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THE COST COMPETITIVENESS OF LIGHT WEIGHT COATED (LWC) MANUFACTURING IN CANADA

Competitiveness Analysis
Corporate and Industrial Analysis Branch

in collaboration with

Forest Industries
Resource Processing Industries Branch
INDUSTRY CANADA

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ABSTRACT

The global forest products sector has been undergoing one of the most difficult periods in its history. Recently strengthened demand and prices have improved significantly the fortunes of the lumber sector; however, appreciable challenges remain for the pulp and paper sector. These market conditions naturally give rise to questions regarding the future of Canada's pulp and paper industry.

This report focusses on one subsector of the pulp and paper industry: high value added magazine (Light Weight Coated (LWC) No. 5) papers. There has been a long-standing concern by many industry observers that Canada is under-represented in this segment of the industry. This analysis examines whether Canada can compete in this grade of papers.

The determination of Canada's ability to compete is based on a long-run cost competitiveness analysis. Representative state-of-the-art plants have been "constructed" in seven locations; three in Canada (Quebec, Ontario, and B.C.) and four in the U.S. (Maine, Michigan, Washington, Alabama). Using a total value added chain analysis - from the forest to the wholesaler - the attractiveness of Canadian sites have been directly compared with their U.S. competitors. The analysis is a quantitative comparison of the total LWC delivered costs and hence indicates whether particular regions of Canada can expect to maintain a presence in these grades. Naturally, the decision to actually construct a plant will involve many other considerations, most particularly the size and condition of the markets.

This report relies on a very comprehensive technical analysis by the consulting firm H.A. Simons. Industry Canada officials were responsible for the financial and economic analyses. Funding was provided by the CPPA and Industry Canada.

The results are very encouraging for Canada. A Michigan site was chosen as the benchmark for comparisons; it is the lowest cost U.S. location; it is also in the heartland of the traditional supply of these papers. The Canadian results are very dependent on exchange rates.

- At a 75¢ Canadian dollar, all three Canadian supply regions are more attractive than Michigan; B.C. being only marginally more attractive.
- At an 81¢ Canadian dollar, the Quebec site is more attractive than Michigan; Ontario and B.C. are less attractive.
- At an 87¢ Canadian dollar, all the Canadian sites are less attractive than Michigan.

The analyses have pointed out the great importance of assumptions regarding electricity cogeneration. Cogeneration was installed when it could profitably back out purchased power. Excess power sales and "crosshauling" (simultaneous sale and repurchase) were not considered.

All Canadian sites had lower operating costs than the Michigan benchmark. Lower cost energy was the principal reason for these lower operating costs. The principal Canadian disadvantage was the higher cost of capital (about 2.0 per cent before tax; 1.6 per cent after tax). The Quebec site, and more particularly the B.C. site, would have to bear higher outbound transportation costs.

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1.0 INTRODUCTION

1.1 Background

In 1992, forest products accounted for 15 per cent of Canadian manufacturing GNP. With exports of $22 billion, the forest industry was by far the largest contributor to Canada's net trade balance. It is of major importance to Canada that this level of performance continue, however, in the light of increasing global competition this is not a *fait accompli*. An evaluation of the Canadian pulp and paper sector production mix reveals a heavy preponderance towards low value commodity grade products. The vast majority of Canadian production is in newsprint and market pulp.

Revolutionary technological improvements are now allowing these products to be made from a much greater diversity of wood fibres. These changes have eroded Canada's historic fibre advantage in newsprint. As a result, new producers and new products are now competing for traditional Canadian markets. In response to this threat, common industry perception is that some of Canadian paper manufacturers must make the transition to higher-value added products such as coated papers. The question that arises is: can Canada compete in manufacturing these grades?

To address this question the Canadian Pulp & Paper Association (CPPA), with the assistance of Industry Canada (IC), commissioned the engineering consulting firm, H.A. Simons, to determine the long-term cost competitiveness of Canada as the location for new light weight coated (LWC) paper manufacturing capacity. In particular, the study focuses on the LWC grade within the coated paper No. 5 category; this grade accounts for the largest component of North American demand for coated printing papers. LWC No. 5 is a coated groundwood covering a range of basis weights. In order to examine the impact of the fibre morphology of the wood base available in each of the regions under study, the analysis was done based on a 50:50 product mix of 47 g/m^2 and 59 g/m^2 basis weight paper.

LWC was chosen for several reasons. First, the natural wood resource base in Canada is generously endowed with fibres of the characteristics desired for producing higher value papers. Canadian softwoods (e.g. spruce and fir) have fibres that produce high strength paper, particularly important for LWC grades. There is also an abundance of Canadian hardwoods (e.g. aspen) that can also contribute desirable attributes to these grades. Second, the market growth rate in this paper grade has been above average. This trend is forecast to continue. Last, as seen in Figure 1, it is a well defined grade with appreciable market volumes.

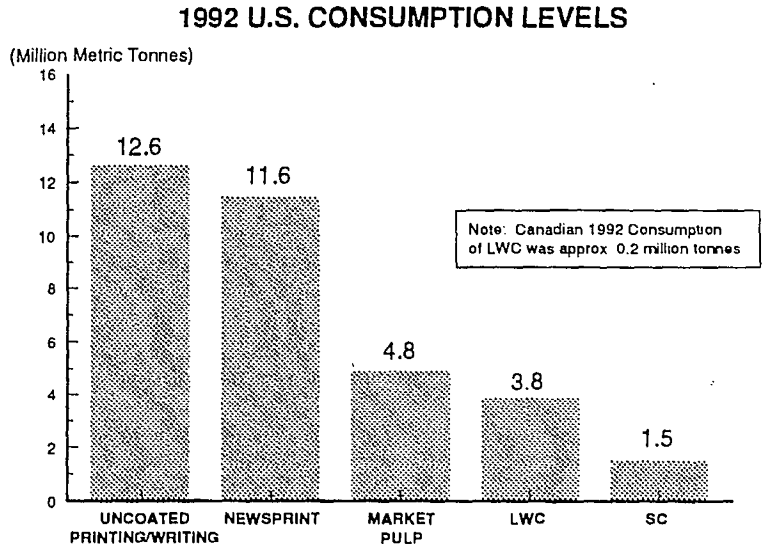


Figure 1 1992 U.S. Consumption

Regional comparisions are based on a modern 430,000 tonne per year mill designed as a representative, typical state-of-the-art investment. This mill was adapted by the engineers to comply with the pertinent characteristics of each location. The cost competitiveness of each region was calculated based on the net present value of the after-tax cashflows for the project discounted at the appropriate weighted average cost of capital. Cash flows were developed based on the capital and operating cost estimates provided by the engineering firm.

1.2 Objectives

The objective of this report is to examine the attractiveness of Canadian locations for new investment in high value added papers.

The study is designed to determine the principal advantages and disadvantages of Canadian sites vis-a-vis themselves and their U.S. counterparts. Seven regions were investigated. In the U.S. the regions were Alabama, Maine, Michigan and Washington state. In Canada, the regions included Quebec, Ontario and British Columbia.

The results of the work will allow Industry Canada to examine the potential for enhancing the advantages or reducing the disadvantages of Canadian locations.

1.3 LWC Markets

Coated printing papers in North America are categorized according to five groups, No.1 to No.5. Of these, No.5 represents the largest in volume usage accounting for over half of U.S. coated paper demand.

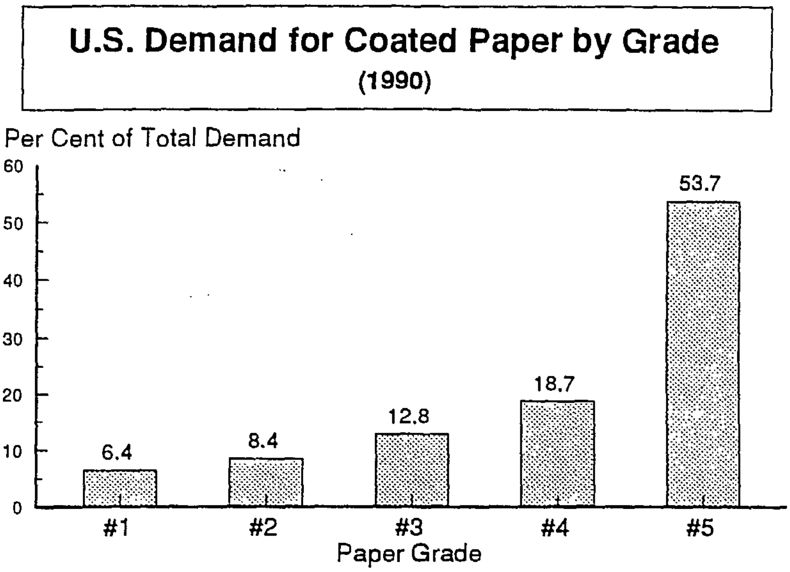


Figure 2 U.S. Coated Paper Demand

This grade structure is generally made on the basis of paper properties such as brightness, gloss, opacity, and surface and printing quality. These paper characteristics tend to improve in progressing up the grade structure (ie. No. 1 would be the brightest, ranging from 80-82, while No. 5 would be the least bright, ranging from 68-72).

Coated printing papers are, in general, used for the purposes of advertising and promotion (such as: magazines, inserts and flyers). When selecting a paper grade, the advertiser is making a choice between paper quality and price. The higher the quality, the higher the price. Typical uses by LWC paper grade are: No. 1 grade is used for annual reports and art prints, No 3. is used in catalogs and magazines that wish to portray an upscale image, and No. 5 is used in cost conscious mass circulation applications. The principal end-uses of No. 5 are magazines (42%), inserts/flyers (27%), catalogs (26%), books (2%), and other commercial printing (6%).

The North American LWC paper demand, seen in Figure 3, is concentrated heavily in the U.S. market. Canada was responsible for only 5.8% of demand in 1992. Hence, any analysis on this paper grade tends to focus primarily on the U.S. marketplace.

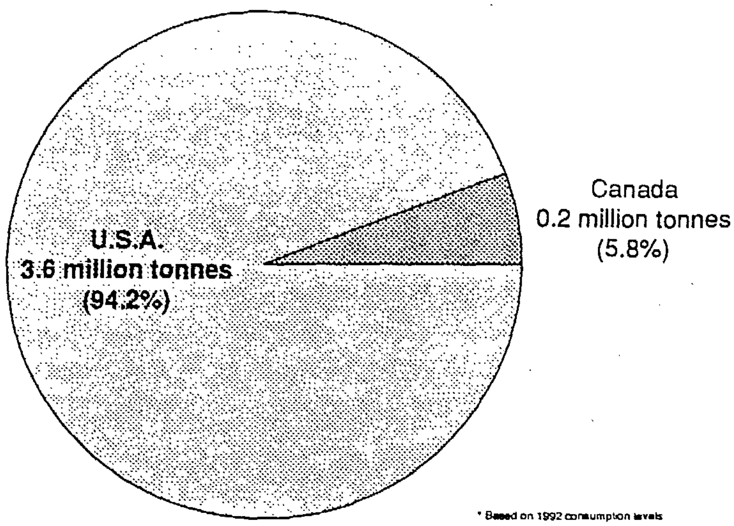


Figure 3 Canadian and U.S. LWC Consumption

Commercial printing in the U.S. is heavily concentrated in the central regions of the country. Some of the most prominent states for printing include; Illinois, Wisconsin, Minnesota and Tennessee. The ten largest consuming states account for nearly 70% of the printing in magazines, catalog, inserts and mailers.

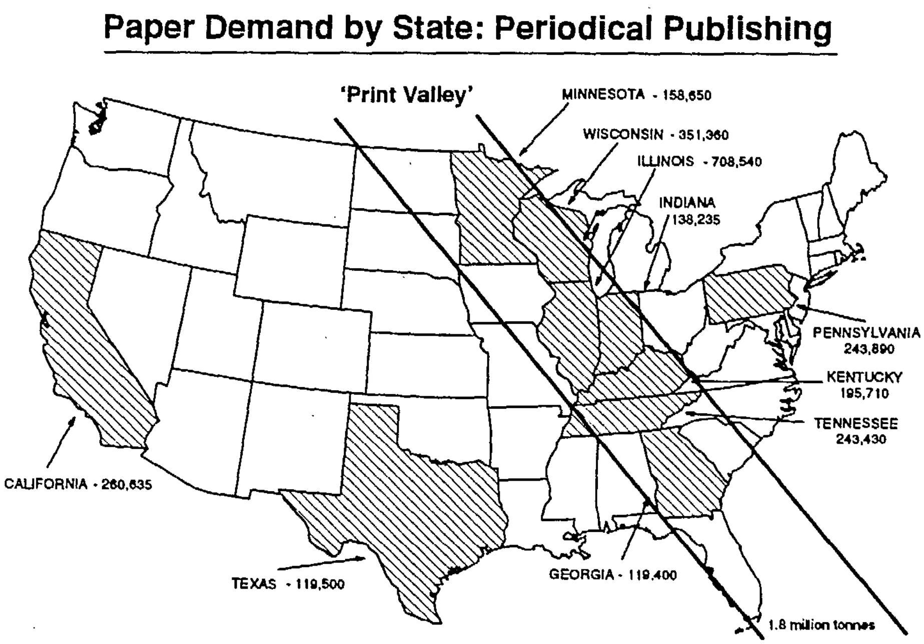


Figure 4 Print Valley

U.S. demand for LWC No. 5 grew at an annual rate of 5.7% over the 1980s. Consumption of No. 5 started the decade at around 2.2 million tonnes and grew by 1.6 million tonnes to reach a consumption level of 3.6 million tonnes in 1992.

Future growth rates are forecast to decrease to an average of 2.6% per year throughout the 1990s. This translates into an increase in demand of approximately 1.2 million tonnes by the year 2000.

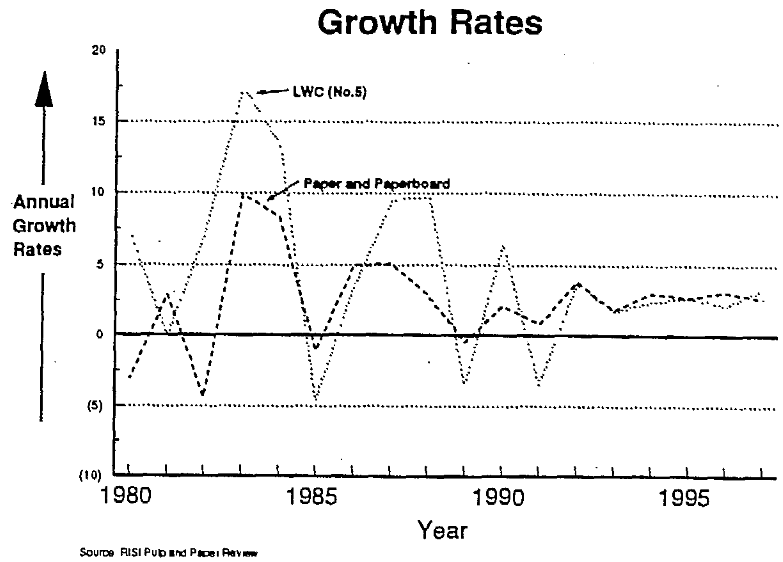
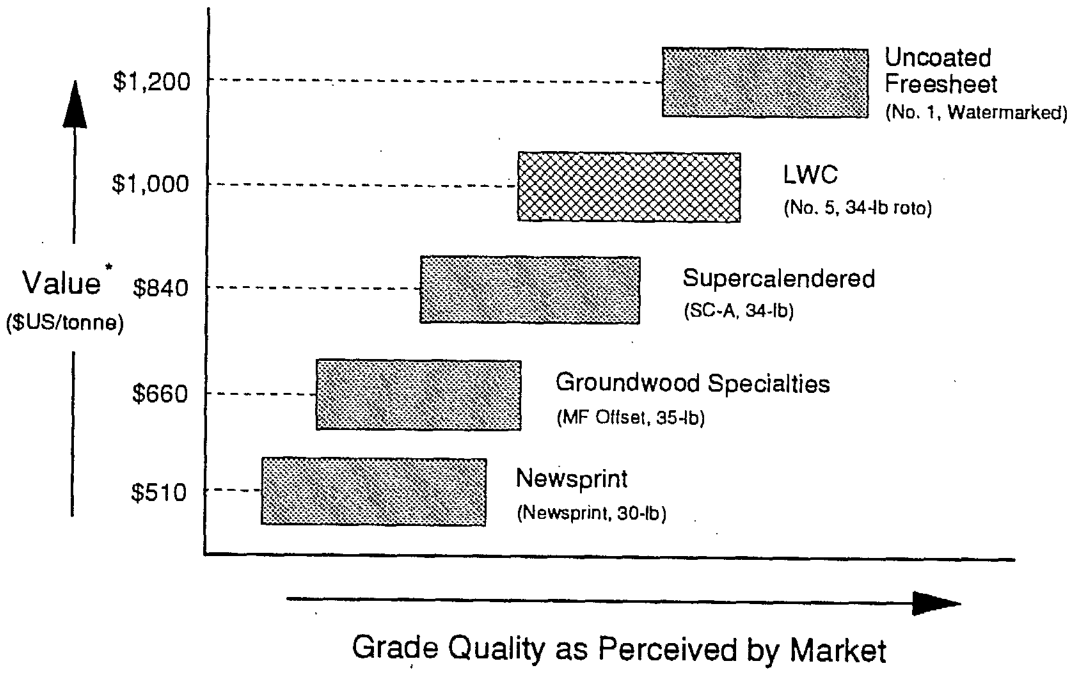


Figure 5 LWC Growth Rates

In addition to a growth rate higher than that anticipated for commodity grades, LWC is an interesting high valued grade - approximately $1,000 US/tonne.



* Note: Prices are approximate 1993 US$/tonne selling price.

Figure 6 Paper Market Prices

1.4 North American LWC Supply

The large majority of North American LWC production capacity is concentrated in the U.S.A.. The geographical breakdown of producers is shown below.

	Capacity (000 tonnes/yr)
U.S.	
Champion International	655
International Paper	560
Consolidated Papers	525
Blandin Paper	305
Madawaska	301
Bowater	295
Mead	280
Boise Cascade	260
James River	235
Pentair	200
Canada	
Repap Enterprises	475
Kruger	140
North American Total	4,231

As a result of large domestic production capacity, U.S. imports of coated paper account for only a small portion of domestic consumption. In 1991, imports of coated paper were 0.74 million tonnes or approximately 10% of the 6.9 million tonnes of coated paper consumption. Canada, with 42%, was the leading source of imports.

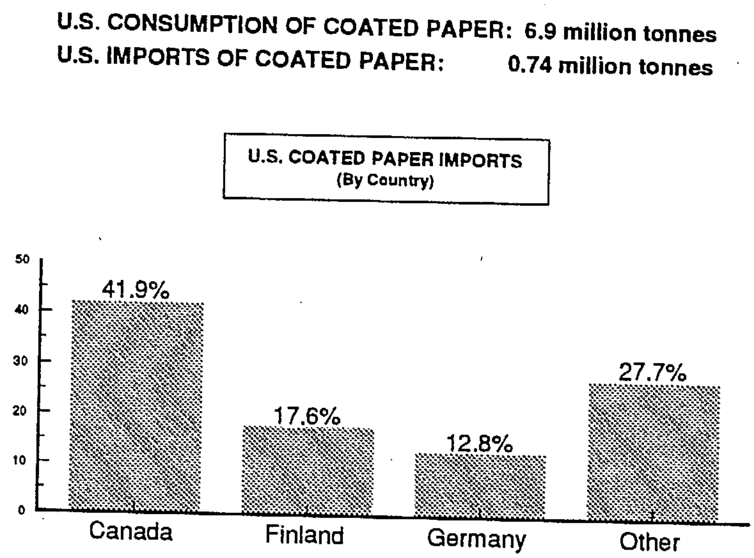


Figure 7 U.S. Coated Paper Imports

2.0 THE APPROACH: LONG RUN COMPETITIVENESS ANALYSIS

2.1 Value Added Chain Analysis

The comparative costs at all stages of the value added chain have an impact on the ability of Canadian sites to compete in the marketplace. This chain begins with the raw materials (wood, clay, chemicals, energy, etc.) that are the inputs to the process, it continues through the manufacturing operations, and it ends with the delivery of the finished product to the consumer.

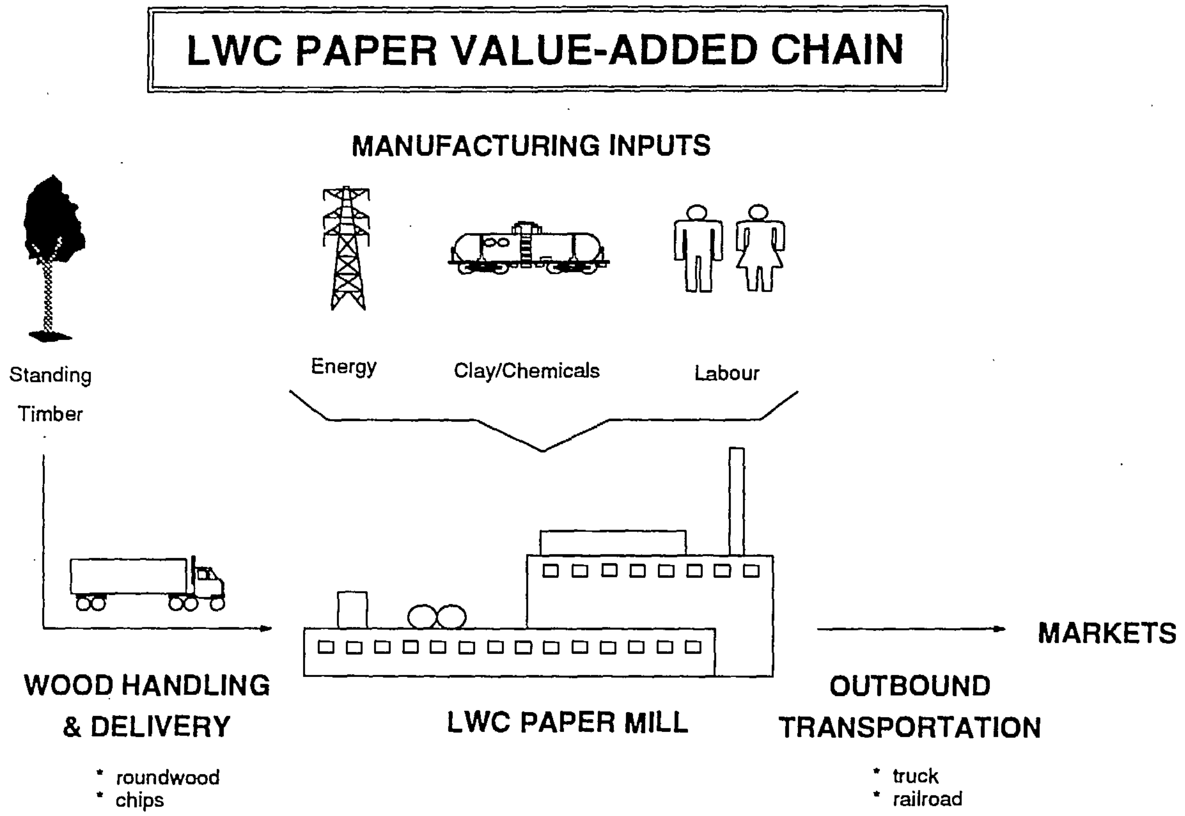


Figure 8 Value-Added Chain For LWC Paper Manufacturing

H.A. Simons was engaged by CPPA and Industry Canada to prepare prefeasibility estimates of facilities for each of the selected U.S. and Canadian sites. This analysis is a long run competitiveness analysis. New, state-of-the-art facilities were "constructed" at logical Canadian and U.S. sites for a new greenfield plant. The cost comparisons included both the operating and capital costs (allocated over the units of anticipated lifetime production).

