



SOCIOECONOMIC TRANSITION IN THE FOOTHILLS MODEL FOREST FROM 1996 TO 2001

M. Patriquin, V. Lantz, R. Furtas, M. Ambard, and W. White

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Northern Forestry Centre

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La forêt modèle Foothills est un partenariat extraordinaire dévoué à fournir des solutions pratiques envers la gestion durable de nos forêts.

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ABSTRACT

This report highlights the economic transition that occurred in the Foothills Model Forest between 1996 and 2001 by updating a 1996 region-specific economic database and a computable general equilibrium impact model for the region. Whereas the 1996 database showed that the mining and forestry sectors were two of the largest and most influential in the region, the 2001 database showed a transition away from coal production toward natural gas exploration. This transition was fueled by changing world prices for coal and natural gas combined with a depletion of coal reserves in the region. The visitor sector also experienced a slight decline in activity during this period. These changes had a significant effect on many socioeconomic variables in the region. The simulations performed with the impact models revealed that the economic transition has caused the socioeconomic variables to become more sensitive to changes in activities in the natural gas sector and less sensitive to activities in the mining and visitor sectors.

RÉSUMÉ

Le présent rapport fait ressortir les points saillants de la transition économique qui s'est produite dans la Forêt modèle de Foothills entre 1996 et 2001 en mettant à jour une base de données économiques et un modèle de calcul des incidences économiques à cadre d'équilibre général pour la région. Bien que la base de données de 1996 montrait que les secteurs des mines et de la foresterie étaient deux des plus grands et des plus influents secteurs de la région, celle de 2001 a mis en évidence une transition de la production de charbon vers l'exploration des gisements de gaz naturel. Cette transition a été motivée par une évolution des prix pour le charbon et le gaz naturel sur les marchés mondiaux combinée à l'épuisement des réserves de charbon dans la région. Le secteur touristique a aussi décliné un peu durant cette période. Ces changements ont eu des répercussions importantes sur de nombreuses variables socioéconomiques. Les simulations effectuées avec les modèles d'impact ont révélé que la transition économique avait rendu certaines variables socioéconomiques plus sensibles aux changements des activités dans le secteur du gaz naturel et moins sensibles aux activités dans les secteurs des mines et du tourisme.

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INTRODUCTION

The Foothills Model Forest (FtMF) has been the subject of much socioeconomic research over the past decade. This research has led to advances in state-of-the-art modeling related to the development of socioeconomic databases and analysis of economic impacts. For instance, Patriquin et al. (2004) applied a hybrid approach to developing a socioeconomic database for the region, and that database can be used to assist regional planners in establishing and maintaining socioeconomic indicators. In addition, Patriquin et al. (2003) and Patriquin et al. (2004) developed and applied one of the few regional computable general equilibrium (CGE) models of economic impacts that exist in Canada to estimate the impacts of potential market and policy changes on the FtMF economy. This model can help regional planners to better understand the relative importance of individual sectors in their region and to begin planning for potential economic transitions that might occur in the future.

Previous socioeconomic research in the FtMF region has yielded extensive information on the state of the regional economy (from the socioeconomic database) and the potential impacts of various market and policy changes (from the CGE model). The ongoing social science research in the FtMF allows the changing state and structure of the regional economy to be analyzed over time.

This report updates a 1996 region-specific socioeconomic database and CGE economic impact model for the FtMF to 2001, the most recent year for which data are consistently available from census-based, business, and economic sources. The 1996 and 2001 databases and CGE models are compared to reveal the socioeconomic transitions that have occurred in this region over the 5-year period.

This report is organized as follows. The next section describes the environmental setting and socioeconomic history of the study area. The third section describes the methods for first developing the 2001 socioeconomic database and then calibrating the CGE model. The fourth section presents the results of the 2001 database for six major sectors in the region (forestry, wood, mining, crude petroleum and natural gas, visitor, and the rest of the economy) and compares them with the results obtained using the 1996 database. The fifth section presents the results of the 2001 CGE model simulations and compares them with the results of the CGE model calibrated for 1996. The final section discusses the implications of the findings and draws conclusions.

ENVIRONMENTAL SETTING AND SOCIOECONOMIC HISTORY OF THE STUDY AREA

The FtMF, situated in Alberta's west-central foothills and mountain region, is the second-largest component of Canada's model forest network in terms of its physical size (For more information about the model forest network and the FtMF itself, consult the network's website: www.fmf.ab.ca). The FtMF is geographically centered on the town of Hinton (285 km west of Edmonton)

and encompasses over 2.75 million hectares. The region includes Jasper National Park, Willmore Wilderness Park, the forest management area (FMA) of West Fraser Mills Ltd. (formerly Weldwood of Canada Limited – Hinton Division), William A. Switzer Provincial Park, and several crown management areas. Communities located within FtMF boundaries include Jasper, Brûlé,

Robb, Cadomin, and Hinton. Grande Cache is located just outside the boundary of the FtMF but is included in parts of this analysis since it is thought to have significant economic interactions with communities located within the FtMF.

The FtMF contains numerous lakes and rivers. Brûlé, Maligne, Medicine, and Jasper are the largest lakes in the area. The Athabasca River, which starts in the glaciers south of Jasper National Park, is Alberta's longest river and flows northeast through the FtMF toward the Arctic Ocean. The section of the Athabasca River nominated to the Canadian Heritage Rivers System is 168 km long and located exclusively within Jasper National Park. The Athabasca River Basin includes other prominent rivers such as the McLeod, Pembina, and Clearwater. A cooperative research project between Jasper National Park and the FtMF is developing a database linked to geographic information systems that will document aquatic information such as water quality, flow regimes, hydrology data, fish distribution, and habitat analysis. Much of this information pertains to the Athabasca River and its major tributaries.

There are four diverse ecoregions within the FtMF landscape: the Upper Boreal-Cordilleran (or Upper Foothills), the Lower Boreal-Cordilleran (Lower Foothills), the Subalpine, and the Montane, comprising 68%, 21%, 10%, and 1% of the total area, respectively (Hall et al. 2006). The FtMF comprises a diverse mix of pine, spruce, and mixed-wood forest of all ages. In general, the forest stands are dominated by lodgepole pine (*Pinus contorta* Dougl. ex Loud. var. *latifolia* Engelm.), with aspen (*Populus* spp.) being codominant in the Lower Foothills. White spruce (*Picea glauca* (Moench) Voss), is common in the Lower Foothills, Upper Foothills, and the Montane, changing to Engelmann spruce (*Picea Engelmannii* Pary ex Engelm.) in the Subalpine (Beckingham et al. 1996).

Economic development in the FtMF was set in motion in the late 1800s with exploration and the fur trade. The region was further developed with the opening of the Grand Trunk Railroad, the discovery of coal, development of the timber

resource, oil and gas exploration, and development of a vibrant tourism industry.

Hinton was established during the early 1900s as a service community for industry operations. In 1908, the Grand Trunk Railroad was opened, and Hinton doubled as the last station before the Canadian Rockies and as an entrance to Jasper National Park. Throughout Hinton's history, natural resources have been a primary economic driver. During the mid-20th century, Hinton grew dramatically because of forestry operations and coal mine development. The FMA surrounding Hinton has been in existence since 1951, making it Alberta's oldest FMA. Energy operations in the Hinton vicinity consist primarily of coal mining and extraction of oil and natural gas.

In 2001, three coal mines were operating within the FtMF: Obed Mountain, Cardinal River, and Coal Valley, the first two of which were located close to Hinton. Coal and natural gas reserves occur throughout the FtMF, and gas located in coal seams, termed coalbed methane, is becoming increasingly economically viable and represents significant potential for future development. The FtMF also features a small amount of conventional oil production.

Hinton's tourism industry continues to expand, and throughout the summer months the town becomes a spillover location for Jasper National Park (AED 2002). Hinton also provides access to nearby Willmore Wilderness Park, Switzer Provincial Park, and many other locations for outdoor adventures such as hiking, fishing, and camping (AED 2002).

Jasper National Park and the town of Jasper are other significant locations in the FtMF and serve primarily as tourist destinations. An estimated 1.8 million people visit Jasper National Park annually, a number that encompasses international, domestic, and local tourists (AED 2003). Most of the employment in the town of Jasper is in the hospitality industry (i.e., accommodation and food and beverage services), which signals a strong tourism industry (MacKendrick and Parkins 2004). The population and economic activity of

the park increase dramatically during the summer months, and the town's infrastructure caters to the surging tourist industry with accommodation, food establishments, and other facilities.

Grande Cache, located on the FtMF's northwest boundary, has an economic structure similar to that of Hinton but on a smaller scale. Grande Cache contributes to the FtMF economy through production and services related to forestry and coal mining. A rejuvenated lumber mill and a metallurgical coal mine might provide town residents with longer-term employment. Grande Cache is located in the middle of a large oil and gas field, which extends into the FtMF. The prospect of major oil and gas developments in the area has given rise to anticipations of spin-off employment, industrial development, and diversification of the economy.

The FtMF rural region includes the villages of Marlboro, Brûlé, Mountain Park, Cadomin, and Robb. These villages, which contribute to the rural population of Yellowhead County, provide only limited services to rural residents. In the past, the FtMF rural villages were vibrant, resource-dependent places relying on the coal and forestry operations that were active in the mid-20th century. Today, Yellowhead County residents continue to rely on forestry and mining for employment, especially in the western sections of the county, although natural gas production is becoming more significant. Overall, the natural resource sectors are responsible for the majority of employment in the area (MacKendrick and Parkins 2004).

Numerous parks and recreation sites in the study area offer a variety of summer activities, including fishing, camping, hiking, hunting, boating, climbing, canoeing, wildlife viewing, horseback riding, and all-terrain vehicle use. Recreational use is also high in the winter, with snowmobiling, ice fishing, and cross-country and backcountry skiing being the most popular (AED 2002). See Appendix A for a complete description of economic sectors and trends in the region.

According to the 2001 census, 27 294 people resided in the FtMF region at that time (Table 1). The Hinton district had a population of 9 405, Jasper was home to 4 180 residents, and Grande Cache's population was 3 828 (Table 2). Yellowhead County, which had a rural population of about 9 900, extends beyond the FtMF but it provided the "best fit" for analysis of rural residents within the region (Table 2) (Patriquin et al. 2004).

From 1991 to 1996, the FtMF region (including Grande Cache) experienced a relatively large population growth rate of 14.5%. During the next 5-year period (1996 to 2001), however, the population decreased by 5.2% (Table 1). This trend contrasts with the figures for overall population growth in Alberta, where the rates for 1991–1996 and 1996–2001 averaged 5.6% and 10.3%, respectively (Table 1).

Table 1. Population statistics for Alberta and the Foothills Model Forest, 1991 to 2001^a

Total population	Foothills Model Forest					
	Alberta		Including Grande Cache		Excluding Grande Cache	
	No.	% change	No.	% change	No.	% change
1991	2 545 553		25 147		21 305	
1996	2 696 826	5.6	28 795	14.5	24 354	14.3
2001	2 974 807	10.3	27 294	-5.2	23 466	-3.6

^aSources: Statistics Canada 2001; MacKendrick and Parkins 2004.

Table 2 demonstrates that the populations in all of the major towns in the FtMF decreased from 1996 to 2001 (MacKendrick and Parkins 2004). Yellowhead County and Jasper sustained minor decreases of 2.1% and 2.8%, respectively. Hinton's decrease was marginally greater at 5.6%, and Grande Cache encountered a major population decline of 13.8% (Table 2). The substantial population decrease in Grande Cache influenced the overall rate of population change when it was

counted as part of the FtMF. With the Grande Cache data, the population of the FtMF decreased by 5.2%, whereas without the Grande Cache data, the overall decline was lower, at 3.6% (Table 1). In towns that depend on natural resources, the population often changes as a result of shifts in global economic markets (MacKendrick and Parkins 2004). Mine closures occurring during this period are one explanation for the population decreases from 1996 to 2001.

Table 2. Population changes in other communities in the Foothills Model Forest, 1991 to 2001^a

Total population	Jasper		Yellowhead County		Hinton		Grande Cache	
	No.	% change	No.	% change	No.	% change	No.	% change
1991	3 567		8 692		9 046		3 842	
1996	4 301	20.6	10 092	16.1	9 961	10.1	4 441	15.6
2001	4 180	-2.8	9 881	-2.1	9 405	-5.6	3 828	-13.8

^aSource: Statistics Canada 2001.

