Yukon
Energy, Mines and Resources

# The Alaska Highway Pipeline Project: Economic Effects on the Yukon and Canada

## Final Report

**April 2002**

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# Preface

This project involved the continuing efforts of the Informetrica team of Nancy Cebryk, Ilona Chmiel, Michelle Lasota, Tyler Minty, Anne Rensonnet, Charles Saunders, and Carl Sonnen. We also benefited from the contributions of Malcolm Taggart and Luigi Zanasi in Whitehorse. They authored several Working Papers and reviewed all of them, providing helpful suggestions.

The team at the Department of Economic Development (Government of Yukon) were of great assistance by arranging meetings, reviewing drafts of the study, and being available to discuss issues. Special thanks go to Greg Komaromi and Toby Sanger.

The people from Foothills Pipe Lines Ltd. in Whitehorse (Brian Love) and Calgary (Jack Shaw) were very helpful in providing information repeatedly and in great detail in response to our questions.

Finally, we talked to many people in Whitehorse, including representatives from Labour, First Nations, environmentalists, businessmen, and public servants. All contributed their insights, patiently and with humour. The shortcomings that remain must be Informetrica's responsibility.

M.C. McCracken
Ottawa
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# Executive Summary

Informetrica Limited has undertaken at the request of the Department of Energy, Mines & Resources, Government of Yukon, a number of studies of the Alaska Highway Pipeline Project (AHPP), as proposed by Foothills Pipe Lines Ltd. These studies examine a number of different dimensions and issues raised by the Project. The output of the research is documented through a series of Working Papers, and summarized in this Final Report.

These studies provide a "benchmark" or framework for comparison to other proposals that may be forthcoming. A number of different tools have been developed that can be applied with different assumptions, allowing a ready comparison. This capacity should allow quick evaluation of new proposals. The other purpose of these studies is to identify potential bottlenecks or pressure points that could be alleviated or mitigated with some forward planning.

The AHPP proposes to construct a 42-inch pipeline from Prudhoe Bay, Alaska to Gordondale, Alberta, a distance of 1,746 miles or 2,810 kilometres. The cost is about $9.1 billion US (2000$) or $13.6 billion in Canadian dollars. More than half the costs are incurred in Canada.

Gas would begin flowing in 2007, at a daily rate of 2.5 billion cubic feet, with a build-up to 4 bcfd by the end of 2012. This is an annual volume of 1.4 tcf. It is assumed that this additional volume can be distributed through the existing network in Alberta and the lower 48. If expansion were needed, then the required investment would be in addition to this project.

Direct employment associated with the construction phase of the project is about 30,000 in Canada. A similar number is expected in Alaska, resulting in about 60,000 in direct employment. (No studies of the Alaska portion have been undertaken here.) Additional person-years of employment will be required for the delivery of materials to the sites, the manufacturing of the pipe and compressors, and the myriad of other indirect components. As well, the incomes earned by workers will be spent, resulting in additional person-years of employment in many other sectors and parts of the country. Over the first 11 years of the Project (construction phase and some early operations), estimates for the Canadian impacts vary from 73,000 person-years of employment to over 194,000, depending on whether governments redistribute their increased revenue through spending increases and tax cuts.

Although the expenditure and job numbers seem large, the project is spread over a number of years. A better approach is to consider the average number of jobs per year and the peak number in the year 2006. On this basis, employment in the Canadian economy is about 6,600 higher per year over the period from 2002-12, with a peak year of 28,500 in Scenario 1 with governments holding onto their improvements in revenue, and about 17,700 on average with a peak of 43,400 in 2006 when governments recycle their improved incomes through tax reductions or spending increases in Scenario 2. There is no evidence that the Canadian economy is strained by these increases.

Impacts on the provinces are also quite modest, with employment spread across several provinces. Only the Yukon is substantially impacted, with GDP increases of 20% to 40% in the

peak year and, subsequently, with the substantial revenue increases from pipeline operations. In employment terms, increases of 7,000 to 8,000 in the peak year are substantially in excess of the labour pool currently residing in the Yukon. Transient workers are expected to exceed 4,000 at the peak, and an average of almost 1,000 over the construction period. This still leaves employment increases for residents of over 900 per year on average in the construction period, with governments not recycling improved revenues, and upwards of 1,700 per year if governments do recycle. At the peak of construction, increases of 3,000 to 4,000 would stretch available labour supply in the Yukon quite tightly. (If these cannot be supplied, then additional transient workers would fill the gap.)

The impacts of construction activity will be felt even more strongly at the local community level, with positive income effects from people working and transients spending some part of their income while in the Yukon. A framework has been provided for thinking through these local impacts, including the effects of bidding up of local wages and prices.

If the Yukon is to maximize the local employment from the project, it will be desirable to ensure adequate supplies of skilled labour. The major occupational groupings with increased employment include the construction trades, managerial and administrative, clerical, and services jobs. Unions and First Nations groups should be part of the planning for the training programs to ensure the broadest participation and targeting on the appropriate skill sets.

Another potential pressure point identified in the studies is the fiscal position of the Territorial government. Current arrangements leave little incremental revenue in the hands of the Yukon government as a result of economic development, even if they have spending requirements arising from training and other needs. If the project proceeds, it would make sense to revisit the fiscal arrangements between the federal and territorial governments.

The fundamentals of the project appear to be sound. The benefit-cost study supports the view that the project is viable at a US city gate price in Chicago greater than $3.00 US (2000$). There remain, however, differing views of future energy prices.

Although post-pipeline projects in the Yukon are discussed, no special provision has been included in the benefit-cost study for possible resource developments triggered by the pipeline ensuring the availability of natural gas in the Yukon. The pipeline will enhance the **choices** for Yukoners, but additional resource developments will have to pass their own benefit-cost evaluations.

The AHPP appears ready to go…if the US is ready to use Alaska gas as part of their energy supply. This Project is particularly interesting in that much of the gas field development has already occurred. Governments have studied the route, the regulatory framework, and other aspects. The lower end of the pipeline has been "pre-built" in the 1980s and 1990s, with capacity to deliver the gas into the US marketplace. The key questions to be answered: Are there better options available for US consumers? Are there better options for North Slope producers? These remain the tough questions that must be answered before construction can start.

**Major Results for the Construction Phase (2002 to 2012)**

| | $ millions | | Direct Employment | |
|---|---|---|---|---|
| **Pipeline Investment** | **Total** | **Annual Average** | **Total** | **Annual Average** |
| Alaska[1] | $6,627 | $602 | 28,859 | 2,624 |
| Canada | $6,990 | $635 | 30,440 | 2,767 |
| Yukon | $3,369 | $306 | 12,114 | 1,101 |
| British Columbia | $2,638 | $240 | 9,965 | 906 |
| Rest-of-Canada | $983 | $89 | 8,360 | 760 |
| | **Scenario 1** | | **Scenario 2** | |
| | **Total** | **Annual Average** | **Total** | **Annual Average** |
| **Real GDP Impact (2000$Mn)** | | | | |
| Canada | $9,762 | $887 | $14,497 | $1,318 |
| Yukon | $3,736 | $340 | $5,082 | $462 |
| British Columbia | $2,293 | $209 | $2,831 | $257 |
| Rest-of-Canada | $3,733 | $339 | $6,583 | $598 |
| **Employment Impact** | | | | |
| Canada | 72,799 | 6,618 | 194,396 | 17,672 |
| Yukon | 19,448 | 1,768 | 28,585 | 2,599 |
| British Columbia | 20,660 | 1,878 | 36,330 | 3,303 |
| Rest-of-Canada | 32,691 | 2,972 | 129,482 | 11,771 |
| **All Government Balance (C$Mn)** | $8,489 | $772 | $3,195 | $291 |
| **Current Account Balance (C$Mn)** | $1,711 | $156 | -$2,559 | -$233 |

**Major Results for the Operations Phase (2013 to 2025)**

| | $ millions | | Direct Employment | |
|---|---|---|---|---|
| **Pipeline Revenue (Cost-of-Service)** | **Total** | **Annual Average** | **Total** | **Annual Average** |
| Alaska[1] | $14,547 | $1,119 | 4,047 | 311 |
| Canada | $15,288 | $1,176 | 4,253 | 327 |
| Yukon | $8,252 | $635 | 2,220 | 171 |
| British Columbia | $6,602 | $508 | 1,910 | 147 |
| Rest-of-Canada | $434 | $33 | 123 | 10 |
| | **Scenario 1** | | **Scenario 2** | |
| | **Total** | **Annual Average** | **Total** | **Annual Average** |
| **Real GDP Impact (2000$Mn)** | | | | |
| Canada | $16,678 | $1,283 | $16,906 | $1,300 |
| Yukon | $7,775 | $598 | $8,911 | $686 |
| British Columbia | $4,810 | $370 | $5,570 | $429 |
| Rest-of-Canada | $4,093 | $315 | $2,425 | $187 |
| **Employment Impact** | | | | |
| Canada | 34,921 | 2,686 | 182,678 | 14,052 |
| Yukon | 13,029 | 1,002 | 21,998 | 1,692 |
| British Columbia | 10,104 | 777 | 31,574 | 2,429 |
| Rest-of-Canada | 11,788 | 907 | 129,105 | 9,931 |
| **All Government Balance (C$Mn)** | $20,043 | $1,542 | $6,366 | $490 |
| **Current Account Balance (C$Mn)** | $22,427 | $1,725 | $7,713 | $593 |

1) Alaska expenditures and revenues not included in impacts. Employment estimates proportional to expenditures and revenues.

# The Alaska Highway Pipeline Project: Economic Effects on the Yukon and Canada

## 1 Introduction

The Department of Economic Development, Government of Yukon requested Informetrica Limited to undertake a series of economic studies of different aspects of the proposed Alaska Highway Pipeline Project (AHPP). This report summarizes that work, with pointers to a series of Working Papers. These papers document the methodology employed, the findings, and provide the details of each aspect. The intent is to document the procedures so that others can understand what was done, and apply other assumptions if desired. In some cases, Excel worksheets are provided to allow for recalculations as needed.

### 1.1 Historical Perspective

The Yukon has been the site for major undertakings in the past, from the Gold Rush, to the construction of the Alaska Highway and CANOL pipeline in World War II, the Faro Mine, and the Dempster Highway. These projects have shaped the economy of the Yukon, building infrastructure and providing significant employment.

In the late 1970s and early 1980s there were intense discussions about the construction of a natural gas pipeline from Prudhoe Bay, Alaska to Alberta and points south. At the end of the day, the US and Canadian governments picked a route along the Alaska Highway, referred to as the Foothills Project.

High interest rates in the early 1980s, falling energy prices in the mid-1980s, and the emergence of a so-called "Gas Bubble" led to postponement of the project. A portion of the southern end in Alberta and the US was constructed and carries substantial volumes of Canadian natural gas to US markets at present. (This is referred to as the "Pre-Build" pipeline.)