As part of the analysis, H.A. Simons was responsible for determining the location of each mill by region, optimizing the paper furnish (i.e. wood fibre, clay and kraft pulp content), and selecting the logical market destinations for each mill. LWC prices were assumed to be the same at all market destinations; similar qualities of LWC were produced at all sites.

2.2 Location of Facilities

The greenfield mills were located at seven locations. The four U.S. locations were: Michigan (our benchmark location reflecting the traditional centre of LWC production), Maine, Alabama, and Washington. The three Canadian locations were: B.C., Ontario, and Quebec.

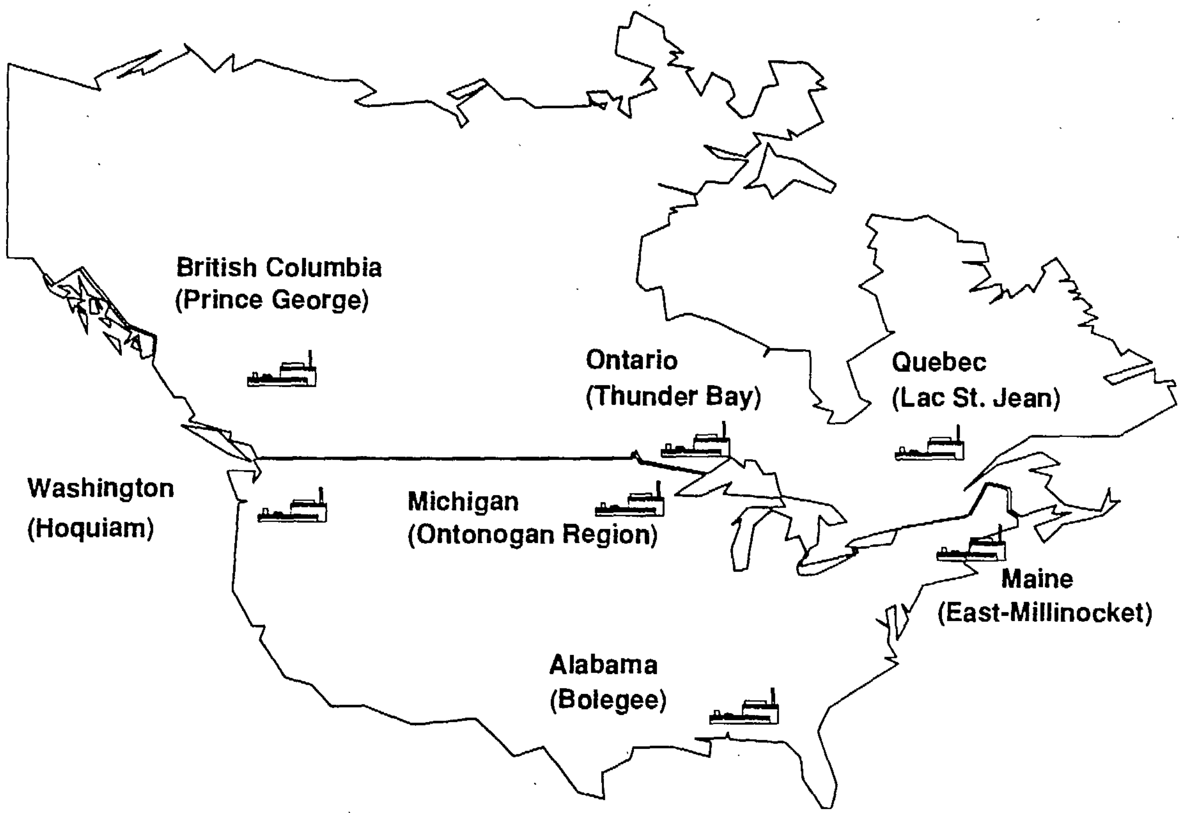


Figure 9 LWC Mill Locations

Primary factors included in the assessment of location suitability were:

- access to an appropriate fibre base,
- access to market softwood kraft pulp,
- adequate infrastructure, and
- ease of access to markets.

As the study is a long-term cost competitiveness analysis, the access to wood fibre was not restricted by current availability and licensing agreements. Instead, the location analysis was based on the physical inventory of wood fibre in the region. The assumption was that for the construction of an LWC mill, adequate furnish would be freed.

2.3 Optimal Wood Fibre by Region

Spruce and aspen are the wood types with the best fibre characteristics for LWC paper manufacturing. These species are found in abundance in five of the seven regions under investigation; Quebec, Ontario, British Columbia Maine, and Michigan. Alder and hemlock were the best alternative for Washington.

In Alabama, loblolly or slash pine is the only species of sufficient quantity to be considered. The fibre characteristics are barely suitable for the production of the heavier basis weight LWC paper and totally unsuitable for any sheets lighter than 50 g/m^2.

2.4 The Paper Mill

The paper mill was designed to produce from 400,000 tonnes per year (tpy) of 47 g/m^2 to 460,000 tpy of 59 g/m^2 of LWC. The different basis weights would be obtained by combinations of mechanical and kraft pulp in the sheet.

The mill was constructed in two phases over a five year period. The first phase consisted of one paper machine and all supporting facilities. Once this machine was fully operational, a second machine was installed along with the required additional support facilities. The production start-up schedule is illustrated in Figure 10, below.

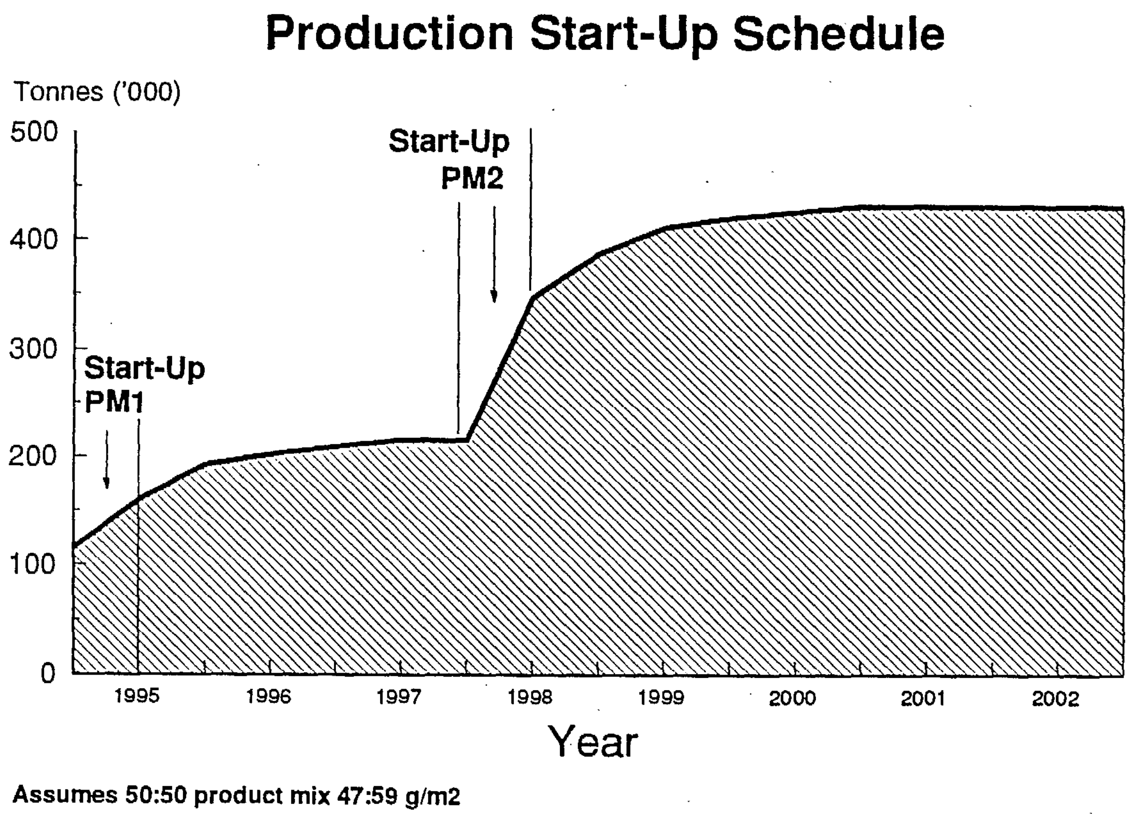


Figure 10 Mill Production Start-Up Schedule

The paper mills were designed around the paper machines; each machine has two identical machines having the following operating characteristics for the two benchmark basis weights.

Table 2-1
Paper Machine Operating Characteristics

Category	Unit	47 g/m²	59 g/m²
PM Efficiency	%	88	90
Operating Time	days per year	356	356
Reel Trim	inches	330	330
Reel Speed	feet per minute	4,230	3,660
Daily Production	BDt/d	1,102	1,262

The mill was laid out in-line. A block diagram of the mill design is illustrated in Figure 11 on the following page. Wood handling facilities (chips and/or roundwood) are located at one end and finished roll shipping is located at the other.

The paper manufacturing operation itself includes pulping, stock preperation, paper forming, coating, winding and supercalendering.

The primary differences in the mill design between regions are evident in the pulping process. Six out of the seven locations under investigation have fibre qualities appropriate for producing both the 47 g/m^2 and 59 g/m^2 basis weights. Alabama is the exception; because of the reliance on pine furnish, only the heavier (59 g/m^2) grade can be produced.

The Quebec, Ontario, British Columbia, Maine and Michigan mills have two thermo mechanical pulp (TMP) lines to process the softwood and two chemical refiner mechanical pulp (CRMP) lines to process the hardwood. The Washington mill uses a similar process arrangement for the heavier basis weight paper; however, only CRMP is used in the lighter weight paper. As a result the line must be larger. In Alabama, there will be three TMP lines that will produce pulp only for the 59 g/m^2 basis weight paper.

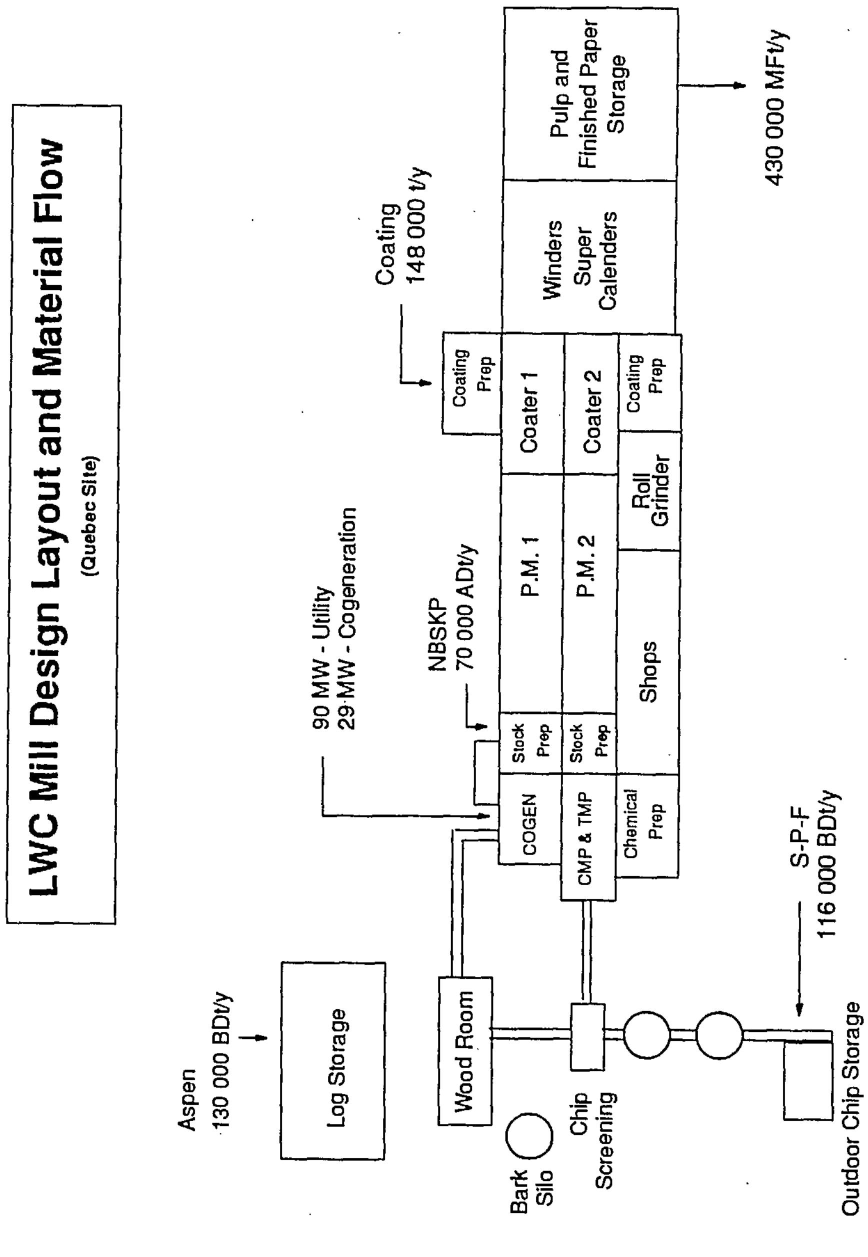


Figure 11 LWC Paper Mill Flow Diagram

The output for the mills, assuming a two machine operation, is illustrated in Figure 12. With the exception of Alabama, output will be 430,000 tonnes per year, consisting of a 50:50 product split between the 47 g/m^2 and 59 g/m^2 basis weights. The nature of the fibre availability limits the Alabama site to producing the heavier paper grade; however, output would be 460,000 tonnes per year.

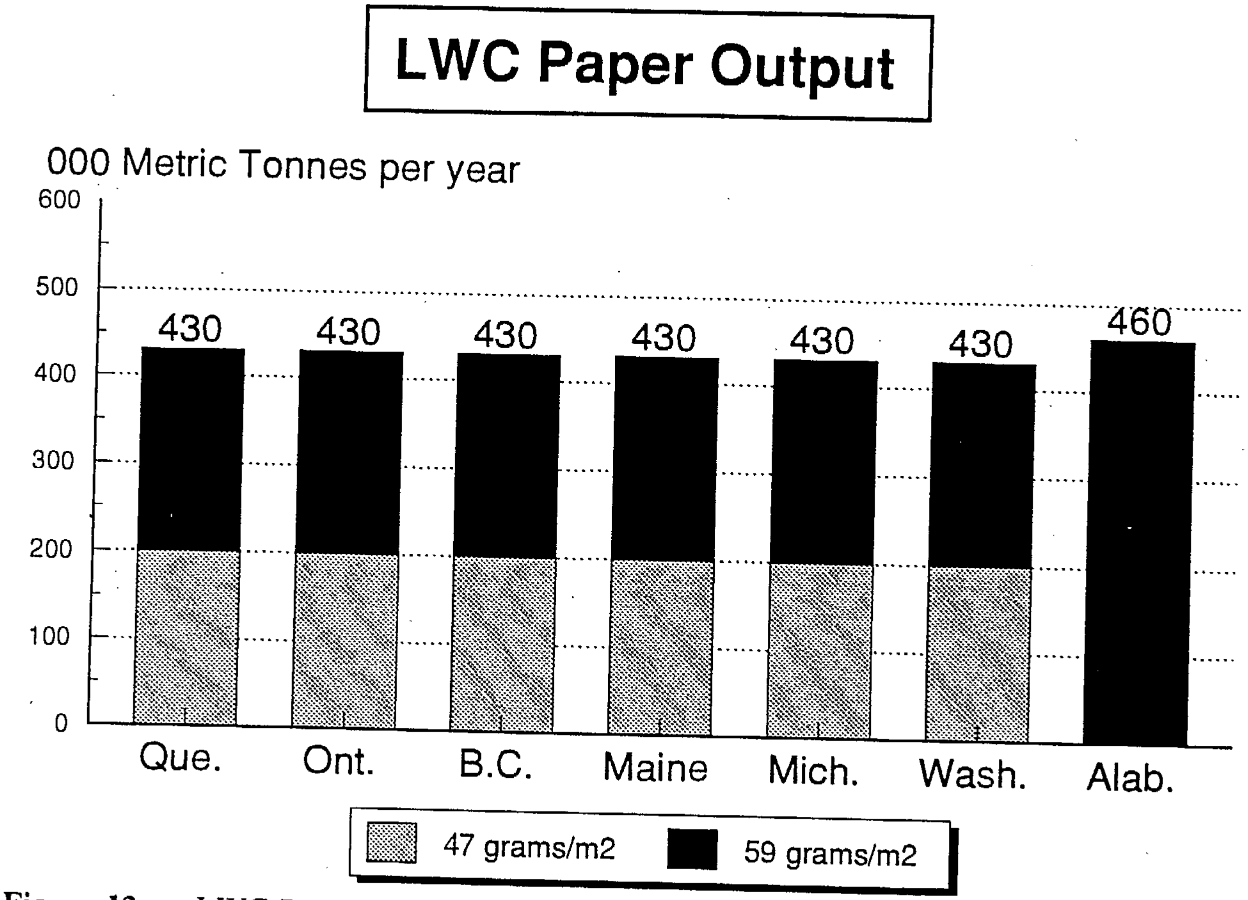


Figure 12 LWC Paper Output By Site

2.5 Raw Materials

The composition of the sheets - wood fibre, clay, and kraft pulp varied between sites. Wood inputs came in the form of roundwood or chips depending on the availability of supply. Chips were the preferred input as they were less costly and easier to handle than roundwood equivalents. The wood inputs by site were as follows:

Table 2-2
Wood Inputs by Site
(Bone Dry Tonnes per Year)

Site	Hardwood (BDt/yr)	Softwood (BDt/yr)
Quebec	Aspen 130,000 Roundwood	S-P-F[1] 120,000 Chips
Ontario	Aspen 130,000 Roundwood	S-P-F 123,000 Roundwood
British Columbia	Aspen 130,000 Roundwood	S-P-F 120,000 Chips
Maine	Aspen 130,000 Roundwood	S-P-F 123,000 Roundwood
Michigan	Aspen 130,000 Roundwood	S-P-F 123,000 Roundwod
Washington	Alder 139,000 Chips	Hemlock 124,000 Chips
Alabama[2]		Yellow Pine 197,000 Roundwood

1. S-P-F = Spruce, Pine and Fir
2. Due to fibre restraints, Alabama can only manufacture the heavier grade paper.

Given the inter-regional differences in fibre availability and characteristics, the kraft pulp and clay contents varied accordingly by mill. In Washington and Alabama, additional kraft was required to enhance the strength of the sheet. Additional clay was also used in these locations.

The kraft pulp and clay requirements by region are illustrated in Table 2.3.

Table 2-3
Kraft Pulp and Clay Inputs

Site	**Kraft Pulp** (admt/yr)	**Clay** (tonnes/yr)
Quebec	70,000	60,477
Ontario	70,000	60,477
B.C.	70,000	60,477
Maine	70,000	60,477
Michigan	70,000	60,477
Washington	124,000	61,977
Alabama	128,314	(40 lbs. only) 71,980

Other raw material inputs required in the LWC manufacturing process were primarily chemicals and fillers including: SO_2, NaOH, latex, starch and curing resins. These other inputs have all been included in the manufacturing cost analysis. However, compared to the volume and cost of the primary inputs the impact of these other inputs on the total operating cost is minimal.

Inbound transportation costs can be the source of significant cost advantage for a location.

Woodfibre inbound transportation costs per BDMT, Figure 13, vary from a low of $13.00 in Alabama to a high of $33.25 in Michigan. Specific regional factors that have a significant influence on transportation costs include the volume of woodfibre required, the average density of the wood, the average haul distance, the terrain and the limits on the number of operating hours per year per truck.

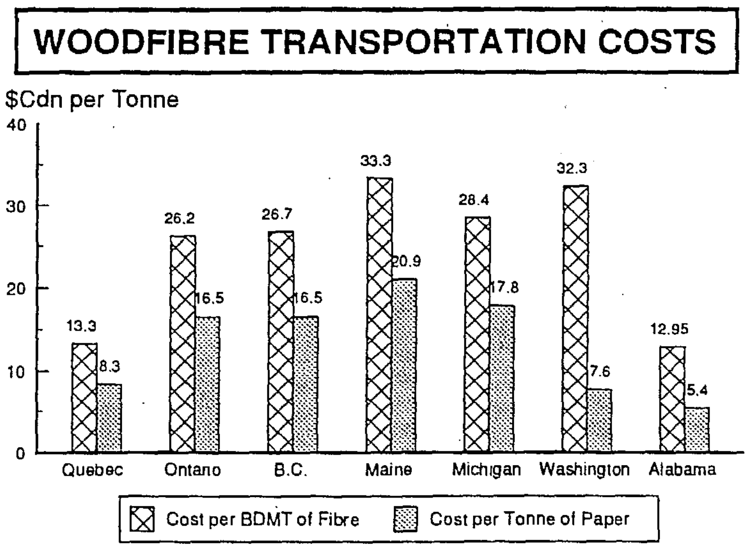


Figure 13 Woodfibre Transportation Costs

Kraft pulp is priced f.o.b. the LWC mill and as such transportation costs are not an issue. The analysis is based on the opposite approach for clay. All clay must be sourced from the same geographical area (Georgia, U.S.A.) and is priced f.o.b. the producer. As most mills require the same volume of clay, the transportation cost differences correlate with the distance from the supplier (Georgia) and the mill.