MacKendrick and Parkins (2004) recently conducted a census-based assessment of community well-being in the FtMF that involved 5-year point data from 1981 to 2001. Within their monitoring framework, they reported on categories of indicators (including population and migration, employment, income distribution, poverty, human capital, and real estate) and discussed indicator trends and issues that have emerged over the period of analysis. This socioeconomic indicator analysis (MacKendrick and Parkins 2004) can be summarized as follows:

- Population—The population of the FtMF decreased in 2001 for the first time since 1986; in general, however, FtMF residents do not migrate.
- Unemployment—There were high unemployment rates in 1986 (highest) and 2001, with a greater proportion of part-time employment (less full-time employment) in 2001 than in 1996. The unemployment rate for men increased from 1996 to 2001, possibly because of the mine closures; however, the proportion of men and women involved in occupations associated with resource extraction industries did not change significantly.
- Poverty—Individual and household incomes were relatively high and growing steadily up to 2001. However, there was evidence of a substantial decrease in the median household income in Grande Cache from 1996 to 2001 (reflecting mine and mill closures).
- Human capital—Education attainment in the FtMF increased over time, and in 2001 a large proportion of the population reported trades or non-university education, whereas the number of individuals with grade 13 or less as their highest level of education had decreased.
- Real estate—Despite economic shocks, the average property value did not decrease in the overall FtMF over the 1986–2001 period. A more detailed analysis demonstrated that property values decreased in Hinton, Jasper, and Grande Cache but increased in rural Yellowhead County. In addition, there was a higher proportion of renters relative to owners in 2001 than in previous years, which reflected uncertainty in the economy.

Update of a Regional Economic Database

The 1996 region-specific economic database for the FtMF study area developed by Patriquin et al. (2002) was updated to the year 2001 following a similar mixed-methods or hybrid approach (intended to overcome the limited availability of regional-level data). This approach consisted of a series of steps, starting with the collection of secondary (pre-existing) data from Statistics Canada's 1999 provincial input-output tables (the most recent available; detailing annual transactions in and structure of the provincial economy) and economic data collected previously in the region (e.g., Patriquin et al. 2002). The provincial input-output tables were then transformed into a social accounting matrix (SAM), which consists of a double-entry, square accounting framework that ensures data consistency when using hybrid sources. The provincial SAM database was then mathematically regionalized using location quotients (i.e., the proportion of regional employment divided by the proportion of provincial employment for each sector). This process was completed using the 2001 census of population from Statistics Canada and resulted in a preliminary region-specific SAM.

Once the preliminary SAM had been constructed, primary data were then incorporated through a process of "selective precision." This involved focusing primary data collection efforts on the major sectors of interest. In this study, primary sector data were collected in spring 2004 through personal communication with representatives of the Government of Alberta and through a survey of businesses in the FtMF (described in the next paragraph).

A stratified (by sector) random sample of 25% of the business population was surveyed, with a response rate of 40% (Grande Cache was excluded from the survey because of business closures). Business owners were asked closed and open-ended questions about their business employment history, business revenue and expenditures, and business wage bill in 2001. The hybrid data (secondary and derived from the survey) were then used to update the preliminary region-specific SAM for the study area.

The socioeconomic variables in the SAM (explained in Table 3) are gross revenue, net regional product, royalties and indirect taxes, labor income, and employment.

Table 3. Summary of economic indicators

Indicator	Explanation
Revenue	The gross amount of economic activity (in dollars) that takes place in the region on an annual basis; determined as the product of quantity and price in an economic market (i.e., the total value of sales)
Net regional product	The combination of all dollar payments for labor, capital, resource rents, and indirect taxes (i.e., the amount of "value-added" activity); represents the value of goods and services produced in the region in a year
Royalties and indirect taxes	Royalties are dollar rents paid by firms to the government for use of publicly owned natural resources; indirect taxes are any taxes other than income or corporate
Labor income	The dollar amount paid by firms to employees (e.g., salaries, wages)
Employment	The number of individuals with primary employment in an individual industry

The industries identified in the region were aggregated into six major sectors: forestry, wood, mining, crude petroleum and natural gas (CPNG), visitor, and the rest of the economy. Where possible, the socioeconomic variables were

reported for each major sector. The components of each major sector are presented in Table 4, and background data for each sector are provided in Appendix A.

Table 4. Description of the major economic sectors in the study region

Sector	Explanation
Forestry	Logging, pulp processing, and forestry-related services
Mining	Metallurgical and thermal coal production
Wood	Lumber processing and manufacturing of wood products
Crude petroleum and natural gas	Oil, gas, and other petrochemical extraction
Visitor	Economic activity related to people visiting the region for the purpose of tourism, business, conventions, etc.; specifically identifies visitor expenditures on accommodations, retail, transportation, and services and separates these from domestic expenditures
Rest of the economy	An aggregate sector encompassing all of the remaining sectors of the economy, including domestic services, manufacturing, construction, agriculture (e.g., farming and agriculture-related services such as veterinary services), domestic retail sales (e.g., clothing and electronics), and public sector (education, health, and government services)

Update of the Computable General Equilibrium Model

The 1996 region-specific CGE model of the FtMF study area (Patriquin et al. 2002) was updated to the year 2001 using the 2001 SAM output described above. The 2001 update was based on the same specifications as the 1996 version. This deterministic model was based on the small, open (to trade) economy of the FtMF region. The FtMF CGE model contained six sectors (forestry, wood, mining, CPNG, visitor, and the rest of the economy) and three primary factors of production (land, labor, and capital). See Appendix B for a detailed description of the model specification.

Following Patriquin et al. (2003), various assumptions were made with respect to the treatment of the primary factors of production in the model. For example, the labor supply was assumed to be fixed (i.e., the migration of labor between the region and the rest of the world was not modeled). In addition, the labor market was modeled under a Keynesian assumption of a rigid

wage rate. Under this assumption, adjustments in the labor market occur because of changes in employment levels. It was assumed that, over the long run, unemployed individuals will migrate out of the region to find employment. The other two primary inputs, capital and land, were assumed to be sector-specific.

The CGE model was used to generate simulations of economic impacts; these simulations were designed to show the relative sensitivity of major socioeconomic variables to marginal changes in each sector's output. The sensitivity was expressed in terms of elasticity, defined as the percent change in a socioeconomic variable resulting from a 1% change in the export value of a sector. The socioeconomic variables and economic sectors considered in the CGE model simulations were similar to those in the socioeconomic database, described above. Specifically, the variables were gross revenue, net regional product, royalties, labor income, and employment, and the sectors were forestry, wood, mining, CPNG, and visitor.

RESULTS FROM THE SOCIOECONOMIC DATABASE

Table 5 compares gross revenue, net regional product, royalties and indirect taxes, labor income, and employment values for the FtMF in 1996 and 2001 (in real 2001 dollars). Grande Cache was not included in determinations of the 1996 socioeconomic variables and was therefore omitted from this analysis to allow comparison of the 1996 and 2001 values. However, in the discussion that follows, employment in the FtMF is considered with and without data for Grande Cache, to illustrate how changes in Grande Cache affect changes in the FtMF.

Total gross revenue (in real 2001 dollars) increased 28%, from \$2.01 billion in 1996 to \$2.58 billion in 2001. This change emerged largely from a dramatic increase in the value of production in the CPNG sector, which more than quadrupled, from \$236.2 million in 1996 to \$1.06 billion in 2001. This sector's contribution to total gross revenue in the region increased from a relatively low 11.8% of the total in 1996 to 41.1% of the total in 2001, making it the largest contributing sector to regional gross revenues in 2001. The mining sector, on the other hand, had a significant decrease in gross revenue over this period, from \$552.9 million in 1996 to \$384.3 million in 2001. This decline reduced the mining sector's contribution to regional gross revenue from 27.5% of the total in 1996 to 14.9% in 2001. Gross revenue in the other sectors remained relatively stable, with slight declines in the visitor and wood sectors, and slight increases in the forestry and the rest of the economy sectors.

Total net regional product increased by almost 20% over the 1996–2001 period, from \$796.2 million in 1996 to \$951.3 million in 2001. The increased net regional product was largely attributable to increases in the CPNG sector, which more than tripled, from \$92.4 million in 1996 to \$340.1 million in 2001. Net regional product in the mining, visitor, and rest of the economy sectors decreased over this period, while it increased in the forestry and wood sectors. Changes in sector

contributions to total net regional product (in percentage terms) followed a pattern similar to that of gross revenues.

For the wood sector, changes in gross revenue and net regional product over the 1996–2001 period moved in opposite directions, with a decrease in gross revenue and an increase in net regional product. This implies that, although gross revenue declined over this time, the value (or value-added) of goods and services in the wood sector increased. The opposite pattern emerged in the rest of the economy sector. This finding emphasizes the importance of incorporating the net regional product variable in the analysis; limiting the analysis to gross revenue would have led to very different conclusions regarding the state of these sectors within the economy.

Royalties and indirect taxes paid by sectors in the region more than doubled from 1996 to 2001, from \$69.0 million in 1996 to \$151.0 million in 2001. The CPNG sector was the driver of this change, with royalties and indirect tax contributions more than quadrupling, from \$25.8 million in 1996 to \$115.5 million in 2001. This sector's contribution to this economic indicator doubled, from a relatively high 37.3% of the total in 1996 to an even higher 76.5% of the total in 2001, making it by far the predominant contributing sector to royalties and indirect tax in 2001. The increase in CPNG sector royalties and indirect taxes paid in the region was only partially offset by decreases in royalties and taxes paid by the wood, mining, and visitor sectors.

Total labor income in the region decreased slightly from 1996 to 2001, from \$482.4 million in 1996 to \$445.0 million in 2001, primarily because of a decrease in labor income in the mining sector, from \$99.9 million in 1996 to \$49.4 million in 2001. This decline was only partially offset by increases in the forestry, wood, and CPNG sectors.

The mining sector's contribution to total labor income decreased from a relatively low 20.7% in 1996 to an even lower 11.1% in 2001. This was partially offset by the CPNG sector contributions, which increased from 5.8% to 11.4% of the total. The rest of the economy sector maintained the largest contribution to total labor income, at about 33% of the total in both 1996 and 2001.

Finally, total employment in the FtMF declined slightly from 1996 to 2001, from 13 485 positions to 13 380 positions. The mining sector accounted for the majority of employment losses, from 1 165 in 1996 to 590 in 2001. These losses were partially offset by increases in the forestry, wood, CPNG, and visitor sectors over this period. Notably, the visitor sector exhibited a decrease in labor income, despite the increase in employment, which indicates more low-paying or part-time positions at the expense of high-paying or full-time positions in 2001 relative to 1996.

Only minor changes in the sector contributions to total employment occurred between 1996 and 2001. The rest of the economy maintained the largest contribution to total employment, at about 57% of the total. Figure 1 demonstrates the proportional sector employment in the FtMF with and without Grande Cache. This figure highlights the dramatic influence of the Smokey River Coal Mine closures that occurred in the Grande Cache area and, to a lesser extent, the reduced wood sector activity in Grande Cache before the closure of the sawmill. With Grande Cache counted as part of the FtMF, the employment losses are amplified compared to when Grande Cache was omitted from the analysis. For example, without Grande Cache data, total employment in the FtMF dropped only slightly, from 13 485 in 1996 to 13 380 in 2001; with the Grande Cache data, total FtMF employment figures declined by 630, from 15 770 in 1996 to 15 140 in 2001.

Table 5. Comparison of economic indicators (without Grande Cache data) for 1996 and 2001 (in real 2001 dollars)

Indicator and sector	1996		2001	
	Value of sector ^a	% of total	Value of sector ^a	% of total
Gross revenue				
Forestry	454.6	22.6	462.5	18.0
Wood	110.1	5.5	103.9	4.0
Mining	552.9	27.5	384.3	14.9
CPNG ^b	236.2	11.7	1 058.7	41.1
Visitor	353.7	17.6	261.5	10.2
Rest of the economy	302.7	15.1	304.4	11.8
Total ^c	2 010.3	100.0	2 575.3	100.0
Net regional product				
Forestry	176.1	22.1	189.1	19.9
Wood	38.9	4.9	41.7	4.4
Mining	177.6	22.3	103.4	10.9
CPNG ^b	92.4	11.6	340.1	35.8
Visitor	116.7	14.7	91.3	9.6
Rest of the economy	194.5	24.4	185.6	19.5
Total ^c	796.2	100.0	951.3	100.0
Royalties and indirect taxes				
Forestry	12.2	17.7	12.4	8.2
Wood	0.7	1.0	0.6	0.4
Mining	21.5	31.2	15.0	9.9
CPNG ^b	25.8	37.4	115.5	76.5
Visitor	5.2	7.5	3.8	2.5
Rest of the economy	3.7	5.4	3.7	2.5
Total ^c	69.0	100.0	151.0	100.0
Labor income				
Forestry	85.1	17.6	96.5	21.7
Wood	32.9	6.8	36.0	8.1
Mining	99.9	20.7	49.4	11.1
CPNG ^b	27.8	5.8	50.7	11.4
Visitor	78.0	16.2	62.7	14.1
Rest of the economy	158.7	32.9	149.6	33.6
Total ^c	482.4	100.0	445.0	100.0
Employment positions				
Forestry	1 050	7.8	1 275	9.5
Wood	505	3.7	570	4.3
Mining	1 165	8.6	590	4.4
CPNG ^b	470	3.5	590	4.4
Visitor	2 650	19.7	2 725	20.4
Rest of the economy	7 645	56.7	7 630	57.0
Total ^c	13 485	100.0	13 380	100.0

^aIn millions of dollars (except employment, which is number of positions).