### 1.2 The Pipeline Project

Northern pipeline projects are now being actively considered again. Lower interest rates, US demand forecasts for increased natural gas use, rising energy prices, and a concern about energy security in the US have all come together to heighten interest in delivering natural gas to market from Prudhoe Bay.

The Alaska North Slope producers have undertaken a major study of the feasibility of different routes to bring the gas to market. The producer study is intended to provide the information needed for a go-no-go decision and to select the preferred route: Alaska Highway or "Over-the-top" with a pipeline under the Beaufort Sea and along the Mackenzie valley. The producer proposal uses some assumptions that are considerably different from the Foothills project, notably as to the size of pipeline required and the volume of gas transported. However, the

required information from the producer study was not available in time for consideration in this analysis.

As well, a number of other alternatives have been proposed, mainly dealing with bringing Mackenzie Delta gas to southern markets. For this study, **the economic analysis is based on the Foothills Alaska Highway Pipeline Project**. Should a different project be selected, especially one involving a different size of pipe or a different route, a number of the studies presented here would have to be redone.

The Alaska Highway Pipeline Project is particularly attractive for a number of reasons, including:

1. Pipeline routing studies completed
2. Engineering studies completed in late 1970s and updated
3. Environmental assessments completed in 1970s
4. Legislation in place in both Canada and United States
5. Agreements in place in Alaska, Yukon, British Columbia, and Alberta
6. Pre-build portion and other pipeline expansions reduce costs from Alberta to US locations
7. Known reserves and flow rates in Prudhoe Bay, with production infrastructure in place
8. Short lead-time to start
9. Cost-effective route, with relatively low tariff

In the coming months, there will be continuing interest in the development of Northern pipelines, with new proposals, updated construction cost estimates, and other studies released. The common thrust will be the search for a feasible plan, with profitability for the private proponents and attractive qualities for the governments involved. These studies of the Alaska Highway Pipeline Project provide a framework for comparison, with most elements detailed sufficiently that others could use similar tools.

# 2 The Economic Questions

Any project evaluation starts with the basic set of questions:

1. Is there a demand for the product I have?

2. Can I deliver it to the marketplace at a competitive price and earn a return on invested capital comparable to other options?

3. Are there adverse side effects or additional benefits that should be considered?

4. Are there any bottlenecks that might affect the timing or costs of undertaking the project?

5. Does this project create a dynamic set of conditions that foster other economic development, either at the same time or afterwards?

Sets of tools have been developed over the years that help shed light on these key questions. Market studies, economic scenarios, and econometric forecasts of energy demand can be drawn on to determine the future demand for natural gas and its price.

Benefit-cost studies help to determine the balancing of revenues and costs with their associated time profiles. As well, each part of the project can be treated separately, and all parts checked for their net benefits. In a multi-jurisdictional project, either all parts need to be viable (positive net benefits) or transfer payments among parties will be needed to motivate each decision-maker to participate in the overall project. Externalities can be introduced into this framework as well.

The search for bottlenecks uses the tools of input-output analysis and economic impact studies, with application at the national, provincial, territorial, and local levels. On the one hand, employment impacts that require substantial increases in employment can be seen as challenges to local labour markets. On the other hand, these employment increases may overcome long-term deficiencies in employment in a region, allowing new economic development and stabilizing the population. Both aspects are important considerations for governments.

Possible follow-on projects can be described, but are probably best studied separately after decisions to proceed on the "trigger project" are a reality. If other activities are a necessary part of a project or, at least, a desirable component, then these "ancillary projects" should be considered more fully as part of the main project study. We have followed that practice here.

## 2.1 Does this project make economic sense?

### 2.1.1 *Project Description*

The first step is to bring together a full description of the project. What are the investment costs by year? What are the operating costs? When do deliveries begin? How long do they continue? What volumes are carried through the pipeline? Foothills Pipe Lines Ltd. provided us with their project definition in sufficient detail that we could undertake the various studies, making this task easier. They also assisted us by answering a number of questions as we proceeded.

The "project definition", however, remains Informetrica's responsibility; since we made assumptions about prices, interest rates, procurement patterns, some employment needs, etc. We also subjected the estimates by comparison to "rules of thumb" for pipeline construction and found the project within the normal ranges. The details are brought together in the Working Paper: **Direct Effects of the Alaska Highway Pipeline Project (5.1.1)** and several tables from that study are included in Appendix A of the Report.

The Alaska Highway Pipeline Project (AHPP) proposes to construct and operate a pipeline from Prudhoe Bay, Alaska to Gordondale, Alberta, traversing 1,750 miles or 2,817 kilometres. This is a shorter section than some other studies have analyzed and therefore the magnitude of impacts is lower than those studies. This project definition was used because it represents the Foothills Pipeline Proposal at this point in time. Existing pipelines are assumed to be adequate to move the gas through Alberta, British Columbia, and Saskatchewan to US markets. If expansion of the lines through Alberta and other provinces were required then this would add additional economic impact to the project.

#### 2.1.1.1 Pipeline Size and Length

The pipeline diameter is specified to be a 42-inch outside diameter pipe, with a working pressure of 2,050 psi, and a steel grade of X80. This pipe can be made in Canada and there appears to be sufficient capacity to produce a large share of the order. Actual procurement plans will follow on the decision to proceed with construction.

#### 2.1.1.2 Construction Costs

The total construction cost is estimated to be about $13.6 billion in Canadian dollars or $9.1 billion in US dollars, based on prices in the year 2000. Current dollar estimates are slightly higher at $9.7 billion US. (Interest during construction is incorporated in the benefit-cost study.)

The activity is split roughly in half between Alaska (49%) and Canada (51%), which implies lower construction costs per kilometre in Canada, reflecting less permafrost in Canada and more benign conditions. The $7 billion in Canada is split across the three jurisdictions as indicated below. The Alberta portion also contains some of the design and project management costs that are part of the construction costs.

**Table 1 Pipeline Length by Segment**

| Segment | Miles | km | % |
|---|---|---|---|
| **Alaska** | **741** | **1,193** | **42%** |
| **Canada** | **1,005** | **1,617** | **58%** |
| Yukon | 517 | 832 | 51% |
| British Columbia | 448 | 721 | 45% |
| Alberta | 40 | 64 | 4% |
| **Total** | **1,746** | **2,810** | |

**Table 2 Construction Costs, millions of dollars**

| Segment | Canadian $ | US $ | % |
|---|---|---|---|
| **Alaska** | **$6,627** | **$4,418** | **49%** |
| **Canada** | **$6,990** | **$4,660** | **51%** |
| Yukon | $3,369 | $2,246 | 48% |
| British Columbia | $2,638 | $1,758 | 38% |
| Alberta | $983 | $655 | 14% |
| **Total** | **$13,616** | **$9,078** | |

#### 2.1.1.3 Operating Costs

Operating costs are modest, using a rough rule of thumb of about one percentage point of capital costs as a guide. Other major costs during the operations phase are the interest on the debt incurred during construction, capital consumption allowances, and the equity return to the pipeline. The method of determining the charges for transporting the gas (the tariff) include all of these factors as well as the construction costs and the volumes of gas moved.

#### 2.1.1.4 Throughput Volumes

The pipeline is designed to carry 2.5 billion cubic feet (bcf) of gas each day initially (November 2007), with incremental increases to 4.0 bcfd after five years (November 2012). The increased

throughput is a result of adding compressors to the system (from 12 to 40), allowing a higher average operating pressure on the line. On an annual basis, volumes of about 1.4 tcf (trillion cubic feet) are expected.

#### 2.1.1.5 Tariffs

The pipeline revenue results from a tariff being charged for the volume of gas carried over a segment of the pipeline, usually stated as dollars per thousand cubic feet or mcf. Actual costs will vary over the life of the pipeline, with heavy costs at the beginning with low volumes and start-up costs, high interest costs, and lower outlays later in the pipeline's life. The normal approach is to calculate a "levelized" tariff that remains unchanged over the design life of the pipeline (25 years in the case of AHPP). In most cases, the tariff is levelized and fixed in nominal terms; however, we have chosen to calculate the tariff in 2000 dollars, and then to escalate it by inflation. The table below shows the constant dollar tariff by segment. In US$, the tariff is just $1.05 from Alaska to Alberta. The tariff from Chicago to Alberta is usually assumed to be about $1.00 US. This means that the Prudhoe Bay producers would receive $1.00 US if the Chicago price were $3.05 US.

**Table 3 Tariffs by Segment ($ per mcf)**

| Segment | Canadian $ | US $ | % |
|---|---|---|---|
| **Alaska** | **$ 0.766** | **$ 0.511** | **49%** |
| **Canada** | **$ 0.805** | **$ 0.537** | **51%** |
| Yukon | $ 0.435 | $ 0.290 | 54% |
| British Columbia | $ 0.348 | $ 0.232 | 43% |
| Alberta | $ 0.023 | $ 0.015 | 3% |
| **Total** | **$ 1.572** | **$ 1.048** | |

Is this return sufficient to justify the pipeline proceeding? Only the producers can answer that question, recognizing that there is uncertainty about all of these components over the next thirty plus years.

#### 2.1.1.6 Comparison to TAPS

How does the AHPP compare to the Tran-Alaska Pipeline, built in the 1970s to carry crude oil from Prudhoe Bay to Valdez, Alaska? We have put the construction costs in comparable dollars (2000 US$) and find that the TAPS line at US $11.3 billion exceeded the expected construction costs of AHPP of US $9.1 billion. The AHPP is a much longer pipeline, 1,750 miles versus 800

miles. Three times more steel is required: 1,381,000 tonnes versus 450,000 tonnes. Direct employment during construction is significantly less than that of TAPS – 59,000 person-years[1] versus 70,000 person-years.

The fundamental difference between the two lines is that the TAPS line needed to maintain the oil at a high temperature so it would flow, and the pipeline needed to be suspended above the ground for most of its length. The Alaska Highway Gas Pipeline can be buried underground, and operated at low temperatures to stabilize the soil when going through permafrost. Construction costs per mile are expected to be much lower than a heated crude oil pipeline.

### 2.1.2 *Ancillary Spending*

We also considered whether other entities would have to undertake additional investments as a result of the pipeline project or in support of its needs. Consideration was given to roads and highways, air transportation, rail transportation, ports, water and sewage treatment, schools, health services, and jails.

**The bottom line is that there may be an additional $20 million in investments required, a small amount relative to the overall project**. This does not include any investments for an Arctic Railroad proposal, since it is unlikely to proceed before the pipeline. For purposes of this study we have ignored these ancillary investments since they are well within the scope of existing government budgets. If the Yukon government decides to spend additional funds on post-secondary education and training then this will also be incremental. As well, any additional regulatory and planning expenses should be considered.

