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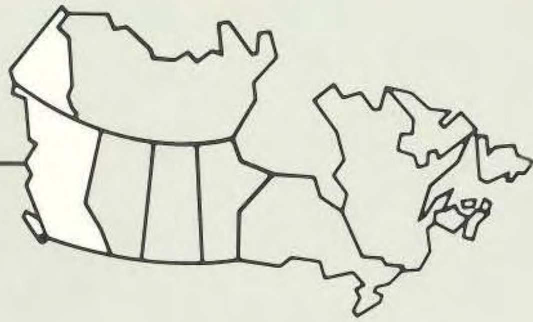

Estimation of the supply of forest biomass for energy conversion in British Columbia

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Foreword

ENFOR is the acronym for the ENergy from the FORest (ENergie de la FORêt) program of the Canadian Forestry Service. This program of research and development is aimed at securing the knowledge and technical competence to facilitate in the medium to long term a greatly increased contribution from forest biomass to our nation's primary energy production. It is part of the federal government's efforts to promote the development and use of renewable energy as a means of reducing dependence on petroleum and other nonrenewable energy sources.

The ENFOR program is concerned with the assessment and production of forest biomass with potential for energy conversion and deals with such forest-oriented subjects as inventory, harvesting technology, silviculture and environmental impacts. (Biomass Conversion, dealing with the technology of converting biomass to energy or fuels, is the responsibility of the Renewable Energy Division of the Department of Energy, Mines and Resources). Most ENFOR projects, although developed by Canadian Forestry Service scientists in the light of program objectives, are carried out under contract by forestry consultants and research specialists. Contractors are selected in accordance with science procurement tendering procedures of the Department of Supply and Services. For further information on the ENFOR Biomass Production program, contact...

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Abstract

This paper, using data from the national biomass inventory and other reports, derives economic supply curves for forest biomass fuels for British Columbia. These curves allow the analysis of the potential for use of bioenergy in British Columbia.

Résumé

A partir de données tirées de l'inventaire national de la biomasse et d'autres rappports, cette publication établit les courbes des ressources en combustibles représentée par la biomasse d'origine forestière de la Colombie-Britannique. Ces courbes permettent d'analyser les ressources virtuelles en bioénergie de la Colombie-Britannique.

Contents

Introduction

Background

The research presented here involves the development of a data base that summarizes the cost and availability of various forms of forest biomass fuels in regions throughout British Columbia. The ENFOR program has over the past 6 years sponsored a series of major studies which together comprise the National Biomass Inventory research program. Briefly, detailed tree sampling has been undertaken in British Columbia, as well as most other provinces, to provide data for statistical estimation of biomass component equations for major tree species. When combined with conventional forest inventory data files, these equations indicate the mass (weight) of standing forest material, by tree component (e.g., merchantable bole, bark and branches) in a given inventory area.

This provincial information, including that from British Columbia, has in turn been compiled by the Forestry Statistics and Systems Branch of the Canadian Forestry Service in order to produce a nationwide biomass inventory study. The resulting biomass inventory (Bonnor 1985) is comparable to the national forest inventory reported in Bonnor (1982). The analytical approach adopted to conduct the national biomass inventory is complex and need not be detailed here. Interested readers are referred to Bonnor (1985) for the national biomass summary data and detailed description of the national biomass inventory compilation process. Readers may also wish to review various British Columbia studies, such as Standish et al. (1985) and British Columbia Ministry of Forests (1984).

The national biomass inventory has produced a data base that effectively treats the standing forest as a stock at a given point in time. The inventory provides estimates of the mass of all standing trees in Canada, subdivided by major tree component, such as merchantable bole, bark and branches. More important, the national inventory has not attempted to extend its data base by incorporating data regarding the rate at which the standing forest stock is harvested to produce an annual flow of forest products. Nor has the national biomass inventory attempted to estimate the amounts of forest biomass fuels that are made available as by-products from this annual harvest, nor the potential costs of these forest biomass fuels.

These latter issues are major concerns for this study. The primary objective is to use the data produced for British Columbia by the national biomass inventory in conjunction with information regarding the size of annual forest harvests in the forest regions of British Columbia, in order to develop estimates of forest biomass fuel quantities available at different costs. Although such estimates have been compiled on a national basis in the past, most notably by Intergroup consulting Economists Ltd. (1981), the previous studies have not had the benefit of the national biomass inventory data, which should allow more accurate estimation of biomass fuel volumes, particularly logging residues.

Approach

Comparison with previous studies

A number of previous studies have either directly or indirectly been concerned with the availability of forest biomass in Canada. The present effort relies heavily on the approach adopted by Intergroup Consulting Economists in its 1981 report undertaken jointly for the ENFOR Program and Energy, Mines and Resources Canada. Intergroup's lucid, informative study was a serious attempt to develop comprehensive estimates of the quantities and costs of biomass fuels in all regions throughout Canada. As will become apparent, the present effort borrows much from Intergroup:

i) the same definitions of British Columbia regions;

ii) similar, although not identical, definitions of the types of biomass fuels available;

iii) the same estimates of quantities of biomass fuel available from certain sources where no new information is at hand regarding these quantities. These sources include plantations, salvage and stand conversion.

The present study is an attempt to update and expand the British Columbia portion of Intergroup's work in light of new information that has become available since 1981. Nevertheless, the present study differs from Intergroup's work in a number of fundamental ways, and consequently provides some very different results.

Key study parameters

Fuel types — This study derives estimates in oven-dried tonnes (ODt) equivalents of the quantities of the following forest biomass fuel types available in the forest regions of British Columbia:

Mill residues
Sortyard residues (British Columbia coast only)
Forest residues
Merchantable surplus
Salvage
Stand conversion
Plantations

These fuel types are defined later.

The major differences, compared to Intergroup's work, are that we have disaggregated sortyard residues in coastal British Columbia, excluded softwoods from the merchantable surplus available for energy, and aggregated the merchantable surplus, stand conversion and salvage categories in the presentation of results.

Time period — This study of regional forest biomass fuel supplies has as its timeframe the period from 1985 to 1995. Production for 1 year, 1990, has been selected to represent the average level of potential output over the decade.

The choice of a single year midway through a 10-year period is obviously less desirable than a series of annual estimates. However, the only reason such annual estimates would differ from year to year is change in the assumed level of annual harvest. All else being equal, harvests could be expected to grow slowly but steadily in all regions where annual harvests lie below the "operable" or practical annual allowable cut. If growth rates for harvests are assumed to be constant over the whole 10-year period, as is typically the case, then averaging a series of 10 annual estimates would yield a single estimate that would be very close if not identical to the 1990 estimate provided here. In sum, no loss of accuracy is expected by relying on a single year as representative of average annual production over the decade.

Cost estimates — Estimates in 1985 dollars have been developed for the cost of supplying increasing volumes of forest biomass in each region. Only direct production and transportation costs are considered. No stumpage fees have been included, and, more importantly, opportunity costs in terms of the value of fibre in other uses have not been analyzed. The omission of opportunity costs is a reasonable approach, in that the study has consciously excluded from consideration all biomass material that has direct potential for for alternative use in the conventional forest industry (e.g., chippable mill residues and surplus softwoods). Thus it can be reasonably expected that opportunity values should be zero, outside of energy uses, for virtually all the types of material considered here over the 10-year timeframe.

Levels of detail in modelling

The availability of data from the British Columbia study for the national biomass inventory (British Columbia Ministry of Forests 1984) has meant that it is possible to obtain information regarding biomass quantities by species, tree size and tree component for individual "cells" or "polygons" (small areas within management units). Thus, modelling was conducted on a highly disaggregated basis. First, the data for small areas from the national biomass inventory were compiled into estimates of biomass quantities, by component and forest type, for some 65 British Columbia forest management units. Special computer runs of the British Columbia national biomass inventory tapes were required for this purpose. Next, estimates of volumes and costs in each of the 65 management units were derived through the modelling procedure outlined below. These cost and volume data, by fuel type and by management unit, were then aggregated to obtain summary estimates for the six British Columbia forest regions.

Detailed methods

Overview

Fuel types

Before beginning the methodological discussion, it is appropriate to first define more clearly the types of fuels under consideration. Following Intergroup, three major categories were defined that relate directly to provincial harvest and allowable cut levels:

i) Mill residues

Mill residues are waste material by-products (e.g., bark, sawdust and shavings) that accumulate at conventional forest products facilities (e.g., sawmills, pulpmills and plywood mills). Larger mill wastes that are or could be chipped for pulp feedstock (e.g., trim ends, slabs and other solid wood) are excluded from consideration; they are instead assumed to be allocated to fibre uses. Thus only bark, sawdust and shavings are considered available for energy conversion. No attempt was made to determine the quantities of these latter materials committed to other uses such as pulp feedstock, landscape applications, or pressed board manufacture, except where identified in provincial sources.

ii) Logging residues

Logging residues are defined as the residual biomass remaining in the forest after commercial harvest activities; these residues include merchantable as well as nonmerchantable tree components. Following Intergroup, the merchantable component of logging residues is excluded from consideration here as an energy source on the assumption that this material should ultimately be collected for conventional forest products as prices increase and harvesting technologies improve. Thus, the residues of interest here include large pieces of broken, rotten or unrecoverable material that fall outside utilization standards, logging slash including branches and tops, unmerchantable trees, and noncommercial species. Biomass in stumps and root systems were excluded due to cost considerations and potential environmental impacts.

Logging residues could be recovered from forest sites and chipped to produce a prepared fuel. A wide variety of options for recovery and chipping technologies have been developed, suitable for various forest types. Different types of operations could also evolve: either a larger initial harvest or a second pass after commercial logging is completed are possibilities. Much of the research sponsored by the ENFOR program that may be amenable to economic analysis is concerned with various types of logging residue recovery technology. As will be seen presently, an effort has been made to develop accurate estimates of the volumes of logging residues potentially available for recovery, as well as the technologies suitable in various regions, and their costs.

iii) Merchantable surplus

Merchantable surplus was defined by Intergroup (1981) as biomass that is available but not utilized for conventional forest products; this material included the portion of each region's economically accessible allowable cut that remains unutilized after foreseeable annual harvesting activities. Both underutilized hardwoods and softwoods were considered by Intergroup to be available for energy purposes. After discussions with forestry officials in British Columbia, it was decided to limit our estimates of merchantable surplus to hardwoods only.

Aside from these three, another category was defined for coastal British Columbia that is also directly related to harvest levels:

iv) Sortyard residues

Sortyard residues are biomass that accumulates at dry land sorting locations on the British Columbia coast. Because the use of sortyards is limited to coastal locations, this category is not relevant elsewhere in Canada. Sortyard residues are in a sense similar to logging residues, in that they are unprocessed tree pieces that for one reason or another are rejected at the sortyard. Yet they are also similar to mill residues in that collection and transport costs are attributed to the commercial logging activity. Sortyard residues are generally the next cheapest biomass energy source after mill residues on the British Columbia coast, and consequently they have received growing attention in research and provide increased commercial fuel production.

Three categories of forest biomass fuels were also defined by Intergroup (1981), for which the potential of output is not directly tied to commercial harvest levels. Intergroup provides more extensive definitions and discussion for these three categories:

v) Salvage

Salvage includes biomass potentially available due to damage by fire, insects, disease, wind or flooding.

vi) Stand conversion

Stand conversion includes biomass potentially available from areas where rehabilitation and regeneration with higher-quality softwoods is desirable.

vii) Biomass plantations

This category consists of intensively managed plantations of fast-growing, high-yield species (typically hardwoods) grown on inferior class agricultural land for harvest over periods of 2 to 6 years.