^bCPNG = crude petroleum and natural gas.

^cFigures have been rounded so sums may not total.

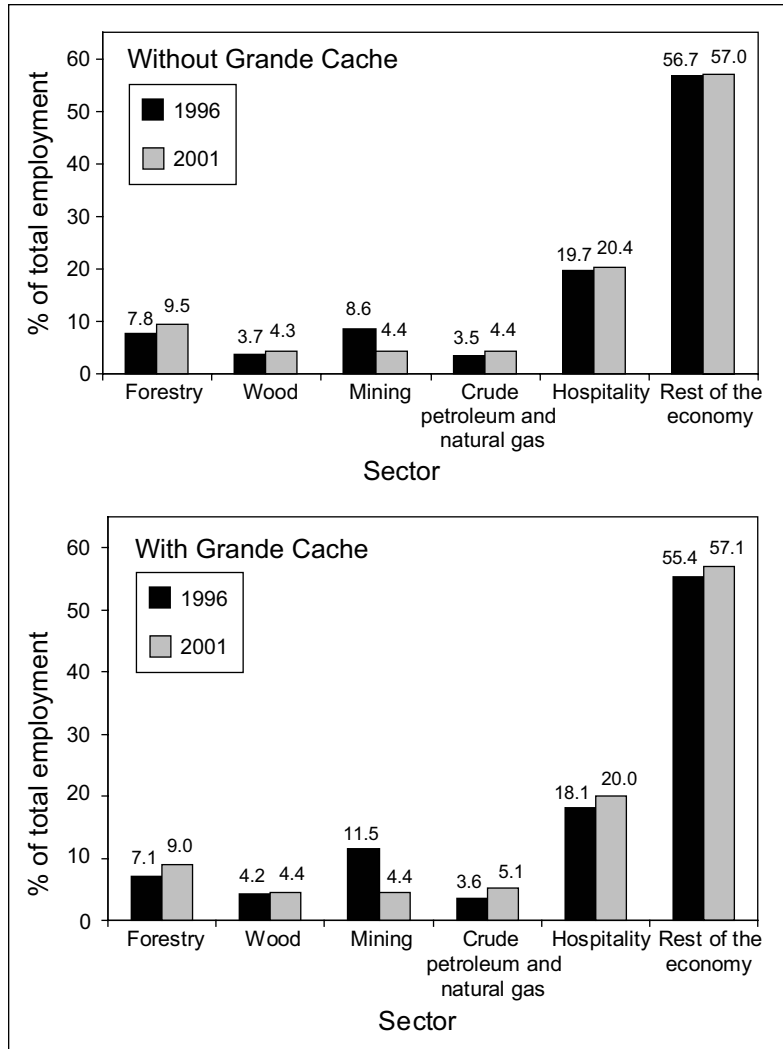


Figure 1. Employment composition for the Foothills Model Forest in 1996 and 2001, without and with data for Grande Cache.

RESULTS FROM THE COMPUTABLE GENERAL EQUILIBRIUM MODELS

Analysis of the percentage change for each socioeconomic variable in relation to a 1% change in the exports of each individual sector (otherwise known as elasticity) in the FtMF (Figure 2) indicates that changes in CPNG sector exports had the largest impact on the socioeconomic variables in 2001. Specifically, a 1% increase in CPNG exports caused changes of 0.49% in revenue, 0.59% in net regional product, 0.97% in royalties and indirect taxes, 0.37% in labor income, and 0.41% in employment. In contrast, changes in wood and mining sector exports had among the lowest impacts on socioeconomic variables of all sectors considered in 2001. See Appendix C (Table C1) for a more detailed presentation of these results.

The elasticities of the socioeconomic variables produced by the 2001 CGE model differed significantly from those produced by Patriquin et al. (2002) for 1996 (Figure 3) (see also Appendix C, Table C2). Specifically, the 2001 elasticities generally revealed that changes in CPNG sector exports had a much greater influence on the socioeconomic variables than was the case in 1996. More specifically, a 1% increase in CPNG sector exports caused the socioeconomic variables to increase by 0.37% (for labor income) to 0.97% (for royalties and indirect tax payments) in 2001, whereas in 1996 these increases were in the range of 0.13% (for employment) to 0.45% (for royalties and indirect tax payments).

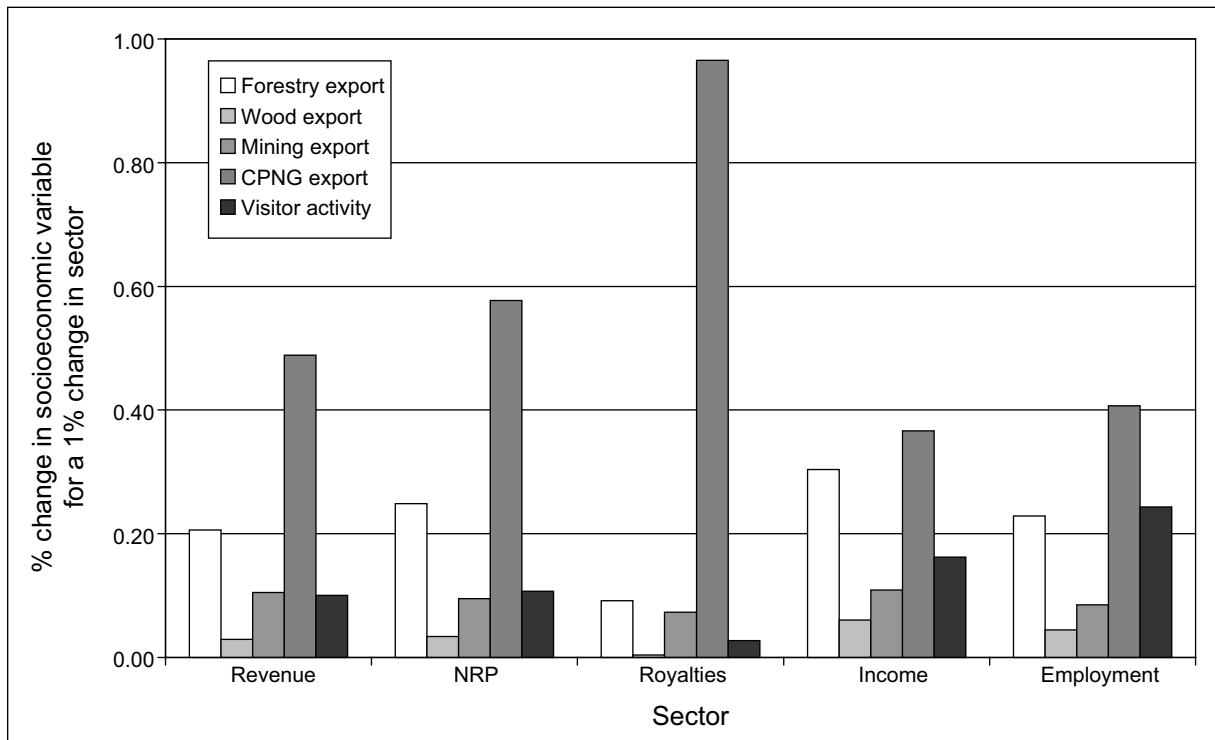


Figure 2. Elasticities for socioeconomic variables relative to 1% changes in sector exports for the Foothills Model Forest in 2001. CPNG = crude petroleum and natural gas. NRP = net regional product.

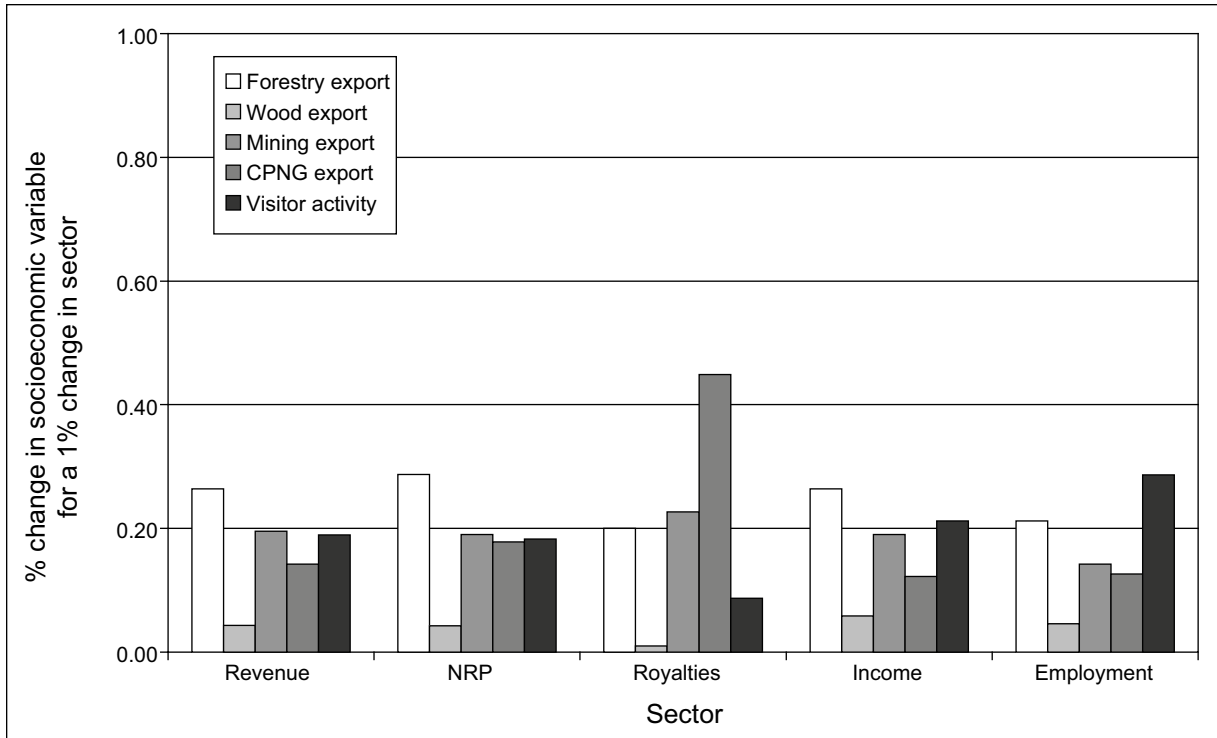


Figure 3. Elasticities for socioeconomic variables relative to 1% changes in sector exports for the Foothills Model Forest in 1996. CPNG = crude petroleum and natural gas. NRP = net regional product.

In contrast to the impacts of changes in CPNG sector exports, changes in mining sector exports generally had less influence on the variables in 2001 than in 1996 (Figures 2 and 3). Specifically, a 1% increase in mining sector exports in 2001 cause the socioeconomic variables to increase by 0.07% (for royalties and indirect tax payments) to 0.11% (for wage income). These elasticities were larger in 1996, ranging between 0.14% (for employment) to 0.23% for royalties and indirect tax payments. The elasticity results for mining and CPNG stem largely from a structural transition away from mining and toward natural gas development in the regional economy.

The elasticities in socioeconomic variables for the forestry, wood, and visitor sectors remained fairly consistent between 1996 and 2001. One of the few major changes was for the forest sector's impact on royalties and indirect tax payments. In 2001, a 1% increase in forestry sector exports caused royalties and indirect tax payments to increase by only 0.09%, whereas in 1996, the impact was much higher (0.20%). The decreased sensitivity of overall royalties and indirect tax payments to changes in forestry exports resulted from the dramatic increase in the proportion of total royalties paid from the CPNG sector relative to forestry.