We are satisfied that there are no major hidden costs that might cause real construction costs to balloon. Our review focused mainly on the Yukon. Others may wish to examine the details for British Columbia and Alaska. The information in most of these areas is summarized in **Ancillary Spending (3.2.1)**.

### 2.1.3 *Energy Demand and Price Assumptions*

The scope of this project precluded a full-scale study of US natural gas markets for the next 35 years. Fortunately, there are high-quality studies in place that can be used to provide the context for the introduction of significant new gas supplies into the North American market. The Energy Information Agency (EIA) of the US Department of Energy (DOE) provides an annual energy outlook, with detailed forecasts for natural gas volumes and prices.

The main conclusions about the US energy future are as follows (EIA 2001).

- An increase in natural gas demand is expected, rising from 21.4 tcf in 1999 to 34.7 tcf by 2020, an increment of 13.3 tcf and an annual rate of growth of 2.3%. Much of the growth occurs through increased penetration of natural gas as the preferred fuel for electricity generation, increasing from 16% market share in 2000 to 36% by 2020.

[1] This estimate is based on direct employment in construction in Canada of 30,000, grossed up by 95% for the Alaska portion.

- A real price for natural gas at Henry Hub of $3.10 per mcf in 1999 rises to $4.04 in 2020, a real increase of 1.3% per year.

- A world oil price of $36 per barrel in nominal terms in 2020 is consistent with a real price of $17.46 in 1999 rising to $22.41 in 2020. Imported oil will provide a growing share of US demand, increasing from about 50% today to 64% in 2020.

- Increased reliance on imported supplies of natural gas from Canada and greater domestic production from Rocky Mountain deposits.

In this context, it is clear that an incremental supply of 1.4 tcf from Alaska will "fit" easily, with little disruption to natural gas markets. The price is in the range required for viability of the project, including adequate returns to the transmission systems, the North Slope producers, and the downstream distribution systems.

If there is a reduction in the price of natural gas as a result of the new supplies it should be modest, given that the supply is small relative to the total expected demand. It should not be forgotten that lower prices do confer a benefit on consumers in Canada and the US.

More details about US energy outlook and a comparison of the macroeconomic assumptions underlying the EIA forecasts are contained in **US Energy Demand and Policies through 2020 (4.4.1).**

There are risks to this outlook. Natural gas prices have become more volatile and there is growing uncertainty about future supplies, with a number of proposals for new LNG supplies along with hopes being pinned on new supplies from Mexico and/or the offshore Gulf of Mexico.

In a recent study by the EIA[2] they assume that an Alaska Highway Pipeline will **not** be built before 2020, based on similar gas prices to those identified above. They cite their assessment that a higher US wellhead price will be required before a pipeline will be built. The study does examine the effect of US government loan guarantees and involvement in speeding up the project, resulting in earlier delivery and lower prices for natural gas.

Some of the other uncertainties cited (p. 19 ff) included:

- The availability of stranded gas to feed the pipeline

- The decision process behind the pipeline

- The capital cost of the pipeline

- The effects of the loan guarantee on investors' perceptions of risk

[2] EIA, The Effects of the Alaska Oil and Natural Gas Provisions of H.R. 4 and S. 1766 on US Energy Markets (February 2002; SR/OIAF/2002-02)

Their calculations essentially use a benefit-cost framework to develop a trigger price for the development, with a requirement for a sustained higher US wellhead price before action is taken. This backward-looking inertia model of decision-making in the US energy industry may be appropriate, but it need not be that way. If the US is interested in reducing its vulnerability to imported oil, in supplying electricity to its high-tech industry, and utilizing the stranded gas in Alaska, then someone needs to step up and assume some risk with, presumably, some expectation of reward. The opportunities seem to be present, as indicated by the first part of the economic studies - the benefit-cost framework.

### 2.1.4 *Benefit-cost*

The methodology and detailed results are described in the Working Paper **Cost-Benefit Analysis of the Alaska Highway Pipeline Project (8.1).** In general terms, the framework looks at Canada and the US (Alaska and the lower 48), with each stakeholder's financial position kept separate (producers, Alaska government, pipeline operators, and consumers). It is recognized that a multi-jurisdictional, private-public venture has the challenge of providing positive net benefits to all parties in order for the project to proceed. (If the initial allocation does not produce this outcome, then side transfers may be necessary to achieve it.)

The project produces positive net present value for Chicago city gate prices in excess of $3.00 US ($2.00 US in Alberta), with discount rates in excess of 10% in real terms.

## 2.2 What is the economic impact of the pipeline project?

The study of the economic impact of a large construction project can be likened to dropping a rock into a pond. If one looks at the pond in its entirety, the impacts are modest (if it is a large pond). But near the entry point of the rock, there are sizeable waves that ripple outward. After the rock reaches bottom, it displaces some water, raising the level of the pond somewhat. This is more akin to the operations phase of the project, with some increase in the level of activity, but not in a readily discernible manner. Of course, if the rock is really big, and some part of it remains above water, then there is a permanent change in the pond, with a new "island" formed by the rock as well as a permanent rise in the level of the pond.

It is not clear if the Alaska Highway Pipeline Project (AHPP) will be big enough in Canada to form a new "island". Even on the North Slope of Alaska much of the infrastructure and gathering systems are already in place, so that post-construction the activity in terms of people will be quite modest.

To assess the economic impact of the project, a large econometric model of the Canadian economy is used. The first step is to develop a plausible view of the path of the economy through 2025, **without** the Alaska Highway Pipeline being built. This constitutes the Reference Case or **Base Case**. Then the pipeline construction and operation is assumed to take place. This generates an alternative path for the economy, referred to as the **Pipeline Case**. Finally, the two cases are compared by subtracting the Base Case from the Pipeline Case. This **difference** is the impact of the decision to build the pipeline. Different assumptions about other factors like government policy responses can generate alternative paths.

A similar process is used to analyze the provincial impacts and the impacts on the Yukon economy, with models of each used to generate several cases that are then compared.

The ability to isolate the impacts of a particular construction project is the strength of this approach. Of course, there may be many other changes that occur in the event that a pipeline is built. New uses of the natural gas will arise; other developments may be triggered, cost-of-living changes may change the population of Yukon, etc. But these other developments should be treated separately, or as part of the articulation of a different vision of Northern development. This effort is beyond the mandate of this project. We have noted several such possible developments, but do not include them as part of the direct impact of the Pipeline Project.

### 2.2.1 *Nationally*

Impacts are reported for each year of 2002 to 2025 in the detailed Working Papers. From the perspective of interpretation, however, readers should understand that there are two overlapping phases represented in these results. The construction phase covers from 2002 to 2012, peaking in 2006, and consists of structure and machinery & equipment investments. The operations phase spans from 2007 to 2025, and increases gradually from 2007 to 2013 after which the impact is constant through the remainder of the years.

The major indicators for macroeconomic effects are Gross Domestic Product (GDP), employment and unemployment, business investment, inflation, and government balances. Also highlighted are industries that are directly impacted by the AHPP, specifically pipeline transportation, oil and gas construction, primary iron and steel fabricating and aircraft and aircraft parts industries.

Both impact cases use the same direct inputs of investment, tariff revenue and operations employment. However, the cases differ on the fiscal position of the federal and provincial governments. In discussing the possible behavior of governments there was substantial uncertainty. Some think that governments will hold on to every additional dollar of revenue that comes there way, using the proceeds to pay down debt or build up reserves for the future. Others suggest that governments should be assumed to reduce taxes or spend any improvement in their fiscal position, passing on, or recycling, improvements in their fiscal position. This assumption is not inconsequential. With recycling there are larger induced effects on people's incomes, more employment, and reduced unemployment. For each impact we have developed **two** scenarios or paths.

**Scenario 1 (No Government Recycling)**

> There is no change in fiscal policy by all levels of government. Consequently, any changes in government balances are assumed to go directly into debt reduction or acquisition of financial assets.

**Scenario 2 (Governments Recycle)**

> The governments recycle the increased revenue using three specific techniques; lower Employment Insurance (EI) contribution rate, keep federal business taxes equal to the base and keep federal personal income taxes equal to the base. The first two techniques

will directly reduce federal revenues, while the last technique will reduce federal and provincial revenues because provincial personal tax rates are linked in the model.

The overall effect of the second scenario is to increase the **induced** effects of the impact, by effectively increasing disposable income through lower tax rates.

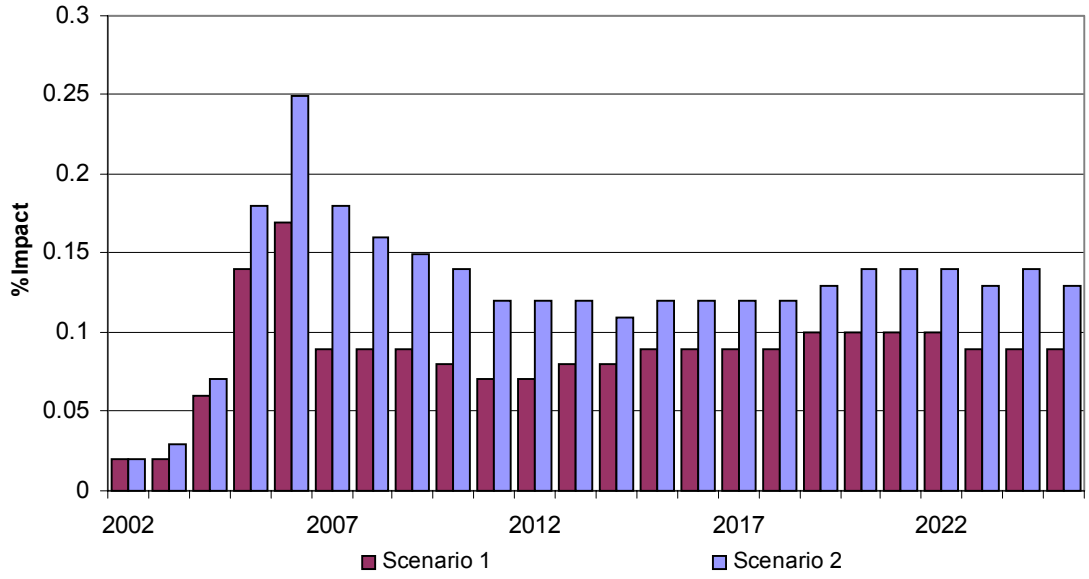
## Table 4 Major Macroeconomic Indicators

| | Scenario 1 | | | Scenario 2 | | |
|---|---|---|---|---|---|---|
| | 2002-2012 | 2013-2025 | 2006 | 2002-2012 | 2013-2025 | 2006 |
| | Average Annual Impact | | | | | |
| Gross Domestic Product | | | | | | |
| Market Prices (2000$Mn) (a) | 0.08% | 0.09% | 0.17% | 0.13% | 0.13% | 0.25% |
| Market Prices (2000$Mn) | $1,009 | $1,425 | $2,043 | $1,622 | $1,984 | $3,012 |
| Total Economy Employment (LFS) | 6,618 | 2,688 | 28,521 | 17,673 | 14,053 | 43,363 |
| All Government Net Lending ($Mn) | 772 | 1,542 | 1,334 | 290 | 490 | 472 |
| Current Account Balance ($Mn) | 156 | 1,725 | -1,091 | -233 | 593 | -1,522 |
| Unemployment Rate (%) (b) | -0.03 | 0.00 | -0.13 | -0.07 | -0.03 | -0.20 |

(a) Average Percentage Impact (b) Percentage Point Impact
Source: Informetrica Limited

The overall effect of the AHPP on Canadian GDP is relatively small, with a peak impact in 2006 of less than 0.2 per cent in Scenario 1 and a peak impact of 0.25 per cent in Scenario 2. The longer-run effects are comparable in both scenarios at 0.1 per cent, with Scenario 2 higher in all years.