Early in this research, we decided to emphasize improvement in the quantity estimates for forest residues and mill residues, since these are the sources which are of greatest potential commercial importance for which new information was available. Thus, the estimates provided by Intergroup for plantations, salvage and stand conversion, by region, in 1990, were used here without alteration. Virtually no new data are at hand regarding these sources. New estimates of merchantable surplus and stand conversion were prepared for British Columbia on the basis of data from the national biomass inventory, and aggregated into one category termed "Noncommercial harvest."

Quantity estimates

Figure 1 is a schematic diagram of the process employed to derive the quantity estimates for mill residues, logging residues, sortyard residues and noncommercial harvests. The process is similar to that employed by Intergroup, but considerably more detailed in that factors are allowed to differ between regions and fuel sources. The data sources and analytical steps are described below.

Steps in quantity estimates

1985 Annual Allowable Cut Data — Annual Allowable Cut (AAC) information was obtained for all Timber Supply Areas (TSA's) and Tree Farm Licenses (TFL's), the two major forest management units. For private lands, which comprise only a small proportion of the total cut, AAC estimates were developed by subtracting the sum of AAC for all TSA's and TFL's from the provincial total AAC. The residual was then allocated to private (or nonprovincial) lands in each forest region on the basis of the region's relative importance in commercial harvests from private lands in recent years.

1985 harvest estimates — 1985 harvests are assumed to equal the operable annual allowable commitments set in each management unit, since previous studies have shown that available forest resources are generally fully committed and in some cases overcommitted, particularly in southern management units.

Growth factor — As the result of discussions with the British Columbia Ministry of Forests, all 1990 harvests are assumed to equal the 1985 AAC commitments.

Density factors — For each region, data were obtained regarding the species mix and relative importance in commercial harvests. Sources of this information included various Ministry of Forests annual reports (e.g., British Columbia Ministry of Forests 1983, 1982, 1981), as well as summary sources including Woodbridge, Reed and Associates (1982) and Bickerstaff et al. (1981). Once the species mix within harvests was at hand, a weighted average density factor was compiled for each region. The factor indicates the weight in oven dry tonnes (ODt) of a typical harvest in cubic metres from that region. The source of density factors for various species was Dobie and Wright (1979).

1990 Harvest in ODt's — Multiplying the 1990

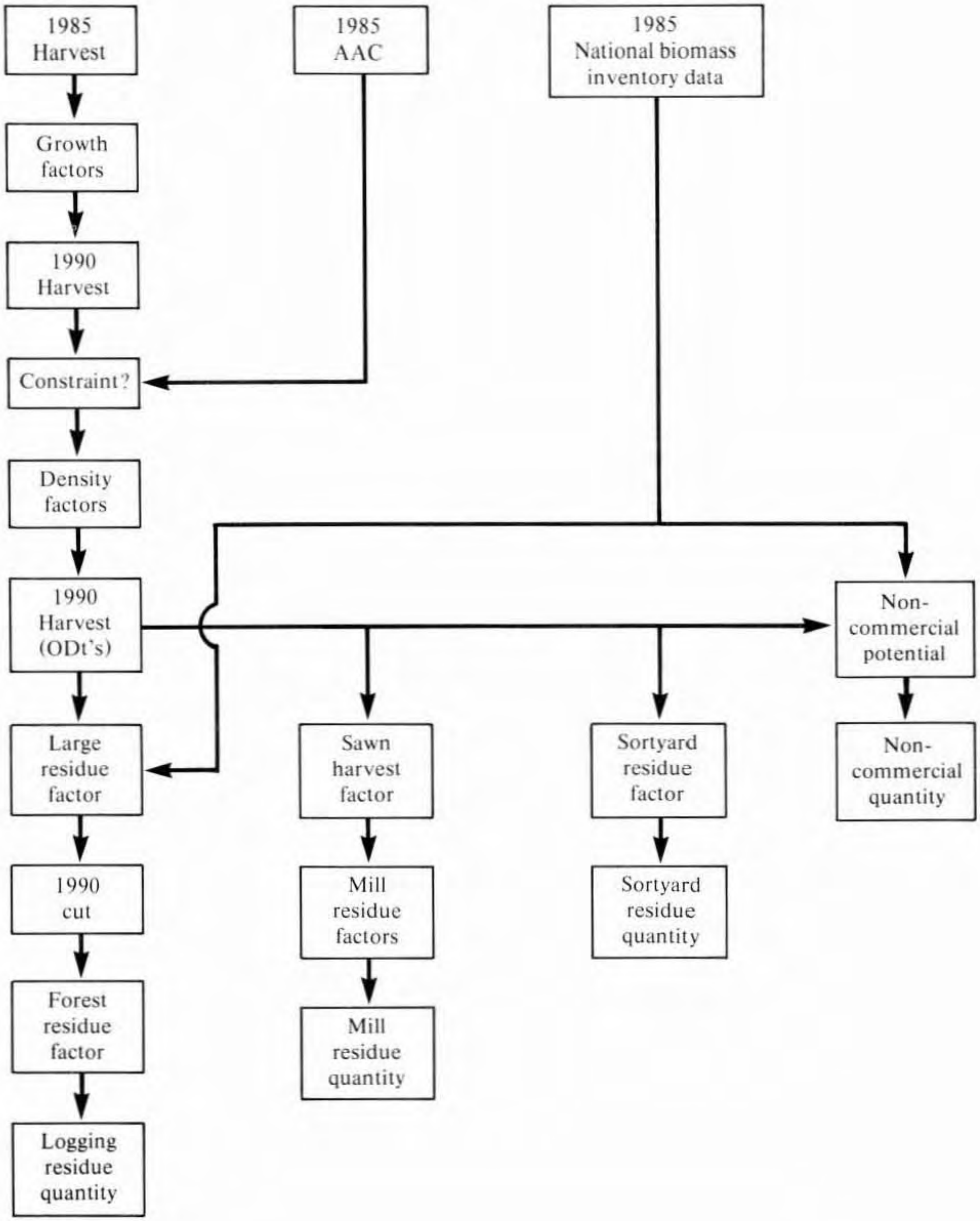

Figure 1. Schematic diagram of quantity estimation process

harvest estimates in cubic metres by the density factors yields estimates of the 1990 harvest in ODt (mass) terms.

Decay, breakage and waste factors and unavoidable residue factors — These factors indicate the relationship between a given level of commercial harvest and the quantity of large nonmerchantable residue pieces left in the forest. Because the relationship is an important one for this study, some background discussion is merited.

Previous studies have indicated that larger-sized forest residues include both merchantable and unmerchantable bole pieces (smaller residues such as branches are considered later). The merchantable component, which comprises sound unbroken bole pieces whose size exceeds the minimum provincial utilization standards, can often amount to one-half of larger logging residues (McDaniels Research 1982). Such merchantable material is excluded from consideration here on the grounds that it should eventually be utilized for fibre as prices increase and recovery technology improves. Consequently this study deliberately adopts a conservative approach to estimation of forest residue quantities.

The large yet unmerchantable bole pieces are the topic of concern here. A number of potential problems could render a tree of otherwise commercial size unusable for processing. These problems include decay, breakage and waste, and "logging chance."

Decay, breakage and waste are problems or defects that render commercially sized trees unmerchantable. These defects generally account for the difference between a stand's gross and net merchantable volume. The extent to which they reduce the volume recoverable from a stand depends greatly on factors such as age, species, terrain and climate. "Logging chance" is a broad term referring to events such as the position of trees after felling, or similar difficulties, that preclude merchantable pieces from being recovered intact. Thus logging chance accounts for the share of net merchantable volume that becomes classed as "unavoidable residues."

These two types of problems sound superficially similar and one might ask whether they refer to the same material. Extensive discussions with individuals from the British Columbia Ministry of Forests confirm that they do not. The distinction lies in whether the material is viewed as part of the net merchantable volume. Decay, breakage and waste factors reduce the gross merchantable volume to the net amount estimated to be recoverable, while unavoidable residues are part of the net merchantable volume that for good reasons cannot be recovered for fibre.

Large forest residues will therefore include both material affected by decay, breakage and waste, as well as unavoidable residues. Factors to calculate the quantities of material falling into these categories are therefore required. The process used to estimate these factors for British Columbia relied on data supplied by the British Columbia Ministry of Forests. The Ministry of Forests provided tables of breakage and waste factors, by species and maturity, for representative management units within British Columbia's six forest regions. Weighted average factors were calculated for each region based on the species mix within the region, and assuming that at least 80% of the inventory in each region would be mature at harvest. The factors supplied by the British Columbia Ministry of Forests did not account for decay and so will provide a low estimate. Factors for unavoidable residues were more difficult to obtain, since they require post-harvest site inventories. Limited regional data were available from a study undertaken by the British Columbia Forest Service (1976) which estimated the quantities of avoidable and unavoidable residues in each region. Unavoidable residue factors were interpolated from that source, since there is little reason to expect that recovery standards have improved since the surveys reported in that study were made.

The breakage and waste factors and unavoidable residue factors employed for British Columbia provide conservative estimates of large residues, in that they exclude merchantable material, as well as that affected by decay. Nevertheless, the results are remarkably high. They range from a breakage and waste factor of 10% and an unavoidable residue factor of 13% in the Vancouver Region, to 3.5% and 6.5%, respectively, in the Cariboo Region. In other words, roughly 10 to 23% of the total cut remains on the ground as nonmerchantable or nonrecoverable large pieces in these areas.

1990 total cut — Multiplying the estimated 1990 commercial harvest (in ODt's) for each region by one plus its breakage and waste and unavoidable residue factors, yields an estimate of the quantity of merchantable-sized timber that would actually have to be cut in order to achieve the predicted commercial harvest level. The difference between the 1990 cut and the 1990 harvest comprises the estimated amount of large residues falling outside utilization standards (due to decay, breakage, waste or logging chance) that would remain on the forest site.

Forest residue ratio — The forest residue ratio indicates the quantity of smaller residues such as branches or tops associated with the harvest of merchantable boles. This ratio is the vehicle by which the results of the national biomass inventory are incorporated in this analysis. Some background discussion regarding the approach is therefore necessary.

After reviewing the national biomass inventory data base it became apparent that two basic options were available to utilize national biomass inventory data within this study. One possibility was to treat the inventory data essentially as a map of the standing forest and use it as the basis for a dynamic simulation model that incorporates the growth of trees, the spatial distribution of harvests, the location of conversion centers, utilization standards, and many other parameters in order to model the production of different types of biomass fuels. The second option was much less detailed, and would entail using the inventory data as the basis for factors (or ratios) that indicate the relationship between merchantable harvests and residue quantities, by component and by species, in a given area. Obviously, the smaller the area, the more precise would be the estimates of residue quantities.

Given the enormity of the simulation modelling necessary for the former approach, it seemed clear that the latter approach was more appropriate for this study.