DISCUSSION AND CONCLUSIONS

Significant change has occurred in the FtMF economy over the period from 1996 to 2001. Ongoing social science research in the FtMF has afforded a unique opportunity to gain an understanding of the transitions that have occurred. This report documents a comparison of socioeconomic databases and impact models for the region for 1996 and 2001. The database analysis has demonstrated how the region's economy changed in response to changes in commodity-based natural resource sectors. For example, the mining sector suffered a downturn as a result of low global commodity prices and the phasing out of the Gregg River Mine in 2001 because of depleted reserves (the effect of which was exacerbated by low prices). However, at the same time the world price of natural gas was on the rise, which led to greater exploration and extraction in the FtMF region. Tourism also suffered a slight decline in 2001 because of global events; however, the relative stability of the forestry and wood sectors helped to even out the overall impacts. For the purposes of future monitoring, the authors recommend that this database be updated every 5 years (following census updates).

The comparison of the 2001 and 1996 CGE models demonstrated the structural transition away from coal mining and toward natural gas extraction in the region during the period of analysis. It is difficult to conclude whether the transition has yielded net benefits to the region. For example, the amount of gross revenue, net regional product, and royalties and indirect taxes derived from the region increased from 1996 to 2001, which suggests greater value in the amount of economic activity occurring on the landscape. However, total labor income, employment, and population declined over the same period, which suggests that the transition is of limited benefit to households in the region. Informal discussions with local officials and residents have suggested that more energy sector workers are relocating to the area. Thus, more local benefits may be seen in the next update of the socioeconomic variables, following the release of the 2006 census of population data.

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■ APPENDIX A

Sector Profiles

Forestry and Wood

Forestry constitutes an established and essential resource sector of the Foothill Model Forest. In 2001, Weldwood of Canada Limited (Hinton Division) was the region's single forestry company, operating a sawmill and a pulpmill. In 2005 this company was acquired by West Fraser Mills Ltd., which is now responsible for managing a timber resource of approximately one million hectares and for operating the two mills, Hinton Wood Products and Hinton Pulp (Weldwood 2004). It is estimated that the Hinton operations directly employ 1 000 persons residing within the Foothills Model Forest (FtMF) (Town of Hinton 2005).

In Alberta, landscapes are managed through forest management agreements (FMAs). Each FMA is an area-based tenure agreement between a forest company and the provincial government that gives the company the right to grow, harvest, and remove timber. The FMA in the study region has been in existence since 1951, making it the oldest FMA in Alberta (West Fraser Mills Ltd., Hinton Wood Products 2005). It is the lone commercial harvesting area in the FtMF, with the exception of an annual amount of timber (8 500 m³) harvested by authority of a commercial timber permit (West Fraser Mills Ltd., Hinton Wood Products 2005).

Table A1 reports the land base allocation on the West Fraser FMA for the period of interest (Weldwood, Hinton Division, Forest Resource Department 2001). Overall, 5.1% (52 281 ha) of the total land base (1 031 317 ha) was "removed" from the FMA because it represented town sites and noncompany dispositions such as facilities, roads, and other linear corridors (Weldwood, Hinton Division, Forest Resource Department 2001). The estimated timber harvesting land base, also known as the contributing land base, available over the 1996–2001 period was 709 737 ha

or 68.8% of the total. The West Fraser annual allowable cut (AAC) — the maximum volume of timber that can be harvested each year (see below for a more detailed description) — is calculated from this contributing land base of 709 737 ha (Weldwood, Hinton Division, Forest Resource Department 2001). Noncontributing land in the West Fraser disposition, including parks, recreation areas, ecological reserves, lakes, river buffer zones, roads, steep slopes, and nonmerchantable lands (Weldwood, Hinton Division, Forest Resource Department 2001), accounted for 25.6% of the total (264 452 ha of 1 031 317 ha).

A comparison of the 1996 and 2001 AACs for the FtMF reveals a 38% increase in the deciduous timber AAC but a marginal increase of only 2% for the much more substantial coniferous timber AAC (Table A2). The 2001 Hinton FMA harvest totaled approximately 2.4 million m³ supplying approximately 70% of the total fiber needed for the Hinton Wood Products and Hinton Pulp mills (Weldwood 2004). Contracts and trade with neighboring forest companies supplied the remainder of the roundwood and chips needed for fiber (Weldwood 2004). The 2001 total harvest was estimated at approximately 586 000 m³ more than the 1996 harvest (Table A2).

Forestry production has undergone significant changes over its life in the region. First, technological advancement and specialization have led to greater efficiency and production and lower labor intensity (Patriquin et al. 2004). Second, substantial increases in harvesting rates (corresponding to increases in the land base) have boosted forestry production. For example, the AAC for the West Fraser FMA has almost tripled since 1960 (Weldwood, Hinton Division, Forest Resource Department 2001). Figure A1 illustrates the trends in harvest totals from 1996 to 2004.

Table A1. Allocation of the land base in the Foothills Model Forest 2001^a

Category	Area (ha)
Total land within perimeter of forest management agreement	1 031 317
Land removed (not owned by West Fraser, town site land)	52 281
Forest management agreement land base	973 190
Land removed (total noncontributing lands)	264 452
Forest (contributing land with timber harvest scheduled)	709 737

^aSource: West Fraser Mills Ltd., Hinton Wood Products 2005.

Table A2. Physical account of timber (in cubic meters) in the Foothills Model Forest, 1996 to 2001^a

	1996		2001	
	Deciduous	Coniferous	Deciduous	Coniferous
Forest stock				
Opening stock	11 152 641	67 460 335	14 716 000	110 285 000
Annual allowable cut	126 000	1 900 000	174 280	1 936 801
West Fraser harvest	87 026	1 723 698	127 420	2 269 529
Growth	65 700	1 355 000	65 700	1 355 000

^aSources: Weldwood, Hinton Division, Forest Resource Department 2001; Patriquin et al. 2004; Hugh Lougheed, West Fraser Ltd., Hinton, Alberta, personal communication 8 February 2005.

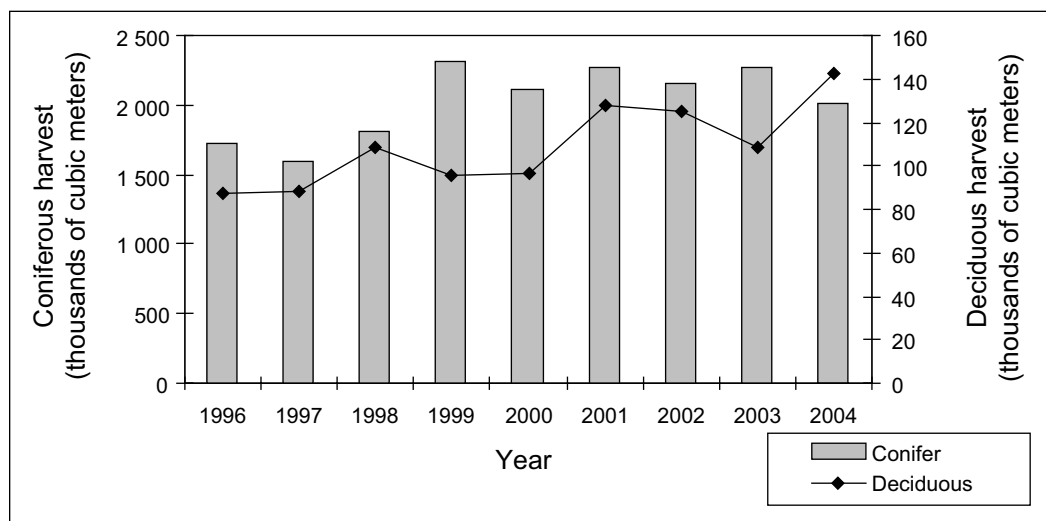


Figure A1. Coniferous and deciduous harvest totals for the Hinton Forest Management Agreement. Source: Hugh Lougheed, West Fraser Ltd., Hinton, Alberta, personal communication 8 February 2005.

The integrated lumber and pulp operations of West Fraser Mills Ltd. offer a variety of efficiencies for the company. By working together, the Hinton operations are able to keep inventories low, which results in better quality lumber, pulp, and chip products (Murphy et al. 2002). Cooperation between mills and forest operations is essential, because the mill produces commodity products that require specific lengths and grades, which are marketed as premium products (Murphy et al. 2002). In addition, optimizing the wood cut in the FMA allows trade with other forestry firms. For example, Hinton Pulp sources approximately 67% of its fiber from residual chips (23% of the residual chips are obtained from sawmills owned by other companies) and 33% from woodroom pulp log conversion (Jim LeLacheur, West Fraser Ltd., Hinton, Alberta, personal communication 2 June 2005).

Hinton Wood Products manufactures kiln-dried lumber, and Hinton Pulp produces northern bleached softwood kraft pulp marketed as Hinton Hi-Brite (Weldwood 2004). The primary markets for these products are North America, South America, Asia, and Europe (Weldwood 2004). The lumber mill manufactures quality kiln-dried lumber, some of which is certified to the Japanese Agricultural Standard for export.

Table A3 reveals the extent of volatility in both production at the Hinton mills and product price. In 1998, Hinton Pulp recorded a 5-year production low. The 1998 decrease in pulp production coincided with a price drop of \$27/Mt. Prices continued to drop in 1999, but

by 2000 they had increased to 5-year high levels (Table A3). Pulp production followed the price decline (decreasing by 43 000 t in 1998) but did not effectively rebound, despite pulp prices reaching a 5-year high in 2000.

Lumber experienced similar price instability, dropping in 1998 by \$72/thousand board feet (Mfbm), rebounding in 1999 by \$93/Mfbm, and dropping again in 2000 by \$149/Mfbm (Table A3). Despite the price fluctuations production levels remained relatively stable over the period. The stability in production can be partly explained by a mixed marketing strategy for export lumber, which provides a buffer against North American commodity price swings (Jim LeLacheur, West Fraser Ltd., Hinton, Alberta, personal communication 2 June 2005).

Revenue for Hinton pulp and Hinton Wood Products decreased dramatically in 1998 as a result of low production and prices. In 1999, pulp revenue remained relatively unchanged, but growth in lumber revenue was strong because of price recovery. In 2000, pulp revenue increased, despite slight production decreases due to the large pulp price increase of \$187/Mt. Despite stable production, lumber revenue dropped in 2000 as prices fell to 5-year record lows (Table A3). It is noteworthy that lumber production has been valued according to published commodity prices such that it approximates revenue and that fluctuations in revenue over time may not reflect the stability of the revenue actually obtained through the mixed marketing strategy.

Table A3. Hinton pulp and sawmill production and revenue, 1996 to 2001^a

Year	Pulp			Lumber		
	Price (2001 dollars/Mt)	Production (t)	Revenue (2001 dollars)	Price (2001 dollars/Mfbm) ^b	Production (Mfbm)	Revenue (2001 dollars)
1996	904.90	406 543	375 326 702	576.82	223 266	128 784 024
1997	900.06	414 130	372 113 880	575.25	227 517	130 879 170
1998	873.28	371 122	325 288 219	503.38	233 606	117 593 540
1999	852.84	376 318	319 753 133	596.36	230 473	133 454 718
2000	1 038.95	375 603	390 232 232	447.43	241 812	103 426 177
2001	1 123.03	411 803	462 466 059	425.98	243 990	103 933 864

^aSources: Toronto Dominion Bank 2005; Hugh Loughheed, West Fraser Ltd., Hinton, Alberta, personal communication 8 February 2005.

^bMfbm = thousand board feet.

Note: Figures have been rounded so sums may not total.

Forestry also makes significant economic contributions in Grande Cache. The Grande Cache lumber mill manufactures a variety of products, including framing lumber, premium-grade lumber for the export market, and machine stress rated lumber used in roof trusses and other commercial applications. Weyerhaeuser purchased the sawmill in 1992 and sold it in 2003 to C & C Wood Products Ltd. C & C plans to produce value-added forest products (Weyerhaeuser 2003, 2004). During Weyerhaeuser's operation, the mill produced an estimated 130 million board feet of lumber per year and the estimated revenue generated by lumber production in 2001 was \$55 million dollars (price \$425.98 per million board feet, in 2001 dollars) (Weyerhaeuser 2003; Toronto Dominion Bank 2005). Before the sale in 2003, the mill ceased operation, which eliminated the jobs of 156 employees (Weyerhaeuser 2003). C & C Wood Products Ltd. began production in late 2004.

Mining

Coal has been mined in the FtMF for over a century, initially by an underground approach, but now primarily with standard open-pit truck and shovel equipment (the only exception being the underground operation of the Smokey River Coal Mine). The two types of coal mined in the FtMF are thermal bituminous and metallurgical bituminous. The thermal bituminous coal is

exported for industrial power generation, whereas the metallurgical bituminous coal (coking coal) is exported for producing coke, the reducing agent and heat source used in steel-making processes (Natural Resources Canada 2004c). The metallurgical coal produced in the FtMF primarily supplies the international steel markets in Asia (EUB 2001). The thermal coal, which comes from the Coal Valley and Obed Mountain mines, is also exported to foreign markets, although shipments to Ontario have recently resumed (EUB 2001).