Table 2-4
Clay Transportation Costs
($Cdn per Dry Tonne)

Site / Source	Quebec	Ontario	British Columbia	Maine	Michigan	Washington	Alabama
(DBK) Kaolin	$125	$123	$147	$88	$72	$136	$45

The costs of transporting clay from Georgia to the mills represent between 83% and 96% of the transportation costs for input materials other than woodfibre.

2.6 The Markets

An appropriate market mix was developed for each mill. Transportation costs can be a significant factor in the final delivered cost for paper to a customer. As a result, it is prudent for paper companies to supply customers close to their mills. Based on available modes of transportation, and the size and geographical location of the major LWC markets in North America, the following breakdown of product destination by site was created.

Table 2-5
Paper Sales to Major Markets By Site
(Thousands of Tonnes)

Site / Destination	Quebec	Ontario	British Columbia	Maine	Michigan	Washington	Alabama
California			128			128	
Georgia							46
Illinois	162	162	85	162	162	85	162
Indiana	43	43		43	43		46
Kentucky	22	42		22	42		69
Minnesota	22	42	87	22	42	87	
Pennsylvania	44	44		44	44		
Tennessee							91
Texas							46
Wisconsin	75	75	86	75	75	86	
Quebec	50	7		50	7		
Washington						44	
B.C.			43				
Ontario	15	15		15	15		
TOTAL	430	430	430	430	430	430	460

The variation in average outbound transportation costs in dollars per tonne of paper produced is illustrated in Figure 14.

There are three factors contributing to the total outbound transportation cost per tonne; the number of tonnes of finished product; the average distance to market; and the cost per mile. However, since the volume of output (with the exception of Alabama) is the same for all locations, it is not a major factor.

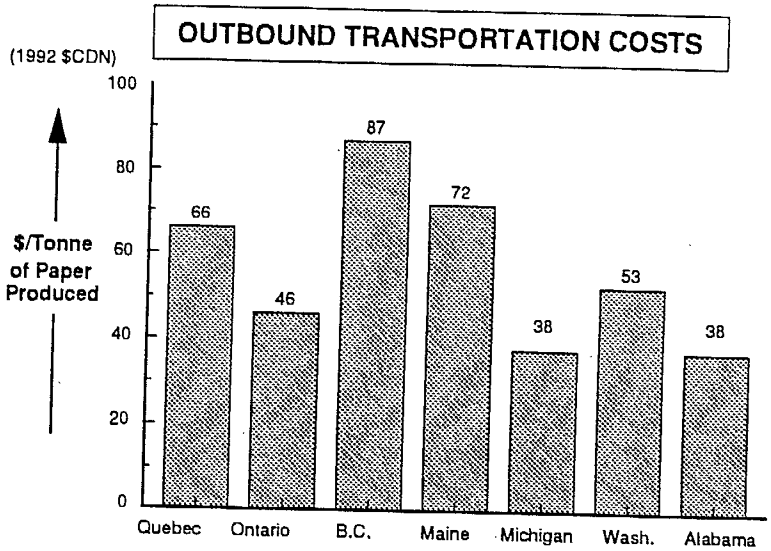


Figure 14 Outbound Transportation Costs

The other two components are broken down in Table 2-6 below.

Table 2-6
Summary of Transportation Costs Factors

Site	Quebec	Ontario	British Columbia	Maine	Michigan	Washington	Alabama
Avg. Distance to mkt (miles)	900	621	1,580	980	504	1,390	512
$/tonne mile	0.07	0.07	0.05	0.07	0.07	0.04	0.07

B.C. and Washington ship most of their product by rail and thus enjoy lower costs per tonne mile. However, this is offset by the extensive distance disadvantage both locations face. The remaining sites ship most of their product by truck and given the competitive nature of the North American trucking industry, there are no significant inter site cost differences in $ per tonne miles.

The most significant factor influencing outbound transportation costs is the average distance to the customer.

3.0 COGENERATION: IMPORTANCE IN SITE OPTIMIZATION

The base-case scenario for all seven mills under investigation included a 29 MWatt steam topping cycle cogeneration facility. In each case, high pressure process steam from the mill's hog fuel boiler was passed through a steam turbine and provided between 20 and 28 per cent of the mill's total electriciy requirements.

From this initial level of design, several questions arose:

- Was the 29 MWatt unit optimal for all locations? If not, what was the optimal size? Were there regions where cogeneration is not at the optimum level?
- Could costs be reduced by expanding the units and selling excess power to the utilities? Again, how do the situations vary between locations?
- What was the appropriate approach for cogeneration at each site: combined cycle or steam topping cycle?
- What about "crosshauling"?

The objective of this section is to address the above questions and to choose the optimum site-by-site approach to cogeneration. With cogeneration optimized, the inter-site comparisons can be analyzed in Chapter 4. All sites, with the exception of Alabama, will be approached on the assumption that for each site 50 per cent of production is at a basis weight of 47 g/m^2 and 50 per cent is at a basis weight of 59 g/m^2. The Alabama case is based on 100 per cent production of the higher basis weight paper.

3.1 The Incentives For Cogeneration

There is potential for cogeneration to significantly alter the electricity costs between sites. In the locations with comparatively high purchased power costs, there is the opportunity of reducing this disadvantage through self-generation.

For self-generation to be economically attractive, it is necessary that the combined unit capital and operating costs be less than the rate at which the mill could alternatively purchase the electricity. As a result, not all locations are well suited for cogeneration in this greenfield site comparison.

The LWC mills face significantly different unit electricity costs by region. In addition, electricity requirements, particularily for Washington and Alabama, differ by site.

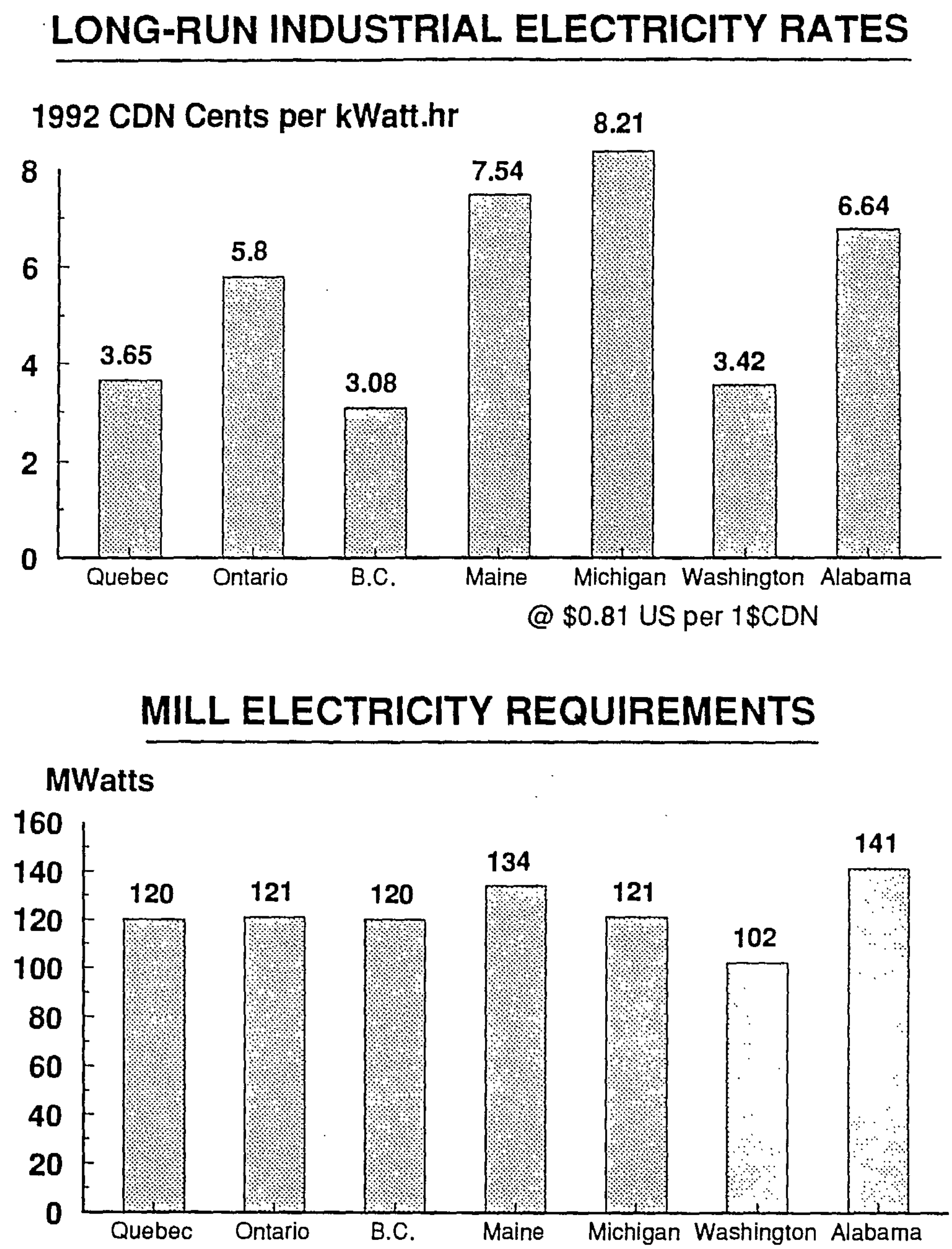


Figure 15 Electricity Rates and Requirements By Site

In the absence of cogeneration, the inter-site differences in electricity costs per tonne and as a per cent of total production costs, vary significantly.

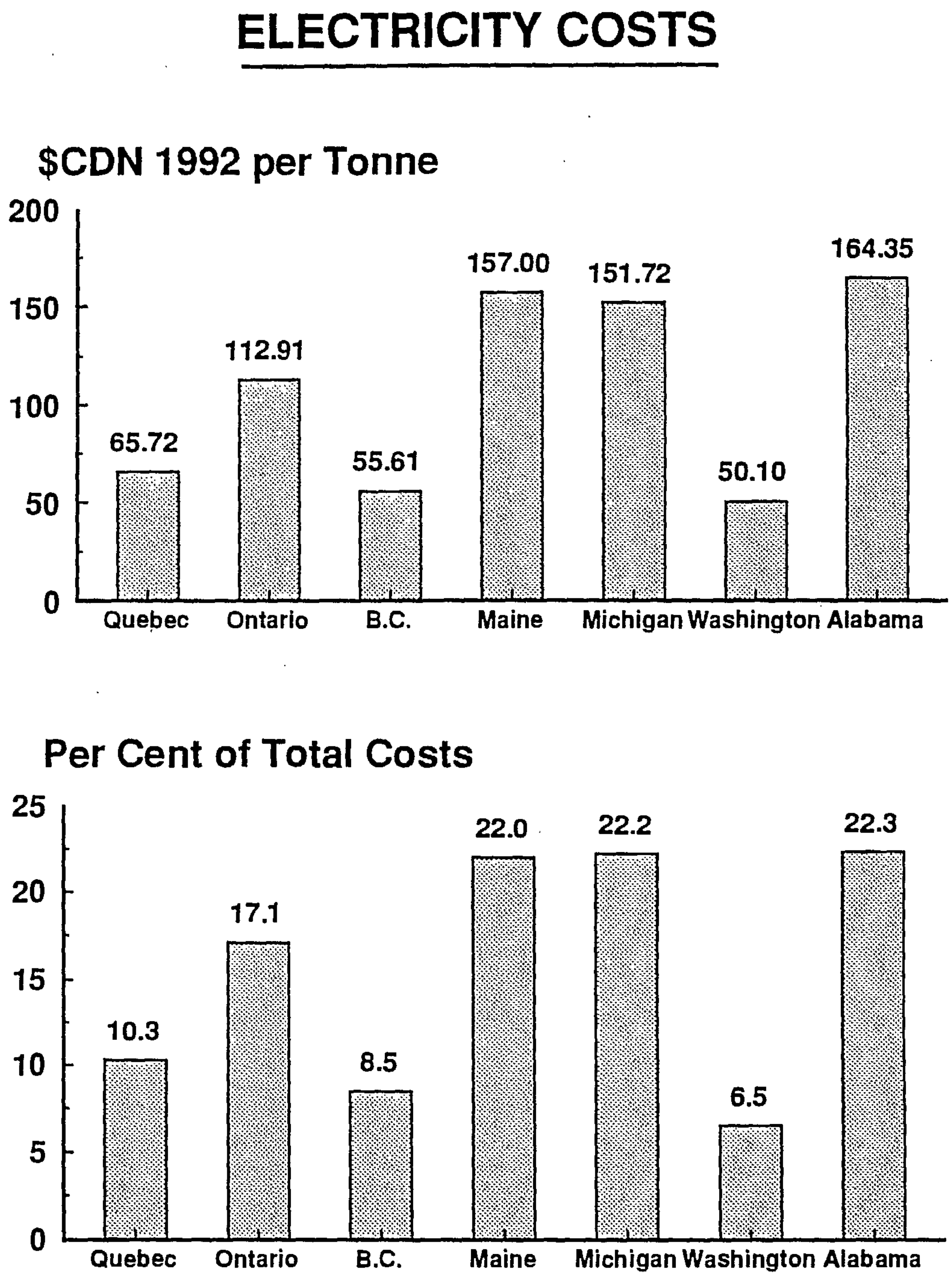


Figure 16 Electricity Costs By Site

A first-cut review of the cogeneration potential by site illustrated:

- British Columbia and Washington have very low industrial electricity rates: there was no economic rationale for attempting to back out their power purchases through self-generation. The attractiveness of sites in these locations would be reduced by cogeneration. Hence, comparisons with these sites would be based on purchased power.

- Quebec's industrial electricity rate was similarly low making the feasibility of self-generation very sensitive to the price of the optimal input fuel, natural gas. Hence, Quebec was investigated as a potential site for cogeneration.

- The lack of a natural gas supply at the Maine location increased the expense associated with installing a combined-cycle facility. Fuel oil was the logical alternative, however, properties of this fuel dictated that these facilities incur higher capital and operating costs than their natural gas driven counterparts. Despite these additional costs, the very high industrial electricity rate in Maine suggested that this location be investigated for potential cost reductions.

3.2 Cogeneration Technology

For each mill, two cogeneration alternatives were considered:

(i) a combined cycle natural gas cogeneration facility utilizing combustion and steam turbines to generate electricity; and

(ii) a steam topping cycle design, thermally balanced to match the mill's steam requirements.

The electrical generation capacity of a steam topping cycle is directly proportional to the mill steam requirements. In the LWC mill, the average normal boiler load was 250,000 kg/hr when operating at full capacity. Given a steam heat value of approximately 988 Btu per pound, a steam turbine with a 20 per cent efficiency would be capable of generating around 30 MWatts of electricity. This represented only 25 per cent of the mill's electricity consumption when producing a 50:50 product mix.

Thus, in order for the mill to be self-sufficient in its electrical requirements, it was necessary to use a combined cycle facility. However, even in the situation where electrical self-sufficiency was not economically justified, it was in the best interest of the mill to install a steam turbine unit. The mill must create steam for its production process, thus, there was essentially zero fuel cost for running the steam driven generator.

A typical combined-cycle facility is described in Figure 17 on the following page.[1]

[1] For ease of calculation and for comparative purposes, all steam energy values are shown in MWatt thermal equivalents based on: 1 Btu per hour = 0.29295 Watts.

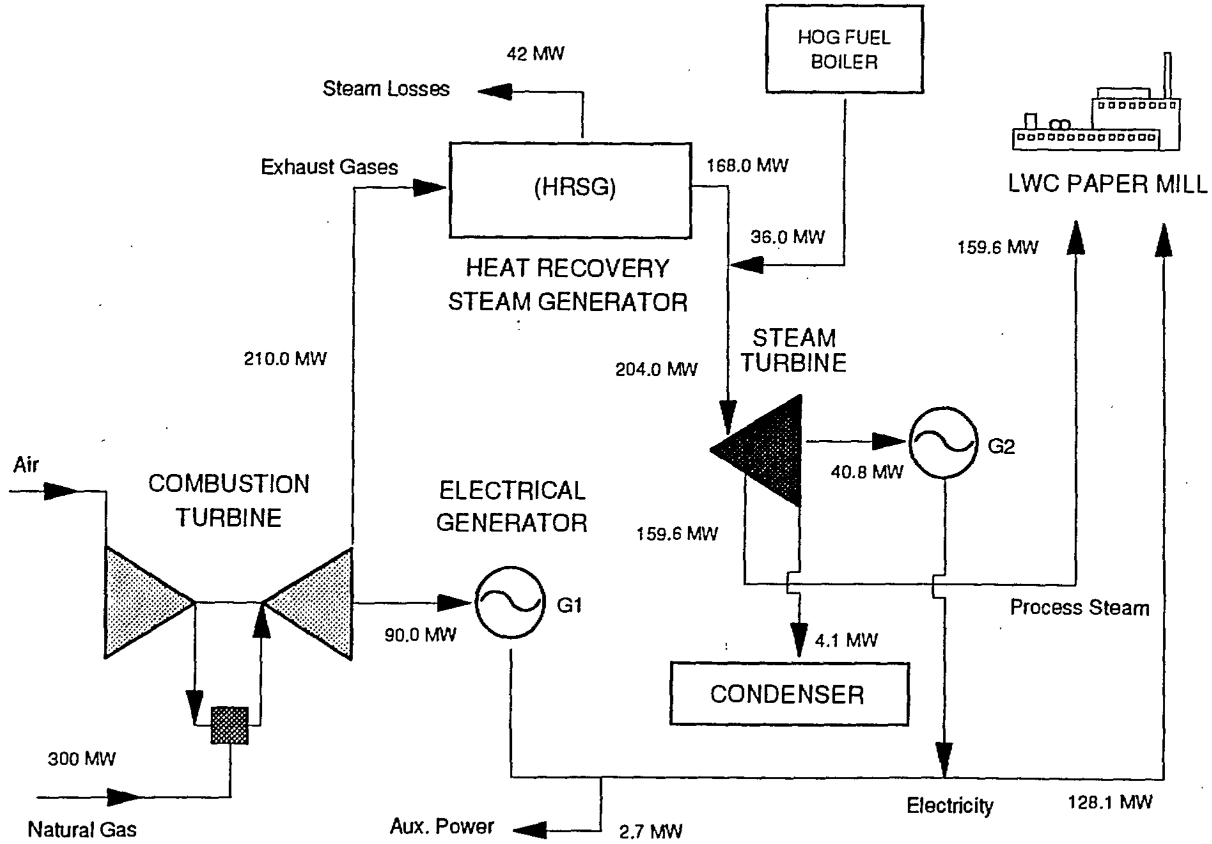


Figure 17 Combined-Cycle Cogeneration Diagram

The basic combined-cycle process is described below.

- Natural gas is burned in a combustion turbine that drives the first electric generator. Typical energy efficiency is around 30 per cent (ie. 30% of the energy input in the form of natural gas is converted to electrical energy).

- Exhaust gases from the combustion turbine are sent to a heat recovery steam generator (HRSG). Approximately 80 per cent of the heat energy from the exhaust gases is converted to steam energy.

- The high pressure steam from the HRSG is combined with that from the hog fuel boiler and then passed through a steam turbine. This turbine serves the dual purpose of driving the second electric generator and of helping to reduce the steam pressure. (Steam emerges from the HRSG at around 1,000 psi. The steam pressure required in the mill ranges from 200 to 50 psi.) Typical steam turbine energy efficiency is around 20 per cent.

- The lower pressure exhaust steam from the steam turbine is sent to the mill for use in the LWC production process. Any excess steam is condensed as required.

- The system is balanced to provide 250,000 kgs per hour of steam to the mill.

Operational parameters for the combined-cycle cogeneration facilities in each region, based on steam and power requirements for production of a 50:50 product mix, are shown in Table 3-1.

Table 3-1
Typical Cogeneration Facility Operation Parameters
(MWatt Thermal Equivalents)

	Quebec	Ontario	Michigan	Alabama[2]	Maine
Net Heat to Process	159.6	159.6	159.6	113.3	159.6
Natural Gas Turbine	300.0	287.0	287.0	340.0	290.0
Generator 1 Power	90.0	86.1	86.1	102.0	87.0
Exhaust Gases	210.0	200.9	200.9	238.0	203.0
Heat from HRSG	168.0	160.7	160.7	190.4	162.4
Losses from HRSG	42.0	40.2	40.2	47.6	40.6
Steam from Hog Fuel	0.0	27.0	27.0	20.0	21.0
Generator 2 Power	33.6	37.5	37.5	42.1	36.7
Condensed Steam	0.0	0.0	0.2	56.9	2.7
Steam from Turbine	134.4	150.2	150.2	168.3	146.7
Total Aux Power	2.7	2.6	2.6	3.1	2.6
Net Electric Generation	120.9	121.1	121.1	141.0	121.1

To ensure that mills would be self-sufficient in electricity, a 130 MWatt cogeneration facility was fitted into each location. Alabama, the exception, required a 145 MWatt facility.

Capital costs for a combined-cycle natural gas-fired cogeneration package were estimated at approximately one million dollars per megawatt of capacity. In the case of the oil-fired unit required in Maine, capital costs were estimated at $1.22 million per megawatt.

- When these additional capital costs were integrated into the total capital costs by region, the base case cogeneration configuration and steam room physical plant were taken into consideration.

- The base case 29 MWatt generator would not be required. In addition, since the mill's entire steam requirements would be provided by the cogeneration facility, it would not be necessary to purchase external hog fuel. Hence, a much smaller hog fuel boiler would be capable of handling the internally generated wood waste.

2 Operational parameters for Alabama are based on 100% production of 59 g/m² paper.

- Given these cost offsets, the incremental capital cost of upgrading to a 130 MWatt cogeneration unit would be $109 million in Ontario and Michigan, and $105 million in Quebec. The 130 MWatt oil-fired unit at Maine would cost $137 million and the 145 MWatt unit in Alabama would cost $122.5 million on an incremental basis.

Operating costs will be significantly higher with the 130 MWatt generating unit.

- Fuel costs would represent the largest component of the increases. Natural gas consumption would increase by around 200 million cubic meters in Quebec, Ontario and Michigan. Alabama gas requirements would increase 250 million cubic meters and Maine would require 213 million litres of fuel oil. This cost would be partially offset by the savings from not purchasing additional hog fuel.

- Incremental labour and maintenance costs were estimated at an additional one million dollars per year for the gas-fired units. The nature of an oil-fired cogeneration unit resulted in a $1.5 million annual increase in Maine.

Based on these parameters, the unit self-generation production cost of each project (given a 50:50 production mix) is illustrated in Table 3-2 below.