Special runs of the British Columbia biomass inventory data base were made. This data base, discussed in British Columbia Ministry of Forests (1984), contains inventory data in terms of species, size, biomass components, and other characteristics for thousands of cells (small area polygons roughly equal to map sheets) throughout the province. The following operations were conducted on the data base for this study:

i) The process began with the final data set originally supplied by the British Columbia Ministry of Forests to the national biomass inventory. It contains records (rows in the matrix) corresponding to forest areas and fields (columns in the matrix) corresponding to descriptive characteristics and volumes of biomass for each area.

ii) The first step was to delete certain records on the basis of codes in particular fields in order to eliminate areas that are unlikely to be utilized for commercial harvests or energy production. Examples include provincial and national parks, municipal land, unproductive areas, nonforest land, and others.

iii) Next, the remaining records were grouped into 65 different management units (TSA's or TFL's).

iv) Within each management unit the records were segmented into those with stands where commercial harvests were likely to occur and those where harvests were not. The criterion was stand type: softwoods and mixed stands dominated by softwoods were defined as commercial harvest areas, while hardwoods and hardwood-dominant mixed stands were noncommercial areas. Commercial areas accounted for over 90%, on average, of the total available biomass in all management units.

v) For the commercial harvest areas, the total biomass for all species and age classes was summed by tree component (i.e., merchantable bole, foliage, and so on) within each management unit.

vi) For the noncommercial areas, the total quantity of biomass was summed by management unit irrespective of tree component.

For commercial harvest areas, the result of this process was a large matrix with eight biomass components listed as fields (columns) along the top (i.e., merchantable bole, bole bark, top, branches, stump, stump bark, foliage and submerchantable trees) and some 65 management units (TSA's and TFL's) listed as records (rows) down the left side. The contents of a given cell in the matrix indicated the weight in ODt of that biomass component for all merchantable trees in that unit. For example, one cell might contain the weight of all branches of merchantable trees in the Nootka TSA. For noncommercial stands, the quantities were also aggregated by management unit in order to estimate the total potential noncommercial harvests by management unit, as discussed later in this section.

Once the matrix was developed, ratios were calculated for the commercial harvest areas in each management unit with the following formula:

$$\frac{\text{tops} + 0.75\ (\text{branches} + \text{nonmerchantable trees})}{\text{merchantable bole} + \text{merchantable bole bark}}$$

The ratio indicates the quantity of small residues suitable for recovery through chipping for fuel, for every unit in ODt of merchantable bole. Stumps and foliage are assumed unrecoverable due to environmental considerations. Only 75% of the total weight of branches and nonmerchantable trees are assumed to be suitable for chipping because of handling limitations on small pieces.

Logging residue quantities — Once these steps were completed, the total available logging residues suitable for energy production could be estimated. In order to obtain an estimate of the quantity of large nonmerchantable residues in each management unit, the difference between the 1990 commercial harvest and 1990 cut necessary to achieve that recovered harvest was calculated. In addition, the forest residue ratio was multiplied by the 1990 cut in order to obtain an estimate of the quantity of small residues such as tops, branches and submerchantable trees associated with that cut. The sum of these two quantities indicates the total quantity in ODt's of logging residues suitable for energy recovery.

The results generally indicate considerably higher logging residue quantities than had been estimated in previous studies. These calculations yielded an estimate for total logging residues of 11.6 million ODt yearly, while Intergroup's estimate for 1990 was 7.1 million ODt. The higher results are obtained even though the findings here are certain to underestimate the total logging residues available for energy, since residues classed as merchantable by provincial standards are ignored, as are the small residue components (i.e., tops, branches) associated with these merchantable residues.

Sawmill utilization factor — This factor indicates the share of the total harvest that is processed in sawmills. Statistics Canada data (Catalogue 25-202) regarding the composition of harvests from 1978 to 1983 were employed to estimate these proportions.

Sawdust and shavings factors — These factors indicate that the average quantity of sawdust and shavings produced from a given quantity of roundwood sawmill input were derived for each forest region in British Columbia through reference to Reid, Collins and Associates (1978a) and conversations with forest industry sources knowledgeable about changes in sawmill technology since that study was completed.

Bark factors — Data from the special runs of the national biomass inventory data base for British Columbia were employed to compile ratios showing the weight of bark per unit of merchantable bole for each region.

Mill residue production — Detailed surveys resulted in estimates provided by Reid, Collins and Associates (1978a and 1978b) which were later revised slightly by Intergroup (1981). The figures derived here for mill residues through the process outlined above amount to about 80% of the Reid, Collins estimates for 1990. Moreover, an update of the 1978 Reid, Collins work is under way which will yield even more precise estimates.

Noncommercial harvest quantities — Earlier, when discussing computer runs of the national biomass inventory data base for British Columbia, we indicated that all material in noncommercial areas was summed by weight for each management unit. These biomass quantities primarily involve hardwoods and brush that are unlikely ever to be harvested for commercial purposes. This material is assumed to be readily available for energy harvests. We therefore decided to provide an estimate of "noncommercial biomass harvests," likely conducted on a whole-tree chipping basis, for each management unit. This potential harvest of noncommercial stands would incorporate two categories of biomass fuel sources estimated by Intergroup: the hardwood component of merchantable surplus, and stand conversion.

Of course, the key question is the percentage of the total quantity in each management unit likely to be harvested in a given year, if such harvests are eventually conducted. No guidance was available from the provincial Ministry of Forests on this topic. For purposes of this study, it was conservatively assumed that 3% of the total quantity in each management unit could be harvested annually. Such a low harvest rate would ensure a long-term supply from this source.

Sortyard residues — For the two coastal regions in British Columbia, sortyard residues are increasingly important biomass fuel sources. A review of available reports (Sinclair 1981, 1982) and discussions with engineers at the Forest Engineering Research Institute of Canada indicate that an amount equal to about 5% of the annual coastal commercial harvest accumulates yearly as sortyard residues on the coast. However, it is uncertain whether the discarded material has been scaled as part of the harvest, and so represents a 5% reduction in processed wood throughput, or whether the material has not been scaled because, for example, it is the wrong species.

For simplicity, we assumed that an amount equal to 3% of the annual commercial harvest represents sortyard residues available for energy production, and that this material is not part of the scaled harvest. The remaining sortyard residues (the other 2% of commercial harvests) are assumed to be unusable for energy because they are too dirty, or too small, or for other reasons.

Cost estimates

An overview of the process adopted to derive biomass delivered-cost estimates and supply curves is shown in Figure 2.

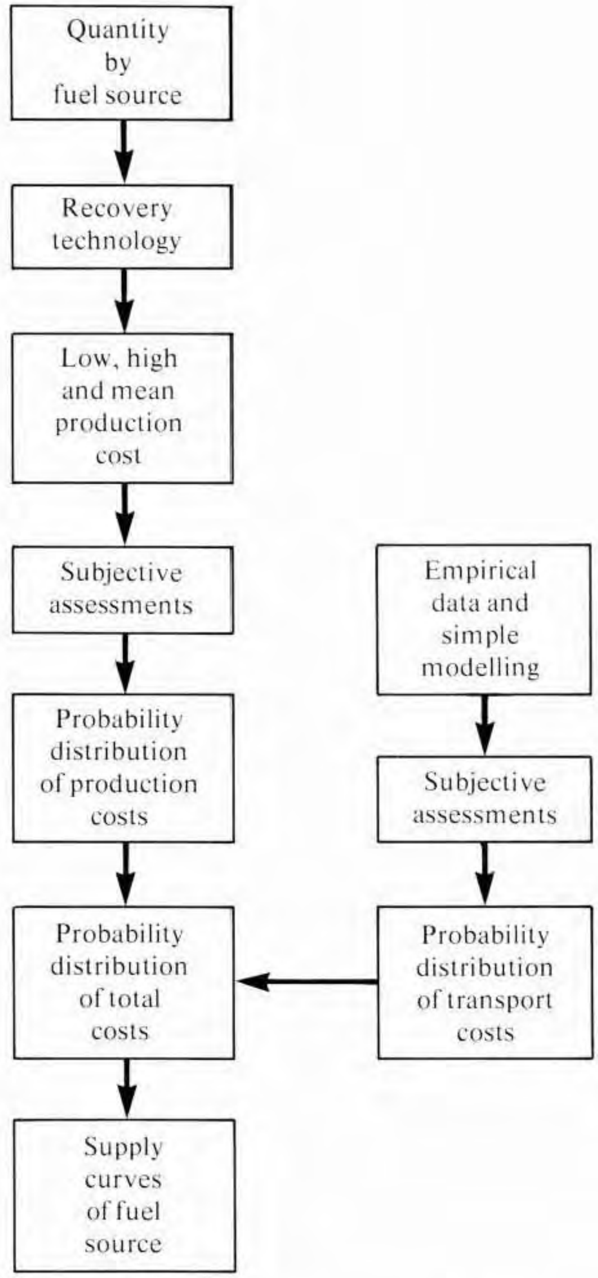

Figure 2. Schematic diagram of cost estimation process

Production cost estimates

Production cost estimates refer to the cost of obtaining a usable biomass fuel, chipped at the roadside. For example, forest residue production costs would include recovery, handling and chipping. Estimation of accurate, up-to-date production costs is a crucial step in successfully completing this study, so some background discussion is appropriate.

The process of obtaining production cost estimates began with a review of many different publications summarizing the estimated production costs of chips for energy through either recovery of logging residues or whole-tree chipping. The contents of each of these studies was carefully analyzed and summarized in a data base of fuel cost estimates. The data base includes characteristics such as region, forest type, fuel source type, primary logging method, residue handling method, equipment costs, and basis of costs.

In assembling the cost estimates, care was taken to ensure the figures reflected actual experience (if the source involved field trials) or the actual calculated costs (if the source involved engineering estimates). Costs were converted to 1985 dollars through the use of Statistics Canada's GNE deflator index (Catalogue 13.001) and, where necessary, the costs were converted from U.S. to Canadian dollars assuming that 75 cents (U.S.) = $1 (Cdn).

Based on the limited information at hand, production costs per ODt in 1985 dollars were estimated for logging residue recovery and merchantable surplus, salvage and stand conversion in each region. A mean estimate and a low and high range estimate to bracket the mean were compiled. The ranges were necessary because studies have shown that even for a given recovery method and given location production costs can vary dramatically depending on terrain and other factors (e.g., Nagle 1980). In some cases the ranges also reflected differences between marginal cost and average cost estimates; the former occurred where residue recovery is added onto an existing logging operation (Forestal International 1983). Merchantable surplus, stand conversion, and salvage were treated together because they would likely all employ the same process whole tree-chipping.

Finally, production costs for mill residues were assigned a nominal value of $1/ODt, to reflect the costs of fuel preparation, or "hogging." Plantation costs were taken from Forestal International (1983), as well as by reference to Intergroup (1981).

Distribution of production costs

Given an average, low and high production cost estimate for each fuel type, the next issue is how the actual production costs of fuels might be distributed within this cost range. In other words, a probability distribution for production costs is needed.

Generally speaking, probability distributions for a random variable such as production costs can be developed on the basis of the relative frequency of observed events, or on the basis of subjective estimates. Because the available data regarding the range and frequency of observed production costs is so limited and site specific, we are forced to rely on subjective estimates. To make these assessments, it was assumed that the average production cost for a given source equals the mean or expected value of the probability distribution and the probability of a given production cost falling between the high and low estimates is 100%. Within these limits the distributions are assumed to be approximately normal.

Following these rules, it was possible to estimate the probability that production costs would fall into a series of cost intervals of $15/OD+. The sum of the probabilities in all cost intervals must equal one. For example, consider a quantity of forest residues with average cost estimate of $50, a low estimate of $40 and a high estimate of $60. This fuel category could have a production cost probability of, say, 0.10 under $31-$45, 0.90 under $46-$60, and zeros in all other cost intervals. Obviously the allocation of probabilities to cost ranges is a subjective exercise open to uncertainty, and yet it also has an important bearing on the cost results.