As of 2001, three mines were producing coal in the FtMF: the Cardinal River Coal Mine, the Coal Valley Coal Mine, and the Obed Mountain Coal Mine. The combined production from these mines totaled 9.3×10^6 t of raw, high- to medium-volatility bituminous coal, representing 13% of all Canadian coal production (Table A4). Coal mining continues to contribute substantially to the regional economy despite major disruptions in operations, and the phasing out of mature mines. For example, production at the Gregg River Mine (owned by Luscar Limited) finished at the end of 2000, and the mine is currently undergoing reclamation. Both surface and underground operations at the Smokey River Coal Mine near Grande Cache were discontinued for 2001 (Table A4) but resumed in summer 2004 (GCCC 2004). In May 2003, production at the Obed Mountain Mine (Luscar Limited) was also suspended.

Luscar Limited currently has just one mine in production within the FtMF region, the Coal Valley Coal Mine, located 100 km south of Edson, which produced 3.01×10^6 t of raw thermal bituminous coal in 2001 (Table A4). The Elk Valley Coal Corporation owns the Cardinal River Coal Mine and the Cheviot Mine, the latter of which is currently under development. The Cardinal River and Cheviot mine sites are relatively close to one another and share the Cardinal River preparation plant, located 42 km south of Hinton. In 2001, the Cardinal River preparation plant was the only operating plant in Alberta producing clean metallurgical coal for export (EUB 2001). The Elk Valley Coal Corporation expanded within the FtMF in fall 2004, when the new Cheviot Mine commenced operation. This mine was initially predicted to produce 1.4×10^6 t/year. The Cheviot

and Cardinal River operations will together supply the processing plant with 2.8×10^6 t of metallurgical coal per year (Elk Valley Coal 2004). Eventually, production at Cheviot will be increased as the Cardinal River operation is phased out, which will allow the processing plant to continue running at capacity.

The 2001 price of thermal bituminous coal was \$35.13/t (adjusted to 2001 dollars and FOB mine), and the estimated 2001 revenue from the Coal Valley and Obed Mountain operations was valued at \$190.8 million (Table A5). The price of thermal coal (adjusted for inflation) spiked during 1998 at \$36.07/t, decreased significantly during 1999, and reached a low of \$33.06/t in 2000 (Figure A2). Both price and production returned to moderate levels in 2001.

Table A4. Coal production in the Foothills Model Forest, 1996 to 2001 (data in raw tonnes)^a

Mine	1996	1997	1998	1999	2000	2001
Cardinal River	3 497 388	3 468 445	3 555 274	2 988 309	3 473 163	3 864 436
Gregg River	2 861 369	3 016 631	2 453 458	2 988 309	1 535 775	0
Coal Valley	3 518 124	3 529 819	3 865 179	3 335 865	2 445 838	3 017 285
Obed Mountain	3 034 660	2 599 442	2 698 866	2 494 389	2 577 871	2 414 423
Cheviot	0	0	0	0	0	0
Smokey River						
Underground	1 212 915	953 462	1 226 870	692 129	345 256	0
Surface	2 640 751	2 491 259	2 399 577	1 433 207	51 580	0
Alberta	NA ^b	NA	NA	NA	30 896 834	30 911 020
Canada	NA	NA	NA	NA	70 470 574	70 470 574

^aSources: Shad Watts, Alberta Department of Energy, Edmonton, Alberta, personal communication 5 May 2003; CAC 2004.

^bNA = not available.

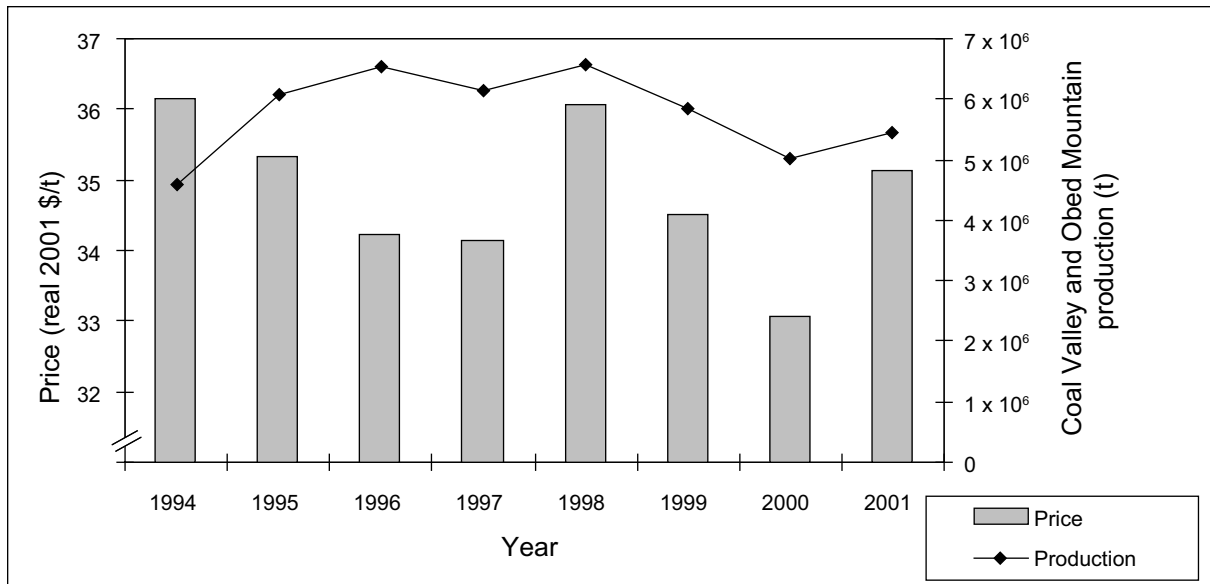


Figure A2. Production of and price for thermal bituminous coal from the Coal Valley and Obed Mountain mines in the Foothills Model Forest, 1994 to 2001. Sources: Shad Watts, Alberta Department of Energy, Edmonton, Alberta, personal communication 5 May 2003; EIA 2004a.

Prices for metallurgical bituminous coal averaged \$50.06/t in 2000, generating estimated revenue of \$193.5 million for the Cardinal River mine in 2001 (Table A5). Metallurgical coal experienced pricing trends similar to those of thermal coal: the price spiked in 1998 at \$51.47/t, then declined significantly during 1999 and 2000. The 2000 average price (\$46.82/t) was the lowest over an 8-year period, but the price recovered to \$50.06/t in 2001 (Figure A3). Total FtMF coal revenue for 2001 was valued at \$384.3 million (Table A5), significantly less than the 1996 baseline revenue estimate of \$494.0 million (nominal 1996 Canadian dollars).

The FtMF production decline is partially explained by the phasing-out of the Gregg River operation, which leaves only the Cardinal River Coal Mine producing metallurgical coal in the area. However, the future of metallurgical coal production in the FtMF is promising. Despite strong opposition from environmental coalitions to development during the approval process, the Cheviot pit run by Elk Valley Coal Corporation

is now active and is expected to produce 2.8×10^6 t/year based on 62×10^6 t in total reserves (Elk Valley Coal 2004). The Grande Cache Coal Corporation has re-activated both of the Smokey River coalfields, and the current production plan is to produce 24.7×10^6 t of saleable coal over a 12-year period (from 2004 to 2016) (GCCC 2004). Production at the Smokey River mine sites started again in August 2004, with each mine contributing 50% to production.

Employees at the Cardinal River operation will finish processing that mine's reserves and will then be shifted to work at the Cheviot pit. The combined employment at the Cardinal River and Cheviot mines is 250 positions. The Coal Valley operation has 230 employees, and the Grande Cache Coal Corporation employs a total of 250 people (GCCC 2004). Total current direct employment in the mining sector within the FtMF is estimated at 730 positions, although Statistics Canada's employment estimate for the mining sector in 2001 was 590 (Statistics Canada 2004).

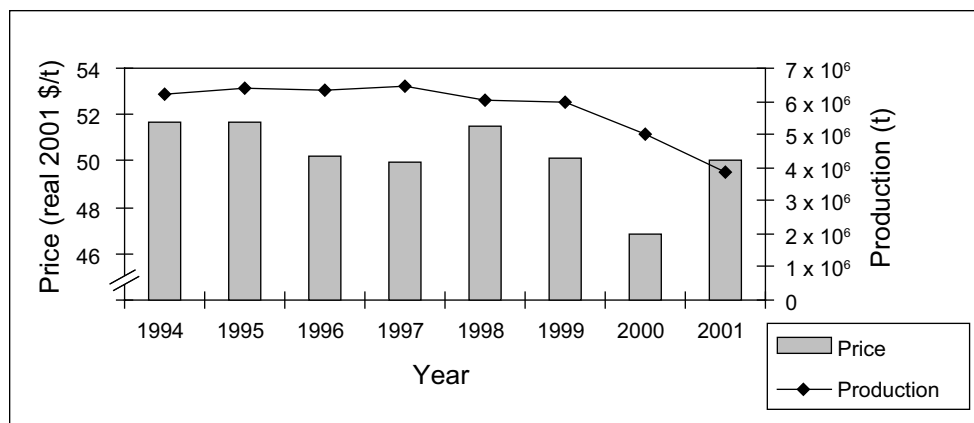


Figure A3. Production of and price for metallurgical coal from the Foothills Model Forest, 1994 to 2001. Sources: Shad Watts, Alberta Department of Energy, Edmonton, Alberta, personal communication 5 May 2003; EIA 2004b.

Table A5. Price, production, and revenue for coal produced in the Foothills Model Forest, 2001^a

Mine	Price (\$/t)		Production (t)	Revenue (2001 dollars)
	Metallurgical	Thermal		
Cardinal River	50.06	–	3 864 436	193 462 318
Coal Valley	– ^b	35.13	3 017 285	105 997 222
Obed Mountain	–	35.13	2 414 423	84 818 680
2001 total	50.06	70.26	9 296 144	384 278 220

^aSources: Shad Watts, Alberta Department of Energy, Edmonton, Alberta, personal communication 5 May 2003; EIA 2004a; EIA 2004b.

^bDashes indicate not applicable.

Crude Petroleum and Natural Gas

The Western Canada Sedimentary Basin, a geologic formation that encompasses the FtMF, is responsible for Alberta's significant oil and natural gas reserves. Both natural gas and oil are relatively new resource sectors in the FtMF region, and increasing energy development in the region is expected to bring economic opportunities. Natural gas production begins with extraction at the well site; the gas is then processed, compressed, and distributed by pipeline throughout Canada and the United States (Natural Resources Canada 2002b). Various industrial sectors, the primary source of demand, use petrochemicals as a source of heat, power, and chemical feedstock (Natural Resources Canada 2002b). Further demand originates from the electricity requirements of residential and

commercial sectors. Natural gas is growing in economic importance, and approximately 60% of Canadian natural gas production is exported to the United States (Natural Resources Canada 2002b).

A new development to the FtMF region is the processing of natural gas from coal (NGC), also known as coalbed methane. NGC is an almost pure form of natural gas that is found in various coal deposits. This unconventional resource is expected to contribute significantly to Alberta's and Canada's future energy supply. Extraction of NGC is in its early stages, but the process is remarkably similar to extraction of conventional natural gas. In terms of potential, there is an estimated $14.2 \times 10^{12} \text{ m}^3$ of NGC located throughout the eastern slopes of Alberta (Alberta Department

of Energy 2004). Even though NGC is of higher quality than natural gas from traditional sources, it is considered less economically viable because of somewhat higher production costs (Alberta Department of Energy 2004).

Total natural gas production from the FtMF region has increased substantially, from about 3.6×10^9 m³ in 1996 to about 5.4×10^9 m³ in 2001, an increase of about 1.8×10^9 m³ (Table A6). This translates into a production growth rate of 51%. The increased production also resulted in an increase in the share of FtMF production as a percentage of the Alberta total, from 1.2% in 1996 to 3.9% in 2001 (Table A7). These figures demonstrate the growing importance of natural gas activity to the region and the rest of the province.

The increased natural gas activity in the FtMF may be a result of increases in commodity

prices, from an average of \$1.73/GJ in 1996 to \$5.12/GJ in 2001, nearly a tripling in real-dollar terms (Table A6).