Table 3-2
128 MWatt Cogeneration Facility Production Cost
(1992 Cdn Cents/kWh)

LOCATION	COGENERATION PRODUCTION COST	INDUSTRIAL ELECTRICITY RATE	OPTIMAL ELECTRICITY SOURCE
Quebec	4.4	3.6	Utility
Ontario	4.2	5.8	Cogeneration
Michigan	6.9	8.3	Cogeneration
Alabama	5.4	6.7	Cogeneration
Maine	8.2	7.6	Utility

Ontario, Michigan and Alabama would all improve their competitiveness by becoming self-sufficient with respect to their electricity requirements as their unit production costs are below that of their local utility.

On the other hand, Quebec and Maine would find it optimal to install the 29 MWatt steam topping cycle unit and to purchase their remaining electricity requirements from the local utility.

Thus, in the financial analysis to follow in Chapter 4, operating and capital costs have been amended to include combined cycle cogeneration units in the three locations: Ontario, Michigan and Alabama.

Note: It is important to optimize the cogeneration facilities by site to obtain meaningful inter-site comparisons. It was assumed for all sites that the size of the cogeneration plant would be optimized based on backing out purchased electricity but not selling excess power. Moreover, no cross-hauling (i.e. concurrent sale of power at high rate to utility and repurchase of same quantity at low rate) was included.

3.3 Cogeneration: Additional Benefits

For cogenerators, the advantage of generating their own electricity is the difference between their unit production cost and the utility's industrial rate, multiplied by the amount of electricity they self-generate. However, in addition to this natural advantage there are potentially two other benefits that can be realized with cogeneration:

i. Profits from the Sale of Excess Power

- Under contract, cogenerators are entitled to sell excess power to the utility at a negotiated rate, not exceeding the utility's avoided cost. Thus, cogenerators can make a profit on the sale of power if their combined unit capital and operating costs are below the utility's avoided cost.

ii. Crosshauling

- Under this arrangement, mills with cogeneration facilities are able to sell their self-generated power to the utility at a high rate (the utility's avoided cost) and then repurchase the power at a lower rate (the utility's industrial rate). This benefit is equal to the difference between the utility's avoided cost rate and the industrial rate, multiplied by the amount of electricity crosshauled. The amount of electricity crosshauled depends on the contractual arrangement reached between the mill and the utility. The total amount crosshauled, however, cannot exceed the electricity consumption level of the mill.

Given the opportunity, these additional benefits could be the source of significant revenues. To see just how potentially lucrative these benefits could be, three sites were analysed based on the hypothetical situation where they would crosshaul their electricity production and sell an excess 140 MWatts of energy to the utility grid.

In addition to the natural benefit of lower operating costs from self-generation, there are two other potential benefits available from a cogeneration facility. The first is illustrated (using hypothetical rates) in Figure 18 below:

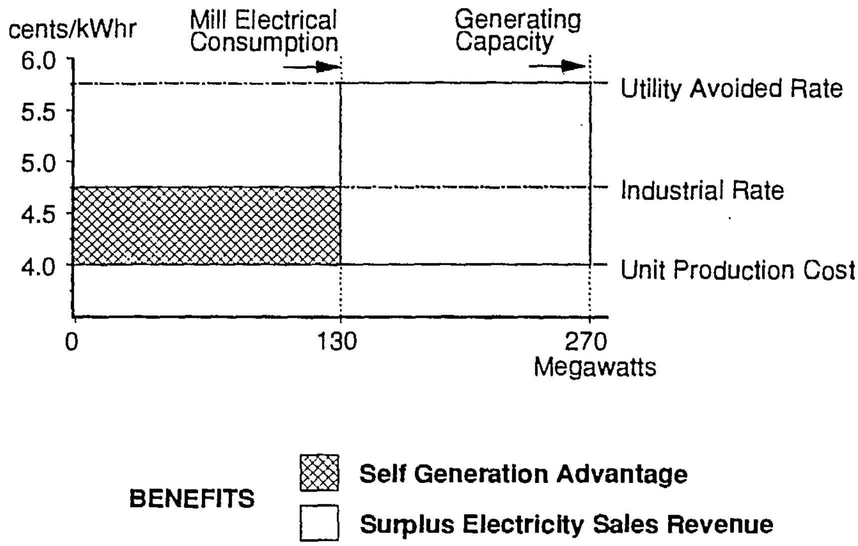


Figure 18 Revenues From Excess Power Sales

Under the scenario where the Quebec, Ontario and Michigan mills were fitted with a 270 MWatt cogeneration facility (the approximate size unit for a 65% energy cycle efficiency at the mill), additional revenues would be realized on the sales of 140 MWatt of excess power.

- Annual after-tax profit from these sales would be: Quebec $5.2 million, Ontario $12.8, and Michigan $21.1 million.

The third potential benefit available from a cogeneration facility is illustrated in Figure 19 below.

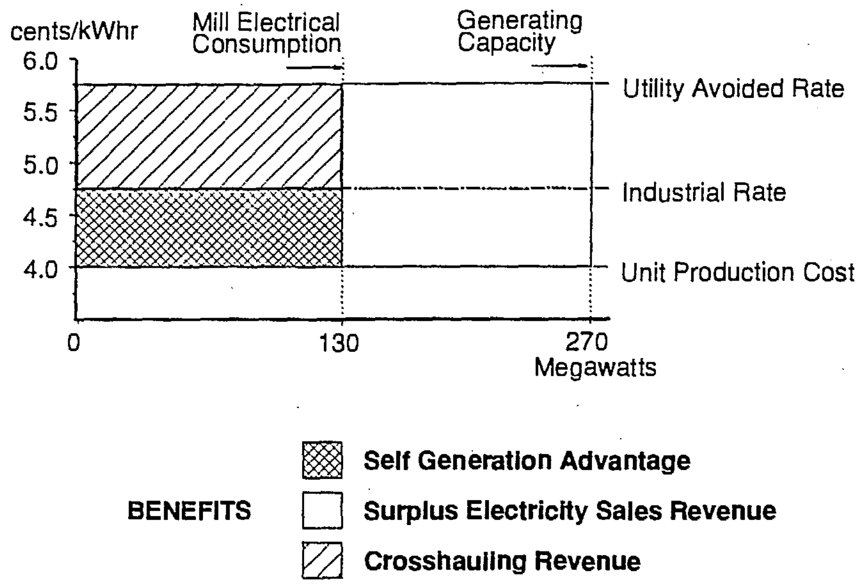


Figure 19 Crosshauling Revenues

With a 270 MWatt cogeneration facility, the Quebec, Ontario and Michigan mills would realize additional revenues from the crosshauling of the approximately 130 MWatts consumed by the mills.

- Annual after-tax profit from crosshauling revenues would be: Quebec $10.4 million, Ontario $1.4, and Michigan $5.5 million.

Given the opportunity to engage in both excess sales and crosshauling, the additional revenues have a very significant impact on the net present value of each location. Assuming these annual revenues were a perpetuity, the respective NPV of each location would increase by the following:

Table 3-3
Cogeneration Benefits by Site
(Million 1992$ CDN)

Site	Incremental NPV based on Cost Savings	Incremental NPV based on Excess Sales	Incremental NPV based on Crosshauling
Quebec	(54.2)	47.4	94.7
Ontario	82.9	116.6	12.8
Michigan	127.6	225.9	58.9

In total, the respective NPV of each site would increase by:

- Quebec $87.9 million, Ontario $212.3 million, and, Michigan $412.3 million.

A 270 MWatt cogeneration unit installed at any of these locations would dramatically increase the viability and profitability of the LWC mill.

4.0 FINANCIAL ANALYSIS

4.1 Introduction

This chapter incorporates all of the operating and capital costs associated with the manufacturing of LWC by site and provides detailed financial statements from which financial comparisons can be made for each location.

The chapter has been divided into the following sections:

¶ Capital Costs and Cash Flow Curve.

¶ Production Start-Up detailing the production which was assumed for the start-up of both machines.

¶ Weighted Average Cost of Capital

¶ Assumptions

- This section discusses the assumptions behind the financial analysis.

¶ Financial Analysis

- The attractiveness of the seven North American regions are compared. With the exception of Alabama all financial analyses were based on a 50:50 mix of 47 g/m^2 and 59 g/m^2 basis weights. For Alabama the revenues and costs were based on the 59 g/m^2 sheet as the 47 g/m^2 is impossible to produce given the available furnish.

- The capital and operating costs for all sites were examined. Net present values for each project were calculated using the appropriate weighted average cost of capital. (The cost of capital methodology and calculations are shown in another Industry Canada study) Based on the results, and various qualitative reasons, the Michigan site was chosen as the benchmark site; the components of the capital and operating costs are shown in detail. The other sites were compared against Michigan and the reasons for the differences were determined. The comparisons for the Canadian sites were based on an $US0.81 per Canadian dollar. The sensitivities to alternative exchange rates are illustrated.

¶ Sensitivity to Exchange Rates

¶ Internal Rate of Return

4.2 Capital Costs and Cash Flow Curve

Before increasing cogeneration capacities to optimum levels, the capital costs across sites, with the exception of Alabama, only varied within 6 per cent from lowest to highest.

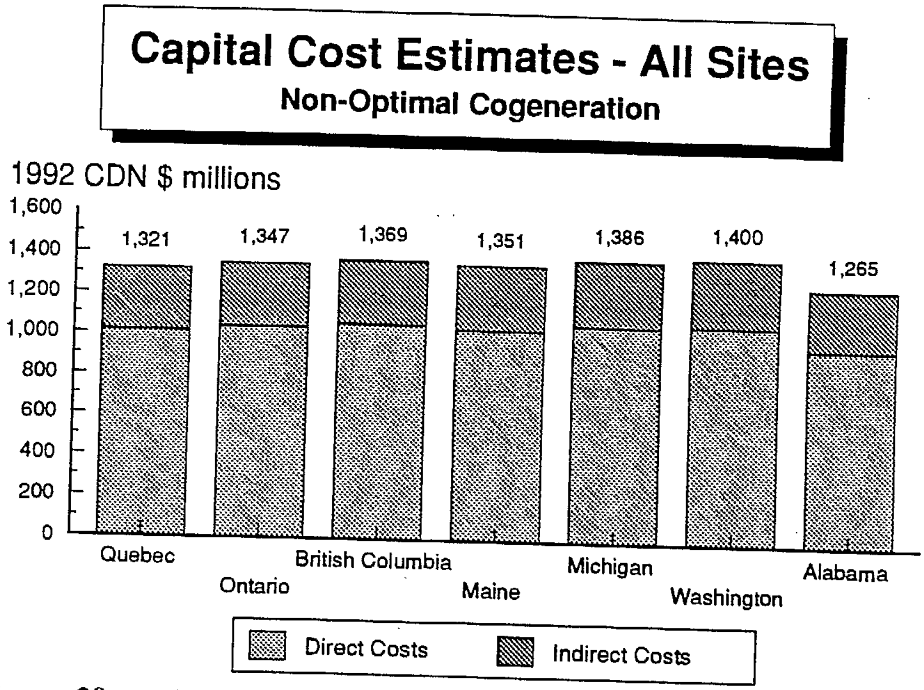


Figure 20 Capital Costs Without Optimal Cogeneration

For three locations, Ontario, Michigan and Alabama, an additional $110-$120 million in capital was required to optimize cogeneration facilities.

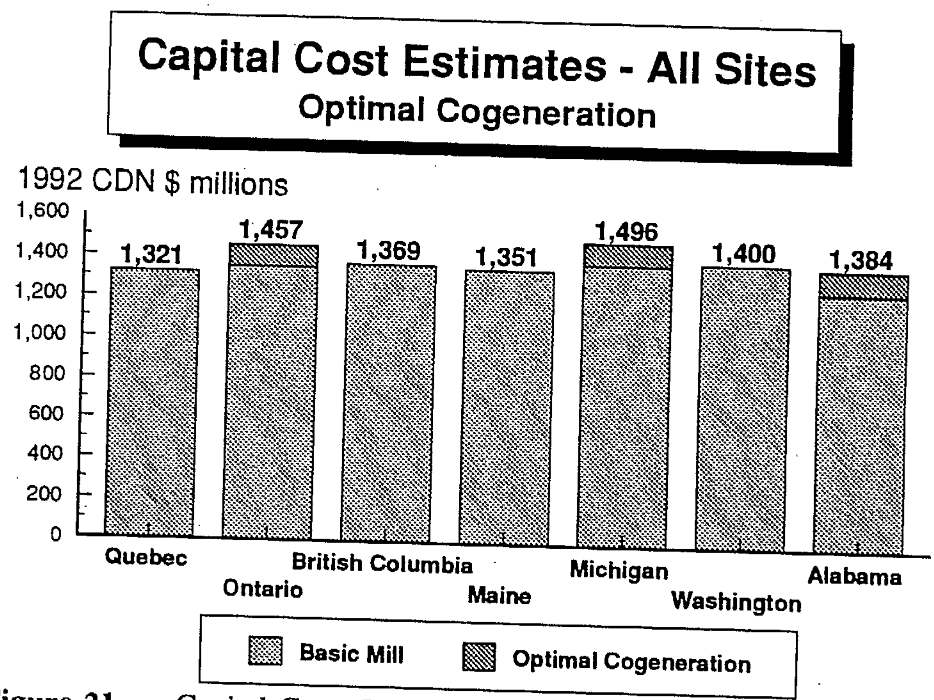


Figure 21 Capital Costs Including Optimal Cogeneration

With the exception of Alabama the material flows for all mills were very similar. The capital cost estimates by site are as follows:

Table 4-1
Capital Cost Breakdown
(Millions 1992 CDN $s)

Principal Components	U.S.				Canadian		
	Mich[1]	Alab	Maine	Wash	B.C.	Ont	Que
Roundwood	29.5	20.4	28.4	17.1	28.7	27.0	27.4
CTMP	114.3	92.1	110.5	115.6	114.4	112.2	109.1
Stock Prep.	35.4	34.4	34.1	39.6	34.4	33.6	32.7
Paper Mach.	323.6	303.4	316.4	329.5	322.5	318.3	312.6
Coaters	151.4	142.7	148.1	153.9	150.4	148.4	145.9
Finishing (winders, supercal.etc)	184.9	174.8	180.8	188.9	182.4	180.1	177.2
Buildings & Storage	211.5	202.4	204.9	216.0	209.2	205.4	200.5
Cogen	116.4	124.6	7.3	7.6	7.5	116.4	7.3
Indirect Costs	328.9	299.3	321.3	332.0	320.1	315.7	309.1
Total	1,497	1,394	1,352	1,400	1,370	1,457	1,322

1. Benchmark Site

Mill construction would involve two phases. Total capital costs for Phase I and Phase II are summarized in Table 4-1.

Table 4-1
Capital Costs by Region
($millions Cdn 1992)

	Quebec	Ontario	British Columbia	Maine	Michigan	Washington	Alabama
Phase I	807.3	932.9	838.3	822.9	954.6	850.9	878.3
Phase II	486.9	496.1	502.8	495.7	507.2	514.7	496.0
Total	**1,294.2**	**1,429.0**	**1,341.1**	**1,318.6**	**1,461.8**	**1,365.6**	**1,374.3**

Benchmark Site

* Assumes a US$0.81/C$ exchange rate where applicable.

The above costs were spread over a period of 78 months: months 1-30 for Phase I and months 31-78 for Phase II. Figure 22 illustrates the capital cost cash flow curve for the benchmark Michigan mill.

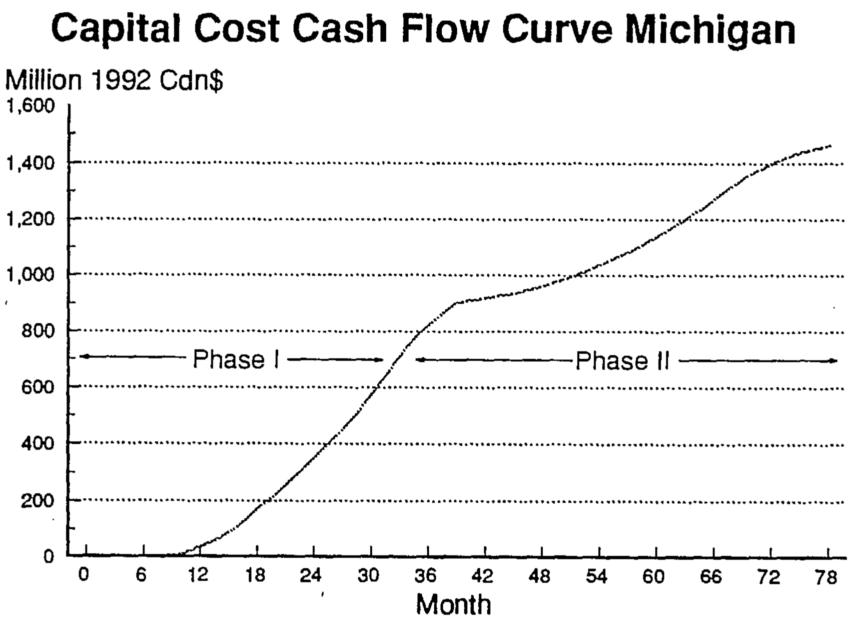


Figure 22 Capital Cost Cash Flow Curve

Table 4-2 details the capital costs by year for each of the regions assuming that work to get environmental permit began January 1st 1993.

Table 4-2
Capital Costs Schedule by Year
($millions Cdn 1992)

	Quebec	Ontario	British Columbia	Maine	Michigan	Washington	Alabama
1993	4.0	4.1	4.2	4.1	4.2	4.3	3.8
1994	278.5	338.7	289.2	283.9	346.4	293.6	321.4
1995	460.2	524.1	477.8	469.1	536.7	485.0	492.4
1996	64.5	65.9	67.1	65.8	67.7	68.1	60.8
1997	170.4	173.6	176.0	173.5	177.5	180.1	173.6
1998	277.5	282.8	286.4	282.5	289.1	293.4	282.7
1999	38.9	39.7	40.2	39.7	40.6	41.2	39.7

Benchmark Site

* Assumes a US$0.81/C$ exchange rate where applicable.

The above capital costs by region will be applied to the pro-forma financial projections.

4.3 Production Start-Up Schedule

A production start-up schedule typical of a coated paper mill was developed. The schedule for the overall project involved two distinct phases, one for each machine. Construction was planned to span a six-year period.

Typically, a machine's start-up costs net of any revenues will be capitalized and amortized over a five-year period: start-up is defined as a paper machine reaching 70% of its design capacity on a consistent basis. The length of time required to reach this threshold is dependent upon numerous factors, but is generally five to seven months. For the purposes of this study, it was assumed start-up would cover a six-month period. This was assumed for each region.

Paper machine N° 1 was designed to produce just over 50,000 tonnes in the start-up period (first 6 months), and from there production was increased substantially, reaching design capacity at the beginning of year three. In the first half of year one, the machine averaged 74% of its design capacity, and in the second half it averaged 90%; in the first half of year two, it averaged 94%, and in the second half 97%. Design capacity was assumed to be achieved at the beginning of year three.

The start-up period for paper machine N° 2 was designed to occur over the second half of year three. The start-up of paper machine N° 2 would be slightly more rapid than the start-up of paper machine N° 1. In the middle of year four, the machine averaged 79% of design capacity, and at the end of year four, 90%; in the middle of year five, 94% and at the end of the year, 97%. The mill was assumed to reach full capacity at the beginning of year six.

Table 4-3 and 4-4 detail the start-up production schedule for paper machine N° 1 and N° 2 respectively.

Table 4-3
Production Start-Up Schedule: Paper Machine N° 1

Year	Semester	% of Design Capacity
1995	P.M. N° 1 Start-Up	53.0
1996	1	74.7
	2	89.2
1997	1	94.0
	2	97.3
1998	1	100.0

Table 4-4
Production Start-Up Schedule: Paper Machine N° 2

Year	Semester	% of Design Capacity
1998	P.M. N° 2 Start-Up	60.2
1999	1	79.5
	2	90.4
2000	1	94.2
	2	97.3
2001	1	100.0

The above start-up schedule was applied to each region in completing the economic and financial projections.

4.4 Weighted Average Cost Of Capital

In order to calculate the net present value that will be used in the financial analysis, an appropriate discount rate, or weighted average cost of capital (WACC), must be computed. The WACC is used to bring all future cash flows back to the present (1992).

A separate paper produced by Corporate and Industrial Analysis investigated differences in the cost of capital that exist between Canada and the U.S.. The paper concluded that Canadian companies, private and public, pay a significantly higher cost of capital than their U.S. counterparts. At a minimum, Canadian companies bear a 0.86 per cent higher real WACC (after tax) than similar U.S. companies. This difference occurs because Canada historically has been a net importer of capital and has a higher level of country risk relative to the U.S.; foreign investors demand a higher return as compensation.

When exchange rate risk is considered (applicable for those companies which have a combination of U.S. and Canadian denominated cash flows), an additional risk premium is created. Since an LWC mill located in Canada will be exposed to exchange risk, it is appropriate to incorporate an exchange risk premium into the Canadian WACC. An estimate of the spread in the WACC between Canadian and U.S. companies operating in the pulp and paper sector was found to be 1.64 per cent (after tax).

Drawing from the results of the Corporate and Industrial Analysis investigation, this analysis of the competitiveness of Canadian LWC mills considers both WACCs: the average WACC for the pulp and paper sector, and the minimum WACC which assumes no exchange exposure. Although the average spread is not specific to LWC mills, it is specific to the pulp and paper sector and is a reasonable approximation for LWC mills. It is acknowledged that the minimum WACC will over-estimate the competitiveness of Canadian mills vis-a-vis U.S. mills because it assumes that the Canadian mills are not exposed to exchange rate movements. It is included in the analysis however, because it illustrates the significance of the competitive disadvantage the higher WACC creates for Canadian mills even under the most optimistic conditions.

The more realistic U.S. - Canada comparisions are based on the 1.64 per cent (after tax) differential in the cost of capital.

4.5 Assumptions

Listed below are the main assumptions used throughout the analysis:

- All values are shown in constant 1992 Canadian dollars.

- The base case analysis assumes an exchange rate of US$0.81/C$ and a 50:50 product mix of 59g/m^2 and 47g/m^2 for all mills except Alabama (since Alabama can only produce the heavier 59g/m^2 sheet).

- The weighted average cost of capital was estimated assuming a 60 per cent equity and 40 per cent debt capital structure. The U.S. cost of capital equals 9.34%. Two estimates of the WACC were made for the Canadian mills: the first (10.98%) illustrating an average WACC scenario (base case), and the second (10.20%) illustrating a best case scenario. A detailed description of the calculation of the Canadian and U.S. weighted average costs of capital is provided in Appendix II of this chapter.

