



Economic Benefits Arising From the Construction and Operation of the Sisson Project



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by

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for

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EXECUTIVE SUMMARY

The Sisson Project will see the construction and operation of a tungsten and molybdenum mine, and associated processing facilities, located approximately 10 kilometres (km) southwest of Napadogan, and approximately 60 km directly northwest of the City of Fredericton, New Brunswick. The Project is owned by Northcliff Resources Ltd.

The per capita Gross Domestic Product (GDP) in New Brunswick is only 82.2% of the national average. Households appear to be doing relatively better than the rest of the economy as measured by the GDP, with a per capita personal disposable income that is 89.1% of the national figure. However, this seemingly better performance is largely due to a population rate growth that is much lower than the national one, and the growth in personal disposable income has lagged the national performance over the last ten years. The relatively good GDP performance of New Brunswick also masks a labour market that has trailed that of Canada over the last decade. As a consequence there is considerable spare capacity in the provincial labour market.

The economic benefits that are projected to be generated by the Project are substantial and of considerable duration. In particular:

- Construction phase capital expenditures for the Sisson Project are expected to reach \$578.8 million. New Brunswick will be the largest beneficiary, with estimated total expenditures of \$245.1 million (42.3% of the total) (see Table 1). Based on recent investment patterns, the Project would represent approximately 5.4% of total investment in New Brunswick for the first year of construction and 8.8% during the second year, providing business to provincial companies.

Table 1
Sisson Project Expenditures by Jurisdiction, \$ Million

	Construction	Operation	Total	%
New Brunswick	\$245.1	\$1,844.2	\$2,089.3	44.7%
Other Canada	\$170.6	\$1,539.5	\$1,710.1	36.6%
Total Canada	\$415.7	\$3,383.7	\$3,799.4	81.3%
Imports	\$163.2	\$709.2	\$872.4	18.7%
Total	\$578.8	\$4,092.9	\$4,671.7	100.0%

Source: Northcliff Resources and EcoTec Consultants

- The projected expenditures over the 27-year operations phase of the Project total \$4,092.9 million. It is estimated that \$1,844.2 million (45.1% of the total) will be spent in New Brunswick, an average of \$69.3 million each year. The length of this phase will provide greater economic opportunities for New Brunswick-based companies, which will be justified in making additional investments in order to qualify for Project-related business.
- Project construction and operations together are therefore expected to involve total expenditures of \$4,671.7 million, including \$2,089.3 million (44.7%) in New Brunswick.
- The GDP generated by the Project is expected to total \$5,910.7 million (see Table 2). This includes \$3,754.6 million (63.5%) in New Brunswick, comprising \$170.3 million from construction and \$3,584.3 million from operations.

Table 2
Gross Domestic Product Generated by the Sisson Project, \$ Million

	Construction	Operation	Total	%
New Brunswick	\$170.3	\$3,584.3	\$3,754.6	63.5%
Other provinces	\$348.7	\$1,807.5	\$2,156.1	36.4%
Total	\$519.0	\$5,391.7	\$5,910.7	100.0%

Source: EcoTec Consultants

- Household revenues, including salaries, benefits and income of unincorporated businesses, are expected to reach \$2,484.1 million in Canada, including \$1,324.2 million (53.3%) in New Brunswick.
- Together, the two phases of the Project will last 29-years and create 16,406 person-years of direct, indirect and induced employment in New Brunswick, representing 50.3% of Canada's total (Table 3). A person-year is the equivalent of a year's full-time employment for one person.
- The two-year construction phase of the Project is expected to generate an estimated 1,844 person-years of direct, indirect and induced employment in New Brunswick, and 4,942 person-years in Canada as a whole.
- The 27-year operations phase is expected to generate an estimated 14,561 person-years of direct, indirect and induced employment in New Brunswick, 52.6% of the total for Canada. This equates to an average of almost 540 full-time jobs in New Brunswick over the production life of the mine, including about 300 at the Project itself. The duration of operation phase employment will justify additional investments in Project-related training.

Table 3
Employment Generated by the Sisson Project,
by Jurisdiction, Person-Years

	Direct	Indirect	Induced	Total	%
New Brunswick	8,849	3,401	4,156	16,406	50.3%
Other provinces	977	7,619	6,717	16,214	49.7%
Total	9,826	11,020	11,773	32,619	100.0%

Source: EcoTec Consultants

- The Government of New Brunswick will collect an estimated \$20.1 million in construction phase-related direct, indirect and induced personal income tax, indirect taxes (such as sales taxes) and tax on corporate profits. The federal government will receive \$50.6 million, and the other provincial and territorial governments will share \$38.4 million.
- The tax revenues the Government of New Brunswick will receive during operations are estimated at \$722.8 million, including \$280.1 million as mining tax, \$245.0 million for provincial tax on corporate mining profit, and \$197.6 million for other tax revenues, including direct, indirect and induced effects. The federal government is expected to collect \$715.0 million, with other provincial and territorial governments sharing \$234.4 million.
- Government revenues arising from the Project as a whole are therefore expected to total \$1.78 billion. Tax revenues for the Government of New Brunswick are estimated at \$742.9 million, or 41.7% of the total, including \$525.2 million from mining operations and \$217.7 million from other sources.

In summary, the Sisson Project represents a major investment in New Brunswick that will provide it with economic benefits for about 30 years. The Project is a good match for the New Brunswick economy and will provide substantial benefits to both the province and Canada as a whole.

Within New Brunswick, the labour market situation is favourable for the Sisson Project. There are unemployed workers in occupations required for the Project, and labour force mobility within the province is high with workers willing to commute to where employment is available. New employment created by the Project will translate into more jobs for unemployed or under-employed New Brunswickers and have a minimal inflationary impact on incomes. Finally, the provincial economy is diversified and has the depth and breadth to provide a significant portion of goods and services required by the Project.

INTRODUCTION

The Sisson Project will see the construction and operation of a tungsten and molybdenum mine, and associated processing facilities, about 10 km southwest of Napadogan and 60 km northwest of the City of Fredericton, New Brunswick. The Project is owned by Northcliff Resources Ltd. of Vancouver, British Columbia.

This report identifies and quantifies the economic benefits of the Sisson Project. It outlines the expected costs of constructing and operating of the mine (including sustaining capital), and assesses the economic benefits expected to be generated by the Project in New Brunswick and for Canada as a whole.

The next section describes the context for the analysis by providing an overview of the New Brunswick economy. This is followed by a discussion of Project expenditures for construction, operations and in aggregate for them both, focusing on New Brunswick but also estimating the expenditures in other provinces and territories and in Canada as a whole. The final section discusses the benefits of these expenditures on Gross Domestic Product (GDP), employment and taxes, again with a focus on the benefits for New Brunswick.