## Figure 1 GDP Impacts, by Scenario




This is also the case for the employment impacts with peak employment in 2006, at 28,500 when the governments retain increased revenues, and 43,400 employees when the government recycles

revenue. Longer-run impacts (2013-25) are modest at 2,700 employees per year when the government retains increased revenues, but this increases to 14,000 employees annually when the government recycles increased revenues.

The unemployment rate is reduced by a tenth of a percentage point at the peak in both 2005 and 2006, when the governments retain increased revenues. However, when governments recycle increased revenues, the unemployment rate declines by a tenth of a percentage point from 2004 to 2009 and two tenths of a percentage point in 2006.

The investment profile is similar for both scenarios because the initial pipeline investment impacts are identical. However, government recycling increased revenues causes some induced investment in machinery and equipment (M&E) over the 2007 to 2012 period. This induced M&E investment occurs in the service industries, caused by increased consumption and real disposable income.

If governments do not recycle the increased revenue, then all levels of government benefit from the AHPP. In this scenario the federal government gains the most, due initially to increased business tax and personal tax revenue. The scenario specifies that the total gain of the balance be directed to paying down the national debt. The longer term is dominated by lower interest payments on a smaller debt load. This is also the case for hospitals, and the provincial and local governments but to a lesser degree.

The second scenario impact on the federal government balance fluctuates over the first seven years of the impact, but over the medium and longer term the recycling has a negative influence. These modest losses are caused by inflation indexing for many of the federal governments revenues and expenditures.

The provincial governments recover almost all of the recycled provincial personal tax revenues through provincial retail sales tax revenue on higher consumption goods spending. Both CPP and QPP balances increase due to higher activity in the economy, but these will be offset through higher payments in the future as a result of greater employment.

Local government and hospital balances are only marginally increased in both scenarios, and virtually unchanged between the two scenarios.

Detailed discussion of the impacts and the methodology are in the Working Paper, **National Impacts of the AHPP (6.1.1)**.

### 2.2.2 *Industries*

The three most directly affected industries are: primary iron and steel manufacturing, oil and gas facility construction, and aircraft and aircraft parts manufacturing. The primary iron and steel industry manufacture the pipe, valves and fittings used in the AHPP. The oil and gas facility construction industry is responsible for installing the pipe in the ground. The aircraft and aircraft parts industry manufactures the compressor, which is generally a retrofitted jet engine.

From 2005 to 2007, which is during the peak investment period by the pipeline industry, both output and employment peak for all three directly impacted industries in both scenarios. Output

impact on the aircraft and aircraft parts industry remains strong through 2012, reflecting the longer period during which compressors are installed. The greatest impact is on the oil and gas facility construction industry, with output higher by 10% during the peak years as measured by industry GDP or value-added. The primary iron and steel industry and aircraft industry will experience impacts of about 2% of industry GDP over the peak years.

During the operations phase, the Canadian pipeline transportation services industry increases by about 10% relative to the base case. This increase is in line with the increased capital stock put in place for pipelines.

### 2.2.3 *By Region*

The parts of the "pond" most affected by the "rock" are the Yukon, the northeast part of British Columbia, and Alberta. The procurement of the pipe will also send a major ripple through to Saskatchewan and Ontario, and the assumed purchase of compressors from Quebec is a welcome splash there as well. Other parts of Canada are influenced only modestly as a result of the induced spending, or some of their residents temporarily working in Yukon or BC during the construction period.

In the Regional-Industrial Model (RIM) we distinguish only at the provincial level and for the Territories combined (Yukon plus NWT plus Nunavut). The effects on GDP by region show an increase of 8.5% to 11% for the Territories combined, about 0.4% to 0.5% for BC, and a very modest impact of 0.1% to 0.2% for Alberta[3] and the rest-of-Canada (ROC).

**Table 5 Across-province views of GDP Impacts**

**Gross Domestic Product**

| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008-25 |
|---|---|---|---|---|---|---|---|
| | | | % Impact | | | | Av %Imp |
| **Scenario I** | | | | | | | |
| Territories | 0.29 | 0.38 | 1.56 | 4.73 | 8.51 | 5.53 | 8.90 |
| British Columbia | 0.01 | 0.01 | 0.08 | 0.23 | 0.38 | 0.21 | 0.30 |
| Alberta | 0.08 | 0.09 | 0.06 | 0.09 | 0.12 | 0.07 | 0.10 |
| Rest of Canada | 0.01 | 0.01 | 0.05 | 0.12 | 0.10 | 0.05 | 0.05 |
| **Scenario II** | | | | | | | |
| Territories | 0.38 | 0.66 | 2.04 | 6.12 | 11.20 | 8.58 | 10.80 |
| British Columbia | 0.01 | 0.02 | 0.10 | 0.29 | 0.47 | 0.32 | 0.30 |
| Alberta | 0.08 | 0.10 | 0.07 | 0.12 | 0.17 | 0.12 | 0.10 |
| Rest of Canada | 0.01 | 0.02 | 0.06 | 0.15 | 0.17 | 0.12 | 0.02 |

Employment effects are distributed similarly, with peak employment increases in the Territories of about 7,000 to 8,000 during peak construction, larger increases of about 8,000 to 11,000 in

[3] There is no additional expansion of the Alberta pipeline system in this study. The only segment in Alberta is a short one of 64 kilometres from the BC border to Gordondale, Alberta.

British Columbia, and 3,000 to 4,000 in Alberta with 10,000 to 20,000 in the rest-of-Canada. The variations are traceable to the different scenarios for government recycling their revenue improvements.

### 2.2.4 *In the Yukon*

The splash in the Territories is even larger when the focus is the Yukon alone. Almost all of the effects are concentrated there, with little activity attributable to the pipeline in NWT and Nunavut.

Gross Domestic Product (GDP) in the Yukon increases by 20% to 30% at the peak of construction (2006) and by 30% to almost 40% during the operations phase (2013-25). The increase during the operations phase will be mainly due to the inclusion of the pipeline transportation services margins in the Yukon's GDP. The range flows from the two scenarios about fiscal recycling by governments.

Employment increases are measured in two ways: the increase in **workers** within the borders of Yukon and the increase of employment of **residents** of Yukon. In Scenario I in the peak year of 2006, employment increases by about 7,000 employees within the borders of Yukon (36%, see Tables below). The employment increase for residents in the same year is about 2,700, of which about 1,060 are direct construction jobs (20% of the increase in construction employment) plus all of the induced jobs as a result of higher spending by both transients and residents in the Yukon. This increase in employment of residents is what drives the increase in personal disposable income in the Yukon, up by 12.3% during the peak construction years of 2005-07 (see Tables below). Workers resident in other locations also increase the personal disposable income of those other regions.

The actual split between residents and transient workers will be complex. If it is believed that residents will have some preferential treatment, then there will be a surge of "residents" moving from elsewhere, but with a strong likelihood of leaving after the project winds down. We have purposefully assumed that there will be no incentive to move, in order to better understand the impact on **current** residents of the Yukon.

**Table 6 Major Indicators for Scenario 1, Yukon**

| | 2002 | 2003 | 2004 | 2005-07 | 2008-12 | 2013-20 | 2021-25 |
|---|---|---|---|---|---|---|---|
| | | | | Average % Impact | | | |
| **Gross Domestic Product** | 1.0 | 1.3 | 5.3 | 21.2 | 27.5 | 31.8 | 30.0 |
| **Demographics** | | | | | | | |
| Population | 0.0 | 0.2 | 0.4 | 0.6 | 0.6 | 0.6 | 0.6 |
| Employment ('000s) | 1.4 | 1.7 | 8.3 | 36.2 | 5.9 | 7.1 | 9.0 |
| GDP($86)/employed worker | -0.4 | -0.5 | -2.8 | -10.7 | 20.5 | 23.1 | 19.3 |
| **Investment** | | | | | | | |
| Nonresidential Structures | 0.1 | 0.1 | 114.9 | 330.4 | 3.3 | 0.8 | 1.0 |
| Machinery and Equipment | 0.5 | 0.7 | 31.9 | 118.7 | 77.1 | 2.6 | 3.8 |
| **Other Indicators** | | | | | | | |
| Real Personal Disposable Income | 1.1 | 1.2 | 3.3 | 12.3 | 6.9 | 7.5 | 8.0 |

## Table 7 Major Indicators for Scenario 2, Yukon

| | 2002 | 2003 | 2004 | 2005-07 | 2008-12 | 2013-20 | 2021-25 |
|---|---|---|---|---|---|---|---|
| | | | | Average % Impact | | | |
| **Gross Domestic Product** | 1.3 | 2.2 | 6.9 | 29.3 | 34.7 | 37.3 | 37.3 |
| **Demographics** | | | | | | | |
| Population | 0.0 | 0.2 | 0.4 | 0.6 | 0.6 | 0.6 | 0.6 |
| Employment ('000s) | 1.8 | 2.9 | 10.3 | 45.2 | 13.0 | 10.7 | 13.8 |
| GDP($86)/employed worker | -0.5 | -0.7 | -3.1 | -10.7 | 19.3 | 23.9 | 20.7 |
| **Investment** | | | | | | | |
| Nonresidential Structures | 0.1 | 0.2 | 115.1 | 331.4 | 4.3 | 1.9 | 2.7 |
| Machinery and Equipment | 0.6 | 1.1 | 32.6 | 122.3 | 80.0 | 5.2 | 7.7 |
| **Other Indicators** | | | | | | | |
| Real Personal Disposable Income | 1.4 | 2.2 | 4.9 | 20.2 | 14.1 | 12.9 | 15.1 |

The careful handling of employment activities and distinguishing between residents and transients is key to the proper identification of effects in the Yukon. We have tried to make realistic assumptions about the residence of additional workers and their spending patterns, but it may be desirable to investigate this matter in greater detail.

