel making capacity through 1990 was recently predicted by Algoma.** Prices through 1973 and 1974 have been very strong.

(iv) Type of Good

Product is sold to intermediate sectors of demand.

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* *Canada Mineral Yearbook*, *1970, p.279.*

** *Globe and Mail, Feb. 5, 1974.*

(iv) Type of Product

Most products are sold to the intermediate sector of demand. Some, particularly fertilizers, are sold to final demand sectors.

(v) Barriers to Entry

Would vary depending on the product produced. Generally economies of scale are important and capital expenditures large for a plant of minimum efficient size.

(vi) Industry Profit

Profits for the industrial chemicals category were below the average for all manufacturing industry over the 1968 to 1970 period (Table E-4).

(b) Ability to Accommodate Cost Increases

Strong forecast demand for the industry product plus the prospect of cheaper oil and gas feedstocks in Canada than elsewhere suggest the industry will be able to pass on cost increases.

10. Iron and Steel

Includes those categories in SIC 291.

(a) Industry Structure or Performance

(i) Concentration

Concentration in the industry is high with the top 4 enterprises (Stelco, Algoma, Dofasco, Dosco) within this classification are made by only one or two firms.*

(ii) Market Area Served, Tariff Protection

For the chemical and chemical products industry as a whole (which would include SIC's 373, 374 and 375 in addition to this category) imports have been an important part of total supply and exports have been significant. In 1973 shipments of chemicals by Canadian manufacturers were estimated at $3.38 billion, imports at $1.09 billion and exports at $0.52 billion.* Canadian tariffs on industrial chemical products are low (Table E-3).

(iii) Demand Growth Factors

Demand outlook is strong for the next few years. The Canadian and world chemical industries are expected to be working at close to capacity. The Chemicals and Chemical Products Committee of the National Economic Outlook Conference has forecast a decline in imports of chemicals due to a scarcity situation. Imports are forecast to decline from nearly 30 per cent of domestic consumption in 1973 to 15 per cent over the 1975-1980 period. Prices are forecast to be strong.

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* *National Economic Outlook Conference, paper on "Chemicals and Chemical Products," appendix p.6.*

Buyers in some sectors such as automobile manufacturing are very concentrated, and in others such as the construction industry very diverse.

(v) Barriers to Entry

The principal barrier to entry is related to economies of scale and large capital investments required to build a plant of minimum efficient scale. Availability of competitive iron ore or scrap raw material may also be important; ownership of iron ore resources may confer cost advantages to existing firms.

(vi) Industry Profits

Profits over the 1968 to 1970 period were somewhat below the average of all manufacturing industries (Table E-4). The low profit figure for 1969 may have been due in large part to a long industry wide strike in that year.

(b) Ability to Accommodate Cost Increases

The world steel industry has gone through cycles of over and under capacity and will probably continue to do so. The outlook for the immediate years ahead is very good however. The steel industry in Ontario is very highly concentrated and with reasonably good demand prospects should be able to pass on cost increases. In periods of low demand (compared to total world capacity) Ontario producers will have problems with import competition from Japan, Europe, and the U.S.A.

TABLE E-1

INDUSTRY CLASSIFICATION OF THE ONTARIO INPUT-OUTPUT MODEL

Industry Number	Industry Group	Standard Industrial Classification Number (1960 Code)
1	Agriculture, Forestry and Fishing	011, 013, 015, 017, 019, 021, 031, 039, 041, 045, 047
2	Mining	058, 051, 052, 053, 054, 055, 056, 057, 059, 061, 063, 065, 066, 071, 073, 077, 079, 083, 087, 092, 094, 096, 098, 099, 101, 103
3	Meat and Poultry	101, 103
4	Dairy Products	105, 107
5	Grain Mills	123, 124, 125
6	Biscuits and Bakeries	128, 129
7	Sugar and Confectioneries	131, 133
8	Other Food Industries	111, 112, 135, 139
9	Soft Drinks	141
10	Distilleries, Breweries and Wineries	143, 145, 147
11	Tobacco and Tobacco Products	151, 153
12	Rubber Products	161, 163, 169
13	Leather and Leather Products	172, 174, 175, 179
14	Cotton Yarn and Cloth	183
15	Synthetic Textiles	201
16	Knitting Mills	231, 239
17	Clothing Industries	243, 244, 245, 246, 247, 248, 249
18	Other Textile Mills	193, 197, 211, 212, 213, 214, 215, 216, 218, 219, 221, 223, 229
19	Sawmills	251
20	Furniture and Fixtures	261, 264, 266, 268

TABLE E-1 (cont'd)

INDUSTRY CLASSIFICATION OF THE ONTARIO INPUT-OUTPUT MODEL

Industry Number	Industry Group	Standard Industrial Classification Number
21	Other Wood Industries	252, 254, 256, 258, 259
22	Pulp and Paper Mills	271
23	Paper Products	272, 273, 274
24	Printing and Publishing	286, 288, 289, 287
25	Iron and Steel Mills	291
26	Other Primary Metals Industries	292, 294, 295, 296, 297, 298
27	Fabricated and Structural Metals	302
28	Metal Stamping, Pressing and Coating	304
29	Other Metal Fabricating Industries	301, 303, 305, 306, 307, 308, 309, 315
30	Miscellaneous Machinery	311, 316, 318
31	Motor Vehicles and Aircraft	321, 323, 324, 325
32	Other Transportation Equipment	326, 327, 328, 329
33	Electrical Appliances	331, 332
34	Electrical Industrial Equipments	336
35	Communication Equipment	334, 335, 338
36	Other Electrical Equipment	337, 339
37	Clay, Lime and Cement	341, 343, 345, 347, 348, 351, 352, 353
38	Other non-metallic Mineral Products	354, 355, 356, 357, 359
39	Petroleum Refineries and Coal Products	365, 369
40	Plastics and Synthetic Resins	373
41	Paint and Varnish	375
42	Pharmaceuticals and Medicines	374