NEW BRUNSWICK ECONOMY

In order to have a better understanding of the potential economic benefits of the Sisson Project on the New Brunswick economy, it is important to have a good understanding of its current state, and this section presents an overview of the economic situation in the province. The data used in documenting recent economic performance include the GDP, employment and other labour market statistics and demographics. The economic structure of the province is examined using detailed data about employment by industry.

New Brunswick has had a level of economic growth similar to that of Canada as a whole over the last decade. Over the 2001-2011 period, the provincial GDP (in 2002 dollars) rose by 21.6%, compared to the national GDP growth of 20.4%. Shorter-term growth in the New Brunswick has been consistently good, with five-year and one-year rates of growth of 7.0% and 3.1% respectively, compared to 6.2% and 3.2% respectively for Canada (See Table 4).

Table 4
Gross Domestic Product, Canada and New Brunswick,
\$ Billion and Percentages

	2010	1-Year Growth* (%)	5-Year Growth* (%)	10-Year Growth* (%)	Per Capita (\$)
Canada					
Total GDP	\$1,624.6	3.2%	6.2%	20.4%	\$47,606
Personal disposable income	\$1,279.9	1.2%	21.5%	11.0%	\$37,506
New Brunswick					
Total GDP	\$29.4	3.1%	7.0%	21.6%	\$39,116
Personal disposable income	\$25.2	1.1%	19.7%	10.0%	\$33,433

* Growth is calculated with deflated GDP numbers with base 2002=100.

Source: Statistics Canada, 384-0013

Despite this strong growth, the per capita GDP in the New Brunswick is still only 82.2% of the national average: \$39,116 compared to \$47,606. Households appear to be doing relatively better than the rest of the economy as measured by the GDP, with a per capita personal disposable income that is 89.1% of the national figure (\$33,433 versus \$37,506). However, this seemingly better performance is largely due to a population rate growth that is much lower than the national one, and the growth rate in personal disposable income has lagged the national performance over the last ten years. For example, the ten-year personal disposable income growth rate for New Brunswick is 10.0% vs 11.0% for Canada, while the five-year figures are 19.7% and 21.5% respectively.

The relatively good GDP performance of New Brunswick also masks a labour market that has significantly lagged national performance over the last decade, as shown in Table 5. For example, while total provincial employment increased by 6.3% from 2001 to 2011 (a net gain of 21,000 jobs), national employment increased by 15.8%, or about 2.5 times as fast. Over the last five years, the difference in the employment growth rate is even more striking: 5.5% for Canada compared to only 0.5% in New Brunswick.

The lower rate of job creation parallels a higher unemployment rate in New Brunswick. In 2011, the unemployment rate averaged 9.5% in the province and 7.4% in Canada. One positive development in the provincial labour market has been a lower unemployment rate compared to ten years ago (a decline of 1.5 percentage points). This is better than the national labour market that saw an unemployment rate 0.2 percentage points higher. Although its unemployment rate is higher than it was five years ago (+0.8 percentage points), the province still managed to do comparatively better than the national labour market (+1.1 percentage points). However, the relative performance of the New Brunswick job market has been in

decline lately: in 2011 the unemployment rate climbed by 0.2 percentage point over one year while the national average dropped by 0.6 percentage point.

Table 5
Labour Market Statistics, Canada and New Brunswick

	2011	1-Year Growth	5-Year Growth	10-Year Growth
Canada				
Total Employment, numbers	17,306.2	265.2	896.0	2,365.3
Total Employment, percentage		1.6%	5.5%	15.8%
Unemployment Rate	7.4	-0.6	1.1	0.2
Not in Labour Force*	9,288	1.7%	7.6%	11.4%
Ratio NLF / Total Employment	53.7%	0.1	1.1	-2.1
New Brunswick				
Total Employment, numbers	352.0	-4.1	1.7	21.0
Total Employment, percentage		-1.2%	0.5%	6.3%
Unemployment Rate	9.5	0.2	0.8	-1.5
Not in Labour Force*	230.2	2.7%	3.3%	0.0%
Ratio NLF / Total Employment	65.4%	2.4	1.8	-3.5

* Individuals who are 15 years and over but are neither working nor looking for employment.

Source: Statistics Canada 282-0002

Some of the reduction in New Brunswick's unemployment rate results from the out-migration of people in search of work. Another factor behind the seemingly better performance of the provincial labour market is the relatively high number of discouraged workers: people aged 15 years and over who are neither employed nor searching for work and hence not considered part of the labour force. The ratio of the number of people not in the labour force divided by total employment provides a proxy for how workers perceive the labour market: the higher the ratio, the more difficult it is to find employment. In 2011, the ratio stood at 65.4% in New Brunswick compared to 53.7% for Canada. This indicates that there is considerable spare capacity in the provincial labour market and that the economy is operating well below full employment. Any new employment that is created should translate into more jobs for unemployed or under-employed New Brunswickers and have a minimal inflationary impact on incomes.

THE SISSON PROJECT

This section provides a detailed description of the Sisson Project expenditures, including an analysis of the share accruing to New Brunswick and other jurisdictions. Separate discussion of the construction and operations expenditures is followed by consideration of the total spending on the Project.

Construction Expenditures

The construction expenditures for the Sisson Project are expected to total \$578.8 million over a two-year period. About 38% of these expenditures will occur during the first year, with the remainder spent during the second year. On the basis of private sector investment in construction, machinery and equipment in New Brunswick totaling \$4,063 million in 2011, the Project would represent approximately 5.4% of total investment in the province for the first year of construction and 8.8% during the second year.

The direct Project costs, such as for equipment (\$163.2 million), contractor indirects costs (including construction equipment and some plant facilities), buildings (\$43.0 million) and earthworks (\$32.1 million), represent the largest share of the construction costs with a total of \$337.4 million. There will be indirect costs of \$150.8 million, which include contracted indirects (engineering, procurement and construction management, pre-operational testing, etc.). Contingency funding and other expenditures total about \$90.6 million. (Table 6)

Table 7 provides a breakdown of the estimated construction expenditures by jurisdiction, based on the nature of the requirements listed in Table 6, the economy of New Brunswick and studies undertaken for other Canadian mining projects. Most of the \$245.1 million in expenditures to be made in New Brunswick provide businesses with opportunities related to site development and the construction of buildings, various facilities and tailings containment areas. The expenditures in the rest of Canada primarily relate to specialized mining and laboratory services, some process equipment, and engineering specific to mining. It is also assumed that some specialized construction contracts will be awarded to companies in central Canada, and that some specialized mining and processing equipment will be purchased from the United States or overseas.