- Production and sales volume are equal each year, with no allowance for changes in inventory.

- Selling price is based on the long-term forecast for related paper products as discussed in Chapter 2.

- Delivery costs are an average of the projected market-mix by destination as discussed in Chapter 7.4 and Volume 3.

- Selling costs are estimated based on current industry levels for like products: 2% commission and 3% discount. Start-up production has been discounted by 10% due to off-specification start-up tonnage.

- Operating labour, maintenance labour, salaried clerical and administrative personnel and maintenance materials are included in fixed costs. Rates per tonne in start-up years are higher due to the lower production levels through the start-up period.

- Labour requirements during Phase I of the project have been reduced reflecting a single machine operation. Full manning is assumed with the start-up of paper machine N° 2 (i.e. Phase II).

- General and administrative costs have been assumed at $20 per tonne at design capacity on a fixed cost basis. Costs per tonne in start-up years are higher due to lower production levels through the start-up period.

- Property tax and insurance have been assumed at 1% of total capital costs.

- Start-up phase costs estimated at $Cdn15 million for Phase I and $Cdn12 million for Phase II have been amortized over five years on a declining balance basis, as per generally accepted accounting principles. These costs are incurred between the completion of construction and commencement of normal operations; bringing production from zero to approximately 70% of targeted production. Some categories of costs typical to this phase are: salaries and expenses of mill operations and maintenance personnel, vendor/contractor/engineering assistance, input materials, additional fixed capital expenditures, lost product, purchased trial paper, utility costs, etc.. Offsetting these costs are revenues earned from produced saleable output during this phase.

- Owner administrative costs are the costs related to mill administration, personnel and mill administration expenses that will occur from project inception to end of start-up phase. For the start-up phase, these costs estimated at $Cdn5.5 million have been amortized over five years.

- Working capital of $Cdn25 million for Phase I and $Cdn25 for Phase II have been estimated to be the required amount to finance inventories and receivables under full operations.

- Reinvestment capital has been charged to the project at a nominal rate of 2% of original capital costs, applicable to both Phase I and Phase II. The expenditures have been phased in at lower rates for start-up years. This level of capital investment is in addition to normal operating maintenance costs included in cash costs and is considered to be an appropriate expenditure to keep the mill running efficiently at full production. This annual amount is not expected to provide manufacturing cost savings or production volume increases.

- Depreciation has been charged to operations assuming two classes: class 39 - machinery and equipment (55% of investment); and class 3 - building (45% of investment).

- A terminal value has been estimated for the mill operations based on five times the earnings after tax in year 25.

4.6 Financial Analysis

This section provides a detailed financial analysis of cost competitiveness of the different regions and illustrates advantages and disadvantages for various revenue and cost components for each region.

4.6.1 Methodology

The analysis encompasses generating financial statements for a twenty-eight year period with capital costs beginning in 1993 and operations beginning in 1996 and ending in 2020. Based on the cash flow statements, the net present values (NPV) were calculated.

A benchmark analysis was conducted which compared the NPVs and their underlying cost components of each location to a benchmark site; the Michigan location was selected as the benchmark site.

Revenues for the Michigan benchmark were derived such that total costs, capital and operating, are equivalent to total revenues adjusted for the time value of financing. As a result, the NPV of the cash flows will equal zero which implies that the Michigan project is achieving normal returns.

In conducting the comparisons, only the cost components need to be considered because all mills (except Alabama) are assumed to have the same revenues. (Since Alabama can only produce the heavier paper grade, its revenues will be different from the other mill's revenues and therefore must be included in the analysis.) The underlying cash flows include: the components of operating earnings (excluding depreciation since it is subtracted in the cash flow statement), taxes, freight, and capital costs. All costs have been calculated as average costs per metric tonne and were obtained by dividing the present value of the individual cost components by the present value of production.

The net present values of the Canadian firms were analyzed under two different weighted average costs of capital. The first assumes the exchange rate exposure of LWC mills is similar to the overall exchange rate exposure of the pulp and paper sector; the spread between the Canadian and U.S. WACC being 1.64 per cent. The second WACC assumes the Canadian mills have no exchange exposure; it represents the minimum spread that a Canadian mill will pay over and above the U.S. WACC and represents the best case scenario for Canadian mills.

The net present values were also analyzed under different exchange rate scenarios. Since the U.S. mills incur all of their revenues and expenses in US dollars, only the Canadian sites need to be analyzed with respect to exchange rate movements.

Finally, because the net present value does not indicate the relative magnitude of the gain or loss on the investment, an internal rate of return (IRR) analysis was also performed for the exchange rate sensitivities.

4.6.2 The Michigan Benchmark Site

The Michigan, Wisconsin and Minnesota region has for many years been the most important supply region for light weight coated papers. This region is close to the most important printing paper market and its forest resources are well-suited to the manufacturing of these papers. As such, the Michigan location was the best area to be used as a benchmark.

The cost of producing paper in Michigan is illustrated in Figure 23.

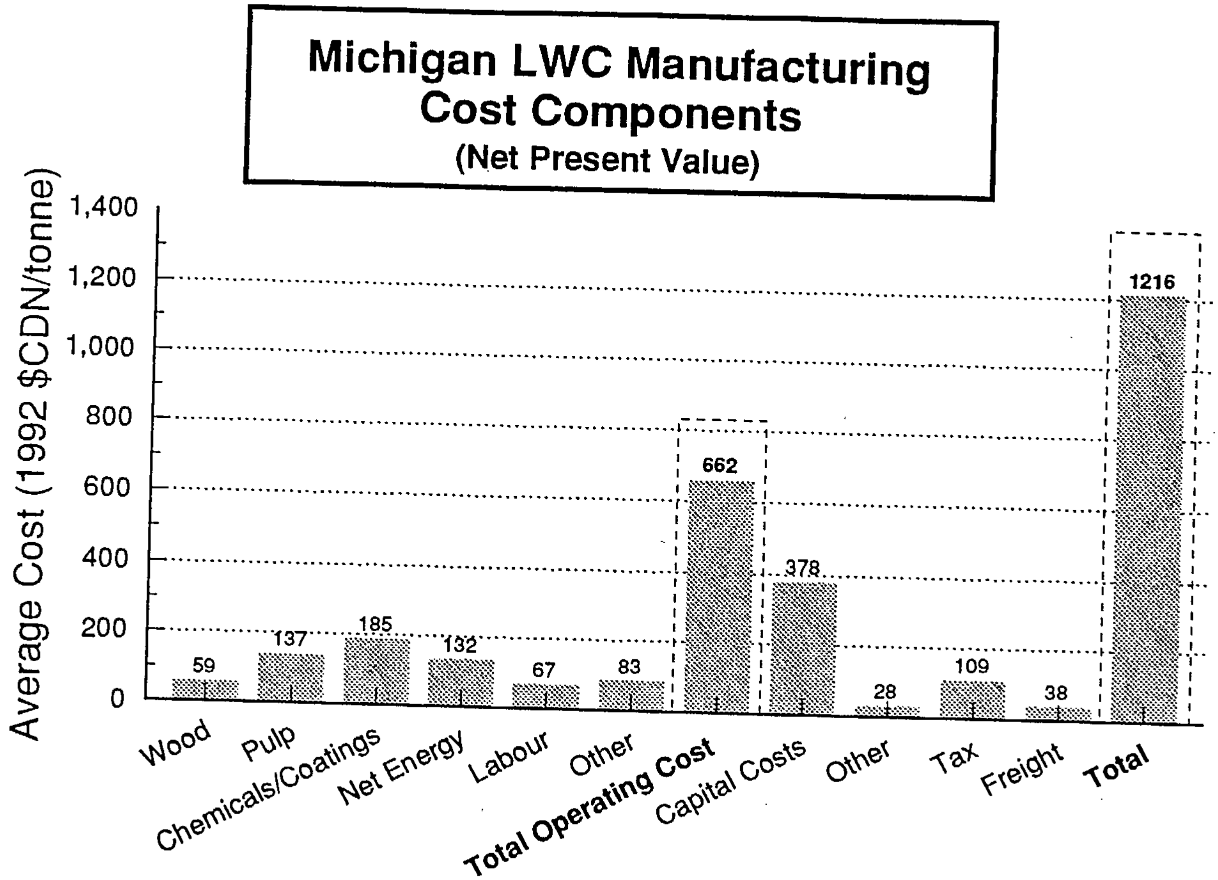


Figure 23 LWC Paper Manufacturing Costs In Michigan

The first six bars in Figure 23 provide the average cost components that were included in the operating costs. Of the six operating cost components, chemicals and coatings were the largest averaging $185 per tonne. The high relative cost of chemicals and coatings (mostly coatings) was the result of the significant input requirements that were necessary in order to manufacture a light-weight coated paper. Similarly, pulp requirements were high in the LWC paper furnish and therefore accounted for the second highest operating cost component averaging $137 per tonne. Net energy, consisting of electricity and fuel costs, had a similar cost to pulp, averaging $132 per tonne. Since a cogeneration facility would provide all of the mill's electricity requirements, the $132 per tonne was based solely on fuel costs. The remaining three operating cost components included; wood ($59 per tonne); labour ($67 per tonne); and "other" ($83 per tonne). The "other" category included operating supplies, maintenance materials, general and administration, and property taxes and insurance. The total average operating costs per tonne was $662.

The capital costs included all the plant and equipment costs. The "other" costs included pre-start-up and start-up, working capital, owners' administration, capital reinvestment, large corporations tax, salvage (terminal) value, and flow through (flowing the mill's losses through to the parent company). (Note that depreciation was not included in the capital costs since it was not included in the operating costs; however the tax effects related to depreciation were captured in the tax cost component discussed below.) The average capital cost was $378 per tonne and the average other cost was $28 per tonne.

The income tax rate for the Michigan mill was 35.6% (based on a 34.0% federal rate and a 2.35% state rate [applied to taxable income reduced by federal tax]) which resulted in an average cost of $109 per tonne.

Freight charges included those expenses that were related to product delivery costs from the mill gate to the various market locations. Michigan is quite close to its markets, thus its freight costs were relatively low, averaging $38 per tonne.

The total combined average cost per tonne of paper at the Michigan location was $1,216.

¶ Other Sites: Comparison With Michigan

In comparing the cost components of the other site locations to the costs of the Michigan benchmark, two WACCs were considered for the Canadian sites. The first WACC assumes a spread of 1.64 per cent (after tax) above the WACC used for the U.S. mills. This WACC represents the average incremental spread Canadian pulp and paper firms can be expected to pay relative to their U.S. counterparts and incorporates an average level of exchange risk exposure.

The second WACC assumes the Canadian/U.S. spread to be only 0.86 per cent (after tax) and represents the minimum spread a Canadian firm could attain. In this scenario, it was assumed the Canadian mills would bear no exchange risk exposure. Although this is an unlikely scenario, it is included because it represents the lowest WACC in the range of WACCs available to Canadian LWC mills, yet still emphasizes the significance the higher Canadian WACC has on attracting capital to Canada.

The comparison of the attractiveness of the six regions with the Michigan benchmark, at the average WACC incremental spread, is illustrated in Figure 24 on the following page.

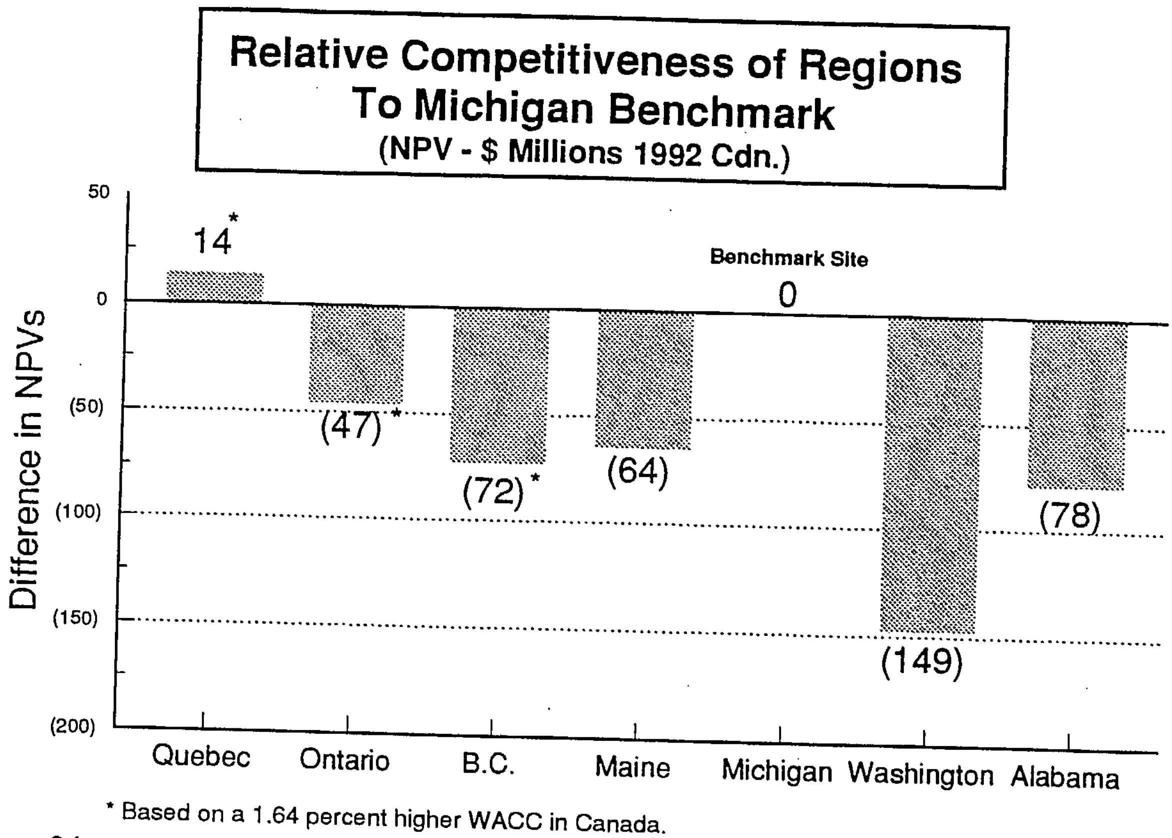


Figure 24 Relative Competitiveness Of Other Regions To Michigan

Figure 24 illustrates that, at an 81 cent dollar, Quebec is a strong competitor of Michigan, having an NPV that is $14 million higher than Michigan's. Conversely, Ontario and British Columbia both have NPVs that are considerably less than the Michigan NPV. Maine and Alabama have NPVs of negative $64 million and negative $78 million respectively, both of which are well below the Michigan benchmark. Washington has the lowest NPV which is $149 million less than that of Michigan.

The above NPV comparisons illustrate that Michigan and Quebec are the best suited locations for producing LWC paper with each location providing normal returns. What follows is a detailed cost comparison which compares the individual cost components of each location with the Michigan benchmark site.

4.6.3 Michigan: Quebec Comparison

Figure 25 compares the individual operating and capital costs associated with the Quebec mill to those costs associated with the Michigan mill. Positive values shown in the top half of the figure indicate an advantage (lower average cost) for Quebec while negative values indicate an advantage for Michigan.

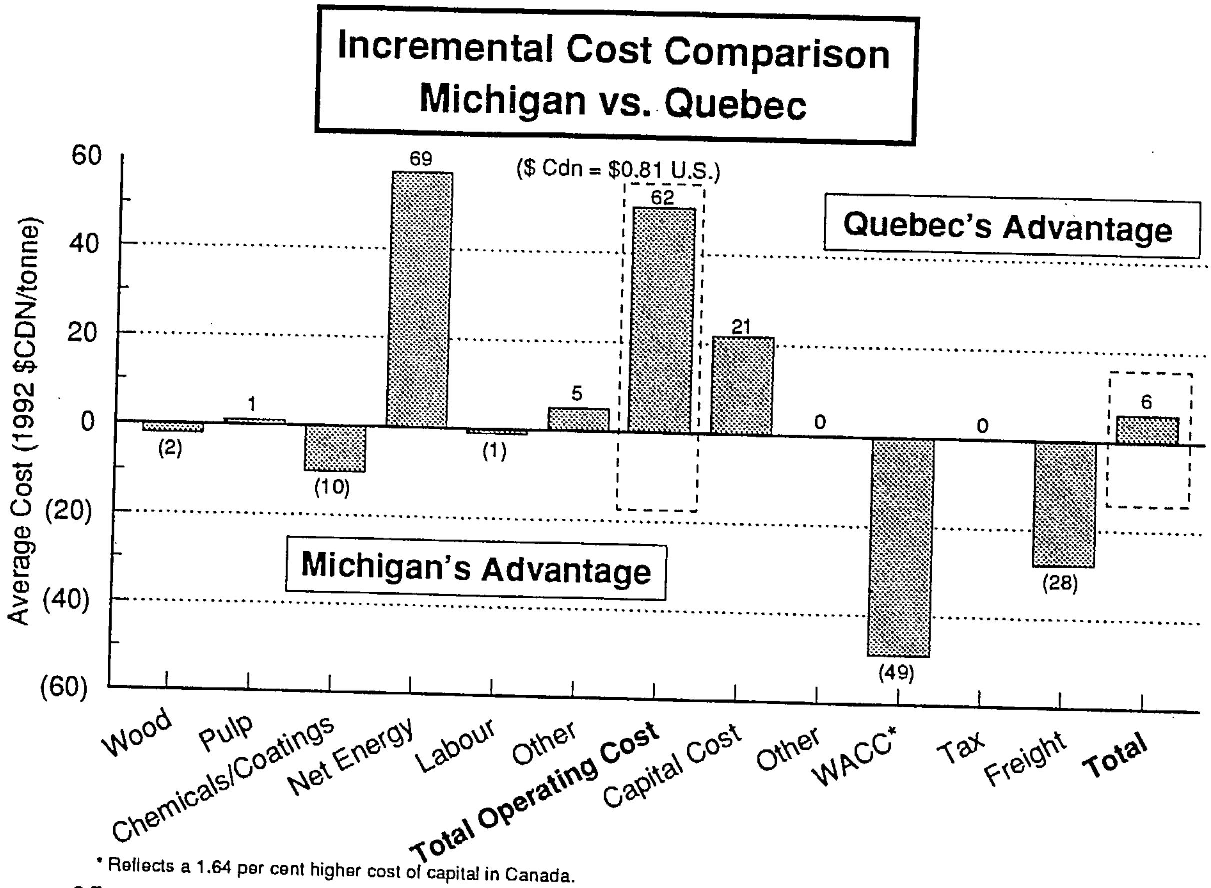


Figure 25 Incremental Cost Comparison: Michigan vs. Quebec

Considering total average costs, the Quebec site has an advantage of $6/tonne. When considering only total average operating costs, Quebec's average cost is lower than Michigan's average cost by $62 per tonne. This is mainly due to a $69 cost advantage Quebec has relative to Michigan with respect to net energy. Although Michigan supplies all of its electricity requirements internally through cogeneration, Michigan still has a higher per unit cost of electricity ($CDN 0.069 per kWh) than Quebec ($0.0365 per kWh), and Michigan has the added capital costs associated with the larger cogeneration unit. Similarly, fuel prices (hog fuel and natural gas) are both higher in Michigan than in Quebec.

Partially offsetting Quebec's net energy advantage is Michigan's $10 per tonne advantage from its lower cost of chemicals and coatings. This is due to the lower transportation cost Michigan pays to transport the chemicals and coatings from the suppliers to its mill.

Québec had a $21 per tonne advantage in capital costs (plant and equipment). This reflects the $65 million higher capital costs in Michigan.

Offsetting Quebec's capital cost advantage however, is the 1.64 per cent lower after tax weighted average cost of capital (WACC) for Michigan which created a considerable disadvantage for Quebec of $49 per tonne.

The total cost of taxes is similar in the two locations despite Quebec having a lower income tax rate (29.9 per cent vs 35.6 per cent for Michigan). The similar average tax cost existed mainly because the Canadian large corporations tax and the Quebec capital tax cause Quebec to have a larger total tax rate than Michigan in the first 5 years of production. In later years, Québec's total effective tax rate is lower. (Depreciation rates are virtually equivalent in the two locations.)

Michigan has an average cost advantage of $28 per tonne relative to Quebec with respect to the cost of outbound transportation. This can be attributed to Michigan being located closer to its buyers (the market) than Quebec; the average distance from the mill to the market is 900 miles (1440 kilometres) for Québec and 504 miles (806 kilometres) for Michigan which results in a 170.5 million difference in tonne miles (total distance times total tonnage production).

Overall, when combining all the advantages and disadvantages that are related to operating costs, capital costs, taxes and freight, Quebec is at a marginal $6 per tonne advantage relative to Michigan (at an 81 cent Canadian dollar).

4.6.4 Michigan: Ontario Comparison

Figure 26 compares the costs of Michigan and Ontario..