Distribution of transportation costs

The distribution of transportation costs is, in general, handled in the same manner as production costs. For a given fuel source in a given region, transportation costs are treated as a probability distribution, defined in $15 cost increments. However there is a major conceptual difference, in that for transport costs the uncertainty arises in terms of the distance to the potential user.

When discussing the distribution of transportation costs, we are actually conjecturing about the future spatial pattern of biomass flows from producer to user. Transportation modelling of such questions is typically handled in one of two ways. Either some type of theoretical model such as a linear programming optimization approach is adopted, or data are assembled regarding a sample of empirical observations. Linear programming models require a number of origin and destination points with production or requirements and distances specified for each point.

The availability of useful data allowed an empirical approach to be adopted for the coastal areas, which include the Vancouver Forest Region and part of the Prince Rupert Forest Region. A two-part process, involving both land and water transport costs, was employed to estimate transportation costs for coastal logging residues and noncommercial harvests. Both modes are required because virtually all biomass fuels are transported by water to pulpmills on the British Columbia coast. To estimate land transport costs, a set of 539 actual cutting permit cost appraisals of the British Columbia Ministry of Forests was used to determine the distribution of land transport distances from the cutting site to a water dump site for logged tree volumes. The data set is supported by the Forest Economics and Policy Analysis project at the University of British Columbia and includes observations from all TSA's and a number of TFL's within the two forest regions for cut blocks appraised in 1983 and 1984. This distribution, when multiplied by an appropriate unit transport cost, provides an estimate of the distribution of land transport costs for logging residue recovery or whole tree biomass harvests. A unit cost of $0.35/ODt/km was assumed to represent the cost of transporting biomass on nonpaved forest roads. This rule of thumb was derived through discussions with log transporters and logging companies in the Vancouver Forest Region. Note that since merchantable bole volume rather than biomass weight is measured in the cutting permit sample, we are implicitly assuming that the ratio of available biomass weight to merchantable bole volume is independent of haul distance.

To these land transport costs must be added the cost of water-borne transport to the point of use. This barge cost is not expected to change greatly for different distances, and is assumed to average $8/ODt, based on the distribution of barge transport costs provided in discussions with tow-boat operators in the Vancouver Forest Region. The result is a probability distribution of total transport costs (both land and water) for biomass fuels derived from forest residues and noncommercial harvests and salvage in the coastal forest regions.

For the British Columbia interior regions, a lack of empirical information mandated that a simple theoretical model be used. The model is based on the area of management units (in this case, TSA's), and works one TSA at a time. It estimates the cost delivery from any point within a disc whose area is equal to that of the TSA to the center of the disc. For simplicity it is assumed that the biomass is uniformly distributed (constant weight per hectare) within the disc. That is, the model effectively treats a TSA as a circle encompassing a supply area, with the point of use in the middle, and a constant density of biomass available throughout the supply area. It assumes that the biomass eligible for delivery to that point of use is all of (and only) the biomass in the TSA.

The calculation proceeds in the following manner. If $R(c)$ is the radius of a disc such that biomass can be brought from any point inside the disc to the center of the disc at a unit cost of less than c, then $R(c)$ (= c/a, where a is the cost/tonne/km of delivery. The area of the corresponding disc is $A(c) = 3.14\ R(c)^2 = 3.14\ c^2/a^2 = 25.65\ c^2$, when $a = 0.35$ (dollars/tonne/km). If the biomass density is constant then the fraction of volume available at a unit cost less than c is equal to the fraction of area such that biomass gathered within the disc of corresponding area is equal to c. If c_1 and c_2 are two costs, with $c_2 > c_1$, then the fraction of volume available at a cost between c_1 and c_2 is just $25.65\ (c_2^2 - c_1^2)/A_{tot}$, where A_{tot} is the area of the TSA. Note that the fraction of volume deliverable at a given cost is independent of the biomass density, once it is assumed that biomass density is constant. This formula is applied for successive discs until the area of the TSA is exhausted. TSA areas were obtained from the Forest and Range Resource Analysis of the British Columbia Ministry of Forests. Transport cost distributions for TFL's in interior regions were interpolated from those of TSA's.

It should be noted that the results generated by this model for the interior can be expected to differ even in theory from the sample-derived results used for the coast. Even if all interior TSA's actually were discs with a single point of use in the middle, one could expect that the sampled fraction of biomass volume lying close to the dump site on the coast would be different from the fraction of biomass volume lying close to the point of use in the interior (as modelled). The reason is that the coastal data shows actual cut while the model for the interior assumed the cut is uniformly distributed throughout the disc. In reality, cut tends to proceed away from the point of use, so that the distance from dump site or point of use to felled tree is in fact time dependent. Thus the theoretical approach of the model can be viewed as providing a long-term approach, showing the distribution of transport costs over time as well as distance.

Distribution of total costs

Once probability distributions for production costs and transport costs have been established, these can be combined into overall probability distributions for total delivered costs, one for each fuel source in each region. The method of combining them depends on the viewpoint adopted regarding the relationship between production and transportation costs. On one hand, the two costs could be viewed as dependent, meaning there is a correlation between the material with the lowest production cost and that with the lowest transport cost. On the other hand, the two costs could be viewed as independent. In that case, the material with the lowest production costs would have a probability distribution of transport costs that is the same as the probability distribution for the total quantity's transport costs.

In this study it is assumed that production and transport costs are independent random variables, meaning there is no correlation between them. The sum of the probability distributions of two independent random variables is called the convolution of the two distributions. An example will indicate how this overall distribution is calculated for each fuel source in each region. To begin, it is necessary to treat each production or transport range as a single number. The midpoint of each range is the number adopted here; for example, the range 0-$15 is treated as $7.50.

Next, suppose we have a fuel source with probability x (say, 0.2) in the 0-$15 range of the production cost distribution, and probability y (say, 0.5) in the 0-$15 range of the transport cost distribution. In that case, the fuel source will have probability xy (in this example, 0.1) in the 0-$15 total cost distribution, since the sum of the two midpoints for each range ($7.50 + $7.50) is at the upper bound but still within the 0-$15 range. More generally, a probability x in the a range of the production cost distribution (where a^1 is the midpoint of the range) and probability y in the b range of the transport distribution (where b^1 is the midpoint) will yield probability xy in the $a^1 + b^1$ range of the total cost distribution, where $a^1 + b^1$ is the upper bound of one of the total cost ranges. Note that this approach will generally, though not always, result in a total probability distribution with a wider dispersion than the two component probability dispersions.

Given a probability distribution for total costs for each fuel source in each region, the remaining step is simply to multiply the distribution by the total quantity to calculate the expected value of the quantity recoverable within each cost range. The quantities within cost ranges can then be aggregated to determine the total quantity of a given fuel source available at or below a given cost. An array showing quantities increasing as costs increase is a supply curve for the fuel in question.

Principal study results

Overview

The estimated weight of forest biomass fuel available annually at different delivered costs, by fuel source for each region, over the period 1985-1995, with totals for the province, are presented in Table 1. Supply curves summarizing the availability of all biomass fuel types are presented in Figure 3.

Comparison

Comparison of the data in Table 1 to the 1990 estimates in Intergroup's Tables III-1 and III-2 yields the following conclusions:

i) The two estimates of the quantity of mill residues are identical, since they are both derived from the Reid, Collins surveys (1978a and 1978b). The delivered costs of mill residues are approximately the same in the two studies.

ii) The estimated quantity of logging residues is approximately 70% higher here than in Intergroup. The increase is undoubtedly due to our derivation of estimates based on specific

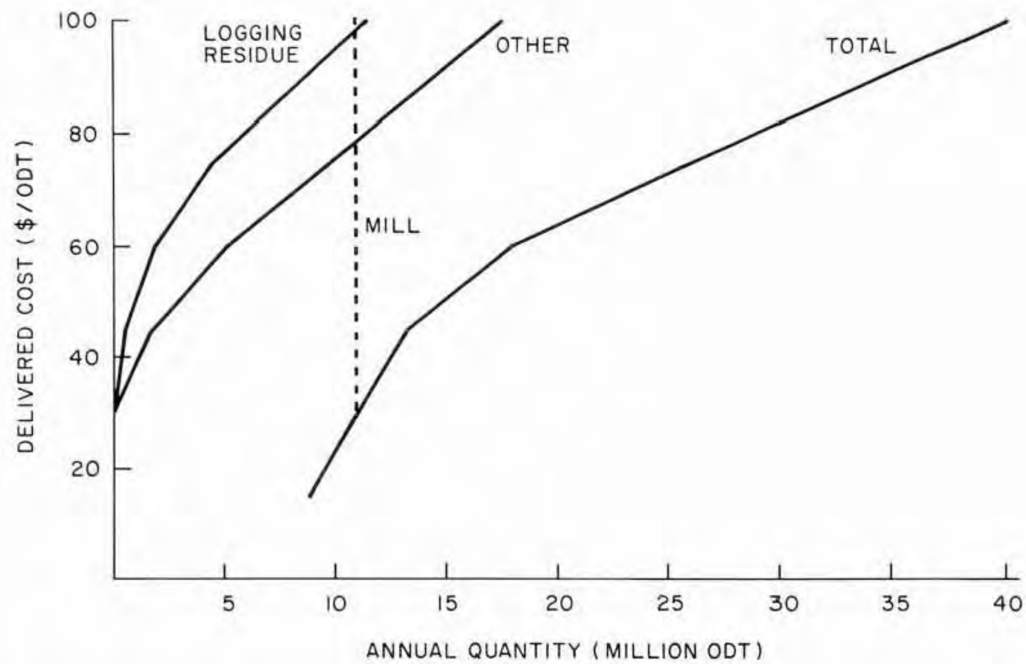

Figure 3. Supply of forest biomass available for energy conversion in British Columbia

breakage and waste and unavoidable residue factors, as well as factors from the British Columbia national biomass inventory data base regarding the quantity of component residues for each management unit.

iii) The cost of logging residue recovery for energy production is dramatically higher here. Over 80% of British Columbia logging residue production is estimated to have delivered costs exceeding $60/ODt, while Intergroup's estimates are consistently lower, particularly for the interior. One factor in the cost increase is undoubtedly inflation, since Intergroup's work was done in 1981 dollars while the present study is in 1985 dollars, which alone would account for a cost increase of roughly 25%. In addition, our estimates do not assume (as did those of Intergroup) that potential cost savings in economies of scale and technology refinement will automatically occur. Also, out estimates are based on a much wider literature review, are specific to the forest conditions in regions and in some cases management units, and involve more detailed transportation analysis.

iv) The volume of forest biomass available from noncommercial harvests, i.e., whole tree harvests of hardwood stands and brush, is vastly greater that estimated by Intergroup for comparable activities. Our estimate for noncommercial harvests and salvage amounts to nearly 17 million ODt per year, while Intergroup's figures for three categories (merchantable surplus, stand conversion, and salvage) amount to roughly 5.5 ODt yearly by 1990. The difference is undoubtedly due to information provided by the British Columbia national biomass inventory data base regarding quantities of noncommercial material available for energy harvests. For example the National biomass inventory data indicate that two northern management units (the Fort Nelson and Peace TSA's) have together over 325 million ODt's in total noncommercial biomass, largely in aspen, that could be harvested for energy. In total, British Columbia has some 567 million ODt's of noncommercial biomass, according to the national biomass inventory data. Moreover, only 3% of the total noncommercial volume is assumed to be harvested yearly to produce the 17 million ODt figure. It would be equally plausible to set the annual harvest at 5%, which would yield production of roughly 28 million ODt yearly. The conclusion is that far greater amounts are available from whole-