Table 6
Sisson Project Construction Expenditures, \$ Million

Description	Mine (incl. SME Facility)	Concentrator (incl. Clarification Plant)	APT	TSF & Environmental	Infra-structure	Owner's Cost	Total
Earthwork	\$8.3	\$6.2	\$0.1	\$14.1	\$3.5	\$0.0	\$32.1
Buildings	\$1.2	\$32.2	\$2.7	\$0.0	\$6.9	\$0.0	\$43.0
Concrete	\$0.0	\$14.6	\$1.9	\$0.0	\$3.7	\$0.0	\$20.2
Steel	\$0.0	\$20.7	\$0.5	\$0.0	\$0.2	\$0.0	\$21.4
Equipment	\$24.5	\$105.5	\$21.0	\$11.2	\$0.9	\$0.0	\$163.2
Piping	\$0.0	\$13.5	\$4.9	\$0.0	\$0.2	\$0.0	\$18.6
Electrical	\$0.0	\$13.4	\$1.1	\$0.0	\$14.2	\$0.0	\$28.6
Instrumentation	\$0.0	\$7.3	\$2.6	\$0.0	\$0.4	\$0.0	\$10.4
Direct Cost	\$34.0	\$213.3	\$34.6	\$25.3	\$30.1	\$0.0	\$337.4
Contractor Ind.	\$1.2	\$43.8	\$8.3	\$2.0	\$4.9	\$0.0	\$60.2
Contracted Ind.	\$0.0	\$36.6	\$6.0	\$0.8	\$4.1	\$0.0	\$47.4
Spares	\$0.7	\$1.3	\$0.2	\$0.0	\$0.0	\$0.0	\$2.2
Initial Fills	\$0.0	\$4.1	\$0.9	\$0.0	\$0.0	\$0.0	\$5.0
Owner's Cost	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$36.0	\$36.0
Indirect Cost	\$1.9	\$85.9	\$15.3	\$2.8	\$8.9	\$36.0	\$150.8
Other Expend & Contingency	\$3.2	\$58.6	\$11.9	\$3.4	\$7.1	\$6.4	\$90.6
Total Cost	\$39.1	\$357.8	\$61.9	\$31.5	\$46.1	\$42.4	\$578.8

Source: Northcliff Resources

Table 7
Sisson Project Construction Expenditures, by Jurisdiction, \$ Million

	Total	%
New Brunswick	\$245.1	42.3%
Ontario	\$81.0	14.0%
Quebec	\$57.5	9.9%
Other provinces	\$32.1	5.5%
Total Canada	\$415.7	71.8%
Imports	\$163.2	28.2%
Total	\$578.8	100.0%

Source: EcoTec Consultants

Operating Expenditures

Based on projected production rates and the measured indicated and inferred reserves, production at the Sisson Project will last about 27 years. Tables 8 and 9 present the operating expenditures for the main Project components, and the expected annual expenditures, respectively.

There will be operation phase expenditures of about \$4.09 billion, including \$3.9 billion in operating expenditures and \$195.8 million in sustaining capital. The most expensive component will be milling at \$2.0 billion, or 48.9% of all operating expenses, followed by mining, with expenditures estimated at \$1.17 billion (28.5%).

Table 8
Sisson Project Operating Expenditures, \$ Million

	Amount	%
Milling	\$2,001.3	48.9%
Mining	\$1,168.1	28.5%
APT Plant	\$428.3	10.5%
Tailings	\$167.1	4.1%
Administration	\$132.3	3.2%
Sustaining capital	\$195.8	4.8%
Total	\$4,092.9	100.0%

Source: Northcliff Resources

The ramp-up to full production will be relatively rapid, with first year operating expenses expected to be \$152.9 million and second year outlays reaching \$157.0 million. The distribution of annual operating expenses over the 27-year production life of the mine is relatively constant with an average of \$151.6 million per year, and estimated annual operating expenditures ranging between \$126.5 million in Year 27 and \$164.0 million in Year 10.

Table 10 provides a breakdown of projected operating expenditures by jurisdiction. It should be noted that at the time of writing, during the Project's engineering phase, such an estimate is preliminary and draws on previous experience with other mining projects and an assessment of the likely location of suppliers for various goods and services required for the operation of such a Project.

Table 9
Sisson Project Operating Expenditures, by Year, \$ Million

Year	Amount	Year	Amount
1	\$152.9	15	\$159.6
2	\$157.0	16	\$161.5
3	\$147.1	17	\$151.4
4	\$149.0	18	\$155.3
5	\$152.8	19	\$155.1
6	\$152.7	20	\$153.4
7	\$152.1	21	\$162.2
8	\$150.8	22	\$149.8
9	\$150.4	23	\$148.1
10	\$164.0	24	\$147.6
11	\$159.3	25	\$142.9
12	\$155.3	26	\$138.5
13	\$151.1	27	\$126.5
14	\$146.6		
Total			\$4,092.9

Source: Northcliff Resources

Table 10
Sisson Project Operating Expenditures (\$ Million) and Employment, by Jurisdiction

	Expenditures	%	Employment	%
New Brunswick	\$1,844.2	45.1%	8,281	92.2%
Quebec	\$943.1	23.0%	517	5.8%
Ontario	\$574.8	14.0%	184	2.0%
Other provinces	\$21.6	0.5%	0	0.0%
Total Canada	\$3,383.6	82.7%	8,982	100.0%
Imports	\$709.2	17.3%	0	0.0%
Total	\$4,092.9	100.0%	8,982	100.0%

Source: EcoTec Consultants

It is estimated that the expenditures in New Brunswick will reach \$1,844.2 million, 45.1% of the total. Quebec and Ontario will see estimated expenditures of \$943.1 and \$574.8 million respectively, with a further \$21.6 million being spent directly in other provinces. The total Canadian content is projected to be \$3.38 billion, or 82.7% of total operating expenditures (including sustaining capital). Direct imports from other countries are projected at \$709.2 million (17.3%), mostly in the form of specialized parts, equipment and chemicals.

ECONOMIC BENEFITS

This section provides a detailed description of the economic benefits from the Sisson Project expenditures, with a focus on the share accruing to New Brunswick. This includes analysis of the effects on employment, GDP and tax revenues. Separate discussion of the construction and operations phase benefits is followed by consideration of the total benefits from the Project.

Construction Benefits

Direct employment for construction refers to the amount of employment (measured in person-years, where a person-year is considered to be 2,080 hours of work) that will occur at the Project site. It is expected that some direct employment will come from other provinces such as Quebec and Ontario, due to the national mobility in construction workers and the likelihood that some construction contracts will be awarded to firms outside of New Brunswick.