The combination of increasing price and increasing production generated a dramatic change in natural gas revenue for the region over the period 1996 to 2001. Gross revenue in 2001 reached \$1.05 billion, an increase of more than \$800 million over 1996 levels. This substantial increase represented a revenue growth rate of almost 350% (Tables A6 and A7).

The average price of natural gas rose continuously until 2001, but in 2002 it crashed because of a mild winter and massive reductions in demand in the industrial sector; in 2003 and 2004, prices recovered to 2001 levels (Figure A4).

Table A6. Natural gas production, price, and revenue in the Foothills Model Forest, 1996 and 2001^a

Year and region	Natural gas (m ³)	Price (\$/GJ)	Revenue (2001 dollars)
1996			
Foothills Model Forest	3 553 607 471	1.73	234 905 894
Alberta	132 311 040 000	1.73	8 746 231 221
2001			
Foothills Model Forest	5 377 473 934	5.12	1 052 026 385
Alberta	140 580 480 000	5.12	27 529 431 713

^aSources: CAPP 2003; Tom Churchill, Alberta Department of Energy, Edmonton, Alberta, personal communication 9 December 2004.

Table A7. Natural gas statistics for the Foothills Model Forest and Alberta, 1996 to 2001^a

Variable	Value (%)
Foothills Model Forest as percent of Alberta	
1996	1.16
2001	3.85
Production growth rate	
Foothills Model Forest	51.11
Alberta	6.25
Revenue growth rate	
Foothills Model Forest	348.85
Alberta	214.75

^aSources: CAPP 2003; Tom Churchill, Alberta Department of Energy, Edmonton, Alberta, personal communication 9 December 2004.

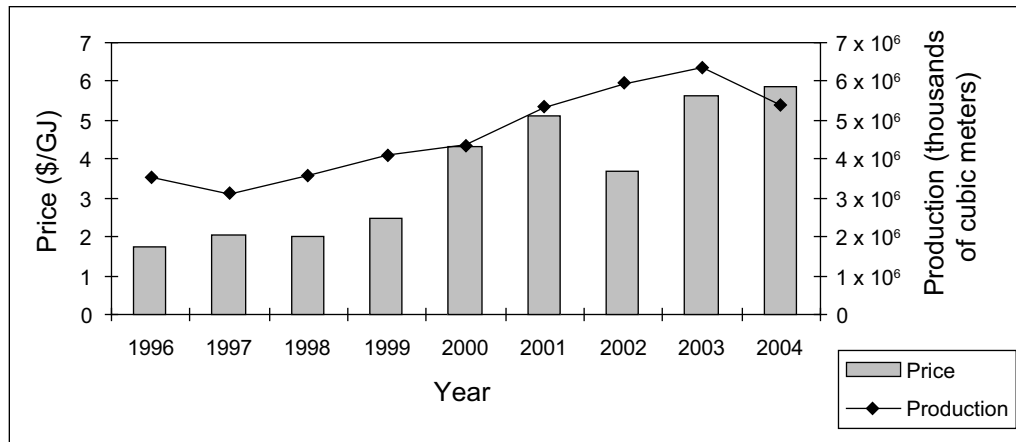


Figure A4. Production of and price for natural gas from the Foothills Model Forest, 1996 to 2004. Sources: Natural Resources Canada 2002a; Tom Churchill, Alberta Department of Energy, Edmonton, Alberta, personal communication 9 December 2004.

Crude oil is another important mineral resource in the FtMF, although it is not as important as natural gas. The term “crude oil” encompasses light, medium, and heavy crude oil, which differ in specific gravity. The oil produced in the FtMF is graded as light, sweet crude and is valued because of its low sulfur content. For example, light, sweet crude yields high-value products such as gasoline, diesel fuel, heating oil, and jet fuel (FuturesBuzz 2004).

Trends in the production of oil in the FtMF have differed from those of natural gas. In 1996, oil production totaled 200 508 barrels (bbl), but by 2001 it had dropped to 173 483 bbl (Table A8). Nonetheless, in general terms, oil production in the FtMF was relatively static over this period (Figure A5). Crude oil production for Alberta as a whole also decreased slightly from 1996 levels. The change in oil production from 1996 to 2001 was -13.5% for the FtMF and -0.8% for

Alberta. Despite current declines in production, new technology presents an opportunity to revisit existing FtMF oil wells to extend production when commodity prices are high (Natural Resources Canada 2004b).

Regardless of the production decreases in Alberta and the FtMF, prices for crude oil have remained strong, and significant revenue has been generated from these resources. Crude oil prices have increased by \$5.61/bbl in real 2001 dollars (Table A8). Crude oil experienced a price spike in late 2000 that continued into the early part of 2001. Prices fell again during the late part of the year, but the average 2001 price was substantially higher than the average 1996 price, which more than compensated for reduced production (Figure A5) (Natural Resources Canada 2004b). Despite the production decreases, oil revenues grew by 1.3% from 1996 to 2001.

Table A8. Crude oil production and revenue in the Foothills Model Forest and Alberta, 1996 and 2001^a

Year and location	Crude oil (bbl)	Price (\$/bbl)	Revenue (\$)
1996			
Foothills Model Forest	200 508	32.77	6 570 647
Alberta	568 305 000	32.77	18 623 354 850
2001			
Foothills Model Forest	173 483	38.38	6 657 615
Alberta	563 560 000	38.38	21 627 279 581

^aSource: Tom Churchill, Alberta Department of Energy, Edmonton, Alberta, personal communication 9 December 2004.

Note: Figures have been rounded so sums may not total.

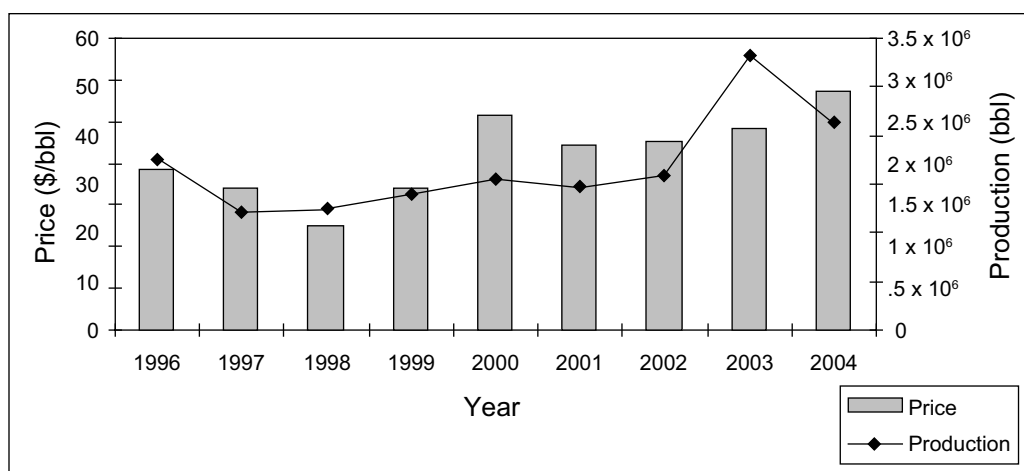


Figure A5. Production of and price for oil from the Foothills Model Forest, 1996 to 2004.

Source: Tom Churchill, Alberta Department of Energy, Edmonton, Alberta, personal communication 9 December 2004.

Development of oil and natural gas resources also yields valuable by-products, termed condensates and pentanes. These spin-off products consist of a mixture of pentanes and heavier hydrocarbons (EUB 2004). Condensates (liquid hydrocarbons) are extracted in a gaseous state, but become liquid as they cool. Pentanes (hydrocarbons) are obtained during the processing of raw gas, condensates, and crude oil (EUB 2004). Because of the large scale of natural gas production in the FtMF, production of condensates and pentanes is significant. Prices for condensate and pentanes are not available, so the value of natural gas and crude oil as reported here is slightly underestimated. Consistent with natural gas production, production of by-products has increased significantly, from 21 143 bbl in 1996

to 104 100 bbl in 2001 (Tom Churchill, Alberta Department of Energy, Edmonton, Alberta, personal communication 9 December 2004).

Visitor Sector

The importance of visitors to a region cannot be determined solely by analyzing tourism. The definition of tourism is variable and may relate to distance traveled, number of nights away from home, purpose of trip, or some variation or combination of all three (Wellstead et al. 2000). To avoid ambiguity, this analysis follows the example of Wellstead et al. (2000), who used the term “visitors” rather than “tourists.” This term allows consideration of data for everyone traveling to the FtMF for business and personal reasons.

Visitor opportunities within the FtMF are seemingly endless, and every year guests to the area include regional visitors, visitors from the rest of the province, and “long-haul” visitors from North America, Europe, and Asia. Visitor destinations within the FtMF include natural resource locations (such as coal, natural gas, and oil), Jasper National Park, Willmore Wilderness Park, William A. Switzer Provincial Park, and Mountain Park. The region boasts numerous RV (recreational vehicle) parks, recreation areas for horseback riding, areas for all-terrain vehicle use, lakes, and campgrounds. Hinton, Grande Cache, and Jasper each have recreation centers for skating, swimming, and racket sports. Additional recreation facilities include curling rinks, an automobile racetrack, tennis courts, skateboard parks, libraries, golf courses, and a Nordic ski center.

The FtMF region is regarded as the gateway to the Rockies by many visitors traveling west on the Yellowhead Highway into Jasper National Park. Monitoring of traffic flow indicated that a considerable amount of this traffic was destined for Jasper and points west, with a smaller proportion traveling specifically to Hinton and the surrounding area (Alberta Transportation 2003). Canadian baby boomers are predicted to have a continuing and increasing impact on mountain visits, and many of these visitors are interested in cultural, Aboriginal, and heritage sites (AED 2002a).

Jasper and Hinton offer visitors access to areas of natural beauty, and many visitors consider these towns less busy and congested than Banff and Canmore (AED 2002a). For people who frequent the area, Hinton is considered a gateway community and a relatively low-cost alternative for accommodation during visits to the Canadian Rockies (AED 2002a). Hinton hotels have reported that park visitors are becoming more price conscious and are therefore opting for Hinton accommodations, rather than paying the higher prices in Jasper. Even though park spillover is a welcome addition to the already vibrant Hinton hotel market, strong and steady business from industrial work crews continues to be the core of Hinton hotel activity (AED 2002a). Despite discounted hotel prices in nearby Hinton,

Jasper hotel operators have reported that recent visitation numbers have exceeded expectations, with an increase in demand coming from overseas visitors, particularly Europeans. Although Jasper hotel operators believe that visitor levels are not optimal, they are satisfied with levels of occupancy (AED 2004).

Grande Cache also contributes to the FtMF visitor sector. The community has called itself the “gateway to outdoor adventure” because of nearby mountain trails, rivers, lakes, the Death Race adventure racing series, and the numerous adventure outfitters that operate in the area (AED 2002a). The Grande Cache region also boasts thousands of visible dinosaur tracks located on rock faces. Many of these areas are easily accessible, and these historic sites represent an area of potential for economic development and diversification (AED 2002a).

Demand for lodging by individual tourists accounted for only 53.3% of total demand in Jasper in 1999 but 70.4% of total demand in 2001; conversely, demand by tour groups, which accounted for 33.6% of total demand in 1999, dropped to 17.9% of total demand in 2001 (Table A9). All other categories of lodging demand remained static in Jasper. In Hinton, demand for hotels declined for both industrial crews (from 34.0% of total demand in 1999 to 29.2% in 2001) and tour groups (from 11.4% of total demand in 1999 to 2.0% in 2001). Conversely, demand increased for business travelers (from 11.6% of total demand in 1999 to 19.5% in 2001) and conventions (from 0.9% of total demand in 1999 to 6.7% in 2001); demand from individual tourists remained fixed at 34.5% (Table A9).

Further analysis of accommodation information indicates that the 2001 occupancy rate was marginally higher in Hinton (69.9%) than in Jasper (60.0%). The occupancy rate for Grande Cache was not available and has been assumed to be the average between Hinton and Jasper (i.e., 65%) for the purpose of this analysis (Table A9). Actual numbers from Jasper accommodations surpassed those from Hinton because of larger overall capacity, and occupied room nights in Jasper were more than double those in Hinton (Table A10).

Table A9. Sources of room demand in the Foothills Model Forest, 1999 and 2001^{a,b}

Year and location	Industrial crew	Business travel	Tourist	Tour group	Convention	Other
2001						
Hinton	29.2	19.5	34.5	2.0	6.7	8.2
Jasper	0.0	3.5	70.4	17.9	5.5	2.6
Grande Cache	60–70	5–10	10–15	0–5	0–5	5–15
1999						
Hinton	34.0	11.6	34.5	11.4	0.9	7.5
Jasper	0.0	3.7	53.3	33.6	8.8	0.6

^aSources: AED 2002a, 2004.