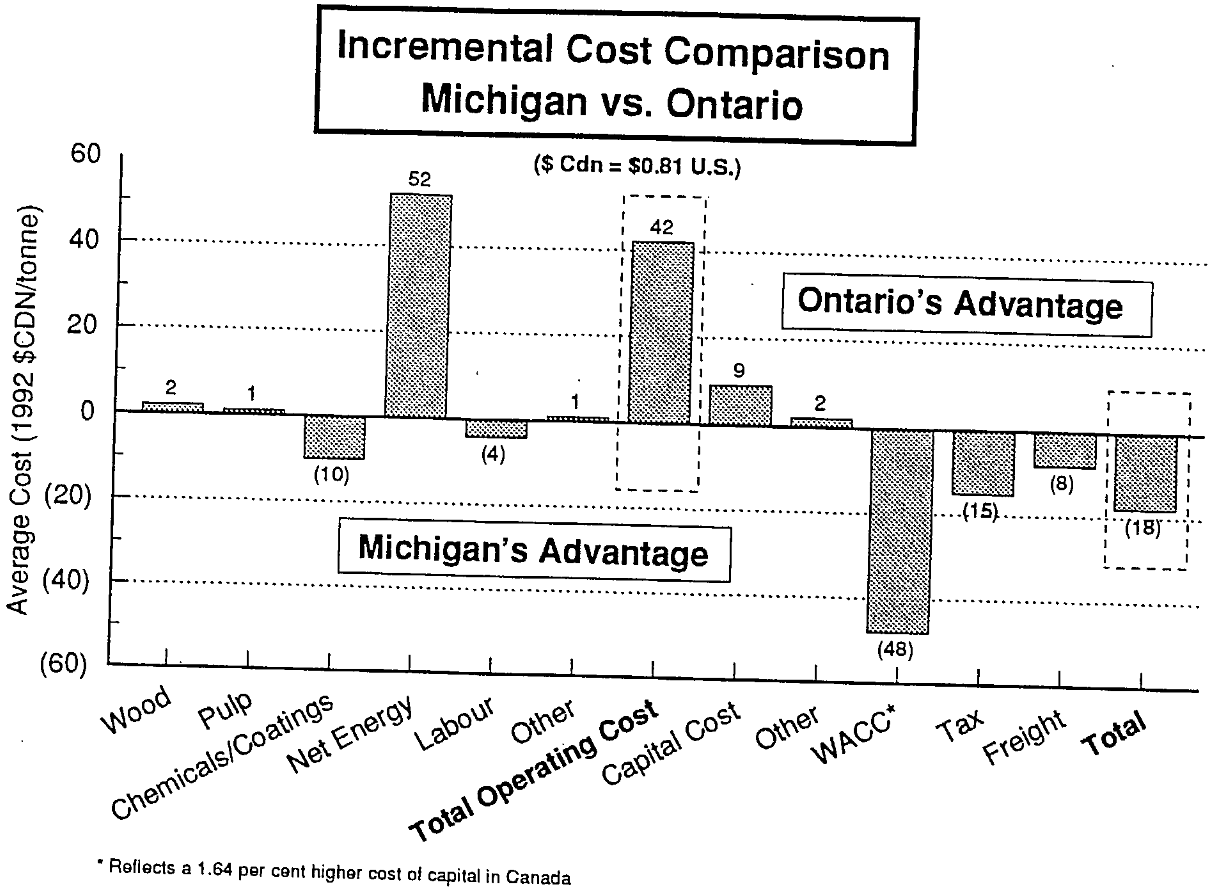


Figure 26 Incremental Cost Comparison: Michigan vs. Ontario

As the figure illustrates, net energy is the key component of the operating costs that gives Ontario a $42 per tonne lower average total operating cost. Both Ontario and Michigan cogenerate to the extent that electricity purchases are backed out and both sites purchase the same amount of natural gas. However, Michigan faces a higher natural gas price of $CDN 20.12/m^3 compared to the Ontario price of $CDN 12.11/m^3 resulting in Ontario benefitting from a $52 per tonne lower average net energy cost.

Ontario also has a slight advantage ($9 per tonne) in capital costs relative to Michigan; this lower cost can be attributed to Ontario having total capital costs that are $39 million (nominal) less than those in Michigan. Of this difference, 34% arises from indirect costs, such as construction, and 66% arises from direct costs.

Offsetting this operating cost advantage is the disadvantage Ontario faces with respect to its real cost of capital. Similar to Quebec, Ontario's WACC is 1.64 per cent higher than Michigan resulting in a $48 per tonne disadvantage relative to Michigan.

Michigan has a $15 per tonne advantage over Ontario with respect to taxes. Although the two locations have virtually the same income tax rates, Ontario must pay the large corporations tax and a provincial capital tax, thereby increasing Ontario's total tax bill. In addition, since Ontario has lower average total operating costs, it has higher earnings subject to tax.

Michigan has an average cost advantage of $8 per tonne relative to Ontario with respect to the cost of freight; the Michigan plant is located closer to the market than the Ontario plant.

The net impact of all of the cost advantages and disadvantages results in Michigan having a $18 per tonne lower total average cost than Ontario (at an 81 cent Canadian dollar).

4.6.5 Michigan: British Columbia Comparison

Figure 27 illustrates the incremental costs that exist between Michigan and British Columbia.

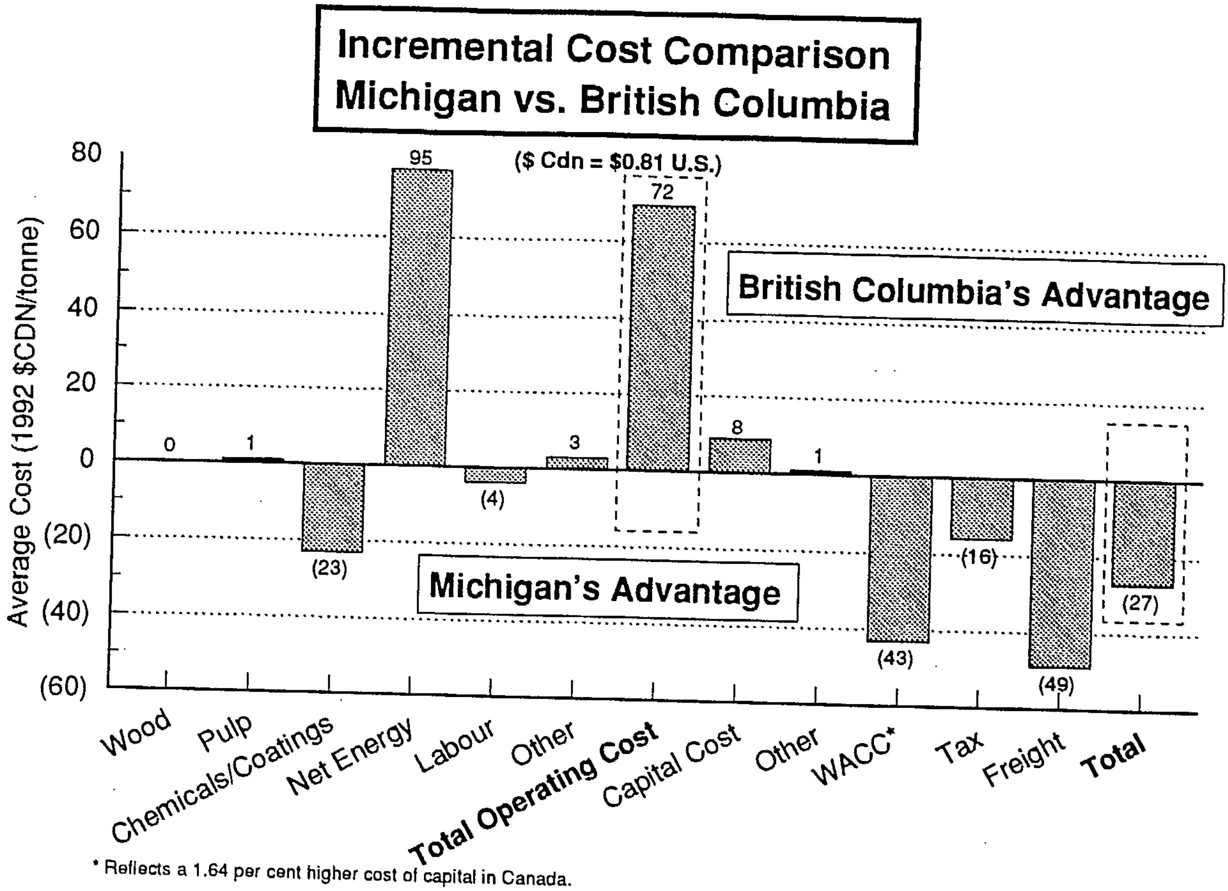


Figure 27 Incremental Cost Comparison: Michigan vs. British Columbia

British Columbia is at a disadvantage with respect to chemicals and coatings; but at a much greater advantage with respect to energy. Since the chemicals and coatings requirement for the British Columbia location are the same as those of the Michigan location, the higher average cost at the British Columbia location is due primarily to the transportation cost associated with the chemicals and coatings. Clay has the most significant transportation cost as it must be shipped from Georgia. The cost disadvantage related to chemicals and coatings equals $23 per tonne.

British Columbia benefits from very low energy costs relative to Michigan. The long-term industrial rate for electricity in British Columbia (i.e. in B.C. Interior) is 3.08¢ per kWh, less than half of the 6.9¢ per kWh cost of electricity cogenerated at the Michigan location. The costs of hog fuel and natural gas in British Columbia are also less than half of the costs in Michigan. British Columbia also benefits from not having incurred the $109 million cost of the larger cogeneration unit which Michigan has. As a result, British Columbia has a very significant net energy advantage that amounts to $95 per tonne and an overall total operating cost advantage of $72 per tonne.

The British Columbia mill also benefits from lower capital costs relative to Michigan because the capital costs required to build the mill, excluding the incremental cogeneration costs, are $17.4 million less for British Columbia.

As with the other two Canadian locations, British Columbia faces a higher cost of capital than Michigan. Using the estimated 1.64 per cent spread between Canadian and U.S. pulp and paper mills, the British Columbia mill must bear a $43 per tonne disadvantage relative to the Michigan mill.

Michigan has a $16 per tonne advantage over British Columbia with respect to taxes. British Columbia's income tax rate is slightly higher than the income tax rate in Michigan (37.5% in British Columbia versus 35.6% in Michigan) and British Columbia must pay the large corporations tax and a provincial capital tax which further increases British Columbia's total tax bill.

The long distance from British Columbia to the markets for LWC paper creates the most significant disadvantage for British Columbia. Even though 25 per cent of the LWC paper is delivered to California, the additional cost of delivering the remaining 75 per cent of paper to the midwestern states results in British Columbia having a $49 per tonne higher average cost of freight than Michigan.

The net impact of all of the cost advantages and disadvantages results in Michigan having a $27 per tonne lower total average cost than British Columbia (at an 81 cent Canadian dollar).

4.6.6 Michigan: Maine Comparison

Figure 28 illustrates the incremental costs that exist between Michigan and Maine.

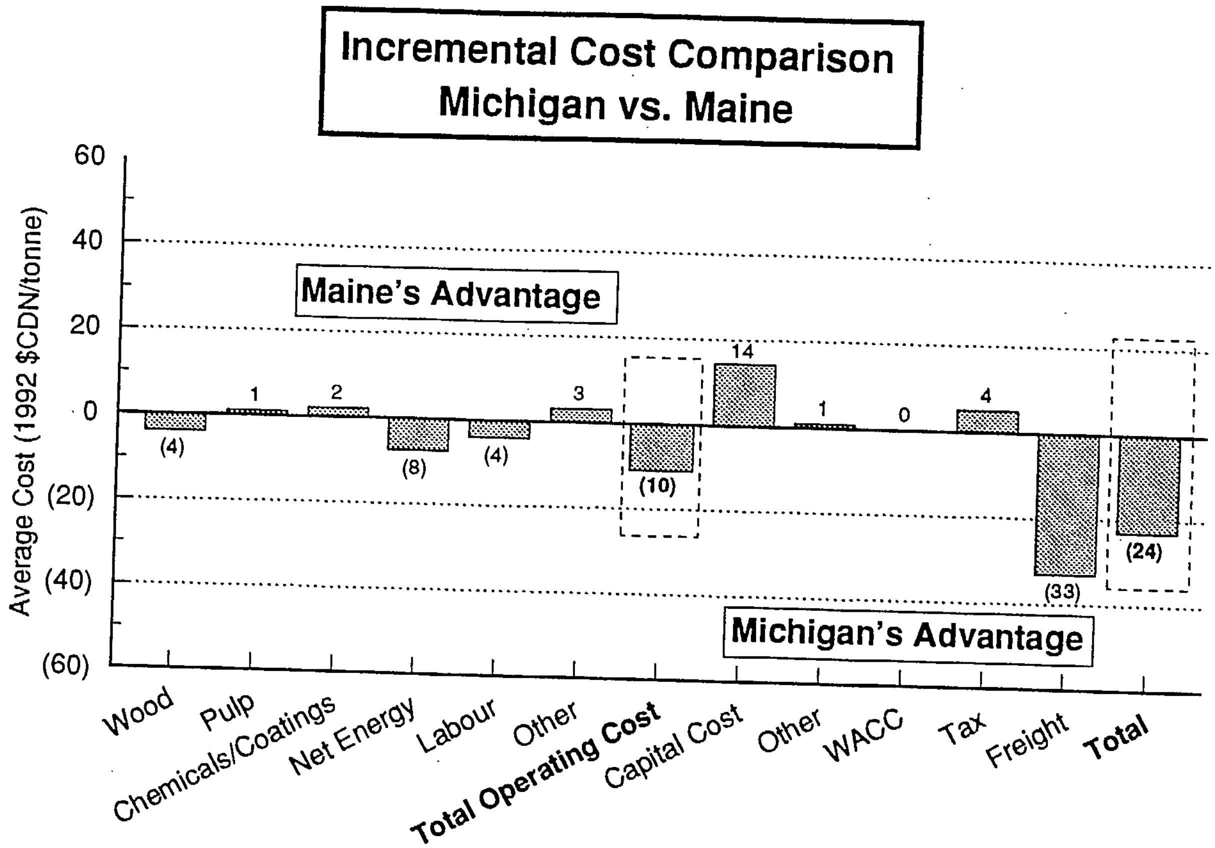


Figure 28 Incremental Cost Comparison: Michigan vs. Maine

Natural gas is not available to the Maine location, therefore the Maine mill must rely entirely on hog fuel as its energy source. In addition, without natural gas it is not economically feasible for the Maine mill to cogenerate all of its electricity requirements. However, Michigan has an energy disadvantage due to the $109 million capital cost of its larger cogeneration unit. The net result is a disadvantage for Maine of $8 per tonne in the average cost of energy.

The overall total average operating costs are $10 per tonne lower for the Michigan mill.

The average capital cost is $14 per tonne lower at the Maine location which is due to lower capital costs in Maine.

There is no difference in the cost of capital because both mill locations are located in the United States.

The higher average outbound transportation costs represent a $33 per tonne disadvantage for the Maine mill. This arises because the average travelling distance from the Maine mill to the market is 895 miles (1576 kilometres) while the average travelling distance from the Michigan mill to the market is only 504 miles (806 kilometres).

The net impact of the cost advantages and disadvantages results in Michigan having a $24 per tonne lower total average cost than Maine.

4.6.7 Michigan: Washington Comparison

Figure 29 illustrates the incremental costs that exist between Michigan and Washington.

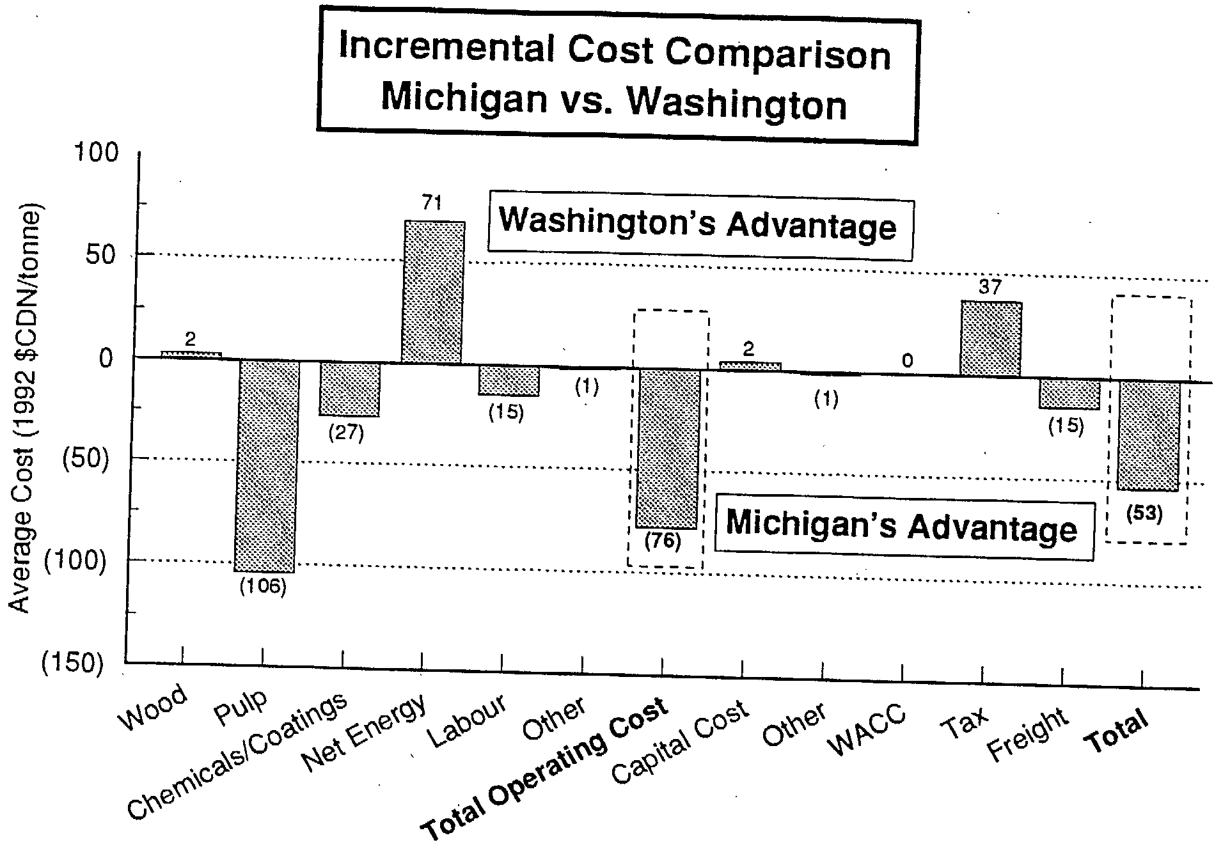


Figure 29 Incremental Cost Comparison: Michigan vs. Washington

With respect to operating costs, the Washington site is at a $76 per tonne disadvantage relative to Michigan. The average pulp cost represents the most significant cost disadvantage for Washington. A good quality of wood species (such as spruce, fur or aspen) required to make LWC is not available to the Washington mill, thus a much higher content of kraft pulp must be used to meet the LWC product specifications. The additional pulp required is 80% more than the amount required at the Michigan mill and represents a disadvantage of $106 per tonne for the Washington mill.

The Washington mill is also at a disadvantage with respect to chemicals and coatings. Due to the large distance from Washington to the coating and chemicals suppliers, the transportation costs associated with the coatings and chemicals are much higher in Washington than they are in Michigan. The average additional cost per tonne for the Washington mill is $27.

The Washington mill benefits from very low energy costs relative to Michigan. Washington has the second lowest industrial rate for electricity (Cdn 3.4¢ kWh) of all seven locations and this rate is considerably lower than the 6.9¢ per kWh cost of electricity cogenerated at the Michigan location. The costs of hog fuel and natural gas in Washington are also less than the costs in Michigan. In addition, Washington benefits from not having to incur the $109 million cost associated with the cogeneration unit at the Michigan site. As a result, Washington has a net energy advantage that amounts to $71 per tonne.

Although there is no state corporate income tax in Washington, much of the tax advantage Washington has over Michigan is due to Washington's smaller tax base. The present value of earnings before tax is only $522 million for Washington compared to a present value of earnings before tax of $906 million for Michigan. The taxes Michigan has to pay on the difference makes up much of the $37 per tonne cost advantage which Washington has over Michigan.

Finally, the long distance from Washington to the midwestern U.S. markets for LWC paper creates a significant disadvantage for Washington in terms of freight. Similar to British Columbia, the cost of delivering 75 per cent of production to the eastern states results in Washington having a $15 per tonne higher average cost of freight than Michigan.

The net impact of all of the cost advantages and disadvantages results in Michigan having a $53 per tonne lower total average cost than Washington.

4.6.8 Michigan: Alabama Comparison

Figure 30 illustrates the incremental costs that exist between Michigan and Alabama.

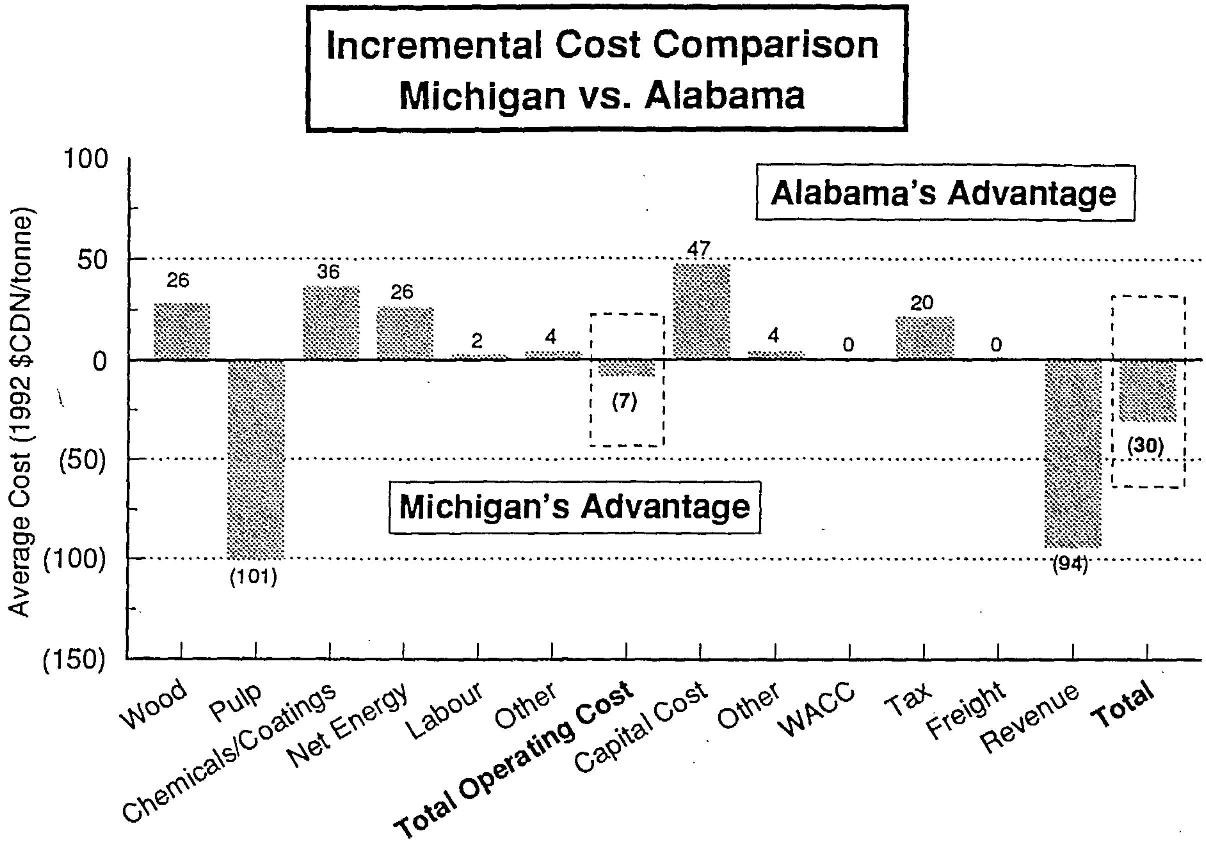


Figure 30 Incremental Cost Comparison: Michigan vs. Alabama

The Alabama location has a $26 per tonne advantage in wood costs relative to Michigan. Due to the fact that the Alabama location does not have the better-suited spruce/fir fibre available to make LWC paper, it relies on a lower quality fibre - yellow pine; and since the quality of yellow pine is low, the Alabama mill must use a larger amount of kraft pulp in LWC production to meet industry standards. The additional pulp is nearly double the amount used at the Michigan mill causing Alabama's average cost of pulp to be $101 per tonne higher than Michigan's average cost of pulp.