The direct employment created by the Project is estimated to total 844 person-years, including 568 filled by New Brunswick residents and 276 by workers from other provinces (Table 11). It should be noted that these workers may be working for (i) New Brunswick-based construction firms, (ii) firms from outside the province coming to deal with specific aspects of the construction or provide engineering supervision, or (iii) the Project owner or engineering companies associated with the Project but working in offices located in British Columbia or other provinces.

Table 11
Employment Generated by the Sisson Project Construction Expenditures, by Jurisdiction, Person-Years

	Direct	Indirect	Induced	Total	%
New Brunswick	568	916	361	1,844	37.3%
Quebec	105	436	427	967	19.6%
Ontario	142	615	544	1,301	26.3%
Other provinces	29	501	299	829	16.8%
Total	844	2,467	1,630	4,942	100.0%

Source: EcoTec Consultants

Indirect employment (i.e. workers employed by suppliers to the Project) is expected to account for 2,467 person-years, of which 916 will be in New Brunswick and 1,551 in other provinces. Suppliers include providers of all steel structural elements, machinery and mining equipment, electronics, pipes and tubes, concrete, furniture, and mobile equipment.

Induced employment is created by household expenditures and reflects where the manufacturers of goods and providers of services are located. For example, the purchase of a truck made in Ontario would generate some retail margin in New Brunswick, but with the bulk of the purchase cost flowing to the plant in Central Canada and some profit and various overhead charges flowing to other countries. It is expected that 361 person-years of induced employment will be generated in New Brunswick and 1,269 in other provinces, for a total of 1,630 person-years.

Hence, the construction phase of the Sisson Project is expected to generate an estimated 1,844 person-years of direct, indirect and induced employment in New Brunswick and 3,098 in the rest of the country, for a total of 4,942 person-years across Canada.

While employment is the measure by which the effects on the labour market are measured, the Gross Domestic Product (GDP) is the best measure for impacts in dollar terms. It relates to the value added generated within an economy and is widely used to measure the size and growth rate of national and provincial economies.

It is estimated that the construction phase of the Sisson Project will generate \$519.0 million in total GDP for Canada, including \$170.3 million in New Brunswick and \$348.7 million in the rest of Canada (Table 12). Direct GDP in New Brunswick is expected to amount to \$59.1 million out of a national total of \$87.6. Indirect GDP is estimated at \$64.5 million for the province and \$165.8 million for the rest of Canada for a total of \$230.3 million. Induced GDP for industries supplying households needs amounts to \$201.1 million, including \$46.7 million for New Brunswick and \$154.4 million for the other provinces.

The amount of household income included within the GDP is estimated at \$347.0 million, or 66.9% of the total GDP. Within New Brunswick, the household income is estimated at \$127.6 million, 74.9% of the total GDP generated in the province.

Table 12
Gross Domestic Product Generated by the Sisson Project
Construction Expenditures, by Jurisdiction, \$ Million

	Direct	Indirect	Induced	Total	%	Household Income
New Brunswick	\$59.1	\$64.5	\$46.7	\$170.3	32.8%	\$127.6
Quebec	\$10.7	\$46.6	\$47.8	\$105.2	20.3%	\$66.6
Ontario	\$14.6	\$66.4	\$65.5	\$146.4	28.2%	\$94.4
Other provinces	\$3.2	\$52.8	\$41.1	\$97.1	18.7%	\$58.4
Total	\$87.6	\$230.3	\$201.1	\$519.0	100.0%	\$347.0

Source: EcoTec Consultants

Another important measure of the economic benefits generated by the construction expenditures is the amount of Project-related tax revenues that will be collected by senior levels of government. As shown in Table 13, it is estimated that the construction phase of the Sisson Project will generate about \$109.1 million in tax revenues for the federal, provincial and territorial governments.

Table 13
Tax Revenues Generated by the Sisson Project
Construction Expenditures, by Jurisdiction, \$ Million

	Direct	Indirect	Induced	Total
Government of New Brunswick	\$5.2	\$4.5	\$10.4	\$20.1
Government of Canada*	\$7.7	\$19.8	\$23.1	\$50.6
Other provinces/territories	\$2.2	\$12.3	\$23.9	\$38.4
Total	\$15.1	\$36.6	\$57.4	\$109.1

* Collected in all provinces and territories

Source: EcoTec Consultants

It is estimated that the Government of New Brunswick will collect \$20.1 million in personal income tax, indirect taxes (such as sales taxes) and tax on corporate profits. The federal government will collect \$50.6 million, and the other provincial and territorial governments will share \$38.4 million.

Although the construction phase will only last two years, its economic benefits will last longer because the money initially spent takes time to circulate through the economy. As money is spent and re-spent by businesses, households, etc., leakages such as imports, taxes and savings slowly reduce the amount of money left in the provincial economy. Table 14 shows how the benefits are expected to flow throughout the provincial economy over time. Employment is expected to reach its peak at year - 1, the second year of the construction phase, with 983 person-years, or 53.3% of the total job creation. The impact on GDP is similarly expected to peak during the second year of construction, at \$90.6 million (53.2% of the total).

(It should be noted that these data are for the construction phase of the project, not on-going operations, and that the numbers in Table 14 are therefore non-cumulative. For example, if it were not for the construction project, the employment level in the province at Year 1 would be lower by 253 person-years, while by Year 2 the employment is only 73 person-years higher than it would have been without the Project.)

Table 14
Economic Benefits Generated by the Sisson Project
Construction Expenditures, by Year, New Brunswick,
Person-Years and \$ Million

Years	Employment	GDP	Provincial Tax Revenues
-2	504	\$46.7	\$4.8
-1	983	\$90.6	\$10.9
1	253	\$23.6	\$3.2
2	73	\$6.6	\$0.9
3	21	\$1.9	\$0.2
4	6	\$0.6	\$0.1
5	2	\$0.2	\$0.0
6	1	\$0.1	\$0.0
7	0	\$0.0	\$0.0
Total	1,844	\$170.3	\$20.1

Source: EcoTec Consultants

Operations Benefits

Sisson Project operations are expected to last about 27 years, generating significant economic benefits over the whole period. Although construction will have a higher peak impact, the longer duration of the operation phase results in a considerably higher total level of economic benefits. The extended length of the operation phase will also provide greater economic opportunities for New Brunswick-based workers and companies, which will be justified in making additional investments in order to qualify for Project and Project-related employment and business.