As the construction period winds down, after 2007, Yukon residents can supply the residual demand for construction workers. During the operations phase (2013-25) employment is modest (about 1,000 to 1,700), with most of it supplied by residents of the Yukon. Direct employment during the operations phase is expected to be about 170 people in Yukon, with a similar number in British Columbia.

## Table 8 Yukon Employment, Construction and Operations

**Annual Average Employment**

| | SCENARIO 1 | | | SCENARIO 2 | | |
|---|---|---|---|---|---|---|
| | 2002-12 | 2013-25 | 2006 | 2002-12 | 2013-25 | 2006 |
| Direct Employment | 1,101 | 171 | 5,287 | 1,101 | 171 | 5,287 |
| Total Employment | 1,768 | 1,002 | 6,933 | 2,599 | 1,692 | 8,254 |
| Residents | 887 | 1,002 | 2,703 | 1,718 | 1,692 | 4,024 |
| Transient | 881 | - | 4,230 | 881 | - | 4,230 |

We have assumed only modest increases in the population of the Yukon as a result of the pipeline. It is conceivable that much larger increases could occur if there was an advantage given to residents for employment on the pipeline's construction or if there were much larger spin-offs than we have identified to date. In our work, we tend to focus on the employment effects, which in turn support people living in the area. During the operations phase, direct employment increases are modest, and existing residents can meet most of the requirements. There is certainly room to lower the unemployment rate of current residents. Hence we have raised the population in the longer term by only 200.

Most of the GDP during operations is allocated to capital consumption allowances (CCA), interest costs, and profits before tax. While important activities, they generate little employment in the Yukon. Further details on the Yukon impacts can be examined in **The Impacts of the AHPP on the Yukon Economy (7.1.2)**.

### 2.2.5 *Communities in the Yukon*

Communities along the pipeline route will feel the largest impacts, with competition for local workers, induced jobs from spending by pipeline workers, and demands on the local infrastructure as well. Detailed studies of each community were not possible under the scope of this project. However, a general tool for such assessments has been provided, along with two example applications – one for Whitehorse and one for Haines Junction. It is recommended that communities concerned about the pipeline impacts use this tool as a starting point for an assessment. Spreadsheets can be provided to interested parties to assist in the calculation of impacts. Full details are provided in the Working Paper **Assessment of Economic Impacts using the Local Area Model (LAM) (7.2.3)**.

The local effects considered include:

- Direct employment by the pipeline or related contractors (direct)
- Local procurement of goods and services by the pipeline construction entities (indirect)
- Spending by non-resident workers (induced external)
- Bidding up local wages and prices
- Population changes and pressure on local infrastructure

The model picks up the induced effects from increased local income being spent locally and also estimates the impact on local taxes.

The major finding is that Whitehorse has larger impacts in size, given that it is in a position to supply some additional services to the pipeline construction and to workers. It will benefit from the movement of people in and out of the Yukon during construction. The percentage impacts are also larger, since the Whitehorse economy is able to supply a larger fraction of induced needs than other locations in Yukon.

The Local Area Model is a simple tool for local assessments. It does not try to account for linkages between cities, or to estimate the time path of activities or the impact on local investments in infrastructure or new capacity. The other models are better suited for such appraisal for the Yukon Territory as a whole.

As the project becomes closer to reality, it should be possible to develop a sense of the range of activity for each local jurisdiction. Discussions can then proceed on either minimizing the impacts or maximizing them, depending on the choices of the community. Some ideas for modifying the local impacts are sketched out in the Working Paper.

### 2.2.6 *Inter-Provincial Input-Output Model*

The Interprovincial Input-Output Model (IPIO), developed by Statistics Canada, defines the relationships between industries and commodities used for production and consumption. The IPIO Model also incorporates the interrelationships between provinces and territories (includes Yukon and combined Northwest Territories and Nunavut) through interprovincial imports and exports, likewise with foreign economies through imports and exports.

Direct impacts of the Alaska Highway Pipeline Project (AHPP) are separated into construction phase and operations phase impacts, and will be dealt with separately. The **construction phase impact**, for the Yukon segment, will be $2,138 million impact from structures investment, and $1,231 million impact from machinery and equipment investment, or a total of $3,369 million. The construction phase impact, for the British Columbia segment, will be $1,711 million from structures investment, and $927 million from machinery and equipment investment, for a total of $2,368 million.

**Table 9 Construction Phase Impacts, in $millions and person-years[4]**

| | Investment | Yukon | B.C. | Rest of Canada | Imports | Inventory Adjustment / Taxes / Subsidies |
|---|---|---|---|---|---|---|
| GDP (Yukon) | $3,369 | $1,106 | $184 | $632 | $1,155 | $291 |
| GDP (B.C.) | $2,638 | $1 | $1,027 | $495 | $887 | $228 |
| **GDP Total** | **$6,006** | **$1,107** | **$1,211** | **$1,127** | **$2,042** | **$519** |
| | **Total** | | | | | |
| Person-Years (Yukon) | 27,894 | 14,261 | 3,624 | 10,009 | | |
| Person-Years (B.C.) | 22,085 | 21 | 14,205 | 7,859 | | |
| **Person-Years Total** | **49,979** | **14,283** | **17,829** | **17,867** | | |

The construction phase is estimated to generate a total of 50,000 person-years of employment in the Canadian economy over the 10-year construction period. In total, 14,300 person-years are generated in the Yukon and 17,800 person-years in British Columbia, primarily in the construction industry. British Columbia has the advantage of providing material input to the Yukon segment which generates a further 3,600 person-years of employment. However, the British Columbia investment does not generate many employment opportunities in the Yukon

[4] Interpretation of this table uses the Yukon as an example but BC follows the same pattern. The investment that occurs in the Yukon is given beside the row titled "GDP (Yukon)" in this case $3,369 million. The consequence of this investment is given in the rest of the row. So it generates $1,106 million of GDP for the Yukon, $184 million for BC, $632 million in the rest of Canada, and $1,155 million is spent on imports, with another $291 million made up of taxes and unallocated inventory change. The employment associated with the GDP generated is given in the row titled "Person-Years (Yukon)". So $1,106 million of GDP in the Yukon generates 14,261 person-years of employment in the Yukon.

because they do not provide inputs for the BC Segment. Central Canada, Saskatchewan, and Alberta are the provinces that also gain employment during the construction phase by providing input materials for the pipeline.

Peak construction occurs in the 5th year, or 2006 in the time path used by Informetrica Limited, with $1,469 million in structures investment and $321 million in M&E investment. Peak employment during the construction phase generates 17,110 jobs in Canada of which 5,367 jobs are in the Yukon, and 6,201 jobs are in British Columbia.

The construction phase investment is expected to generate a total of $3,446 million of GDP for Canada of which $2,318 million is split almost equally between the Yukon and British Columbia.

A significant portion of the investment is accounted for by a rise in imports of $2,042 million. This is attributable to the M&E investment leaking out of the country at a rate of 64% and structures investment leaking out at a rate of 17%. If a domestic supplier of the compressors and pipe is available and expected, it is not reflected in the IPIO model. The employment results are not unlike the findings of the TIM and RIM models with the exception that TIM and RIM assume that 90 per cent of the compressors and pipe can be supplied domestically. This assumption was made to test the economy for capacity (bottle-necks). The reasonableness of this assumption was confirmed through discussions with firms that could likely supply these inputs. Lower import leakage rates resulted in higher indirect and induced impacts to the Canadian economy.

The **operations phase impact**, for the Yukon segment, will be represented by the annual cost-of-service revenue of $635 million generated from the ultimate flow rate of 4.0 billion cubic feet per day. Likewise, the annual cost-of-service revenue of $508 million generated from the ultimate flow rate is representative of the British Columbia segment.

## Table 10 Operations Phase Impacts, in $millions and person-years

| | Cost-of-Service (Peak) | Yukon | B.C. | Rest of Canada | Imports | Inventory Adjustment / Taxes / Subsidies |
|---|---|---|---|---|---|---|
| GDP (Yukon) | $635 | $552 | $3 | $17 | $15 | $48 |
| GDP (B.C.) | $508 | $0 | $444 | $13 | $12 | $38 |
| **GDP Total** | **$1,143** | **$552** | **$448** | **$30** | **$27** | **$86** |
| | **Total** | | | | | |
| Person-Years (Yukon) | 3,455 | 3,115 | 59 | 281 | | |
| Person-Years (B.C.) | 2,764 | 0 | 2,528 | 236 | | |
| **Person-Years Total** | **6,219** | **3,115** | **2,587** | **517** | | |

The operations phase will increase the base employment by 6,219 person-years annually in the Canadian economy with 3,115 person-years occurring in the Yukon and 2,587 person-years in British Columbia. The operations phase generates few employment opportunities in the rest of Canada. $1,143 million of GDP will be generated annually in Canada of which $552 million and

$448 million will be from the Yukon and British Columbia's transportation sectors, respectively. The GDP generated may be inappropriately represented because much it will be used to service the loans on the pipeline investment (pipeline cash flow). This would take place at the head office of the pipeline company (most likely in Alberta but shared over the path of the pipeline, the Yukon and BC), but this type of GDP does not generate employment.

With the GDP mix being abnormal, then employment estimates will also be inflated because of the fixed productivity assumptions of the IPIO Model. The IPIO Model assumes a productivity of approximately $200,000 per employee with a capital-labour ratio of $1 million per employee for the pipeline transportation industry. Historical capital labour ratios for this industry have been more in the order of $4.5 million per employee (based on 1992 capital stock and Labour Force Survey), which would reduce employment estimates by 3,000 person-years during years of peak natural gas flow. New computer monitoring devices in recent years have greatly enhanced labour productivity in the pipeline transportation industry, which would further reduce the employment estimates.

Although the employment estimates are too high, the cost-of-service will provide a significant impact to the Yukon economy. This, combined with the expectation of at least 25 years for the operations phase, would create a new solid base for the Yukon's economy over the next quarter century.

As a cautionary note, when using the IPIO Model for impact analysis the modeller must be aware of the limitations and structural assumptions, about productivity and import leakage, that is inherent in the model. **We are more confident in employment and GDP estimates from TIM and RIM results** because these limitations and structural assumptions have been dealt with and corrected for in an intelligent manner.

Detailed discussion of the impacts and the methodology are in the Working Paper, **Interprovincial Input-Output Analysis of the Alaska Highway Pipeline Project (7.2.1)**. The associated pipeline impact calculator is **7.2.1_IPIO_AHPP_Calculator.xls**, and inputs can be made as a time series of construction investment, M&E investment and cost-of-service revenue in both the Yukon and BC.

# 3 Other Important Dimensions

The benefit-cost and economic impacts are only two of the important dimensions. We have also considered the effects on the human resource needs and government fiscal positions. Issues around the environment and socio-economic impacts are touched on lightly.