Table 1. Quantity (ODt x 1000) of forest biomass fuel available in 1990 from various sources and regions

Region	Source	Cost range ($/OD+)					
		0 – 15	16 – 30	31 – 45	46 – 60	61 – 75	OVER 75
Vancouver	Mill residue	3255.65	171.35	0.00	0.00	0.00	0.00
Vancouver	Sortyard residue	0.00	0.00	250.80	13.20	0.00	0.00
Vancouver	Logging residue	0.00	0.00	0.00	0.00	728.08	2840.92
Vancouver	Noncommercial harvest	0.00	0.00	0.00	0.00	214.00	835.00
Vancouver	Plantations	0.00	0.00	0.00	0.00	150.00	0.00
Pr. Rupert	Mill residue	1343.30	70.70	0.00	0.00	0.00	0.00
Pr. Rupert	Sortyard residue	0.00	0.00	124.45	6.55	0.00	0.00
Pr. Rupert	Logging residue	0.00	0.00	0.00	0.00	316.30	1470.70
Pr. Rupert	Noncommercial harvest	0.00	0.00	0.00	0.00	426.57	1983.43
Kamloops	Mill residue	931.00	399.00	0.00	0.00	0.00	0.00
Kamloops	Logging residue	0.00	0.00	84.37	224.32	486.58	512.74
Kamloops	Noncommercial Harvest	0.00	0.00	25.28	67.23	145.82	153.66
Nelson	Mill residue	741.30	317.70	0.00	0.00	0.00	0.00
Nelson	Logging residue	0.00	0.00	0.00	143.72	247.80	847.48
Nelson	Noncommercial harvest	0.00	0.00	0.00	24.36	42.00	143.64
Pr. George	Mill residue	1900.50	814.50	0.00	0.00	0.00	0.00
Pr. George	Logging residue	0.00	0.00	275.31	653.03	763.42	968.24
Pr. George	Noncommercial harvest	0.00	0.00	1257.11	2981.84	3485.90	4421.14
Cariboo	Mill residue	725.90	311.10	0.00	0.00	0.00	0.00
Cariboo	Logging residue	0.00	0.00	161.42	389.69	325.01	210.88
Cariboo	Noncommercial harvest	0.00	0.00	113.31	273.54	228.14	148.02
Subtot Van	All	3255.65	171.35	0.00	0.00	1092.07	3675.93
Subtot PR	All	1343.30	70.70	0.00	0.00	742.87	3454.13
Subtot Kam	All	931.00	399.00	109.65	291.55	632.40	666.40
Subtot Nel	All	741.30	317.70	0.00	168.08	289.80	991.12
Subtot PG	All	1900.50	814.50	1532.42	3634.87	4249.32	5389.38
Subtot Car	All	725.90	311.10	274.73	663.23	553.15	358.90
Total	Mill residue	8897.65	2084.35	0.00	0.00	0.00	0.00
Total	Sortyard residue	0.00	0.00	375.25	19.75	0.00	0.00
Total	Logging residue	0.00	0.00	521.10	1410.77	2867.18	6850.96
Total	Noncommercial harvest	0.00	0.00	1395.70	3346.97	4542.43	7684.90
Total	Plantations	0.00	0.00	0.00	0.00	150.00	0.00
Total	All	8897.65	2084.35	2292.05	4777.48	7559.61	14 535.86

Source: McDaniels Research Ltd.

tree harvests of hardwoods than had previously been assumed.

v) The costs of whole-tree harvests of noncommercial biomass are greatly increased compared to Intergroup's estimates. Approximately 72% of this material is estimated to have delivered costs exceeding $60/ODt. Intergroup's figures had production costs ranging from $25 to $44/ODt and transport from $11 to $18/ODt. Again, perhaps the major source of the difference is inflation between 1981 and 1985. In addition, cost increases are due to a broader data base of cost studies, reliance on the actual estimated costs in the references, and better estimates of transport costs.

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Appendix 1

Quantity worksheets

BCDATA FILE

BC QUANTITIES MGT UNIT (BY REGION)	B EST TOTAL AAH (000'S M^3)	C DENSITY (%)	D AAH IN MASS (000'S ODT)	E BW FACTOR (%)	F UAR FACTOR (%)	G TOTAL CUT 1990 (000'S ODT)	H FR RATIO (%)	I RESIDUE QUANTITY (000'S ODT)
VANCOUVER								
FRASER	1700	0.378	643	0.104	0.130	709	0.169	120
KINGCOME	1700	0.378	643	0.104	0.130	709	0.133	94
MIDCOAST	1400	0.378	529	0.104	0.130	584	0.118	69
NOOTKA	1400	0.378	529	0.104	0.130	584	0.112	65
QUADRA	2000	0.378	756	0.104	0.130	835	0.230	192
SOO	700	0.378	265	0.104	0.130	292	0.149	44
TFL 6	1320	0.378	499	0.104	0.130	551	0.147	81
TFL 7	544	0.378	206	0.104	0.130	227	0.171	39
TFL 10	219	0.378	83	0.104	0.130	91	0.122	11
TFL 19	978	0.378	370	0.104	0.130	408	0.132	54
TFL 26	37	0.378	14	0.104	0.130	15	0.216	3
TFL 37	1107	0.378	418	0.104	0.130	462	0.124	57
TFL 38	263	0.378	99	0.104	0.130	110	0.132	14
TFL 43	27	0.378	10	0.104	0.130	11	0.182	2
TFL 44	2838	0.378	1073	0.104	0.130	1184	0.152	180
TFL 45	305	0.378	115	0.104	0.130	127	0.141	18
TFL 46	1178	0.378	445	0.104	0.130	492	0.140	69
TFL 25	528	0.378	200	0.104	0.130	220	0.144	32
TFL 39	1836	0.378	694	0.104	0.130	766	0.147	113
TFL 47	873	0.378	330	0.104	0.130	364	0.220	80
PRIVATE,ETC	2300	0.378	869	0.104	0.130	960	0.182	175
VAN TOTAL	23253	0.378	8790	0.104	0.130	9704		1512
PRINCE RUPERT								
BULKLEY	650	0.385	250	0.070	0.105	268	0.294	79
CASSIAR	140	0.385	54	0.070	0.105	58	0.364	21
KALUM	450	0.385	173	0.070	0.105	185	0.202	37
KISPIOX	1100	0.385	424	0.070	0.105	453	0.246	111
LAKES	1500	0.385	578	0.070	0.105	618	0.301	186
MORICE	2000	0.385	770	0.070	0.105	824	0.282	232
NORTHCOAST	600	0.385	231	0.070	0.105	247	0.130	32
QUEEN CHARLOTT	450	0.385	173	0.070	0.105	185	0.124	23
TFL 1	1292	0.385	497	0.070	0.105	532	0.206	110
TFL 24	432	0.385	166	0.070	0.105	178	0.137	24
TFL 41	629	0.385	242	0.070	0.105	259	0.126	33
TFL 25	125	0.385	48	0.070	0.105	51	0.144	7
TFL 39	1503	0.385	579	0.070	0.105	619	0.147	91
TFL 47	217	0.385	84	0.070	0.105	89	0.220	20
PRIVATE,ETC	230	0.385	89	0.070	0.105	95	0.182	17
PR TOTAL	11318	0.385	4357	0.070	0.105	4662		1024
KAMLOOPS								
KAMLOOPS	2350	0.378	888	0.035	0.090	919	0.293	269
LILLOOET	800	0.378	302	0.035	0.090	313	0.296	93
MERRITT	1150	0.378	435	0.035	0.090	450	0.291	131
OKANAGAN	2700	0.378	1021	0.035	0.090	1056	0.285	301
TFL 9	208	0.378	79	0.035	0.090	81	0.302	25
TFL 15	72	0.378	27	0.035	0.090	28	0.317	9
TFL 16	135	0.378	51	0.035	0.090	53	0.325	17
TFL 18	210	0.378	79	0.035	0.090	82	0.246	20
TFL 32	30	0.378	11	0.035	0.090	12	0.363	4
TFL 33	29	0.378	11	0.035	0.090	11	0.227	3

BCDATA FILE

BC QUANTITIES	B	C	D	E	F	G	H	I
MGT UNIT	EST TOTAL AAH	DENSITY	AAH IN MASS	BW FACTOR	UAR FACTOR	TOTAL CUT 1990	FR RATIO	RESIDUE QUANTITY
(BY REGION)	(000'S M^3)	(%)	(000'S ODT)	(%)	(%)	(000'S ODT)	(%)	(000'S ODT)
TFL 35	88	0.378	33	0.035	0.090	34	0.255	9
PRIVATE,ETC	400	0.378	151	0.035	0.090	156	0.265	41
KAMLOOPS TOTAL	8172	0.378	3089	0.035	0.090	3197		922
NELSON								
ARROW	619	0.380	235	0.067	0.105	251	0.314	79
BOUNDARY	700	0.380	266	0.067	0.105	284	0.324	92
CRANBROOK	900	0.380	342	0.067	0.105	365	0.392	143
GOLDEN	650	0.380	247	0.067	0.105	264	0.245	65
INVERMERE	670	0.380	255	0.067	0.105	272	0.318	86
KOOTENAY LAKE	900	0.380	342	0.067	0.105	365	0.323	118
REVELSTOKE	130	0.380	49	0.067	0.105	53	0.218	11
TFL 3	108	0.380	41	0.067	0.105	44	0.338	15
TFL 8	145	0.380	55	0.067	0.105	59	0.272	16
TFL 13	27	0.380	10	0.067	0.105	11	0.610	7
TFL 14	123	0.380	47	0.067	0.105	50	0.309	15
TFL 23	1067	0.380	405	0.067	0.105	433	0.260	112
PRIVATE,ETC	487	0.380	185	0.067	0.105	197	0.270	53
NELSON TOTAL	6526	0.380	2480	0.067	0.105	2646		813
PRINCE GEORGE								
FORT NELSON	850	0.380	323	0.038	0.080	335	0.465	156
MACKENZIE	2900	0.380	1102	0.038	0.080	1144	0.335	383
MCBRIDE	500	0.380	190	0.038	0.080	197	0.271	53
PEACE	2000	0.380	760	0.038	0.080	789	0.397	313
PRINCE GEORGE	8605	0.380	3270	0.038	0.080	3394	0.281	954
TFL 30	437	0.380	166	0.038	0.080	172	0.263	45
TFL 42	120	0.380	46	0.038	0.080	47	0.260	12
PRIVATE,ETC	350	0.380	133	0.038	0.080	138	0.260	36
PR GEORGE TOTA	15762	0.380	5990	0.038	0.080	6217		1953
CARIBOO								
HUNDRED MILE	1250	0.385	481	0.035	0.065	498	0.312	155
QUESNEL	2300	0.385	886	0.035	0.065	916	0.329	302
WILLIAMS LAKE	2500	0.385	963	0.035	0.065	996	0.361	360
TFL 5	119	0.385	46	0.035	0.065	47	0.259	12
PRIVATE,ETC	125	0.385	48	0.035	0.065	50	0.310	15
CARIBOO TOTAL	6294	0.385	2423	0.035	0.065	2508		844
BC TOTAL	71325		24706			28935		7068