Table 15 provides an estimate of the employment generated by the operation phase of the Project. It is estimated it will create 27,677 person-years of employment in Canada, including 8,982 person-years of direct employment, 8,553 person-years of indirect employment and 10,143 person-years of induced work. It is expected that a total of 14,561 person-years (52.6% of the total) will be generated in New Brunswick, including 8,281 direct person-years (92.2%), 2,485 indirect person-years (29.1%) and 3,795 induced person-years (37.4%).

Table 15
Employment Generated by the Sisson Project Operating Expenditures, by Jurisdiction, Person-Years

	Direct	Indirect	Induced	Total	%
New Brunswick	8,281	2,485	3,795	14,561	52.6%
Quebec	517	2,673	2,744	5,933	21.4%
Ontario	184	2,453	2,665	5,302	19.2%
Other provinces	0	942	939	1,881	6.8%
Total	8,982	8,553	10,143	27,677	100.0%

Source: EcoTec Consultants

The total GDP generated is estimated at \$5.4 billion, including \$3.6 billion (66.5%) in New Brunswick and \$1.8 billion in the rest of the country (Table 16). The direct GDP generated is expected to reach \$2.8 billion, almost all of it (\$2.7 billion, or 95.8%) in New Brunswick. The direct GDP generated is made of two major components: \$1.84 billion from operations at Sisson (free after-tax cash flow) and \$860.8 million from the rest of the provincial economy. The indirect GDP generated is estimated at \$1.34 billion (\$409.9 million, or 30.6%, within the province) and induced GDP generated is expected to total \$1.2 billion including \$476.0 million (38.5%) in New Brunswick.

Table 16
Gross Domestic Product Generated by the Sisson Project Operating Expenditures, by Jurisdiction, \$ Million

	Direct	Indirect	Induced	Total	%	Household Income
New Brunswick						
Mining Operations*	\$1,837.6	-	-	\$1,837.6	34.1%	-
Rest of Economy	\$860.8	\$409.9	\$476.0	\$1,746.7	32.4%	\$1,196.6
Total GDP	\$2,698.5	\$409.9	\$476.0	\$3,584.3	66.5%	\$1,196.6
Quebec	\$95.5	\$389.6	\$303.6	\$788.7	22.3%	\$402.9
Ontario	\$21.8	\$346.8	\$320.9	\$689.5	18.7%	\$392.9
Other provinces	\$0.1	\$194.7	\$134.5	\$329.3	9.2%	\$144.7
Total	\$2,815.8	\$1,340.9	\$1,235.0	\$5,391.8	100.0%	\$2,137.1

* Free After Tax Cash Flow from project.

Source: EcoTec Consultants

The total household income (composed of wages and salaries, benefits and revenues of unincorporated businesses) created by the Project is estimated at \$2.1 billion for Canada, including \$1.2 billion (56.0% of Canada's total) in New Brunswick, with the remainder (\$940.5) occurring other provinces.

Government revenues arising from the operation phase are expected to total \$1.67 billion for Canada as a whole (see Table 17). This includes revenues from personal income tax, indirect taxes such as sales tax, and tax on profits. Total tax revenues for the Government of New Brunswick are estimated at \$722.8 million, including \$280.1 million as mining tax, \$245.0 million for provincial tax on corporate mining profit, and \$197.6 million for other tax revenues (personal income tax, sales tax, etc.). The federal government is expected to collect a total of \$715.0 million, including \$367.5 million for federal tax on corporate profits from the mine and \$347.5 million from other tax revenues. Other provincial and territorial governments are expected to share a total of \$234.4 million.

Table 17
Tax Revenues Generated by the Sisson Project
Operating Expenditures, \$ Million

	Revenues from mining operations				Other Tax Revenues	Grand Total
	Mining Tax	N.B. Income Tax	Federal Income Tax	Total		
Government of New Brunswick	\$280.1	\$245.0	N/A	\$525.2	\$197.6	\$722.8
Government of Canada	N/A	N/A	\$367.5	\$367.5	\$347.5	\$715.0
Other provincial governments	N/A	N/A	N/A	N/A	\$234.4	\$234.4
Total	\$280.1	\$245.0	\$367.5	\$892.7	\$779.6	\$1,672.3

Source: Northcliff Resources and EcoTec Consultants

Table 18 describes how the benefits to New Brunswick flow from year to year. The GDP generated in New Brunswick by Project operations will reach a maximum of \$255.8 million at Year 3, comprised of \$199.6 million in free after-tax cash flow and \$56.2 million from other sectors of the provincial economy. Thereafter, the GDP impact is expected to fluctuate between \$140 and \$200 million in most years. Provincial tax revenues are expected to reach a peak of \$44.6 million in Year 5, thanks to taxes on Project operations (\$36.1) and other tax revenues (\$8.4). During the operation phase, annual provincial tax revenues from the Project will mostly fluctuate between \$20 million and \$35 million.

Table 18
Economic Benefits Generated by the Sisson Project Operating Expenditures, New Brunswick, by Year, Person-Years and \$ Million