## 3.1 Human Resource Impacts

During construction, direct employment in Canada of about 10,000 people at the peak construction year in 2006 is supplemented with another 20,000 to 30,000 indirect and induced jobs in other sectors. With over 1,000,000 people unemployed every year since 1981, it would seem that the increase in employment would be welcomed and place little strain on the economy to supply the necessary people. However, the jobs to be filled are not all unskilled positions.

To assess the needs in more detail, the demand for labour has been translated into occupational forecasts by year and by region, with a focus on specific occupations likely to be in short supply or to require special attention. The details of this study are in the Working Paper, **Human Resource Dimensions of the AHPP: Yukon (7.4.1)**.

In the Yukon, the lack of available skills (e.g., pipeline welders) will limit the full participation of Yukon residents in all aspects of the pipeline construction. However, any Yukoners with any of the required skills are likely to get a job on the pipeline construction. There will be significant opportunities in the induced jobs, resulting from the improved incomes of Yukoners and transients.

**Table 11 Major Occupational Demands in Yukon, Annual**

| | Scenario 1 | | |
|---|---|---|---|
| Yukon | 2002-07 | 2008-12 | 2013-25 |
| | **Average Impact** | | |
| Identified Items Below | 2485 | 717 | 944 |
| MANAGERIAL, ADMINISTRATIVE & RELATED | 286 | 89 | 135 |
| NATURAL SCIENCES, ENGINEERING & MATHEMATICS | 114 | 48 | 83 |
| ARTISTIC, LITERARY, RECREATIONAL & RELATED | 21 | 6 | 18 |
| CLERICAL & RELATED | 320 | 123 | 181 |
| SALES | 95 | 77 | 117 |
| SERVICE | 198 | 86 | 173 |
| FARMING, HORTICULTURAL & ANIMAL HUSBANDRY | 67 | 9 | 5 |
| MACHINING & RELATED | 52 | 10 | 8 |
| PRODUCT FABRICATING, ASSEMBLING & REPAIRING | 118 | 48 | 58 |
| CONSTRUCTION TRADES | 1091 | 150 | 77 |
| TRANSPORT EQUIPMENT OPERATING | 76 | 39 | 44 |
| MATERIAL HANDLING & RELATED, N.E.C. | 23 | 9 | 12 |
| OTHER CRAFTS & EQUIPMENT OPERATING | 25 | 23 | 33 |

The preceding table shows those occupations with an **annual** requirement of more than 20 additional workers in the first five years of the project. Later periods are generally less demanding. A number of the skills may be readily available in the Yukon. Others may require additional people from other regions. The development of a detailed human resource plan is beyond the scope of this study, and requires an inventory of existing skills in the Yukon as well as consideration of other demands over the same period. But as a rough guide, occupations with significant employment in each of the three periods over the next twenty-five years may be good career choices for young Yukoners, if the pipeline proceeds. Items with large demands at the beginning but little later (e.g., construction) may be better filled from outside. (This is what we assumed would happen as well, by filling only 20% of the construction jobs from Yukon residents.)

Additional training can help. Plans for expanded training at Yukon College will no doubt expand the choices available to residents. But the general framework should recognize that not all jobs can or will be filled by residents. As well, training should include concerns about post-construction employment opportunities. In the Working Paper, **Human Resource Dimensions of the AHPP: Yukon (7.4.1)** additional detail is provided for the two scenarios.

### 3.1.1 *First Nations*

Concerns about employment of Yukon First Nations people, are addressed in both the occupational study and in a separate Working Paper, **AHPP and First Nations: Linkages (7.6)**. Aboriginal people make up about 20% of the Yukon population, and an even larger share of the younger group, 15 to 34, which is a natural focus for further training. Broad-based training for both the construction jobs and those induced jobs in other sectors is recommended. Several other recommendations are made as well.

### 3.1.2 *Labour Unions*

A brief summary of some of the issues and opportunities of early involvement of the unions in the planning process are laid out in the Working Paper **AHPP and the Unions: Linkages (7.2.7)**. There is also an important role in the delivery of trades training, as exemplified by the United Association of Plumbers and Pipefitters. The Whitehorse Local 310 has undertaken a training course with special emphasis on First Nations participants, providing both local classroom training and apprenticeship training at Fort McMurray in Alberta. With training times in specialized trades measured in years, early development of a strategy is important.

## 3.2 Environmental Impacts

The scope of this study precluded any detailed work on environmental impacts. What was done is a brief overview of the issues identified in earlier studies in the 1970s, as well as issues raised in later years. This has been summarized in the Working Paper **AHPP and the Environment: Linkages (7.2.8)**.

Although construction projects inevitably adversely impact the terrain they cross during construction, it is possible to minimize the immediate and long-term damage and, indeed, even improve on the environment in the process. In the prior process of approval to proceed with essentially this pipeline project, environmental reviews resulted in a go-ahead. Since that time,

construction technologies have improved, with more options now available for river crossings (e.g., tunnelling under them) than in the past. Companies have increased experience in operating in a more environmentally conscious manner. With this particular pipeline project, it would appear that we are in better shape to proceed with a good base of knowledge on local environmental issues than is normal. Monitoring by governments remains important to ensure that we do what we know how to do.

## 3.3 Government Finances

The Yukon government operates in a unique fashion with respect to its own revenues and expenditures and their relationship to the federal government. What was thought to be a simple relationship is anything but, with about 66% of total Yukon government revenue coming in the form of a federal grant. The problem is that any increase in own-account revenues can reduce the federal grant. The question is how much and does it depend on the reason for the increase?

A spreadsheet model of the Yukon Budget balance was constructed and documented. See **Government Expenditure and Revenue Model: Yukon (7.2.5)** for the details, including forecasts with and without the pipeline project. The "perversity factor" shows up, where improvements in own-account revenue lead to lower federal grants, although it appears that they are not so large that the Yukon is worse off with more development.

Of particular concern is that the Yukon government faces increased expenditure requirements without the revenue improvements to finance them. Even though their own-account revenue improves, it is offset by reductions in the federal grant, leaving them in the unenviable position of raising tax rates even though own-account revenues have improved.

The spreadsheet model should help others to understand this issue better and could be the basis for discussions between the federal and territorial governments. Indeed, some new approach would seem warranted and in the spirit of the increased responsibilities being assigned to the territorial government.

# 4 What About?

Although we have examined a number of the economic dimensions of the Alaska Highway Gas Pipeline Project, there are inevitably additional dimensions that could be subjects of additional study. Two areas that are frequently mentioned are developments of oil and gas in the Yukon and subsequent uses of the natural gas in Yukon. Both areas are interesting, but can be separated conceptually from this study. These other activities may be "enabled" or made more economic by the existence of the gas pipeline, but they will need to meet their own benefit-cost criteria. Their economic impact will be subject to a different assessment at a different time. Nevertheless, we have provided some information to assist the reader in sizing these activities and identifying the associated issues.

Another issue that arises is a comparison of this study to other impact studies of gas pipelines. Indeed, we have undertaken other studies ourselves and can usefully compare them.

## 4.1 Yukon Gas and Oil Developments

In a Working Paper, **Development of Gas Fields in Yukon and BC (4.1.1)**, it is noted that the existence of a gas pipeline is likely to spur gas exploration throughout the Territory, since it means that there would be the possibility of transporting the gas to market. If very large reserves are found, then additional pipeline development may be required. There are a number of potential areas in both the Yukon and BC. Indeed recent announcements in northern BC have increased the interest in such developments.

Current gas supplies in the Liard Basin are the most obvious candidates for offering additional supply. Indeed, some part of that gas could be used to "top up" the supply as it leaves Yukon, allowing for gas withdrawals in Yukon for fuel and other applications to be made without reducing delivered volumes.

## 4.2 Post-Pipeline Developments

The availability of natural gas in the Yukon broadens the choices for the Yukon. Cheaper fuel costs for the development of mines and smelters becomes a reality. The local distribution of natural gas for heating and cooking fuel becomes possible in some of the larger communities near the pipeline. The generation of electricity from natural gas is an option, replacing diesel fuel systems. A number of these options are examined in greater detail in the Working Paper, **Pipe Dreams: Post Pipeline Development Impacts (4.2.1)**. The Working Paper resulted from a review of many possible effects, and a separation of these effects into those that were a necessary part of the pipeline development (ancillary developments) and those that may occur but which were not a necessity for the pipeline's success.

Economic development in any form also spurs interest in the development of industrial parks, residential areas, and retail space. However, such developments are best studied separately, since in each case other developments may amplify the need or reduce it.

## 4.3 Comparison to 2000 Study for Federal Government

In 2000, Informetrica Limited undertook an economic impact study of the national effects of several pipeline proposals, including a variant of the Alaska Highway Gas Pipeline; a comparison to this study is provided in Working Paper, **A Comparison: Impact Studies and the Trans-Alaska Pipeline (6.1.2)**.

The general profiles, the relative multipliers, and other dimensions were similar, not surprisingly. After all, the same model was used and similar assumptions made. But several distinctions were important to note. In the 2000 study, the pipeline specified could not be made in Canada and therefore it was imported. This reduced the positive impacts on the Canadian economy. Fiscal policy was "fixed", with any revenue increases being retained by governments. This dampened the positive income effects, and is similar to Scenario I in this study.

In the 2000 study, additional construction activity is undertaken in Alberta and Saskatchewan to enhance pipeline capacity in these provinces and to convey the incremental gas supply to US markets. In this study, no such provision is made explicit, thereby reducing the direct construction costs. At the same time, no explicit revenue is associated with the transmission of gas beyond Gordondale, Alberta in this study.

In this study, additional information was available about the location of construction activity. As well we were able to assess more accurately the supply capability of the Yukon for direct and indirect contributions. Thus the allocation of activity by region is more accurate.

# 5 Assessment of Readiness

## 5.1 Areas requiring further information

### 5.1.1 *Final route definition*

Although there is a routing of the pipeline that was defined previously, there have been some discussions of minor changes in the routing that may reduce the environmental impact. For example, in the Ibex Valley near Whitehorse some changes have been proposed.

As part of a process leading to a decision to proceed, it makes sense to pin down the final version of the proposed routing, and the associated costs of those changes.

### 5.1.2 *Review of subcontracting plans*

The detailed plans of Foothills articulate well the construction crews that are laying the pipeline and building the compressor stations. But there are many other aspects of the project that appear to be "contracted out", including the movement of pipe to the sites, movement of workers to the sites, etc.

Governments are interested in the **total** human resource requirements for the construction phase and operations phase. These estimates feed economic impacts, revenue forecasts, socio-economic studies, and the development of human resource plans. A further detailing of the employment and skill needs in these other areas would be helpful.

### 5.1.3 *Review of human resource needs – occupation*

The Informetrica Occupational Requirements Working Paper should be treated as a first approximation to the overall human resource requirements for the project. We have used the available information, but feel that the subcontracting dimension requires further study. Different approaches to satisfying the logistical needs will imply different occupational mixes.