TABLE E-1 (cont'd)

INDUSTRY CLASSIFICATION OF THE ONTARIO INPUT-OUTPUT MODEL

Industry Number	Industry Group	Standard Industrial Classification Number
43	Other Chemical Industries	371, 372, 377, 378, 379, 376
44	Miscellaneous Manufacturing Industries	381, 382, 383, 384, 385, 393, 395, 397, 398, 399

Source: Ontario Economic Review

TABLE E-2

CONCENTRATION RATIOS - SELECTED INDUSTRIES

SHARES OF INDUSTRY EMPLOYMENT AND VALUE ADDED ACCOUNTED FOR BY THE LARGEST ENTERPRISES - CANADA [1]

Industry Group	Four Largest Enterprises Accounted for		Eight Largest Enterprises Accounted for		Twelve Largest Enterprises Accounted for		Remarks
	% value added	% empl.	% value added	% empl.	% value added	% empl.	
1. Petroleum refining	83.4	x	95.3	02.1	98.6	97.2	Conc. ratio for SIC 365 only, petroleum refining
2. Plastics and synthetic resins	64.1	60.5	x	x	95.2	93.5	
3. Pulp and paper	35.7	37.2	53.5	53.7	67.3	64.3	
4. Other primary metal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	Conc. ratio for SIC 295, smelting and refining not available
5. Cotton yarn	x	x	97.5	96.8	99.8	99.5	
6. Meat and poultry	53.4	54.0	64.8	66.4	67.1	68.6	Conc. ratio for SIC 101 only, meat processors
7. Other non-metallic	x	x	100.0	100.0	-	-	SIC 3561 - glass manufacturers
	67.5	48.9	75.6	59.9	80.1	66.5	SIC 3562 - glass product mfrs.
	81.4	x	95.3	94.9	98.9	98.6	abrasives
8. Synthetic textiles	60.0	54.3	75.4	73.3	82.4	78.6	
9. Other chemicals	36.7	39.2	58.8	61.9	72.0	71.7	Conc. ratio for SIC 378 only, industrial chemicals
10. Iron and steel	80.2	71.6	91.1	88.1	95.1	92.4	

Source: Concentration in the Manufacturing Industries of Canada, Dept. of Consumer & Corporate Affairs, 1971. See Table A-2

1 Concentration ratio's based on 1965 data

x withheld to avoid disclosing figures for individual enterprise

TABLE E-3

NOMINAL AND EFFECTIVE TARIFFS, SELECTED INDUSTRIES - CANADA [1]

Industry Group	Nominal Tariff	Effective Tariff [2]	Remarks
1. Petroleum refining	6.0	33.2	
2. Plastics & synthetic resins	8.2	7.1	
3. Pulp and paper	13.0	74.9	
4. Other primary metal	n.a.	n.a.	No effective tariff rate available for the smelting and refining industry
5. Cotton yarn	20.0	38.0	
6. Meat and poultry	5.2	5.7	Figures are for the category "slaughtering and meat packing"
7. Other non-metallic	10.1 20.5	11.5 44.1	Glass and glass products Abrasives
8. Synthetic textiles	30.3	58.2	
9. Other chemicals	6.8	5.3	Figures are for industrial chemicals manufacturers
10. Iron and steel	6.7	8.6	

Source: J. Melvin and B. Wilkinson, Effective Protection in the Canadian Economy, Economic Council of Canada, Special Study No. 9, August 1968.

1 Except for item 1, petroleum refining, all figures are based on pre "Kennedy round" tariff rate levels.

2 The effective tariff may be defined as the percentage increase in value added per unit of output made possible by the tariff structure.

TABLE E-4

PROFITS BEFORE TAX ON CAPITAL EMPLOYED, SELECTED INDUSTRIES, CANADA, 1968, 1969, 1970

Industry Group	1968	1969	1970	Remarks
1. Petroleum refining	8.7	6.6	8.9	
2. Plastics and synthetic resins	n.a.	n.a.	n.a.	
3. Pulp and paper	4.6	5.9	3.3	
4. Other primary metal	12.3	9.0	4.9	Profit figures for smelting and refining only
5. Cotton yarn	1.4	3.4	9.1	Profit figures are for cotton and woollen mills
6. Meat and poultry	7.9	13.1	16.3	Profit figures are for "meat products"
7. Other non-metallic	6.5	9.1	2.5	Profit figures are for "glass and glass products" only
8. Synthetic textiles	8.7	9.9	-3.7	
9. Other chemicals	6.3	7.1	6.3	Profit figures are for industrial chemicals only
10. Iron and steel	9.3	6.8	8.4	
Total manufacturing	10.6	10.7	8.2	
Total construction industries	11.3	9.4	7.0	
Total all non-financial industries	8.9	8.7	7.6	

Source: SC 61-207, Corporation Financial Statistics