Years	Employment	GDP			Provincial Tax Revenues		
		Mining Operations*	Rest of the Economy	Total	Mining Operations	Other Tax Revenues	Total
Pre**	0	-\$555.4	\$0.0	-\$555.4	\$0.0	\$0.0	\$0.0
1	254	-\$70.8	\$32.1	-\$38.6	\$0.0	\$4.5	\$4.5
2	406	\$182.0	\$50.0	\$232.1	\$11.3	\$6.7	\$18.0
3	457	\$199.6	\$56.2	\$255.8	\$21.4	\$7.6	\$29.0
4	492	\$179.5	\$59.3	\$238.8	\$17.5	\$8.0	\$25.5
5	523	\$130.5	\$63.0	\$193.5	\$36.1	\$8.4	\$44.6
6	560	\$82.6	\$66.7	\$149.3	\$13.0	\$5.9	\$18.8
7	578	\$102.7	\$69.1	\$171.9	\$28.8	\$6.2	\$35.0
8	578	\$125.0	\$69.9	\$195.0	\$33.4	\$6.2	\$39.6
9	580	\$126.7	\$69.6	\$196.3	\$34.3	\$6.2	\$40.5
10	613	\$67.9	\$70.9	\$138.7	\$11.2	\$6.4	\$17.7
11	489	\$68.8	\$62.4	\$131.2	\$15.2	\$8.6	\$23.8
12	530	\$69.6	\$64.6	\$134.2	\$13.7	\$8.6	\$22.3
13	537	\$76.1	\$65.9	\$142.1	\$15.4	\$8.8	\$24.2
14	537	\$83.5	\$65.2	\$148.7	\$18.4	\$8.7	\$27.1
15	558	\$74.4	\$67.0	\$141.4	\$19.0	\$9.0	\$27.9
16	579	\$66.2	\$69.4	\$135.6	\$14.5	\$6.2	\$20.7
17	585	\$75.3	\$69.9	\$145.2	\$16.4	\$6.3	\$22.6
18	589	\$71.2	\$70.7	\$141.9	\$15.3	\$6.3	\$21.6
19	589	\$61.6	\$70.9	\$132.5	\$12.5	\$6.3	\$18.8
20	591	\$65.0	\$69.9	\$134.9	\$15.9	\$6.3	\$22.2
21	492	\$29.1	\$61.7	\$90.7	\$5.9	\$8.4	\$14.3
22	518	\$53.7	\$63.9	\$117.5	\$15.9	\$8.5	\$24.4
23	537	\$76.0	\$64.8	\$140.8	\$24.9	\$8.7	\$33.6
24	541	\$79.8	\$65.3	\$145.0	\$24.1	\$8.7	\$32.8
25	540	\$83.4	\$63.5	\$146.9	\$27.6	\$8.5	\$36.1
26	538	\$96.4	\$63.1	\$159.6	\$33.2	\$5.6	\$38.7
27	539	\$137.2	\$60.0	\$197.2	\$30.3	\$5.4	\$35.7
28	157	\$0.0	\$15.0	\$15.0	\$0.0	\$1.9	\$1.9
29	49	\$0.0	\$4.5	\$4.5	\$0.0	\$0.6	\$0.6
30	16	\$0.0	\$1.5	\$1.5	\$0.0	\$0.2	\$0.2
31	5	\$0.0	\$0.5	\$0.5	\$0.0	\$0.1	\$0.1
32	2	\$0.0	\$0.2	\$0.2	\$0.0	\$0.0	\$0.0
33	1	\$0.0	\$0.1	\$0.1	\$0.0	\$0.0	\$0.0
Total	14,561	\$1,837.6	\$1,746.6	\$3,584.2	\$525.2	\$197.6	\$722.8

* Free After Tax Cash Flow from project

**Negative Net Cash Flow from project before start of production

Source: EcoTec Consultants

Total Benefits

The two phases of the Sisson Project will last a total of 29 years and provide significant economic benefits for New Brunswick and Canada. The total employment generated by the Project in Canada is expected to reach 32,619 person-years, including 9,826 of direct employment, 11,020 of indirect employment and 11,773 of induced employment. It is estimated that 16,406 person-years will be created within New Brunswick, representing 50.3% of Canada's total. The provincial total is composed of 8,849 person-years of direct employment (90.1% of the national total), 3,401 of indirect employment (30.9%) and 4,156 of induced employment (35.3%). The other provinces and territories are expected to benefit from an additional 16,213 person-years. (Table 19)

Table 19
Employment Generated by the Sisson Project,
by Jurisdiction, Person-Years

	Direct	Indirect	Induced	Total	%
New Brunswick	8,849	3,401	4,156	16,406	50.3%
Quebec	622	3,108	3,170	6,901	21.2%
Ontario	326	3,068	3,209	6,603	20.2%
Other provinces	29	1,443	1,238	2,710	8.3%
Total	9,826	11,020	11,773	32,619	100.0%

Source: EcoTec Consultants

The economic benefits vary by industry, because some industries produce goods and services in New Brunswick that will be required to build and operate the Project (repair services being one of them), and other industries are either absent from the province (e.g. heavy truck manufacturers) or not relevant to the Project (e.g. food processing).

Table 20
Employment Generated by the Sisson Project,
by Industry, New Brunswick, Person-Years

Industries	Construction	Operation	Total
Metal ore mining and processing*	0	8,281	8,281
Retail trade	132	1,438	1,570
Other engineering construction	1,006	237	1,242
Accommodation and food services	77	750	826
Non-residential building construction	348	103	450
Administrative and support services	16	432	448
Electric power generation	3	401	403
Truck transportation	11	374	385
Repair construction	12	356	368
Professional and technical services	18	280	298
Arts, entertainment and recreation	9	86	94
Finance, Insurance and Real Estate	10	84	94
Repair and maintenance	7	80	87
Others	198	1,661	1,859
Total	1,844	14,561	16,406

* Sisson Project

Source: EcoTec Consultants

The industry with the most employment is metal ore mining and processing (i.e. the Sisson Project itself once it is operational) with 8,281 person-years. Retail trade ranks second, reflecting the important role played by salary expenditures in the Project, with 1,570 person-years including 1,438 during operation and 132 during construction. Construction-related industries are ranked third (other engineering construction: 1,242), fifth (non-residential building construction: 450) and ninth (repair construction: 368). As a sector, construction therefore sees a total of 2,060 person-years of employment, placing it in aggregate in second place behind metal ore mining and processing (Table 20).

The accommodation and food services industry receives the fourth largest amount of employment, 826 person-years, thanks mostly to household expenditures. Suppliers of services include administration and support services (448 person-years), electric power generation (403), truck transportation (385), and professional and technical services (298).

The total GDP generated by the Sisson Project is estimated at \$5.91 billion, including \$3.75 billion (63.5%) in New Brunswick and \$2.16 billion in the rest of Canada (Table 21). The direct GDP generated is expected to reach an estimated \$2.90 billion, including \$2.76 billion (95.2%) in New Brunswick (\$1.84 billion from mining operations as free after tax cash flow and \$0.92 billion from other parts of the

provincial economy), while the indirect GDP generated is estimated at \$1.57 billion (\$474.4 million in New Brunswick) and induced GDP generated is expected to total \$1.44 billion (\$522.6 million in New Brunswick).

Table 21
Gross Domestic Product Generated by the Sisson Project,
by Jurisdiction, \$ Million

	Direct	Indirect	Induced	Total	%	Household Income
New Brunswick						
Project Operations*	\$1,837.6	-	-	\$1,837.6	31.1%	-
Rest of Economy	\$920.0	\$474.4	\$522.6	\$1,917.0	32.4%	\$1,324.2
Total GDP	\$2,757.6	\$474.4	\$522.6	\$3,754.6	63.5%	\$1,324.2
Quebec	\$106.2	\$436.2	\$351.4	\$893.8	15.1%	\$469.5
Ontario	\$36.3	\$413.1	\$386.4	\$835.9	14.1%	\$487.3
Other provinces	\$3.3	\$247.5	\$175.6	\$426.4	7.2%	\$203.1
Total	\$2,903.4	\$1,571.2	\$1,436.1	\$5,910.7	100.0%	\$2,484.1

* Free After Tax Cash Flow from project

Source: EcoTec Consultants

The total Project-related income (composed of wages and salaries, benefits and revenues of unincorporated businesses) of New Brunswick households is estimated at \$1.32 billion. The household income accruing in the rest of Canada totals \$1.16 billion, and thus the total for the whole country is \$2.48 billion.