In contrast, Alabama has a $36 per tonne lower average cost of chemicals and coatings than Michigan. Much of this cost advantage can be attributed to Alabama not having to pay the high transportation costs associated with the purchase of clay that Michigan must pay.

Alabama also has a cost advantage with respect to energy. Both locations cogenerate their electricity however, the price of natural gas (used by both mills) is 10 per cent lower in Alabama resulting in a $26 per tonne lower average energy cost. Offsetting part of the gain from the lower gas price in Alabama is the additional natural gas that must be purchased because Alabama does not have as much on site hog fuel.

The combined advantages and disadvantages of the operating costs result in Michigan having a $7 per tonne advantage.

The capital cost is $121 million lower in Alabama than in Michigan. Most of the cost savings can be attributed to direct, physical costs as opposed to indirect, service-related costs. The lower capital cost provides Alabama with a $47 per tonne capital cost advantage.

Because taxable income for the Alabama mill is considerably lower than taxable income for the Michigan mill (the present value of the earnings before tax for Alabama is $682 million compared to the present value of the earnings before tax for Michigan of $906 million), a tax advantage of $20 per tonne exists for Alabama, despite Alabama having a 1.7 per cent higher income tax rate.

Due to the lack of suitable wood species suitable for the production of 32 lb LWC paper, the Alabama mill can only manufacture the heavier 40 lb. sheet. As a result, Alabama has a unique marketing mix compared to the other sites. The market price for the 40 lb. sheet is $1,196 (Cdn.) which is $202 lower than the price of the 32 lb. sheet ($1,399). Thus, by only selling the less expensive 40 lb. sheet, Alabama has lower revenues. This represents a disadvantage of $94 per tonne for the Alabama location.

Overall, Alabama has a $30 per tonne disadvantage in total cash flows relative to the Michigan benchmark.

4.7 Minimum Canadian Weighted Average Cost of Capital

Canada is a net importer of capital (primarily from the U.S.) and has been for quite some time. In order for Canadian firms to attract additional capital into Canada, foreign investors demand higher returns. In the past ten years, Canadian corporations have been faced with a WACC that at a minimum has been 0.86 per cent higher than that of similar U.S. corporations.

In the previous cost comparisons, each of the Canadian location's cost components and NPVs have been calculated assuming a Canadian/U.S. spread of 1.64 per cent which represents the average spread between Canadian and U.S. pulp and paper companies and includes both an allowance for country risk and exchange risk. To examine the significance of the WACC under the most optimum scenario, the cost comparisons will be based on the minimum historical spread of 0.86 per cent based on including only the country risk premium common to all Canadian industries.

Figure 31 illustrates the impact of the change in the WACC on the NPVs for the Canadian sites.

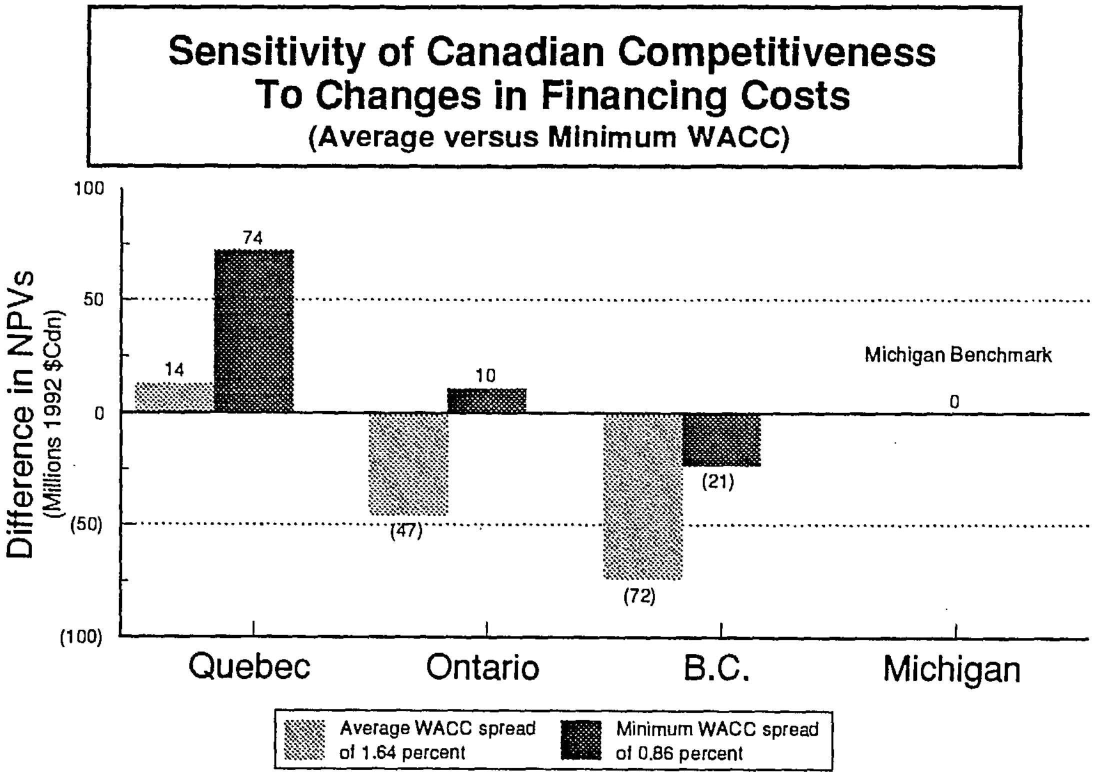


Figure 31 NPV Sensitivities To WACC

4.7.1 Quebec WACC Comparison

The reduction of 0.78 per cent (1.64 - 0.86) in the after tax WACC increased the NPV of the Quebec mill by $60 million to $74 million making Quebec considerably more attractive than the Michigan benchmark. For Ontario and B.C., the lower WACC increased their NPVs to $10 million and $(21) million respectively, indicating both locations would become competitive with Michigan.

The impact of the lower Canadian WACC on a cost per tonne basis relative to the Michigan benchmark is also examined and is illustrated below for each Canadian location. Since the impact for Canadian mills will be captured in the WACC cost component, it is only necessary to examine the respective WACC cost components of each Canadian mill; no other cost components will change. Figure 32 illustrates the impact of the lower WACC on the total average production cost per tonne when measured against the Michigan mill.

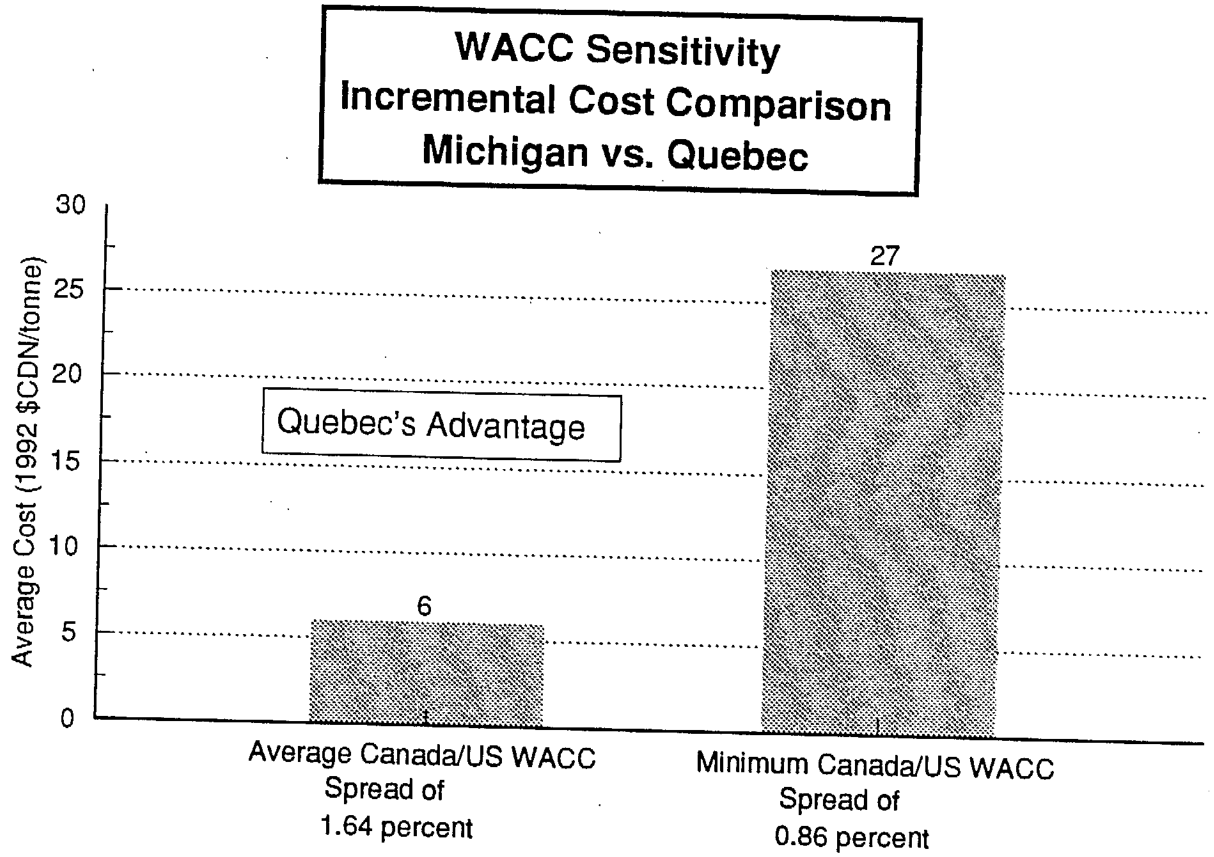


Figure 32 Michigan vs. Quebec Comparison - Minimum Canadian WACC

The lower WACC resulted in Michigan's WACC cost advantage being reduced from $49 per tonne to $27 per tonne. The effect on the total average production cost is an increase from the $6 per tonne advantage (based on the 1.64 per cent spread) to $27 per tonne advantage, an improvement of $21 per tonne.

4.7.2 Ontario WACC Comparison

Figure 33 illustrates the impact of the lower WACC on the total average production cost per tonne for the Ontario mill.

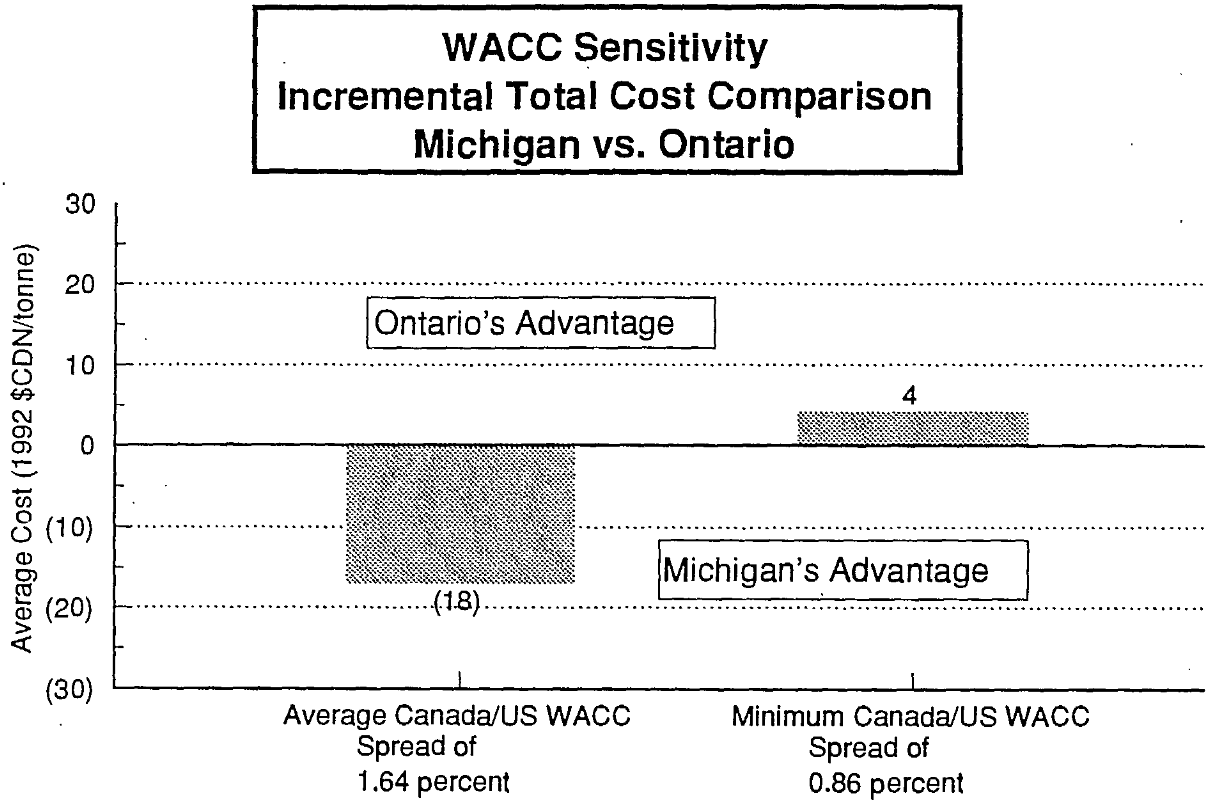


Figure 33 Michigan vs. Ontario Comparison - Minimum Canadian WACC

With the minimum spread of 0.86 per cent, the Michigan's WACC cost advantage falls from $48 per tonne to an average of $27 per tonne, again a $21 per tonne improvement. In this case, the total average production cost comparison between Ontario and Michigan reveals that Ontario now has a slight advantage of $4 per tonne.

4.7.3 British Columbia WACC Comparison

Figure 34 illustrates the impact of the lower WACC on the total average production cost per tonne for British Columbia relative to the Michigan mill.

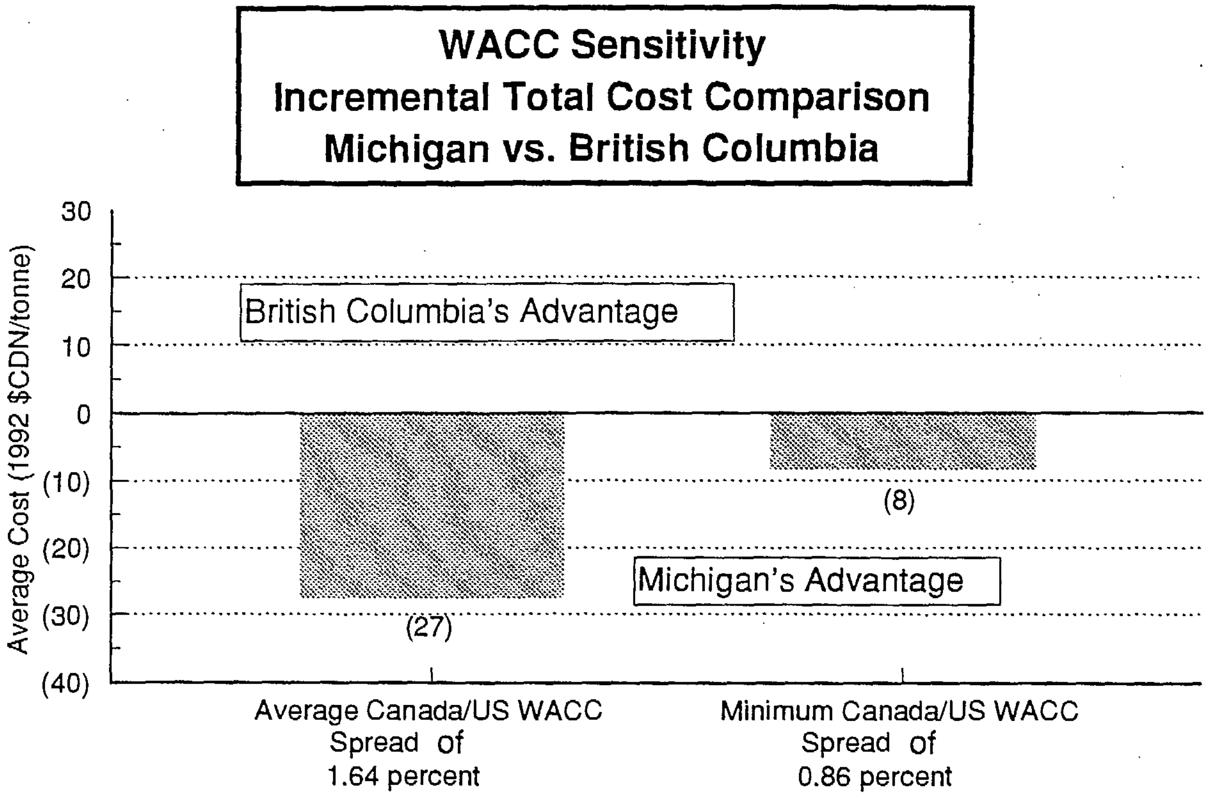


Figure 34 Michigan vs. British Columbia Comparison - Minimum Canadian WACC

For British Columbia, when the minimum spread of 0.86 per cent is considered, the WACC disadvantage becomes $24 per tonne, resulting in a the total average production cost disadvantage reduction from $27 per tonne to $8 per tonne, a $19 per tonne improvement.

This analysis illustrates that the Canadian mills are very sensitive to changes in their financing costs; the reduction in the spread between the Canadian WACC and the U.S. WACC has a very significant impact on the total production costs for Canadian LWC mills. Using the average spread of 1.64 per cent, only the Quebec mill has a total production cost that is competitive with that of Michigan, however when the minimum spread of 0.86 per cent is considered, both the Ontario and British Columbia mills have production costs that are competitive with Michigan, while the production costs for the Quebec mill become considerably lower than that of the Michigan mill.

4.8 Canadian Sites: Sensitivities To Exchange Rate

Canadian pulp and paper companies sell most of their products in the U.S. market and are therefore exposed to a considerable amount of exchange risk exposure. This section examines historical exchange rate fluctuations that have occurred in the past twenty years and then examines the sensitivity of the Canadian mills' NPVs to various exchange rate movements.

¶ Exchange Rates in the Past Twenty Years

Figure 35 illustrates the volatility of the exchange rate over the past 20 years. In the early-to-mid seventies the Canadian dollar was very strong reaching over $US1.00 per Canadian dollar. During the mid nineteen eighties the dollar fell reaching nearly $US0.70 per Canadian dollar and then increased to over $US85 by the early nineties. The average for the 20 year period was just below $US0.86 with a standard deviation of approximately $US0.09.

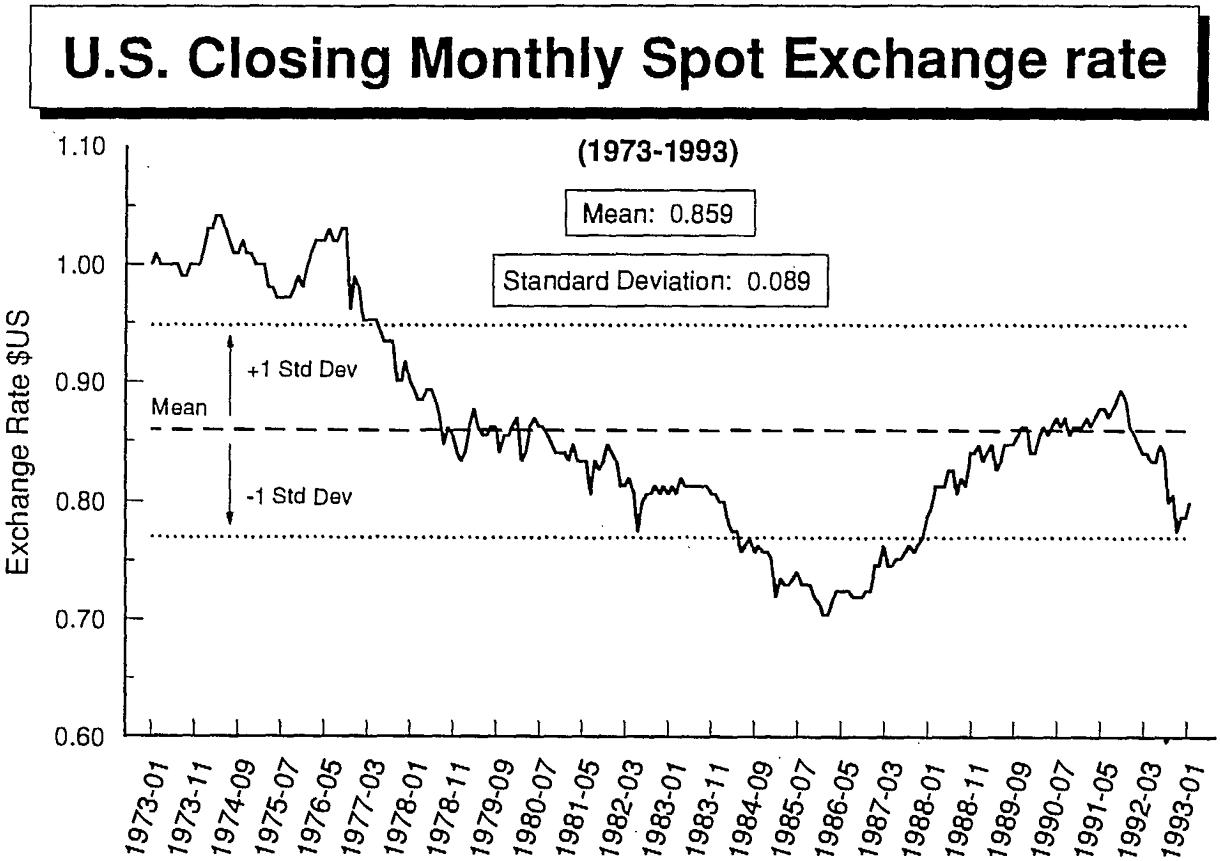


Figure 35 Canada-U.S. Exchange Rates (1973-1993)

When a shorter period is analyzed the average exchange rate and standard deviation are reduced significantly. Figure 36 illustrates the changes in the exchange rate for the past ten years. During this period the average was $US0.80 and the standard deviation was $US0.05.