We note that the model “signals” a significant risk of labour shortages in the Yukon, which could affect project economics and the effects reported here. The scale of potential effects in the Territory, and uncertainty about local-area impacts, sources of labour supply, and tax status of affected populations are important qualifications to the effects reported.

### 5.1.4 *Contingency plans for low natural gas price world*

There is general agreement that the project is viable with natural gas prices in the range of $3.00 to $4.00 US per MMBtu at Chicago (2002 prices). The project risk is that the price for natural gas stays closer to $2.00 US per MMBtu, leaving no economic rents at the North Slope and squeezing the transportation margins. It would be useful for all participants to consider possible contingency arrangements that could be put in place before the project proceeds or that could be triggered in the event that prices fall. Note that the concern is about prices during operations, not during the construction period. Indeed, low oil prices during construction will help to reduce construction costs, even if it makes North Slope producers nervous in the process.

Some elements of a contingency framework might include the following:

- A constant dollar tariff will reduce costs at the front-end, escalating with inflation later, when presumably the revenues in nominal terms at least will be improved.

- What are the minimal prices along the system below which it is less costly to cease operations? Pipeline operations must cover variable costs and producers require variable costs as well. Is the "close-down" price higher? Do producers simply leave it in the ground for another day? Or continue to reinject it to maintain field pressure, thereby reducing oil-lifting costs?

- Can long-term contracts for natural gas be struck at "economic" levels (around $3.00)? If so, who sells them, what volumes are covered, and how are they rolled over in the longer term?

- Can the financing of the pipeline use indexed bonds, linked to natural gas prices? This could provide increased variability in total costs under different natural gas price scenarios.

## 5.2 Steps after decision to proceed

Although there remain a number of areas for further research and deliberation, some are better postponed until there is a reality of a project facing all participants. Otherwise, while discussions may be fruitful, there is no incentive to resolve the issues and to put in place an operational plan. Nor are answers necessary before the decision to proceed.

### 5.2.1 *Procurement Plans*

We have reported for this study that half the pipe for the Canadian portion is being manufactured by Welland Pipe in Ontario, and the other half by IPSCO in Regina. This assumes that our Canadian mills are able to produce the pipe with the required combination diameter, thickness, yield strength and toughness. If the requirements are such that the pipe needs to be purchased abroad (most likely in Japan), much of the indirect impact in manufacturing in the ROC will "leak" to imports.

The compressors for the Canadian portion have been assumed to come from aircraft plants in Quebec. Again, other procurement patterns are possible.

An early step will be to pin down the actual suppliers of the major inputs. This should be done for the whole pipeline, not just the Canadian portion. I suspect that we will find Canadian producers able to produce some parts for the entire pipeline, and other parts being supplied by foreign producers or US suppliers.

The most crucial aspect of the procurement plan is that it results in dependable supply at low cost. The long-term viability of the pipeline depends on it being a cost-effective transportation option for natural gas from Alaska to the lower 48.

### 5.2.2 *ROW use*

The pipeline construction will clear a right-of-way (ROW) during construction and restore it upon completion, leaving a long strip of open space parallel to the Alaska Highway. The ROW will be kept clear to provide access to the pipeline in case of the need for repairs as well as to allow frequent monitoring of the pipeline path for security purposes.

Environmentalists have raised concerns about the use of the ROW by snowmobiles, the effects on the mobility of predators (e.g., wolves), and the increased accessibility provided to hikers and others during summer and winter. Those who enjoy the outdoors in all seasons see that same access as a plus. It would seem desirable to develop a ROW use plan that can address the concerns while enhancing the uses of the route.

### 5.2.3 *Training of Yukoners*

Lead times for training require efforts begin quickly after the "go-decision" if the employment opportunities for Yukoners are to be maximized. Yukon College appears ready to be a major contributor to this activity.

### 5.2.4 *Yukon business mobilization*

When the pipeline project becomes a reality, then local businesses in Yukon need to decide if they are going to participate as major suppliers. In some cases, increased investment may be required. Training of additional staff will be needed. Partnerships may need to be struck. The YTG Economic Development can help the process by extending the register of Yukon businesses, certifying certain capacities if necessary, and providing information flows to the business community about the pipeline project and possible business opportunities.

### 5.2.5 *Federal-territorial Agreements*

Although existing agreements result in balancing revenue and normal expenditures, it is likely that the gas pipeline will require major efforts and new responsibilities for the Government of Yukon. In some cases, additional capacities may need to be developed within the territorial government. Timely development of intergovernmental agreements can avoid any adverse effects on the critical path of the project.

### 5.2.6 *Agreements with Alaska*

It will be necessary to put in place agreements between Alaska and Yukon, perhaps with additional Canada-US agreements to enable them. A number of practical areas will need clarification and direction.

**Movements of people** - One source of labour we have not tapped could be found in Alaska, which would increase the amount of "leakage" outside the region. At the same time, Yukoners could also work in Alaska during the construction period. First Nation Yukoners are especially well placed to take advantage of employment opportunities in Alaska because of the provisions of Jay's Treaty.

**Movements of goods and services** – The logistics of pipeline construction are likely to require the movement of goods and services through the ports and highway system in both countries. It

would seem reasonable to put in place some mechanisms to minimize the disruptions in crossing borders for these goods and services.

**Supply Contracts –** It is likely that the impacts of the pipeline construction will exceed the combined capacity of Yukon, Northern BC, and Alaska to supply the needs of the pipeline. In other words, there will be more than enough business for everyone. The key is to make that business flow smoothly throughout the combined region, allowing for efficient operations wherever possible. Some agreement to foster a cooperative approach among the governments could underpin the importance of developing a smooth business approach to supplying the needs of the construction sector.

**Coordination of Regulatory Aspects –** There will be opportunities to coordinate the regulation of construction and operations of the pipeline across jurisdictions. An early effort to put in place a framework is likely to pay dividends to everyone.

**Information Flows –** One obvious area for cooperation is in exchanging information about the pipeline construction among all interested parties, including the territorial and state governments, First Nation governments, local governments, federal departments, pipeline operations, construction firms, major suppliers, etc. The existence of the Internet should enable a major innovation in this area with many benefits to all participants.

# 6 The Alaska Highway Pipeline Project– Will the Project Proceed?

From a Yukon perspective the AHPP widens many choices for Yukoners. These include broadened fuel choices, employment opportunities in many different sectors, improved costs for mineral developments, and a delivery option if Yukon gas supplies are developed. At the time of construction Yukoners will have to cope with a large influx of transient workers, crowding of some facilities, inevitable turmoil in local labour markets, and increased local traffic. But the positive impacts would seem to outweigh the negatives, at least in aggregate. Can these impacts be managed?

Once the operations phase is in place, the pipeline is likely to be almost invisible. There will be a few additional jobs, enhanced territorial revenue, and natural gas availability, resulting in lower energy costs.

The AHPP appears ready to go…if the US is ready to use Alaska gas as part of their energy supply. We are moving to a North American gas market, with a supply pool that includes Canadian supplies along with US supplies. At some point Mexican supplies may also be joined into the pool. Withdrawals from the pool can occur anywhere as well, Eastern Canada and the US, Mexico, Alberta, BC, California. All that is required is that a user be hooked up to a gas pipeline that in turn is connected to part of the pool. Swaps throughout the system can effectively move gas from Alberta to Florida, without requiring the physical movement of the gas. Indeed, it is conceivable that even if the person is not hooked up directly to the network that a trade can be accomplished that reflects a "virtual hook-up" to the pool.

Is the pool ready to absorb another 4 bcfd of natural gas from Alaska? What is the expected price at the Alberta border with BC? The proponents of the AHPP must then decide if the risk-reward balance is sufficient to proceed. Governments along the way need to make their regimes clear so that the calculations can be made.

The Alaska Highway Pipeline Project is particularly interesting in that much of the gas field development has already occurred in the past. Governments have studied the route, the regulatory framework, and other aspects. The lower end of the pipeline has been "pre-built" in the 1980s and 1990s, with capacity to deliver the gas into the US marketplace. The key questions to be answered: Are there better options available for US consumers? Are there better options for North Slope producers? These remain the tough questions that must be answered before construction can start.

# Appendix A – Details of AHPP (from Working Paper 5.1.1)

**Table 1: Profile of the Alaska Highway Pipeline Project over Time and by Region (Cdn$millions)**

| | | Profile of Capital Expenditure | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
| **Alaska Segment** | **$ 6,627** | **$ 111** | **$ 131** | **$ 508** | **$ 1,540** | **$ 2,091** | **$ 1,085** | **$ 343** | **$ 340** | **$ 272** | **$ 137** |
| **Canada Segment[1]** | **$ 6,990** | **$ 149** | **$ 178** | **$ 622** | **$ 1,676** | **$ 1,973** | **$ 1,053** | **$ 395** | **$ 393** | **$ 314** | **$ 158** |
| Yukon Segment | $ 3,369 | $ - | $ - | $ 238 | $ 833 | $ 1,004 | $ 536 | $ 223 | $ 222 | $ 178 | $ 89 |
| British Columbia Segment | $ 2,638 | $ - | $ - | $ 195 | $ 667 | $ 786 | $ 417 | $ 169 | $ 168 | $ 134 | $ 68 |
| Alberta Segment | $ 983 | $ 149 | $ 178 | $ 189 | $ 176 | $ 183 | $ 100 | $ 2 | $ 2 | $ 2 | $ 1 |
| **Total Project** | **$ 13,616** | **$ 260** | **$ 309** | **$ 1,131** | **$ 3,216** | **$ 4,064** | **$ 2,138** | **$ 737** | **$ 733** | **$ 586** | **$ 295** |
| **Natural Gas Flow (Bcf/d) [2]** | | | | | | | **2.5** | **2.8** | **3.1** | **3.4** | **3.7** |

1 Canadian portion of the project is specified as the Alaska-Yukon Border to Gordondale Alberta

2 Billion cubic feet per day and this flow rate is fixed from November of current year to November of the next year

N.B. All dollar amounts are given in constant 2000 dollars.