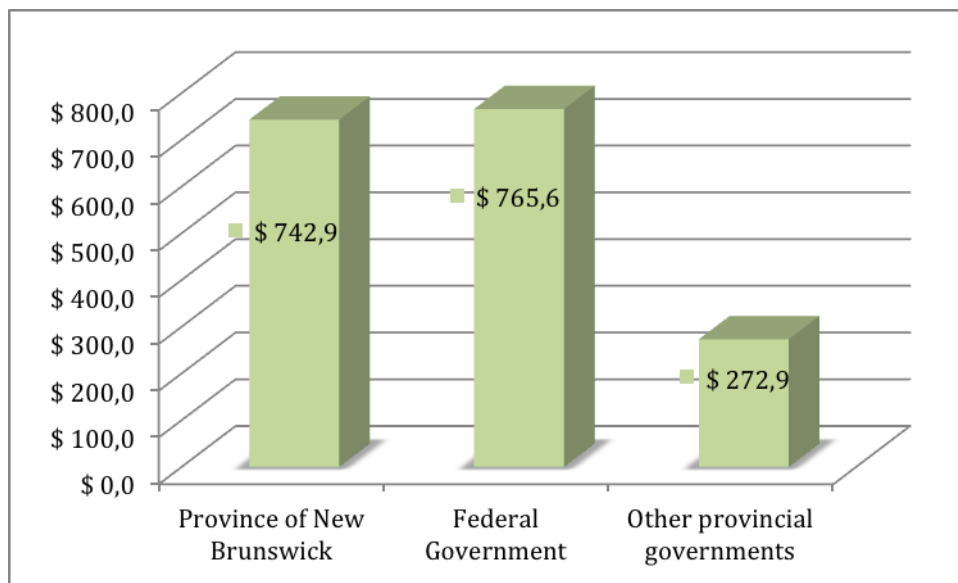
The federal and provincial government revenues arising from the Project are expected to total \$1.78 billion (Table 22 and Figure 1). The tax revenues received by the Government of New Brunswick are estimated at \$742.9 million, including \$525.2 million from Project operations and \$217.7 million from other sources of fiscal revenues. The Government of Canada is expected to collect \$765.6 million, including \$367.5 million from Project operations at Sisson. Other provincial and territorial governments are expected to share \$272.9 million.

Table 22
Tax Revenues Generated by the
Sisson Project, by Jurisdiction, \$ Million

	Revenues from Mining Operations	Other Tax Revenues	Total	%
Government of New Brunswick	\$525.2	\$217.7	\$742.9	41.7%
Government of Canada	\$367.5	\$398.1	\$765.6	43.0%
Other provinces and territories	-	\$272.9	\$272.9	15.3%
Total	\$892.7	\$888.7	\$1,781.3	100.0%

Source: Northcliff Resources and EcoTec Consultants

Figure 1
Government Tax Revenues Generated by
Sisson Mine



Source: EcoTec Consultants

Table 23 shows how the benefits generated by the Sisson Project are expected to flow from year to year in the New Brunswick economy. Project-related employment is expected to peak at 983 person-years (i.e. the equivalent of 983 full-time jobs) in Year -1. The GDP will peak at \$257.8 million in Year 3 of production with provincial tax revenues peaking in Year 5 at \$44.6 million.

Table 23
Economic Benefits Generated by Year in New Brunswick
by the Sisson Project, Person-Years and \$ Million

Years	Employment	GDP			Provincial Tax Revenues		
		Project Operations*	Rest of the Economy	Total	Project Operations	Other Tax Revenues	Total
-2	504	-\$225.6	\$46.7	-\$178.9	-	\$4.8	\$4.8
-1	983	-\$329.8	\$90.6	-\$239.2	-	\$10.9	\$10.9
1	506	-\$70.8	\$55.7	-\$15.0	-	\$7.7	\$7.7
2	479	\$182.0	\$56.6	\$238.7	\$11.3	\$7.6	\$18.9
3	479	\$199.6	\$58.1	\$257.8	\$21.4	\$7.8	\$29.2
4	498	\$179.5	\$59.9	\$239.4	\$17.5	\$8.0	\$25.5
5	525	\$130.5	\$63.2	\$193.6	\$36.1	\$8.5	\$44.6
6	561	\$82.6	\$66.8	\$149.4	\$13.0	\$5.9	\$18.9
7	579	\$102.7	\$69.2	\$171.9	\$28.8	\$6.2	\$35.0
8	578	\$125.0	\$69.9	\$195.0	\$33.4	\$6.2	\$39.6
9	580	\$126.7	\$69.6	\$196.3	\$34.3	\$6.2	\$40.5
10	613	\$67.9	\$70.9	\$138.7	\$11.2	\$6.4	\$17.7
11	489	\$68.8	\$62.4	\$131.2	\$15.2	\$8.6	\$23.8
12	530	\$69.6	\$64.6	\$134.2	\$13.7	\$8.6	\$22.3
13	537	\$76.1	\$65.9	\$142.1	\$15.4	\$8.8	\$24.2
14	537	\$83.5	\$65.2	\$148.7	\$18.4	\$8.7	\$27.1
15	558	\$74.4	\$67.0	\$141.4	\$19.0	\$9.0	\$27.9
16	579	\$66.2	\$69.4	\$135.6	\$14.5	\$6.2	\$20.7
17	585	\$75.3	\$69.9	\$145.2	\$16.4	\$6.3	\$22.6
18	589	\$71.2	\$70.7	\$141.9	\$15.3	\$6.3	\$21.6
19	589	\$61.6	\$70.9	\$132.5	\$12.5	\$6.3	\$18.8
20	591	\$65.0	\$69.9	\$134.9	\$15.9	\$6.3	\$22.2
21	492	\$29.1	\$61.7	\$90.7	\$5.9	\$8.4	\$14.3
22	518	\$53.7	\$63.9	\$117.5	\$15.9	\$8.5	\$24.4
23	537	\$76.0	\$64.8	\$140.8	\$24.9	\$8.7	\$33.6
24	541	\$79.8	\$65.3	\$145.0	\$24.1	\$8.7	\$32.8
25	540	\$83.4	\$63.5	\$146.9	\$27.6	\$8.5	\$36.1
26	538	\$96.4	\$63.1	\$159.6	\$33.2	\$5.6	\$38.7
27	539	\$137.2	\$60.0	\$197.2	\$30.3	\$5.4	\$35.7
28	157	\$0.0	\$15.0	\$15.0	\$0.0	\$1.9	\$1.9
29	49	\$0.0	\$4.5	\$4.5	\$0.0	\$0.6	\$0.6
30	16	\$0.0	\$1.5	\$1.5	\$0.0	\$0.2	\$0.2
31	5	\$0.0	\$0.5	\$0.5	\$0.0	\$0.1	\$0.1
32	2	\$0.0	\$0.2	\$0.2	\$0.0	\$0.0	\$0.0
33	1	\$0.0	\$0.1	\$0.1	\$0.0	\$0.0	\$0.0
Total	16,404	\$1,837.6	\$1,916.9	\$3,754.5	\$525.2	\$217.7	\$742.9