^bData given as percentages of total for each town for each year.

Table A10. Summary of the Foothills Model Forest accommodation industry, 2001^a

Variable	Hinton	Jasper	Grande Cache
Annual occupancy rate (%)	70	60	65
Occupied no. of room nights	212 527	481 800	59 313
Annual average daily rate (\$)	68.75	180.00	68.75
Gross room revenue (\$)	14 611 262.53	86 724 000.00	4 077 734.38
No. of properties	20	22	6
Average no. of rooms/property	42	100	42
Available no. of room nights	304 045	803 000	91 250

^aSources: AED 2002b, 2004.

Gross hotel revenue in 2001 was estimated at \$86.7 million for Jasper and \$18.7 million for Hinton and Grande Cache combined. The difference in revenue can be attributed to higher volume of rooms in Jasper and significantly higher room rates: about \$70/night in Hinton and Grande Cache and \$180/night in Jasper (AED 2004). Hotels in Jasper average 100 rooms per property, whereas the average is 42 rooms per property in Grande Cache and Hinton. Accommodation information from Grande Cache, Hinton, and Jasper indicates that the FtMF centers enjoy vibrant markets, but that Jasper far exceeds Hinton and Grande Cache because of greater capacity and a stronger marketplace in terms of promotional efforts and international visitors (AED 2004).

Further analysis of overall visitor expenditures in the FtMF necessitates an investigation of spending in restaurants. According to Wellstead et al. (2001), meals represented 12.4% of accommodation-based expenditure in the FtMF in 1996. FtMF restaurant revenue can be estimated by multiplying the average yearly revenue for restaurants in Alberta (derived from restaurant, caterer, and tavern statistics [Wellstead et al. 2001]) by the number of restaurants in Grande Cache, Hinton, and Jasper. Using this calculation, yearly restaurant revenue in the FtMF was estimated at \$65.8 million (Table A11).

Expenditures by FtMF residents at restaurants within the region can be estimated by studying consumer expenditures within the FtMF (Wellstead et al. 2001). Restaurant spending by residents represented 25.7% of total expenditures at Hinton restaurants, but only 10.9% at Jasper restaurants (Wellstead et al. 2001). Visitors accounted for the remainder, which translates to restaurant revenue of \$28.7 million in Jasper and \$18.6 million in Hinton (Table A11). Total visitor expenditure on restaurants in the FtMF was estimated at \$47.3 million.

Camping is a popular activity for people visiting the FtMF from Canada and abroad. Most campsites are available from spring to early fall, with a few offering winter camping. Outside of Jasper National Park, campgrounds are privately owned and operated, with a total of 947 campsites available. A “high–low calculation” can be used as the basis for average revenue generated by privately owned campgrounds in the FtMF. A low occupancy of 11% and a high occupancy of 45% generates revenue estimates of \$228 700 and \$894 915, respectively, which yields a total average revenue of \$561 807 for these campgrounds (Table A12). Jasper National Park manages 1 851 sites, providing 237 777 available camp nights. Occupancy is 45% or 107 000 occupied campsites, which generates gross revenue of approximately \$1.9 million (Table A12).

Additional accommodation data were collected from the Jasper Private Home Association to estimate accommodation expenditures in private homes (home accommodation and bed and breakfast establishments). As of late 2004, a total of 187 licensed private homes were renting out an estimated 350 rooms within the FtMF (Jasper Private Home Association, Jasper, Alberta,

personal communication December 2004). The average room cost was \$75 per night, with 100% occupancy in July and August, 75% occupancy in June and September, and limited occupancy (weekends and holidays) for the rest of the year (Jasper Private Home Association, Jasper, Alberta, personal communication December 2004). Estimated revenue was \$3.1 million (Table A13).

Jasper National Park is the focal point for FtMF visitors and is considered the second most popular destination in the Rockies (after Banff) (AED 2003). In 2001, approximately 1 927 900 visitors traveled to Jasper, slightly more than the 1996 total of 1 759 800 (AED 2003). Hinton represents a service center for regional resource sectors (coal, oil, natural gas, and forestry) and highway traffic, and it also represents an accommodation overflow alternative to Jasper during the summer high season (AED 2002a).

Visitors generate significant benefits in the combined accommodation and food and beverage service industry, also known as the hospitality industry. The retail and service sectors also benefit from visitor demand. For example, retail expenditures by visitors to Jasper were estimated at \$33.1 million for 2003. Visitor expenditures on retail goods and services in the FtMF are not available for 2001 but can be estimated by assuming that the proportion of money spent on accommodations and restaurants relative to that spent on retail and services remained constant from 2001 to 2003. In 2003, expenditures by visitors on accommodations and restaurants represented about 63% of total expenditures. Excluding Grande Cache, the adjusted total expenditures by visitors to the FtMF in 2001 was estimated at \$261.5 million (see Table A14 for details).

Table A11. Estimated restaurant revenue in the Foothills Model Forest region, 2001^a

Variable	Hinton	Jasper	Grande Cache	Foothills Model Forest
No. of restaurants	35	45	12	92
Average yearly revenue	715 222	715 222	715 222	715 222
Revenue from Foothills Model Forest residents	6 420 905	3 508 163	– ^b	9 929 068
Revenue from visitors	18 611 865	28 676 827	–	47 288 692
Total yearly revenue	25 032 770	32 184 990	8 582 664	65 800 424

^aSources: Canadian Business Patterns 2001; Wellstead et al. 2001.

^bDashes indicate not applicable.

Table A12. Camping revenue for the Foothills Model Forest, 2001^a

Variable	No. of camp and recreational vehicle sites	No. of occupied campsites	Gross camping revenue (\$)
Hinton area, low estimate	947	22 870	228 700
Hinton area, high estimate	947	89 491	894 915
Average of low and high estimates	947	56 180	561 807
Jasper National Park	1 851	107 000	1 861 794
Total (using average estimate)	2 721	158 156	2 423 601

^aSources: Alberta Community Development 2002; Parks Canada 2004.

Table A13. Revenue for accommodation in licensed private homes in the Foothills Model Forest, 2001^a

Time of year	No. of occupied nights	Revenue (\$)
June to September	22 814	1 711 050
Rest of the year	17 952	1 346 400
Total	40 766	3 057 450

^aSource: Jasper Private Home Association, Jasper, Alberta, personal communication December 2004.

Note: Cost per night throughout the year was \$75.00.

Table A14. Summary of estimated visitor sector expenditures in the Foothills Model Forest (excluding Grande Cache)

Category	Expenditure (\$ millions) and % of total	
Accommodations (including camping and bed and breakfasts)	106.8	(40.8)
Restaurants	57.2	(21.9)
Subtotal	164.0	(62.7)
All other expenses	97.5	(37.3)
Total	261.5	

Rest of the Economy

The rest of the economy is a composite sector comprising agriculture, retail, manufacturing, commercial and residential construction, domestic services, and the public sector (education, health, and government services).

Agriculture

Agriculture plays a minor role in the FtMF regional economy. Most agricultural production takes place in the eastern sections of Yellowhead County, which lie outside FtMF boundaries. Statistics Canada boundaries do not correspond directly to the boundaries of the FtMF study area, which means that a broader agricultural analysis will overestimate agricultural activity in the FtMF economy (Patriquin et al. 2004).

The minimal agricultural activity in the FtMF is due primarily to a lack of suitable soil. According to the Canadian land inventory, FtMF soils range from class 5 to class 7 (Natural Resources Canada 2004a), with the latter dominating. Class 7 soils have no capability for arable culture or permanent pasture, which prevents agricultural production on most FtMF land (Natural Resources Canada 2004a). Class 6 soils, located primarily along a corridor stretching northeast to Obed and southwest past Hinton, are capable of producing only perennial forage (Natural Resources Canada 2004a). A small proportion of the north and northeast areas of the FtMF has class 5 soil, which is deemed severely limited and able to produce only perennial forage (Natural Resources Canada 2004a).

Actual use of land with class 5 and 6 soils in the FtMF is typically for rough grazing and rangeland. Areas with these uses are natural grasslands with up to 25% coverage by assorted bushes and trees;

sporadic wet hay lands are included, as long as the land is being used (Natural Resources Canada 2004a). Rangeland within the FtMF is provincially owned and operated by Alberta Sustainable Resource Development, which determines stocking rates on public grazing lands. The department has determined that FtMF carrying capacity is 4 324 animal unit months (AUM, the amount of forage required by an animal for 1 month). As of October 2000, only 3 634 AUMs were being actively grazed, slightly less than the carrying capacity (Patriquin et al. 2004). The FtMF carrying capacity was distributed among 32 active grazing dispositions covering 7 987 ha for local livestock production.

Economic studies indicate that private pasture rents in Alberta are approximately \$25/AUM, assuming the existence of fencing and water infrastructure (AFRD 2004). Public pasture rent in Alberta is significantly less, averaging \$2.50/AUM, but public pasture renters are responsible for fencing and municipal taxes. Public pasture rent in the FtMF has been calculated as \$1.39/AUM, much less than the Alberta average (Dave Karasek, Alberta Sustainable Resource Development, Edson, Alberta, personal communication 9 December 2004). Rent per AUM provides the basis for valuing pastureland production within the FtMF. The potential cost to producers to pasture livestock elsewhere would be \$25/AUM, so a replacement cost for operations on FtMF public lands can be estimated as \$85 799. The actual revenue per AUM from public land grazing in Alberta is variable, and the total revenue is significantly lower than this amount (\$5 051) (Table A15). The amount of grazing on public land in the FtMF is insignificant relative to Alberta totals.

Table A15. Pasture rent in Alberta and the Foothills Model Forest, 2001^a

Region	Animal unit months (AUM)	Rental cost (\$/AUM)			Pasture rent collected by Alberta government (\$)
		Private pasture	Public land	Replacement value (\$)	
Foothills Model Forest	3 634	25.00	1.39	90 850	5 051
Alberta	1 600 000	25.00	2.50	40 000 000	4 000 000

^aSources: FtMF 2002; ASRD 2004b.

Retail

Retail operations (stores supplying consumers) are situated in the FtMF centers of Hinton, Grande Cache, and Jasper. The size of the FtMF retail sector remained stable at 148 establishments over the 3-year period 1999 to 2001 (Table A16). Analysis of 2000 and 2001 data for FtMF retail stores reveals revenue growth of 5.6% and 9.1%, respectively (Table A16). FtMF retail employment was estimated at 1 285 positions: 780 in Hinton, 200 in Grande Cache, and 305 in Jasper (Table A16). Retail locations sell primarily clothing, electronics, hardware, sporting goods, fuel, and groceries.

Manufacturing and Construction

In 2001, manufacturing and construction employed almost 1 500 FtMF residents (Table A17).

Manufacturing in the rest of the economy consists of non-forestry manufacturing, and construction includes renovations, additions, and new residential and commercial developments. A breakdown of Hinton building permits exemplifies the construction industry's economic contribution in the FtMF. In 2001, Hinton building developments totaled \$9.3 million, which accounted for only part of the total value of construction in the FtMF (Table A18). A more accurate estimate of the total value of construction in the FtMF would require similar estimates for Jasper, Grande Cache, and the surrounding rural area, but similar data were not available.

Table A16. Retail statistics for the Foothills Model Forest (excluding Grande Cache), 1999 to 2001^a

Year	Revenue (\$)	Revenue growth rate (%)	No. of establishments
1999	170 566 436		148
2000	180 098 728	5.59	150
2001	196 537 947	9.13	148

^aSource: Statistics Canada 2001b.

Table A17. Employment statistics for the rest of the economy, Foothills Model Forest, 2001^a

Region	No. of employment positions		
	Manufacturing and construction industries	Retail trade	Wholesale trade
Hinton	1 150	780	120
Jasper	110	305	15
Grande Cache	215	200	15
Foothills Model Forest			
Without Grande Cache	1 260	1 085	135
With Grande Cache	1 475	1 285	150

^aSource: Statistics Canada 2001c.

Table A18. Dollar value of building developments in Hinton, Alberta, 1996 to 2002^a

Type	1996	1997	1998	1999	2000	2001	2002
Residential	9 447 120	14 698 600	7 630 140	1 583 246	1 600 800	1 240 660	2 573 043
Commercial or industrial	2 600 000	6 418 000	765 000	2 380 250	5 655 000	2 504 000	9 969 800
Institutional	550 800	1 595 000	1 346 940	4 950 000	1 494 000	4 245 900	1 600 000
Parks and recreation	0	0	0	0	0	0	200 000
Community service	0	0	0	0	410 000	1 315 000	7 500
Total	12 597 920	22 711 600	9 742 080	8 913 496	9 159 800	9 305 560	14 350 343

^aSource: Town of Hinton 2004.