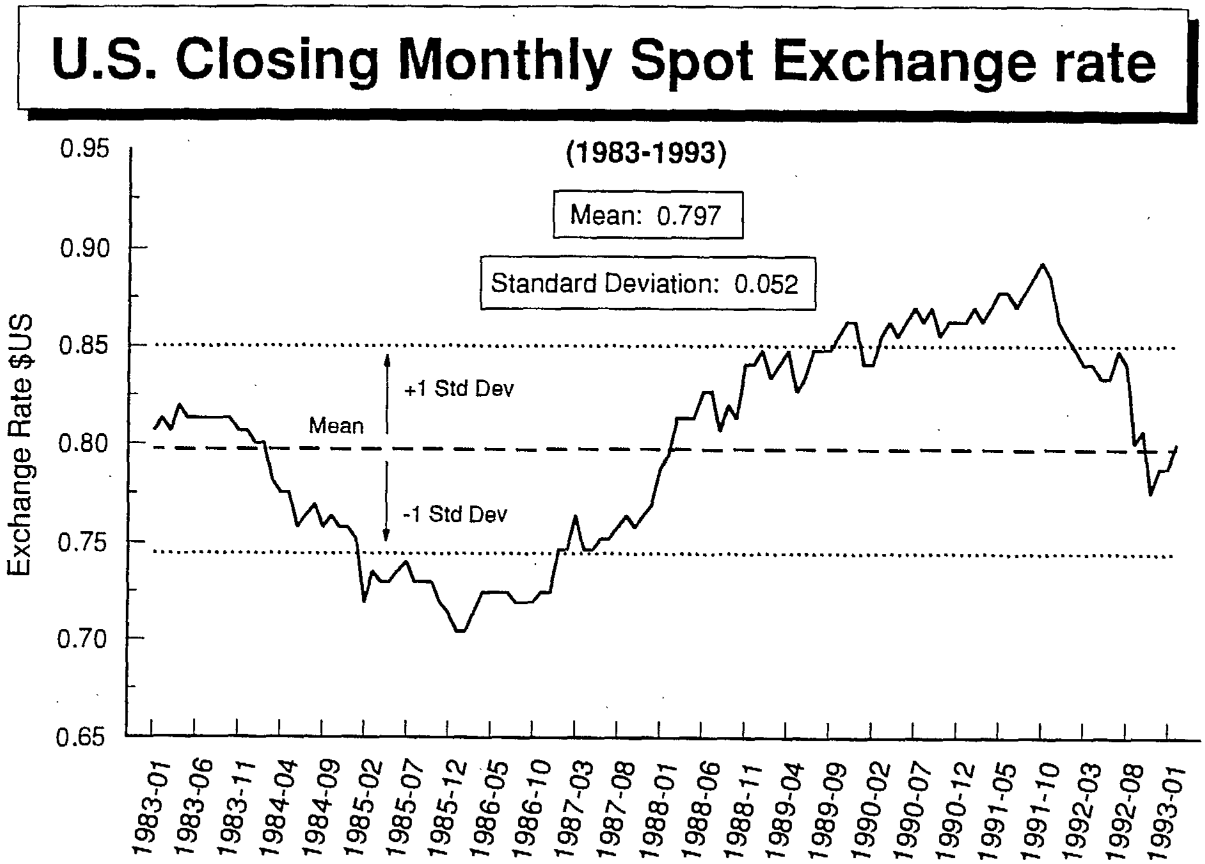


Figure 36 Canada-U.S. Exchange Rates (1983-1993)

Figures 37 and 38 illustrate the corresponding frequency distributions for the exchange rate movements during the past twenty and ten year periods, respectively. Neither figure suggests a strong central tendency towards the mean; especially the 1983-1993 period.

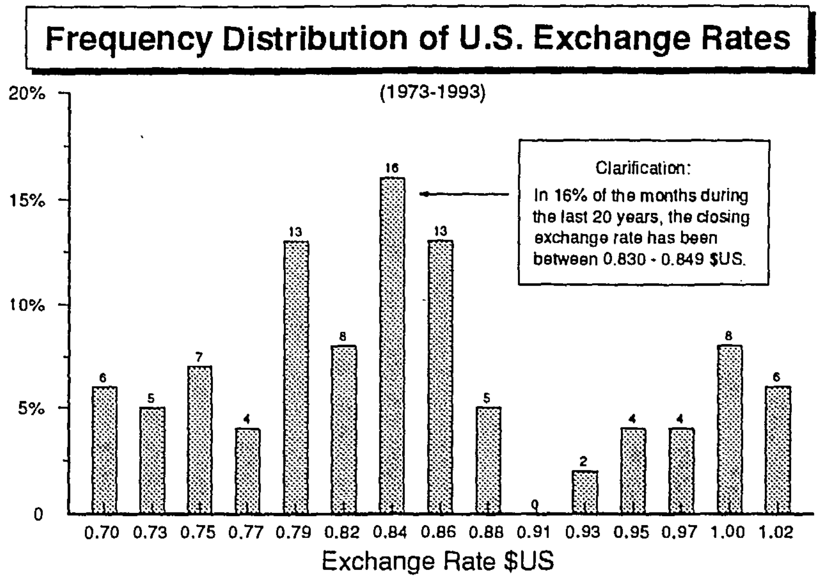


Figure 37 Monthly Exchange Rate Frequency (1973-1993)

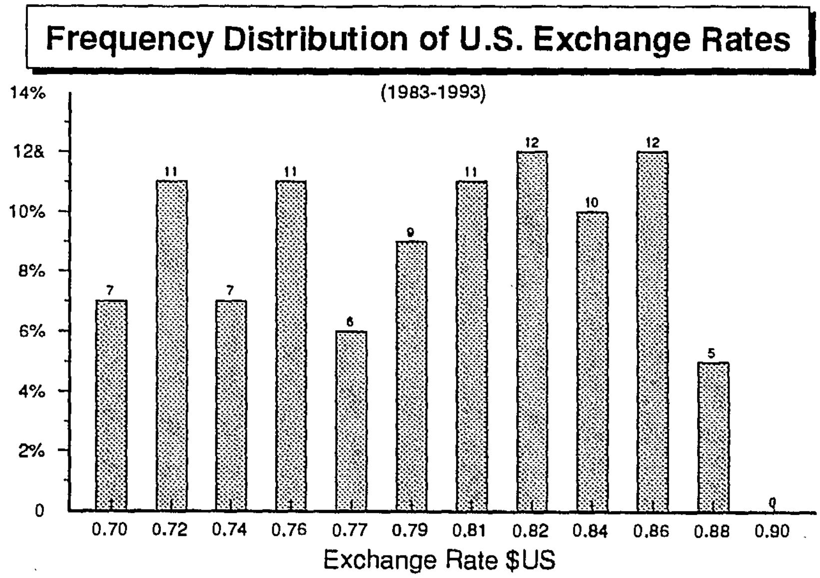


Figure 38 Monthly Exchange Rate Frequency (1983-1993)

¶ Sensitivity of Canadian LWC Mills to Exchange Rate Movements

A sensitivity analysis was performed to measure the effects of the Canadian locations' NPVs to various exchange rate movements. Figure 39 illustrates the results assuming the Canadian dollar is valued at US75¢, US81¢ and US87¢.

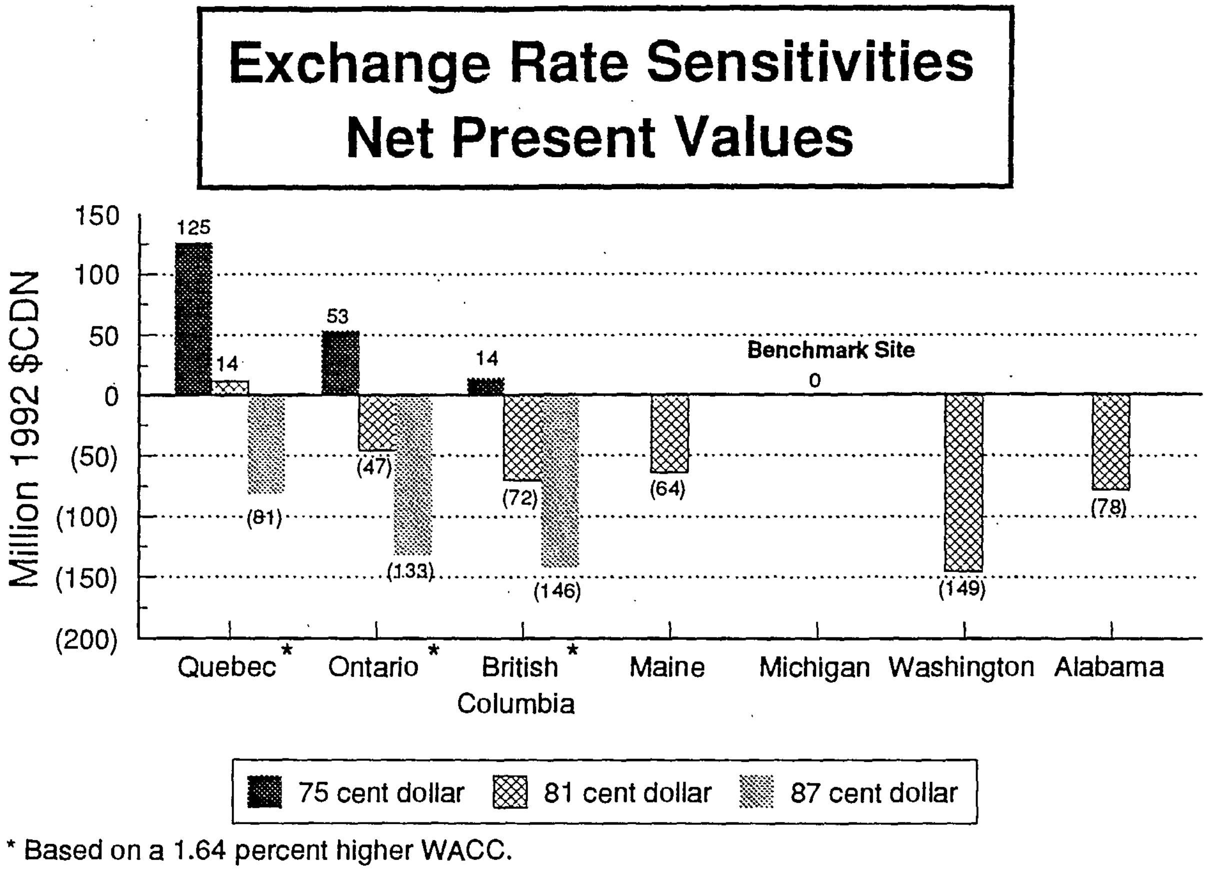


Figure 39 Exchange Rate Sensitivity

With a US75¢ dollar, Quebec and Ontario have NPVs which are considerably higher than the Michigan benchmark, $125 million and $53 million, respectively, while the NPV for British Columbia is only marginally better ($14 million). In contrast, when the exchange rate is US87¢ per Canadian dollar, all Canadian locations have NPVs substantially below that of Michigan. This illustrates the high sensitivity of Canadian mills' cash flows to movements in the exchange rate.

4.9 Internal Rate Of Return (IRR) Comparison

An alternative method of comparing the viability of LWC manufacturing in each location is on the basis of the IRR for each project. From a "textbook" perspective, there are several fundamental weaknesses associated with evaluating a project using the IRR approach. However, in the "real" world this methodology is often employed and hence is presented in addition to the NPV calculations.

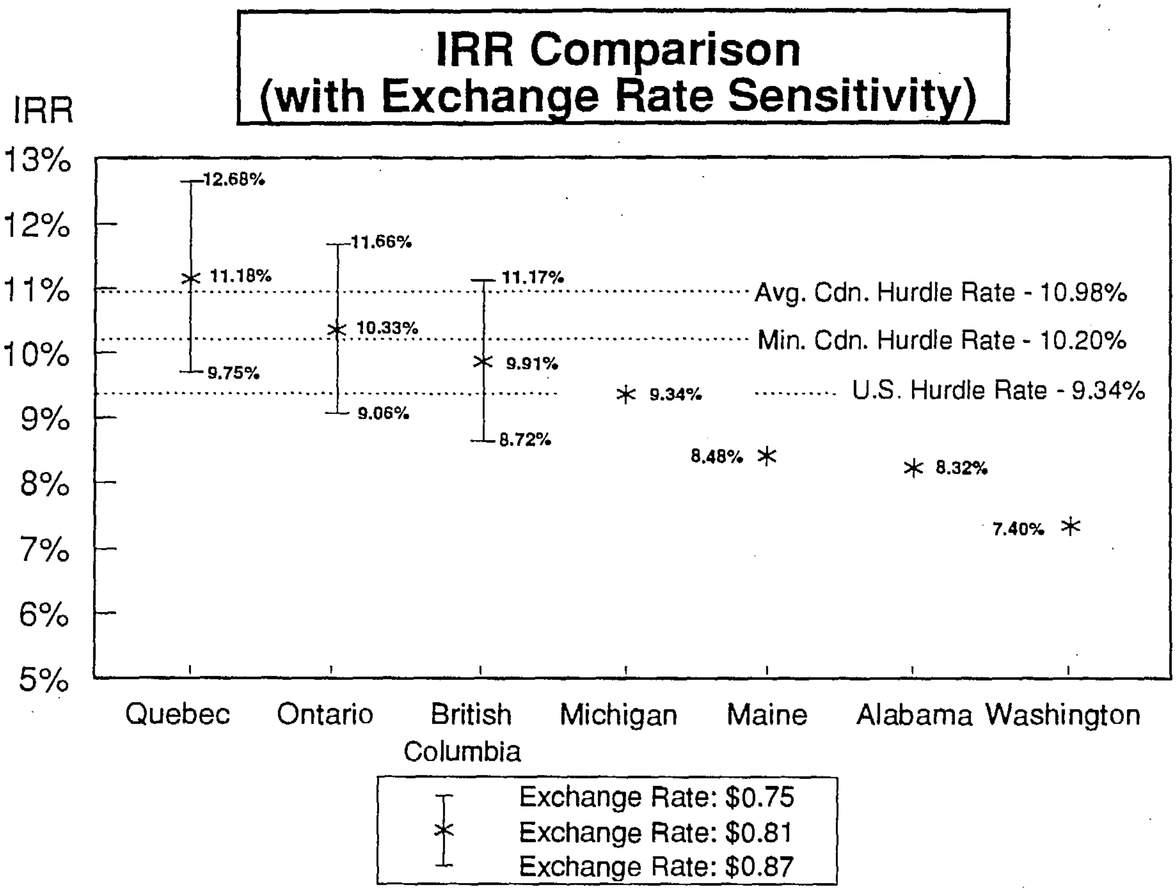


Figure 40 IRR Comparison

The IRR value for each of the seven locations is shown below in Figure 40. Only the locations with an IRR greater than their respective cost of capital, or hurdle rate, are profitable. The exchange rate sensitivity is shown for the three Canadian sites.

At the US$0.81 per Canadian dollar, Quebec has the highest IRR (11.18%) of all locations. When compared to its respective average Canadian hurdle rate of 10.98%, the IRR at the Quebec site is marginally above (0.20%) the Canadian hurdle rate. For Ontario and British

Columbia, neither IRR surpasses the average hurdle rate, yet the Ontario IRR is greater than the minimum Canadian hurdle rate.

When the Canadian dollar equals 75 cents US, all three Canadian sites have IRRs that are greater than the average Canadian hurdle rate and all sites are preferred to the Michigan site. Conversely, when the Canadian dollar equals 87 cents US, the Canadian sites have IRRs that are much lower than either the average or minimum Canadian hurdle rate, and neither site is preferred to the Michigan site.

The exchange rate sensitivity analysis indicates that Canadian mills are very sensitive to movements in the exchange rate. The marginal Canadian mill (Quebec) has as its breakeven point an exchange rate that is slightly above 81 cents U.S. per Canadian dollar.

5.0 CONCLUSIONS

The analysis of Canada's comptetiveness as a LWC site was based on constructing a two machine, 430,000 tonnes/yr greenfield mill. The investment for this mill at the seven North American sites examined varied from $1.3 to $1.5 billion Cdn (1992).

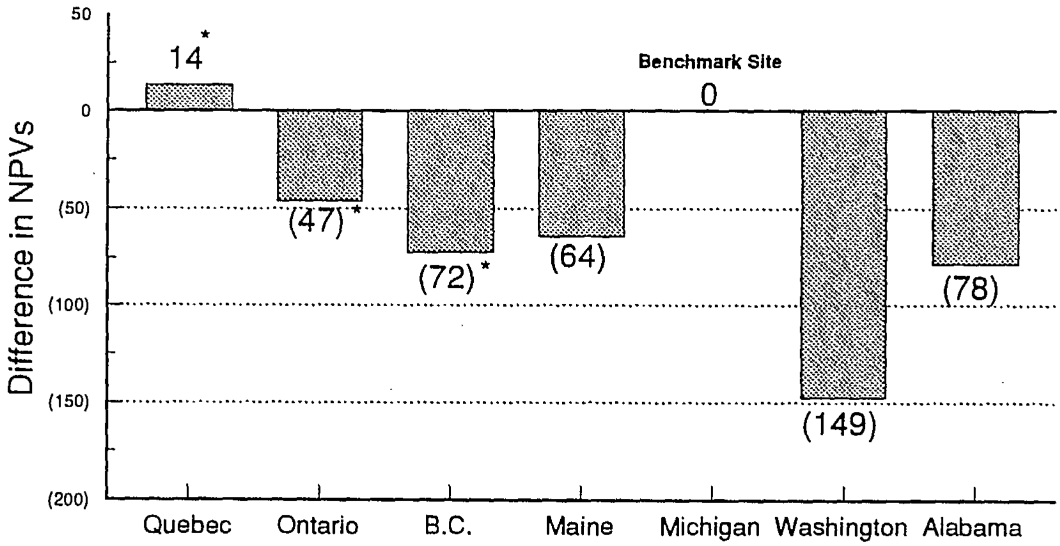
¶ The U.S. Benchmark Site:

The Michigan site was the most attractive of the four U.S. supply areas compared. The analysis confirms the logic of locating U.S. magazine paper facilities in the mid-west states of Michigan, Wisconsin, and Minnesota. Hence, Michigan was the "benchmark" used for assessing Canada's competitiveness.

¶ Eastern Canadian Sites Are Very Competitive:

The Canadian sites are very cost competitive with Michigan.

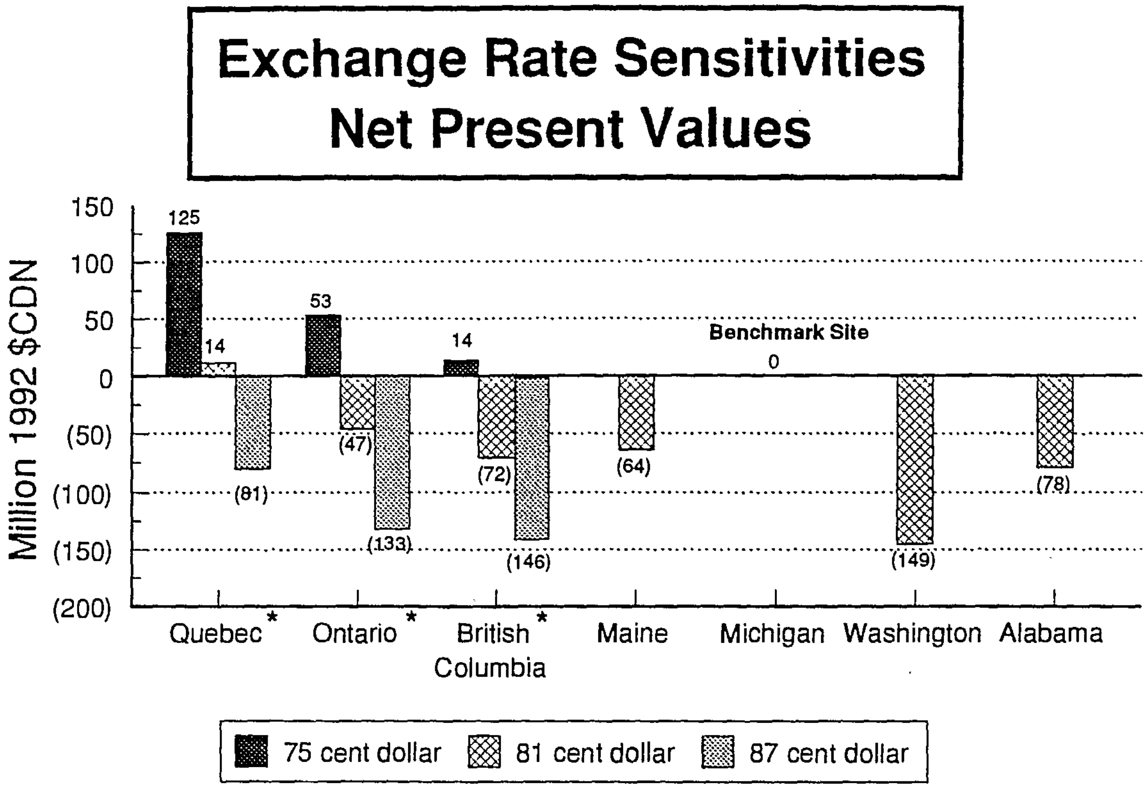
Relative Competitiveness of Regions To Michigan Benchmark
(NPV - $ Millions 1992 Cdn.)



* Based on a 1.64 percent higher WACC in Canada.

¶ The results, however, are very sensitive to the exchange rate.

- As illustrated below, at a 75¢ Canadian dollar, British Columbia and Ontario are also competitive sites.



* Based on a 1.64 percent higher WACC.

¶ <u>All Canadian sites suffer from a cost-of-capital disadvantage compared to Michigan.</u>

- Quebec has significant energy advantages but a modest outbound transportation penalty.

- Ontario has a smaller (i.e. than Quebec) energy advantage but has some minor disadvantages in chemicals/coatings; tax; and freight.

- British Columbia has an energy advantage but significant outbound freight disadvantages and a modest disadvantage in clay costs.

¶ Cogeneration: An Important Consideration

Any analysis of competitiveness in the pulp and paper sector should be most clear on the assumptions with respect to cogeneration. In this analysis it was assumed that:

- cogeneration, if attractive, would be installed to back out purchased electricity
- no excess power sales would exist
- no simultaneous sale and purchase of electricity (i.e. "cross-hauling") would occur.

Should any of these assumptions be changed, there could be very significant impacts on competitiveness.

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