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BC QUANTITIES MGT UNIT (BY REGION)	J LRG RES QUAN (000'S ODT)	K TOTAL FOR RES (000'S ODT)	L SAW FACTOR (%)	M SHAV FACTOR (%)	N BARK FACTOR (%)	O PERCENT AAH (%)	P SAWDUST (000'S ODT)	Q SHAVINGS (000'S ODT)
VANCOUVER								
FRASER	150	270	0.08	0.09	0.153	0.813	42	47
KINGCOME	150	245	0.08	0.09	0.151	0.813	42	47
MIDCOAST	124	193	0.08	0.09	0.150	0.813	34	39
NOOTKA	124	189	0.08	0.09	0.159	0.813	34	39
QUADRA	177	369	0.08	0.09	0.160	0.813	49	55
SOO	62	105	0.08	0.09	0.153	0.813	17	19
TFL 6	117	198	0.08	0.09	0.159	0.813	32	37
TFL 7	48	87	0.08	0.09	0.159	0.813	13	15
TFL 10	19	31	0.08	0.09	0.155	0.813	5	6
TFL 19	87	140	0.08	0.09	0.157	0.813	24	27
TFL 26	3	7	0.08	0.09	0.160	0.813	1	1
TFL 37	98	155	0.08	0.09	0.160	0.813	27	31
TFL 38	23	38	0.08	0.09	0.153	0.813	6	7
TFL 43	2	4	0.08	0.09	0.158	0.813	1	1
TFL 44	251	431	0.08	0.09	0.156	0.813	70	78
TFL 45	27	45	0.08	0.09	0.158	0.813	7	8
TFL 46	104	173	0.08	0.09	0.157	0.813	29	33
TFL 25	47	78	0.08	0.09	0.154	0.813	13	15
TFL 39	162	275	0.08	0.09	0.157	0.813	45	51
TFL 47	77	157	0.08	0.09	0.161	0.813	21	24
PRIVATE,ETC	203	378	0.08	0.09	0.155	0.813	57	64
VAN TOTAL	2057	3569	0.08	0.09		0.813	572	643
PRINCE RUPERT								
BULKLEY	44	123	0.08	0.10	0.137	0.835	17	21
CASSIAR	9	30	0.08	0.10	0.124	0.835	4	5
KALUM	30	68	0.08	0.10	0.155	0.835	12	14
KISPIOX	74	186	0.08	0.10	0.150	0.835	28	35
LAKES	101	287	0.08	0.10	0.101	0.835	39	48
MORICE	135	367	0.08	0.10	0.127	0.835	51	64
NORTHCOAST	40	73	0.08	0.10	0.151	0.835	15	19
QUEEN CHARLOTT	30	53	0.08	0.10	0.149	0.835	12	14
TFL 1	87	197	0.08	0.10	0.154	0.835	33	42
TFL 24	29	53	0.08	0.10	0.155	0.835	11	14
TFL 41	42	75	0.08	0.10	0.157	0.835	16	20
TFL 25	8	16	0.08	0.10	0.154	0.835	3	4
TFL 39	101	192	0.08	0.10	0.157	0.835	39	48
TFL 47	15	34	0.08	0.10	0.161	0.835	6	7
PRIVATE,ETC	15	33	0.08	0.10	0.152	0.835	6	7
PR TOTAL	763	1787	0.08	0.10		0.835	291	364
KAMLOOPS								
KAMLOOPS	111	380	0.09	0.11	0.137	0.948	76	93
LILLOOET	38	130	0.09	0.11	0.141	0.948	26	32
MERRITT	54	185	0.09	0.11	0.138	0.948	37	45
OKANAGAN	128	429	0.09	0.11	0.134	0.948	87	106
TFL 9	10	34	0.09	0.11	0.126	0.948	7	8
TFL 15	3	12	0.09	0.11	0.118	0.948	2	3
TFL 16	6	24	0.09	0.11	0.114	0.948	4	5
TFL 18	10	30	0.09	0.11	0.123	0.948	7	8
TFL 32	1	6	0.09	0.11	0.132	0.948	1	1
TFL 33	1	4	0.09	0.11	0.155	0.948	1	1

BCDATA FILE

BC QUANTITIES	J	K	L	M	N	O	P	Q
MGT UNIT	LRG RES QUAN	TOTAL FOR RES	SAW FACTOR	SHAV FACTOR	BARK FACTOR	PERCENT AAH	SAWDUST	SHAVINGS
(BY REGION)	(000'S ODT)	(000'S ODT)	(%)	(%)	(%)	(%)	(000'S ODT)	(000'S ODT)
TFL 35	4	13	0.09	0.11	0.128	0.948	3	3
PRIVATE, ETC	19	60	0.09	0.11	0.132	0.948	13	16
KAMLOOPS TOTAL	386	1308	0.09	0.11		0.948	264	322
NELSON								
ARROW	40	119	0.09	0.10	0.142	0.940	20	22
BOUNDARY	46	138	0.09	0.10	0.127	0.940	23	25
CRANBROOK	59	202	0.09	0.10	0.123	0.940	29	32
GOLDEN	42	107	0.09	0.10	0.137	0.940	21	23
INVERMERE	44	130	0.09	0.10	0.123	0.940	22	24
KOOTENAY LAKE	59	177	0.09	0.10	0.141	0.940	29	32
REVELSTOKE	8	20	0.09	0.10	0.146	0.940	4	5
TFL 3	7	22	0.09	0.10	0.142	0.940	3	4
TFL 8	9	25	0.09	0.10	0.121	0.940	5	5
TFL 13	2	8	0.09	0.10	0.132	0.940	1	1
TFL 14	8	23	0.09	0.10	0.120	0.940	4	4
TFL 23	70	182	0.09	0.10	0.145	0.940	34	38
PRIVATE, ETC	32	85	0.09	0.10	0.140	0.940	16	17
NELSON TOTAL	427	1239	0.09	0.10		0.940	210	233
PRINCE GEORGE								
FORT NELSON	38	194	0.12	0.10	0.131	0.925	36	30
MACKENZIE	130	513	0.12	0.10	0.122	0.925	122	102
MCBRIDE	22	76	0.12	0.10	0.139	0.925	21	18
PEACE	90	403	0.12	0.10	0.121	0.925	84	70
PRINCE GEORGE	386	1340	0.12	0.10	0.121	0.925	363	302
TFL 30	20	65	0.12	0.10	0.145	0.925	18	15
TFL 42	5	18	0.12	0.10	0.143	0.925	5	4
PRIVATE, ETC	16	52	0.12	0.10	0.143	0.925	15	12
PR GEORGE TOTA	707	2660	0.12	0.10		0.925	665	554
CARIBOO								
HUNDRED MILE	48	204	0.11	0.11	0.122	0.935	49	49
QUESNEL	89	390	0.11	0.11	0.101	0.935	91	91
WILLIAMS LAKE	96	456	0.11	0.11	0.111	0.935	99	99
TFL 5	5	17	0.11	0.11	0.112	0.935	5	5
PRIVATE, ETC	5	20	0.11	0.11	0.113	0.935	5	5
CARIBOO TOTAL	242	1087	0.11	0.11		0.935	249	249
BC TOTAL	4581	11649					2250	2365

BCDATA FILE

BC QUANTITIES MGT UNIT (BY REGION)	R BARK (000'S ODT)	S TOTAL MILL RES (000'S ODT)	T TOTAL NCBQ (000'S ODT)	U ANNUAL NCBH (%)	V ANNUAL NCBQ (000'S ODT)	W ANNUAL SY RESIDUE Q (000'S ODT)
VANCOUVER						
FRASER	98	187	10845	0.03	325	19
KINGCOME	97	186	4598	0.03	138	19
MIDCOAST	79	153	2270	0.03	68	16
NOOTKA	84	157	349	0.03	10	16
QUADRA	121	225	3633	0.03	109	23
SOO	40	77	2174	0.03	65	8
TFL 6	79	148	313	0.03	9	15
TFL 7	33	61	647	0.03	19	6
TFL 10	13	24	317	0.03	10	2
TFL 19	58	109	38	0.03	1	11
TFL 26	2	4	151	0.03	5	0
TFL 37	67	125	137	0.03	4	13
TFL 38	15	29	278	0.03	8	3
TFL 43	2	3	26	0.03	1	0
TFL 44	167	316	421	0.03	13	32
TFL 45	18	34	148	0.03	4	3
TFL 46	70	131	63	0.03	2	13
TFL 25	31	58	343	0.03	10	6
TFL 39	109	205	986	0.03	30	21
TFL 47	53	99	3241	0.03	97	10
PRIVATE,ETC	135	255	4000	0.03	120	26
VAN TOTAL	1372	2587	34978	0.03	1049	264
PRINCE RUPERT						
BULKLEY	34	72	4888	0.03	147	8
CASSIAR	7	15	39335	0.03	1180	2
KALUM	27	53	4026	0.03	121	5
KISPIOX	64	127	9829	0.03	295	13
LAKES	58	145	9100	0.03	273	17
MORICE	98	214	5939	0.03	178	23
NORTHCOAST	35	70	479	0.03	14	7
QUEEN CHARLOTT	26	52	484	0.03	15	5
TFL 1	77	151	2726	0.03	82	15
TFL 24	26	51	237	0.03	7	5
TFL 41	38	74	750	0.03	23	7
TFL 25	7	15	80	0.03	2	1
TFL 39	91	178	807	0.03	24	17
TFL 47	13	26	648	0.03	19	3
PRIVATE,ETC	13	27	1000	0.03	30	3
PR TOTAL	614	1269	80328	0.03	2410	131
KAMLOOPS						
KAMLOOPS	122	290	7067	0.03	212	0
LILLOOET	43	100	76	0.03	2	0
MERRITT	60	142	109	0.03	3	0
OKANAGAN	137	330	4995	0.03	150	0
TFL 9	10	25	54	0.03	2	0
TFL 15	3	8	4	0.03	0	0
TFL 16	6	15	19	0.03	1	0
TFL 18	10	25	132	0.03	4	0
TFL 32	1	4	40	0.03	1	0
TFL 33	2	4	28	0.03	1	0

BCDATA FILE

BC QUANTITIES MGT UNIT (BY REGION)	R BARK (000'S ODT)	S TOTAL MILL RES (000'S ODT)	T TOTAL NCBQ (000'S ODT)	U ANNUAL NCBH (%)	V ANNUAL NCBQ (000'S ODT)	W ANNUAL SY RESIDUE Q (000'S ODT)
TFL 35	4	11	26	0.03	1	0
PRIVATE,ETC	20	49	500	0.03	15	0
KAMLOOPS TOTAL	417	1003	13050	0.03	392	0
NELSON						
ARROW	33	75	2167	0.03	65	0
BOUNDARY	34	81	599	0.03	18	0
CRANBROOK	42	103	1359	0.03	41	0
GOLDEN	34	78	1746	0.03	52	0
INVERMERE	31	77	733	0.03	22	0
KOOTENAY LAKE	48	109	1741	0.03	52	0
REVELSTOKE	7	16	278	0.03	8	0
TFL 3	6	13	92	0.03	3	0
TFL 8	7	17	15	0.03	0	0
TFL 13	1	3	2	0.03	0	0
TFL 14	6	14	47	0.03	1	0
TFL 23	59	131	782	0.03	23	0
PRIVATE,ETC	26	59	500	0.03	15	0
NELSON TOTAL	334	777	10061	0.03	302	0
PRINCE GEORGE						
FORT NELSON	42	108	174997	0.03	5250	0
MACKENZIE	134	359	18581	0.03	557	0
MCBRIDE	26	65	4827	0.03	145	0
PEACE	92	247	158771	0.03	4763	0
PRINCE GEORGE	396	1061	46082	0.03	1382	0
TFL 30	24	58	884	0.03	27	0
TFL 42	7	16	214	0.03	6	0
PRIVATE,ETC	19	46	500	0.03	15	0
PR GEORGE TOTA	740	1959	404856	0.03	12146	0
CARIBOO						
HUNDRED MILE	59	158	4499	0.03	135	0
QUESNEL	89	272	9228	0.03	277	0
WILLIAMS LAKE	107	305	10621	0.03	319	0
TFL 5	5	15	577	0.03	17	0
PRIVATE,ETC	5	15	500	0.03	15	0
CARIBOO TOTAL	266	764	25425	0.03	763	0
BC TOTAL	3743	8359	568698		17061	394