Sand and gravel operations (excavating, crushing, and distribution) also contribute to the rest of the economy in the FtMF. These businesses are based in Hinton, Grande Cache, and Edson (servicing Yellowhead County). They provide wholesale sand and gravel, and also haul and supply such products for industrial construction. Production and price for sand and gravel are unavailable, which leads to an underestimation of the value of the rest of the economy in the FtMF.

Domestic Services

The domestic service sector encompasses only expenditures by residents and local businesses on non-industry services, such as insurance agents, banks, and real estate; businesses directly servicing an industry (e.g., forestry) are included in the corresponding sector analysis. In 2001 an estimated 454 businesses designated as domestic services operated in the FtMF region, 293 located in Hinton and 161 in Jasper. An additional 99 businesses designated as domestic services operated in Grande Cache, bringing the FtMF total to 553 businesses. Hinton has the largest population to support service businesses; Jasper restricts business development in an effort to uphold high tourist standards.

Categorization and distribution of non-industry services shows that Hinton, Grande Cache, and Jasper offer a similar range of services (Table A19). The transportation and storage division represents an exception, with Hinton having a distinct advantage. These services have a strong link to the natural resource industries.

Financial, realty, insurance, esthetic, and automotive services make up the bulk of services offered. The domestic service analysis for the FtMF may underestimate overall value because of omission of data from Yellowhead County.

Public Sector

The FtMF public sector assessment includes employment information for Hinton, Jasper, Grande Cache, and Yellowhead County and therefore overestimates true FtMF value, because of the inclusion of rural municipalities lying outside FtMF boundaries. Table A20 provides a breakdown of public employees by service. The general service category includes municipal, provincial, and federal government services. The social service category consists of educational, health, and social services. The utilities category consists of communication, energy, and waste transfer services.

The social service category employs the largest number of FtMF residents, with approximately 60% of FtMF full-time public sector employment (Table A20). The Hinton area has significantly more social service employees because of its larger population. General public sector employment in the Jasper region is largely due to Parks Canada employment. Grande Cache public sector employment is significant because of a minimum-security penitentiary, which employs approximately 150 people (AED 2002a). In total, the FtMF public sector employs approximately 1 900 persons (Table A20).

Table A19. Establishment counts in the service sector of the Foothills Model Forest, by division, 2001^a

Location	No. of establishments				
	Finance and insurance industries	Real estate operator and insurance agent industries	Business service industries	Other service industries	Transportation and storage industries
Hinton	24	33	63	80	93
Jasper	24	30	22	79	6
Grande Cache	7	10	19	40	23
Foothills Model Forest					
Without Grande Cache	48	63	85	159	99
With Grande Cache	55	73	104	199	122

^aSource: Canadian Business Patterns 2001.**Table A20. Employment statistics for the public sector in the Foothills Model Forest, 2001^a**

Region	No. of employees		
	General	Social	Utilities
Hinton	140	645	10
Jasper	230	160	10
Grande Cache	195	150	85
Yellowhead County	100	180	0
Total	665	1 135	105

^aSource: Statistics Canada 2001a.

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■ APPENDIX B

Computable General Equilibrium Model Specification

The computable general equilibrium modeling framework used in this study is characterized by five categories of equations (Table B1): demands for factors of production and intermediate inputs, unit costs of production, final demand for sector output, market clearing conditions, and other equations required for closure of the model.

More specifically, equations 1–4 describe the demand for factors of production and intermediate inputs, assuming that producers minimize their costs of production subject to a Cobb–Douglas production function. Equation 5 is the derived

unit cost equation, assuming perfect competition. Equation 6 describes the final demand for output, assuming that households maximize their Cobb–Douglas utility function, subject to income constraints. Equations 7–9 describe the market clearing conditions, where the supply of inputs or outputs equals the total demand for inputs or outputs. Finally, Equation 10 is the household income equation.

Table B2 describes the endogenous and exogenous variables and additional model parameters.

Table B1. Equations for generalized linear computable general equilibrium model

1.	$L_j = X_j - [W - (\alpha_W W + \alpha_{R^K} R^K_j + \alpha_{R^D} R^D_j)]$	$j = \text{sector } 1, 2, \dots, 6$
2.	$K_j = X_j - [R^K_j - (\alpha_W W + \alpha_{R^K} R^K_j + \alpha_{R^D} R^D_j)]$	$j = \text{sector } 1, 2, \dots, 6$
3.	$D_j = X_j - [R^D_j - (\alpha_W W + \alpha_{R^K} R^K_j + \alpha_{R^D} R^D_j)]$	$j = \text{sector } 1, 2, \dots, 6$
4.	$X^C_{ij} = X_j$	$i, j = \text{sector } 1, 2, \dots, 6$
5.	$P_j = \sum_{i=1}^6 \delta_{p^c} P_{ij}^C + (\delta_W W_j + \delta_{R^K_j} R^K_j + \delta_{R^D_j} R^D_j + \delta_{PM} PM_j + \delta_{GT} GT_j)$	$i, j = \text{sector } 1, 2, \dots, 6$
6.	$X^F_j = Y - P_j$	$j = \text{sector } 1, 2, \dots, 6$
7.	$ELF = \sum_{j=1}^6 \beta_j L_j$	$j = \text{sector } 1, 2, \dots, 6$
8.	$X_j = \sum_{i=1}^6 \phi X^C_{ij} + \eta X^F_i + \theta E_j + \eta_G G_i$	$j = \text{sector } 1, 2, \dots, 5$ $i = \text{sector } 1, 2, \dots, 6$
9.	$E_j = -\phi(P_j - W^P_j + ER)$	$j = \text{sector } 1, 2, \dots, 5$
10.	$Y = \lambda_W ELF_j + \lambda_W W + \lambda_{R^K} K_j + \lambda_{R^K} R^K_j + \lambda_{R^D} D_j + \lambda_{R^D} R^D_j + \lambda_G G$	$j = \text{sector } 1, 2, \dots, 6$

Table B2. Model variables and parameters

Variable or parameter	Definition
Endogenous variable	
L	Labor
X	Output
R^K	Rental rate of capital
R^D	Rental rate of land
X^F	Final demand for output
X^C	Intermediate demand for output
Y	Household income
P	Domestic price of output
W^P	World price of output
ELF	Employed labor force
P^C	Intermediate outprice price
Exogenous variable	
K	Capital
D	Land
E	Exports
ER	Foreign exchange rate
G	Government expenditure
PM	Price of imports
GT	Indirect taxes
W	Wage rate
Parameter	
α	Factor share
β	Employed labor force share
φ	Intermediate demand share
η	Final demand share
θ	Export share
η_G	Government demand share
δ	Primary and intermediate input cost share
ϕ	Factor share of export demand
λ	Factor income share

■ APPENDIX C

Detailed Simulation Results from the Computable General
Equilibrium Models

The CGE model was used to generate simulations of economic impacts allowing a comparison of the relative sensitivity of major socioeconomic variables to marginal changes in each sector's output in 2001 and 1996. The sensitivity was expressed in terms of elasticity, defined as the percent change in a socioeconomic

variable resulting from a 1% change in the export value of a sector. The comparison of the 2001 and 1996 CGE models demonstrated the structural transition away from coal mining and toward natural gas extraction, while forestry, wood, and the visitor sector remained relatively stable.

Table C1. Detailed simulation results from the Foothills Model Forest computable general equilibrium model for 2001

Socioeconomic variable and sector	Elasticity (% change in socioeconomic variable for 1% change in value of sector exports)				
	Forestry export	Wood export	Mining export	Crude petroleum and natural gas export	Visitor activity
Revenue	0.21	0.03	0.10	0.49	0.10
Forestry	0.93	0.00	0.00	0.01	0.00
Wood	0.19	0.61	0.00	0.01	0.01
Mining	0.01	0.00	0.61	0.17	0.02
CPNG ^a	0.00	0.00	0.00	0.94	0.00
Visitor	0.04	0.01	0.01	0.09	0.78
Rest of the economy	0.21	0.03	0.09	0.57	0.15
Net regional product	0.25	0.03	0.09	0.58	0.11
Forestry	0.97	0.00	0.00	0.01	0.00
Wood	0.19	0.61	0.00	0.01	0.01
Mining	0.01	0.00	0.68	0.19	0.02
CPNG ^a	0.01	0.00	0.00	1.22	0.00
Visitor	0.04	0.01	0.01	0.09	0.78
Rest of the economy	0.21	0.03	0.09	0.57	0.15
Royalties	0.09	0.00	0.07	0.97	0.03
Forestry	0.97	0.00	0.00	0.01	0.00
Wood	0.19	0.61	0.00	0.01	0.01
Mining	0.01	0.00	0.68	0.19	0.02
CPNG ^a	0.01	0.00	0.00	1.22	0.00
Visitor	0.04	0.01	0.01	0.09	0.78
Rest of the economy	0.21	0.03	0.09	0.57	0.15
Income	0.30	0.06	0.11	0.37	0.16
Forestry	0.97	0.00	0.00	0.01	0.00
Wood	0.19	0.61	0.00	0.01	0.01
Mining	0.01	0.00	0.68	0.19	0.02
CPNG ^a	0.01	0.00	0.00	1.22	0.00
Visitor	0.04	0.01	0.01	0.09	0.78
Rest of the economy	0.21	0.03	0.09	0.57	0.15
Employment	0.23	0.04	0.09	0.41	0.24
Forestry	0.97	0.00	0.00	0.01	0.00
Wood	0.19	0.61	0.00	0.01	0.01
Mining	0.01	0.00	0.68	0.19	0.02
CPNG ^a	0.01	0.00	0.00	1.22	0.00
Visitor	0.04	0.01	0.01	0.09	0.78
Rest of the economy	0.21	0.03	0.09	0.57	0.15

^aCPNG = crude petroleum and natural gas.

Table C2. Detailed simulation results from the Foothills Model Forest computable general equilibrium model for 1996

Socioeconomic variable and sector	Elasticity (% change in socioeconomic variable for 1% change in value of sector exports)				
	Forestry export	Wood export	Mining export	Crude petroleum and natural gas export	Visitor activity
Revenue	0.26	0.04	0.20	0.14	0.19
Forestry	0.94	0.00	0.00	0.00	0.00
Wood	0.18	0.67	0.00	0.00	0.01
Mining	0.01	0.00	0.61	0.03	0.02
CPNG ^a	0.02	0.00	0.02	0.94	0.01
Visitor	0.03	0.00	0.02	0.02	0.86
Rest of the economy	0.22	0.03	0.14	0.14	0.20
Net regional product	0.29	0.04	0.19	0.18	0.18
Forestry	0.98	0.00	0.00	0.00	0.00
Wood	0.18	0.67	0.00	0.00	0.01
Mining	0.01	0.00	0.67	0.03	0.02
CPNG ^a	0.02	0.00	0.02	1.15	0.02
Visitor	0.03	0.00	0.02	0.02	0.86
Rest of the economy	0.22	0.03	0.14	0.14	0.20
Royalties	0.20	0.01	0.23	0.45	0.09
Forestry	0.98	0.00	0.00	0.00	0.00
Wood	0.18	0.67	0.00	0.00	0.01
Mining	0.01	0.00	0.67	0.03	0.02
CPNG ^a	0.02	0.00	0.02	1.15	0.02
Visitor	0.03	0.00	0.02	0.02	0.86
Rest of the economy	0.22	0.03	0.14	0.14	0.20
Income	0.26	0.06	0.19	0.12	0.21
Forestry	0.98	0.00	0.00	0.00	0.00
Wood	0.18	0.67	0.00	0.00	0.01
Mining	0.01	0.00	0.67	0.03	0.02
CPNG ^a	0.02	0.00	0.02	1.15	0.02
Visitor	0.03	0.00	0.02	0.02	0.86
Rest of the economy	0.22	0.03	0.14	0.14	0.20
Employment	0.21	0.05	0.14	0.13	0.29
Forestry	0.98	0.00	0.00	0.00	0.00
Wood	0.18	0.67	0.00	0.00	0.01
Mining	0.01	0.00	0.67	0.03	0.02
CPNG ^a	0.02	0.00	0.02	1.15	0.02
Visitor	0.03	0.00	0.02	0.02	0.86
Rest of the economy	0.22	0.03	0.14	0.14	0.20

^aCPNG = crude petroleum and natural gas.



Canada