Source: EcoTec Consultants

CONCLUSION

The Sisson Project represents a major investment in New Brunswick that will provide economic benefits for about 29 years. The Project is a good match for the New Brunswick economy and will provide substantial benefits for the province and Canada as a whole.

Within New Brunswick, the labour market situation is favourable for the Sisson Project. There are unemployed workers in occupations required for the Project, and labour force mobility within the province is high with workers willing to commute, daily or weekly, to where employment is available. Finally, the provincial economy is diversified and has the depth and breadth to provide a significant portion of goods and services required by the Project.

ANNEX A – Economic Impact Model

The economic benefits generated by the construction, operation and closure of the Sisson Project have been calculated using an economic impact model developed by EcoTec Consultants and peer-reviewed by Wade Locke Economic Consulting. This model is dynamic and is based on an Input-Output algorithm core supplemented by econometric modules. All data used in the impact model come from either Statistics Canada or the Canada Revenue Agency.

Input-Output (IO) models are widely used to calculate economic impacts throughout Canada. These models provide a fairly accurate representation of the national, provincial or regional economy. By following the path taken by the Project's expenditures throughout the economy, IO models are able to estimate total sales and employment by industry as well as government tax revenues. These models have been used across Canada over the last 30 years to estimate economic benefits for a wide range of impact scenarios. They have been used extensively to estimate the economic impacts of the existing mines and mining projects.

This model is unique in that it uses sales-employment elasticities to deal with a significant drawback of ordinary input-output models: their linearity. For example, a doubling of sales at a retail store will always translate into a doubling of employment. This leads to a significant overestimation of employment created by a given project. EcoTec's model uses coefficients to take into account the fact that most industries will not increase their workforce at the exact same pace as sales. For example, an industry may have a sales-employment elasticity of 0.7, which means that every one percent increase in sales results in an employment increase of 0.7%. Hence, by reducing somewhat employment estimates, EcoTec's model provides a much more realistic picture of employment creation.

Before discussing in more details the model used to calculate the impacts, it is useful to go over the definition of a few terms used in this document.

Direct Impacts

In the case of a Project's expenditures, direct economic impacts refer to the employees of the construction firms working on the Project site (for construction phase) or the employees working at the Project once it is operational (operation).

Indirect Impacts

The indirect impacts are essentially the suppliers for the Project who do not work on-site. For example, a concrete plant providing truckloads of ready-mix concrete to build foundations for buildings at the Project site. Indirect impacts also encompass the suppliers of that concrete plant and the suppliers of those suppliers, etc. Hence, they include the sales and employment of firms providing fuel, repairs, etc. to the concrete plant. As a whole, indirect impacts represent the total economic benefits of business to business purchases.

Induced Impacts: Consumer Expenditures

Induced economic impacts are generated by the consumer expenditures of employees of all the firms that benefited from the direct and induced impacts. Since consumer expenditures represent over 60% of the Gross Domestic Product, it is essential to have an accurate assessment of the induced impacts in order to fully comprehend the overall economic benefits generated by the Project. This is especially true for an industry such as mining where relatively high wages and salaries levels lead to a corresponding level of household expenditures.

In order to ensure that induced impacts are not overestimated, a number of steps are taken, including:

- Subtracting both federal and provincial income tax from earned income before the households are allowed to spend the money in the economy; and
- Subtracting all employee contributions to Employment Insurance, pension funds and RRSP, etc.

Gross Domestic Product (GDP) and Sales

The Gross Domestic Product (GDP) is the measure, in dollars, of the total production in a given economy. The impact statistics on GDP shown in this report include the following elements:

- Indirect taxes on goods and services, such as the HST;
- Indirect taxes on production, such as excise taxes on alcohol and tobacco;
- Subsidies to businesses, including to the agriculture sector;
- Wages and salaries;

- Supplementary Labour Income: Employer's contributions for Employment Insurance, Canada Pension Plan, private pension plans, medical and dental plans, etc.;
- Revenues of unincorporated businesses (professionals, home-based businesses, etc.); and
- Profits and depreciation allowance for incorporated firms.

Interprovincial Model

An economic impact simulation starts with a vector of expenditures by goods and services for either construction or operation (salaries, machinery, steel, etc.). The maximum number of types of goods and services in the model is 469. The first iteration (round of expenditures) of the main algorithm starts with the calculation of imports from other countries as well as from each of the other nine provinces. These imports are subtracted from the initial vector of expenditures to ensure that only goods and services purchased AND made in New Brunswick are kept in the province by the model. Then, the model determines which industries will produce the goods and services purchased in New Brunswick to either build or operate the Project. Therefore, the model will effectively provide an estimate of sales by industry.

Using the figures of sales by industry, the model will identify the GDP components and calculate employment by industry. Finally, provincial and federal tax revenues are calculated for four major categories of tax revenues: personal income tax, sales tax, other indirect taxes and tax on corporate profits.

The second round of expenditures identifies the suppliers of industries which benefited from construction or operating expenditures. For example, shops that provide repair services for machinery and equipment. During the third round of expenditures, suppliers to the suppliers will benefit from purchases such as electricity to provide power to the repair shops. At each round of expenditures, the amount of money that remains in the economy is reduced by three main factors: imports of goods and services from other countries and other provinces, taxes collected by governments and household's savings. The model iterates until all initial expenditures are reduced to zero.

Assumptions and Limitations

The models used to calculate the economic benefits are based, like any model, on certain assumptions and have some limitations. Some of the known limitations of Input-Output models are:

- Homogenous technology. The models assume that the technology used in New Brunswick is the same as the technology used for Canada as a whole. For example, an engineering firm in Fredericton is assumed to have the same mix of expenditures as the industry average for the country (same percentage of expenditures going towards electric power, salaries, etc.).
- Fixed technology. Technology is assumed constant over time.