Appendix 2

Cost worksheet

BCCOST FILE

BC COSTS	B	C	D	E	F	G	H	I
PROVINCE	REGION	BIOFUEL TYPE	QUANTITY (000'S ODT)	TECHNOLOGY	AVAILABILITY	AVG PROD COST ($/ODT)	MIN COST ($/ODT)	MAX COST ($/ODT)
BRITISH COL	VANCOUVER	MILL RES	3427.00		0.00	1.00	1.00	1.00
BRITISH COL	VANCOUVER	SY RES	264.00		0.40	34.00	31.00	38.00
BRITISH COL	VANCOUVER	LOGGING RES	3569.00	1/MAN/LR/CS/CA	1.00	90.00	61.00	125.00
BRITISH COL	VANCOUVER	NONCOMML HAR/S	1049.00	1/MAN/WT/CS/CA	1.00	90.00	61.00	125.00
BRITISH COL	VANCOUVER	PLANTATIONS	150.00	1/MEC/WT/FF	1.00	67.00	61.00	75.00
BRITISH COL	PR RUPERT	MILL RES	1414.00		0.50	1.00	1.00	1.00
BRITISH COL	PR RUPERT	SY RES	131.00		1.00	34.00	31.00	38.00
BRITISH COL	PR RUPERT	LOGGING RES	1787.00	1/MAN/LR/CS/CA	1.00	100.00	61.00	125.00
BRITISH COL	PR RUPERT	NONCOMML HAR/S	2410.00	1/MAN/WT/CS/CA	1.00	100.00	61.00	125.00
BRITISH COL	KAMLOOPS	MILL RES	1330.00		0.80	1.00	1.00	1.00
BRITISH COL	KAMLOOPS	LOGGING RES	1308.00	1/MAN/LR/CS/TW	1.00	57.00	33.00	80.00
BRITISH COL	KAMLOOPS	NONCOMML HAR/S	392.00	1/MAN/WT/CS/TW	1.00	57.00	33.00	80.00
BRITISH COL	NELSON	MILL RES	1059.00		0.80	1.00	1.00	1.00
BRITISH COL	NELSON	LOGGING RES	1239.00	1/MAN/LR/CS/TW	1.00	85.00	50.00	125.00
BRITISH COL	NELSON	NONCOMML HAR/S	210.00	1/MAN/WT/CS/TW	1.00	85.00	50.00	125.00
BRITISH COL	PR GEORGE	MILL RES	2715.00		0.80	1.00	1.00	1.00
BRITISH COL	PR GEORGE	LOGGING RES	2660.00	1/MAN/LR/CS/WG	1.00	48.00	35.00	65.00
BRITISH COL	PR GEORGE	NONCOMML HAR/S	12146.00	1/MEC/WT/FB/WG	1.00	48.00	35.00	65.00
BRITISH COL	CARIBOO	MILL RES	1037.00		0.80	1.00	1.00	1.00
BRITISH COL	CARIBOO	LOGGING RES	1087.00	1/MAN/LR/CS/WG	1.00	48.00	35.00	125.00
BRITISH COL	CARIBOO	NONCOMML HAR/S	763.00	1/MEC/WT/FB/WG	1.00	48.00	35.00	125.00
BRITISH COL	SUBTOT VAN	ALL TYPES	8459.00			62.00	46.00	81.50
BRITISH COL	SUBTOT PR	ALL TYPES	5742.00			67.00	41.00	83.67
BRITISH COL	SUBTOT KAM	ALL TYPES	3030.00			38.33	22.33	53.67
BRITISH COL	SUBTOT NEL	ALL TYPES	2508.00			57.00	33.67	83.67
BRITISH COL	SUBTOT PG	ALL TYPES	17521.00			32.33	23.67	43.67
BRITISH COL	SUBTOT CAR	ALL TYPES	2887.00			32.33	23.67	83.67
BRITISH COL	TOTAL	MILL RES	10982.00			1.00	1.00	1.00
BRITISH COL	TOTAL	SY RES	395.00			34.00	31.00	38.00
BRITISH COL	TOTAL	LOGGING RES	11650.00			71.33	45.83	107.50
BRITISH COL	TOTAL	NONCOMML HAR/S	16970.00			71.33	45.83	107.50
BRITISH COL	TOTAL	PLANTATIONS	150.00			67.00	61.00	75.00
BRITISH COL	TOTAL	ALL TYPES	40147.00			61.17		

BCCOST FILE

BC COSTS	B	C	J	K	L	M	N	O
PROVINCE	REGION	BIOFUEL TYPE	PC 0-$15/ODT	PC $16-30/ODT	PC $31-45/ODT	PC $46-60/ODT	PC $61-75/ODT	PC OVER $75/ODT
			(DISTRIBUTION OF PRODUCTION COSTS---------ENTER AS DECIMALS SUMMING TO ONE--------)					
BRITISH COL	VANCOUVER	MILL RES	1.00	0.00	0.00	0.00	0.00	0.00
BRITISH COL	VANCOUVER	SY RES	0.00	0.00	1.00	0.00	0.00	0.00
BRITISH COL	VANCOUVER	LOGGING RES	0.00	0.00	0.00	0.00	0.30	0.70
BRITISH COL	VANCOUVER	NONCOMML HAR/S	0.00	0.00	0.00	0.00	0.30	0.70
BRITISH COL	VANCOUVER	PLANTATIONS	0.00	0.00	0.00	0.00	1.00	0.00
BRITISH COL	PR RUPERT	MILL RES	1.00	0.00	0.00	0.00	0.00	0.00
BRITISH COL	PR RUPERT	SY RES	0.00	0.00	1.00	0.00	0.00	0.00
BRITISH COL	PR RUPERT	LOGGING RES	0.00	0.00	0.00	0.00	0.30	0.70
BRITISH COL	PR RUPERT	NONCOMML HAR/S	0.00	0.00	0.00	0.00	0.30	0.70
BRITISH COL	KAMLOOPS	MILL RES	1.00	0.00	0.00	0.00	0.00	0.00
BRITISH COL	KAMLOOPS	LOGGING RES	0.00	0.00	0.15	0.20	0.60	0.05
BRITISH COL	KAMLOOPS	NONCOMML HAR/S	0.00	0.00	0.15	0.20	0.60	0.05
BRITISH COL	NELSON	MILL RES	1.00	0.00	0.00	0.00	0.00	0.00
BRITISH COL	NELSON	LOGGING RES	0.00	0.00	0.00	0.20	0.20	0.60
BRITISH COL	NELSON	NONCOMML HAR/S	0.00	0.00	0.00	0.20	0.20	0.60
BRITISH COL	PR GEORGE	MILL RES	1.00	0.00	0.00	0.00	0.00	0.00
BRITISH COL	PR GEORGE	LOGGING RES	0.00	0.00	0.45	0.50	0.05	0.70
BRITISH COL	PR GEORGE	NONCOMML HAR/S	0.00	0.00	0.45	0.50	0.05	0.70
BRITISH COL	CARIBOO	MILL RES	1.00	0.00	0.00	0.00	0.00	0.00
BRITISH COL	CARIBOO	LOGGING RES	0.00	0.00	0.45	0.50	0.05	0.70
BRITISH COL	CARIBOO	NONCOMML HAR/S	0.00	0.00	0.45	0.50	0.05	0.70
BRITISH COL	SUBTOT VAN	ALL TYPES	0.25	0.00	0.00	0.00	0.40	0.35
BRITISH COL	SUBTOT PR	ALL TYPES	0.33	0.00	0.00	0.00	0.20	0.47
BRITISH COL	SUBTOT KAM	ALL TYPES	0.33	0.00	0.10	0.13	0.40	0.03
BRITISH COL	SUBTOT NEL	ALL TYPES	0.33	0.00	0.00	0.13	0.13	0.40
BRITISH COL	SUBTOT PG	ALL TYPES	0.33	0.00	0.30	0.33	0.03	0.47
BRITISH COL	SUBTOT CAR	ALL TYPES	0.33	0.00	0.30	0.33	0.03	0.47
BRITISH COL	TOTAL	MILL RES	1.00	0.00	0.00	0.00	0.00	0.00
BRITISH COL	TOTAL	SY RES	0.00	0.00	1.00	0.00	0.00	0.00
BRITISH COL	TOTAL	LOGGING RES	0.00	0.00	0.18	0.23	0.25	0.58
BRITISH COL	TOTAL	NONCOMML HAR/S	0.00	0.00	0.18	0.23	0.25	0.58
BRITISH COL	TOTAL	PLANTATIONS	0.00	0.00	0.00	0.00	1.00	0.00
BRITISH COL	TOTAL	ALL TYPES						

BCCOST FILE

BC COSTS	B	C	Q	R	S	T	U	V
PROVINCE	REGION	BIOFUEL TYPE	TC 0-$15/ODT	TC $16-30/ODT	TC $31-45/ODT	TC $46-60/ODT	TC $61-75/ODT	TC OVER $75/ODT
			(DISTRIBUTION OF TRANSPORTATION COSTS-----ENTER AS DECIMALS SUMMING TO ONE-------)					
BRITISH COL	VANCOUVER	MILL RES	0.95	0.05	0.00	0.00	0.00	0.00
BRITISH COL	VANCOUVER	SY RES	0.95	0.05	0.00	0.00	0.00	0.00
BRITISH COL	VANCOUVER	LOGGING RES	0.68	0.25	0.04	0.02	0.01	0.00
BRITISH COL	VANCOUVER	NONCOMML HAR/S	0.68	0.25	0.04	0.02	0.01	0.00
BRITISH COL	VANCOUVER	PLANTATIONS	1.00	0.00	0.00	0.00	0.00	0.00
BRITISH COL	PR RUPERT	MILL RES	0.95	0.05	0.00	0.00	0.00	0.00
BRITISH COL	PR RUPERT	SY RES	0.95	0.05	0.00	0.00	0.00	0.00
BRITISH COL	PR RUPERT	LOGGING RES	0.59	0.20	0.10	0.04	0.04	0.03
BRITISH COL	PR RUPERT	NONCOMML HAR/S	0.59	0.20	0.10	0.04	0.04	0.03
BRITISH COL	KAMLOOPS	MILL RES	0.70	0.30	0.00	0.00	0.00	0.00
BRITISH COL	KAMLOOPS	LOGGING RES	0.43	0.57	0.00	0.00	0.00	0.00
BRITISH COL	KAMLOOPS	NONCOMML HAR/S	0.43	0.57	0.00	0.00	0.00	0.00
BRITISH COL	NELSON	MILL RES	0.70	0.30	0.00	0.00	0.00	0.00
BRITISH COL	NELSON	LOGGING RES	0.58	0.42	0.00	0.00	0.00	0.00
BRITISH COL	NELSON	NONCOMML HAR/S	0.58	0.42	0.00	0.00	0.00	0.00
BRITISH COL	PR GEORGE	MILL RES	0.70	0.30	0.00	0.00	0.00	0.00
BRITISH COL	PR GEORGE	LOGGING RES	0.23	0.29	0.29	0.09	0.00	0.00
BRITISH COL	PR GEORGE	NONCOMML HAR/S	0.23	0.29	0.29	0.09	0.00	0.00
BRITISH COL	CARIBOO	MILL RES	0.70	0.30	0.00	0.00	0.00	0.00
BRITISH COL	CARIBOO	LOGGING RES	0.33	0.43	0.15	0.09	0.00	0.00
BRITISH COL	CARIBOO	NONCOMML HAR/S	0.33	0.43	0.15	0.09	0.00	0.00
BRITISH COL	SUBTOT VAN	ALL TYPES	0.83	0.14	0.02	0.01	0.01	0.00
BRITISH COL	SUBTOT PR	ALL TYPES	0.71	0.15	0.07	0.03	0.03	0.02
BRITISH COL	SUBTOT KAM	ALL TYPES	0.52	0.48	0.00	0.00	0.00	0.00
BRITISH COL	SUBTOT NEL	ALL TYPES	0.62	0.38	0.00	0.00	0.00	0.00
BRITISH COL	SUBTOT PG	ALL TYPES	0.39	0.29	0.19	0.06	0.00	0.00
BRITISH COL	SUBTOT CAR	ALL TYPES	0.45	0.39	0.10	0.06	0.00	0.00
BRITISH COL	TOTAL	MILL RES	0.78	0.22	0.00	0.00	0.00	0.00
BRITISH COL	TOTAL	SY RES	0.95	0.05	0.00	0.00	0.00	0.00
BRITISH COL	TOTAL	LOGGING RES	0.47	0.36	0.10	0.04	0.01	0.01
BRITISH COL	TOTAL	NONCOMML HAR/S	0.47	0.36	0.10	0.04	0.01	0.01
BRITISH COL	TOTAL	PLANTATIONS	1.00	0.00	0.00	0.00	0.00	0.00
BRITISH COL	TOTAL	ALL TYPES						

BCCOST FILE

BC COSTS	B	C	X	Y	Z	AA	AB	AC
PROVINCE	REGION	BIOFUEL TYPE	TQ 0-$15/ODT	TQ 0-$30/ODT	TQ 0-$45/ODT	TQ 0-$60/ODT	TQ 0-$75/ODT	TQ 0-OVER $75/ODT
			(000 ODT'S AVAILABLE BELOW A GIVEN TOTAL COST-----------			000 ODT'S AVAILABLE-------)		
BRITISH COL	VANCOUVER	MILL RES	3255.65	3427.00	3427.00	3427.00	3427.00	3427.00
BRITISH COL	VANCOUVER	SY RES	0.00	0.00	250.80	264.00	264.00	264.00
BRITISH COL	VANCOUVER	LOGGING RES	0.00	0.00	0.00	0.00	728.08	3569.00
BRITISH COL	VANCOUVER	NONCOMML HAR/S	0.00	0.00	0.00	0.00	214.00	1049.00
BRITISH COL	VANCOUVER	PLANTATIONS	0.00	0.00	0.00	0.00	150.00	150.00
BRITISH COL	PR RUPERT	MILL RES	1343.30	1414.00	1414.00	1414.00	1414.00	1414.00
BRITISH COL	PR RUPERT	SY RES	0.00	0.00	124.45	131.00	131.00	131.00
BRITISH COL	PR RUPERT	LOGGING RES	0.00	0.00	0.00	0.00	316.30	1787.00
BRITISH COL	PR RUPERT	NONCOMML HAR/S	0.00	0.00	0.00	0.00	426.57	2410.00
BRITISH COL	KAMLOOPS	MILL RES	931.00	1330.00	1330.00	1330.00	1330.00	1330.00
BRITISH COL	KAMLOOPS	LOGGING RES	0.00	0.00	84.37	308.69	795.26	1308.00
BRITISH COL	KAMLOOPS	NONCOMML HAR/S	0.00	0.00	25.28	92.51	238.34	392.00
BRITISH COL	NELSON	MILL RES	741.30	1059.00	1059.00	1059.00	1059.00	1059.00
BRITISH COL	NELSON	LOGGING RES	0.00	0.00	0.00	143.72	391.52	1239.00
BRITISH COL	NELSON	NONCOMML HAR/S	0.00	0.00	0.00	24.36	66.36	210.00
BRITISH COL	PR GEORGE	MILL RES	1900.50	2715.00	2715.00	2715.00	2715.00	2715.00
BRITISH COL	PR GEORGE	LOGGING RES	0.00	0.00	275.31	928.34	1691.76	2660.00
BRITISH COL	PR GEORGE	NONCOMML HAR/S	0.00	0.00	1257.11	4238.95	7724.86	12146.00
BRITISH COL	CARIBOO	MILL RES	725.90	1037.00	1037.00	1037.00	1037.00	1037.00
BRITISH COL	CARIBOO	LOGGING RES	0.00	0.00	161.42	551.11	876.12	1087.00
BRITISH COL	CARIBOO	NONCOMML HAR/S	0.00	0.00	113.31	386.84	614.98	763.00
BRITISH COL	SUBTOT VAN	ALL TYPES	3255.65	3427.00	3427.00	3427.00	4519.07	8195.00
BRITISH COL	SUBTOT PR	ALL TYPES	1343.30	1414.00	1414.00	1414.00	2156.87	5611.00
BRITISH COL	SUBTOT KAM	ALL TYPES	931.00	1330.00	1439.65	1731.20	2363.60	3030.00
BRITISH COL	SUBTOT NEL	ALL TYPES	741.30	1059.00	1059.00	1227.08	1516.88	2508.00
BRITISH COL	SUBTOT PG	ALL TYPES	1900.50	2715.00	4247.42	7882.29	12131.62	17521.00
BRITISH COL	SUBTOT CAR	ALL TYPES	725.90	1037.00	1311.73	1974.95	2528.10	2887.00
BRITISH COL	TOTAL	MILL RES	8897.65	10982.00	10982.00	10982.00	10982.00	10982.00
BRITISH COL	TOTAL	SY RES	0.00	0.00	375.25	395.00	395.00	395.00
BRITISH COL	TOTAL	LOGGING RES	0.00	0.00	521.10	1931.86	4799.05	11650.00
BRITISH COL	TOTAL	NONCOMML HAR/S	0.00	0.00	1395.70	4742.67	9285.10	16970.00
BRITISH COL	TOTAL	PLANTATIONS	0.00	0.00	0.00	0.00	150.00	150.00
BRITISH COL	TOTAL	ALL TYPES	8897.65	10982.00	13274.05	18051.53	25611.14	40147.00

BCCOST FILE

BC COSTS	B	C	AE	AF	AG	AH	AI	AJ
PROVINCE	REGION	BIOFUEL TYPE	0-$15/ODT	$16-30/ODT	$31-45/ODT	$46-60/ODT	$61-75/ODT	OVER $75/ODT
			(000 ODT'S AVAILABLE IN A GIVEN COST RANGE------------				(000 ODT'S AVAILABLE IN COST RA	
BRITISH COL	VANCOUVER	MILL RES	3255.65	171.35	0.00	0.00	0.00	0.00
BRITISH COL	VANCOUVER	SY RES	0.00	0.00	250.80	13.20	0.00	0.00
BRITISH COL	VANCOUVER	LOGGING RES	0.00	0.00	0.00	0.00	728.08	2840.92
BRITISH COL	VANCOUVER	NONCOMML HAR/S	0.00	0.00	0.00	0.00	214.00	835.00
BRITISH COL	VANCOUVER	PLANTATIONS	0.00	0.00	0.00	0.00	150.00	0.00
BRITISH COL	PR RUPERT	MILL RES	1343.30	70.70	0.00	0.00	0.00	0.00
BRITISH COL	PR RUPERT	SY RES	0.00	0.00	124.45	6.55	0.00	0.00
BRITISH COL	PR RUPERT	LOGGING RES	0.00	0.00	0.00	0.00	316.30	1470.70
BRITISH COL	PR RUPERT	NONCOMML HAR/S	0.00	0.00	0.00	0.00	426.57	1983.43
BRITISH COL	KAMLOOPS	MILL RES	931.00	399.00	0.00	0.00	0.00	0.00
BRITISH COL	KAMLOOPS	LOGGING RES	0.00	0.00	84.37	224.32	486.58	512.74
BRITISH COL	KAMLOOPS	NONCOMML HAR/S	0.00	0.00	25.28	67.23	145.82	153.66
BRITISH COL	NELSON	MILL RES	741.30	317.70	0.00	0.00	0.00	0.00
BRITISH COL	NELSON	LOGGING RES	0.00	0.00	0.00	143.72	247.80	847.48
BRITISH COL	NELSON	NONCOMML HAR/S	0.00	0.00	0.00	24.36	42.00	143.64
BRITISH COL	PR GEORGE	MILL RES	1900.50	814.50	0.00	0.00	0.00	0.00
BRITISH COL	PR GEORGE	LOGGING RES	0.00	0.00	275.31	653.03	763.42	968.24
BRITISH COL	PR GEORGE	NONCOMML HAR/S	0.00	0.00	1257.11	2981.84	3485.90	4421.14
BRITISH COL	CARIBOO	MILL RES	725.90	311.10	0.00	0.00	0.00	0.00
BRITISH COL	CARIBOO	LOGGING RES	0.00	0.00	161.42	389.69	325.01	210.88
BRITISH COL	CARIBOO	NONCOMML HAR/S	0.00	0.00	113.31	273.54	228.14	148.02
BRITISH COL	SUBTOT VAN	ALL TYPES	3255.65	171.35	0.00	0.00	1092.07	3675.93
BRITISH COL	SUBTOT PR	ALL TYPES	1343.30	70.70	0.00	0.00	742.87	3454.13
BRITISH COL	SUBTOT KAM	ALL TYPES	931.00	399.00	109.65	291.55	632.40	666.40
BRITISH COL	SUBTOT NEL	ALL TYPES	741.30	317.70	0.00	168.08	289.80	991.12
BRITISH COL	SUBTOT PG	ALL TYPES	1900.50	814.50	1532.42	3634.87	4249.32	5389.38
BRITISH COL	SUBTOT CAR	ALL TYPES	725.90	311.10	274.73	663.23	553.15	358.90
BRITISH COL	TOTAL	MILL RES	8897.65	2084.35	0.00	0.00	0.00	0.00
BRITISH COL	TOTAL	SY RES	0.00	0.00	375.25	19.75	0.00	0.00
BRITISH COL	TOTAL	LOGGING RES	0.00	0.00	521.10	1410.77	2867.18	6850.96
BRITISH COL	TOTAL	NONCOMML HAR/S	0.00	0.00	1395.70	3346.97	4542.43	7684.90
BRITISH COL	TOTAL	PLANTATIONS	0.00	0.00	0.00	0.00	150.00	0.00
BRITISH COL	TOTAL	ALL TYPES	8897.65	2084.35	2292.05	4777.48	7559.61	14535.86