**Table 2: Distribution of Project Capital Cost, Distance and Calculated Tariff**

| | Expenditure by Segment | | | Length of Segment | | | Tariff [2] | | | Compressors | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cdn$mn | US$mn [3] | | miles | km | | Cdn$ | US$ [3] | | Initial | Ultimate |
| **Alaska Segment** | **$ 6,627** | **$ 4,418** | **49%** | **741** | **1,193** | **42%** | **$ 0.766** | **$ 0.511** | **49%** | **5** | **16** |
| **Canada Segment[1]** | **$ 6,990** | **$ 4,660** | **51%** | **1,005** | **1,617** | **58%** | **$ 0.805** | **$ 0.537** | **51%** | **7** | **24** |
| Yukon Segment | $ 3,369 | $ 2,246 | 48% | 517 | 832 | 51% | $ 0.435 | $ 0.290 | 54% | 3 | 10 |
| British Columbia Segment | $ 2,638 | $ 1,758 | 38% | 448 | 721 | 45% | $ 0.348 | $ 0.232 | 43% | 4 | 14 |
| Alberta Segment | $ 983 | $ 655 | 14% | 40 | 64 | 4% | $ 0.023 | $ 0.015 | 3% | 0 | 0 |
| **Total Project** | **$ 13,616** | **$ 9,078** | | **1,746** | **2,810** | | **$ 1.572** | **$ 1.048** | | **12** | **40** |

1 Canadian portion of the project is specified as the Alaska-Yukon Border to Gordondale Alberta

2 Given in dollars per thousand cubic feet. Calculated using Cost-Benefit Framework and Operation Phase Cost of 1% of total CAPEX.

3 Exchange rate is assumed to be such that $1.50 Canadian is equal to $1.00 US.

N.B. The remaining $622 million (US$) of the quoted $9,700 million for the Ultimate AHPP is accounted for by a 1.5 % annual escalation of prices.

N.B. All dollar amounts are given in constant 2000 dollars.

**Table 3a: Employment during Operations in Person Years** [4]

| | 2005 | 2006 [2] | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 [3] | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Alaska Segment** | **0** | **42** | **75** | **126** | **147** | **168** | **189** | **209** | **227** | **227** | **227** | **227** |
| **Canada Segment**[1] | **0** | **68** | **113** | **190** | **222** | **254** | **286** | **318** | **345** | **345** | **345** | **345** |
| Yukon Segment | 0 | 34 | 57 | 91 | 104 | 117 | 130 | 144 | 155 | 155 | 155 | 155 |
| British Columbia Segment | 0 | 33 | 54 | 88 | 107 | 126 | 145 | 164 | 180 | 180 | 180 | 180 |
| Alberta Segment | 0 | 1 | 3 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| **Total Project** | **0** | **110** | **189** | **316** | **369** | **422** | **475** | **528** | **572** | **572** | **572** | **572** |

1 Canadian portion of the project is specified as the Alaska-Yukon Border to Gordondale Alberta

2 The pipeline is operational in November of 2007, but head offices are set up in 2006 (Alaska and Whitehorse)

3 Employment remains at these levels through the remainder of the impact.

4 Person year is equivalent to a 35.5 hrs/w eek.

**Table 3b: Tariff Income for Transport of Pipeline Service (Cdn$)**

| | 2005 | 2006 [2] | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 [3] | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Alaska Segment** | **0** | **0** | **117** | **713** | **797** | **881** | **965** | **1049** | **1119** | **1119** | **1119** | **1119** |
| **Canada Segment**[1] | **0** | **0** | **123** | **750** | **838** | **926** | **1014** | **1103** | **1176** | **1176** | **1176** | **1176** |
| Yukon Segment | 0 | 0 | 66 | 405 | 452 | 500 | 547 | 595 | 635 | 635 | 635 | 635 |
| British Columbia Segment | 0 | 0 | 53 | 324 | 362 | 400 | 438 | 476 | 508 | 508 | 508 | 508 |
| Alberta Segment | 0 | 0 | 3 | 21 | 24 | 26 | 29 | 31 | 33 | 33 | 33 | 33 |
| **Total Project** | **0** | **0** | **239** | **1463** | **1635** | **1807** | **1979** | **2152** | **2295** | **2295** | **2295** | **2295** |

1 Canadian portion of the project is specified as the Alaska-Yukon Border to Gordondale Alberta

2 The pipeline is operational in November of 2007 at initial rates of 2.5 Bcf per day and increases to 4.0 Bcf per day by November 2012.

3 Tariff income remains at these levels through the reminder of the impact

N.B. All dollar amounts are given in constant 2000 dollars.

**Table 3c: Specific Employment requirements for Installation; Pipeline, Compression and Meter Stations**

| | Total | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Alaska Segment** | **4,568** | | | | **381** | **1,817** | **1,763** | **179** | **179** | **143** | **72** | **36** |
| **Canada Segment** | **9,496** | | | | **1,011** | **3,897** | **3,664** | **272** | **272** | **217** | **109** | **54** |
| Yukon Segment | 4,578 | | | | 510 | 2,305 | 1,377 | 114 | 114 | 91 | 46 | 23 |
| British Columbia Segment | 4,309 | | | | 501 | 1,396 | 1,875 | 158 | 158 | 126 | 63 | 32 |
| Alberta Segment | 609 | | | | | 197 | 412 | | | | | |
| **Total Project** | **14,065** | | | | **1,392** | **5,714** | **5,427** | **451** | **451** | **361** | **180** | **90** |

N.B. Does **not** include employment required for the mobilization of the pipe, compressors and metering equipment to the stockpile sites.
This estimate does **not** include employment from project management, engineering and construction management.

# Appendix B: Full Occupational Detail: Yukon (from 7.4.1)

| YUKON | Scenario 1 | | | Scenario 2 | | | Scenario 1 | | | Scenario 2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2002-07 | 2008-12 | 2013-25 | 2002-07 | 2008-12 | 2013-25 | 2002-07 | 2008-12 | 2013-25 | 2002-07 | 2008-12 | 2013-25 |
| | Average Impact | | | Average Impact | | | Average Percentage Impact | | | Average Percentage Impact | | |
| **TOTAL** | **2609** | **762** | **1007** | **3271** | **1698** | **1527** | **20.3** | **5.9** | **7.8** | **25.5** | **13.0** | **11.9** |
| MANAGERIAL, ADMINISTRATIVE & RELATED | 286 | 89 | 135 | 366 | 174 | 106 | 15.9 | 4.9 | 7.5 | 20.4 | 9.6 | 5.9 |
| NATURAL SCIENCES, ENGINEERING & MATHEMATICS | 114 | 48 | 83 | 132 | 27 | -51 | 18.0 | 7.4 | 12.7 | 20.8 | 4.1 | -7.8 |
| OCCUPATIONS IN SOCIAL SCIENCES & RELATED | 34 | 6 | 14 | 40 | -2 | -27 | 8.8 | 1.6 | 3.5 | 10.4 | -0.5 | -6.6 |
| RELIGION | 0 | 0 | 0 | 0 | 0 | 0 | 2.4 | 1.0 | 1.9 | 3.8 | 2.8 | 2.5 |
| TEACHING & RELATED | 3 | 3 | 4 | 4 | 4 | 2 | 0.4 | 0.4 | 0.6 | 0.6 | 0.6 | 0.3 |
| MEDICINE & HEALTH | 5 | 5 | 7 | 9 | 13 | 16 | 1.4 | 1.3 | 2.1 | 2.8 | 3.7 | 4.8 |
| ARTISTIC, LITERARY, RECREATIONAL & RELATED | 21 | 6 | 18 | 36 | 21 | 5 | 13.8 | 3.9 | 11.3 | 23.8 | 13.5 | 3.5 |
| CLERICAL & RELATED | 320 | 123 | 181 | 432 | 262 | 203 | 13.9 | 5.3 | 7.9 | 18.8 | 11.4 | 8.9 |
| SALES | 95 | 77 | 117 | 199 | 273 | 357 | 11.0 | 9.2 | 14.9 | 23.1 | 32.7 | 45.5 |
| SERVICE | 198 | 86 | 173 | 370 | 362 | 407 | 9.4 | 4.2 | 8.7 | 17.6 | 17.8 | 20.5 |
| FARMING, HORTICULTURAL & ANIMAL HUSBANDRY | 67 | 9 | 5 | 70 | 15 | 10 | 46.7 | 6.2 | 3.5 | 49.1 | 9.7 | 7.0 |
| FISHING, TRAPPING & RELATED | 0 | 0 | 0 | 0 | 0 | 0 | 0.4 | 0.1 | 0.0 | 0.5 | 0.4 | 0.1 |
| FORESTRY & LOGGING | 2 | 0 | 0 | 3 | 1 | 0 | 11.3 | 1.6 | 1.0 | 12.0 | 2.4 | 1.4 |
| MINING & QUARRYING INCLUDING OIL & GAS FIELD | 9 | 5 | 6 | 9 | 5 | 5 | 4.4 | 2.7 | 4.0 | 4.6 | 2.7 | 3.5 |
| PROCESSING | 16 | 9 | 13 | 26 | 27 | 34 | 12.8 | 7.3 | 11.1 | 20.5 | 21.3 | 28.7 |
| MACHINING & RELATED | 52 | 10 | 8 | 55 | 13 | 10 | 40.5 | 7.1 | 5.8 | 42.9 | 9.5 | 7.1 |
| PRODUCT FABRICATING, ASSEMBLING & REPAIRING | 118 | 48 | 58 | 157 | 119 | 135 | 23.9 | 9.5 | 11.7 | 31.8 | 23.7 | 27.4 |
| CONSTRUCTION TRADES | 1091 | 150 | 77 | 1128 | 206 | 129 | 77.5 | 9.7 | 4.8 | 80.1 | 13.2 | 8.1 |
| TRANSPORT EQUIPMENT OPERATING | 76 | 39 | 44 | 104 | 94 | 101 | 11.6 | 5.9 | 6.6 | 15.8 | 14.1 | 15.0 |
| MATERIAL HANDLING & RELATED, N.E.C. | 23 | 9 | 12 | 31 | 22 | 22 | 18.5 | 7.3 | 9.7 | 24.7 | 17.2 | 17.7 |
| OTHER CRAFTS & EQUIPMENT OPERATING | 25 | 23 | 33 | 38 | 38 | 40 | 23.7 | 20.7 | 30.1 | 35.3 | 34.3 | 36.9 |
| OCCUPATIONS NEC | 55 | 17 | 19 | 63 | 27 | 21 | 25.7 | 7.4 | 8.6 | 29.3 | 12.0 | 9.6 |

Totals are slightly different from Yukon Model results due to rounding in Occupational Model.

# List of Working Papers

| | |
|---|---|
| 1 | **Working Paper No. 3.1.1:** Canadian Macroeconomic Base Case Scenario - March 2002 |
| 2 | **Working Paper No. 3.1.2:** Key Assumptions for Macroeconomic Study - March 2002 |
| 3 | **Working Paper No. 3.2.1:** Ancillary Spending - March 2002 |
| 4 | **Working Paper No. 4.1.1:** Development of Canadian Gas Fields in Yukon and BC- March 2002 |
| 5 | **Working Papers No. 4.2.1:** Pipe Dreams: Post-pipeline Development Impacts - March 2002 |
| 6 | **Working Paper No. 4.4.1:** US Energy Demand and Policies through 2020 - March 2002 |
| 7 | **Working Paper No. 5.1.1:** Direct Effects of the Alaska Highway Pipeline Project - March 2002 |
| 8 | **Working Paper No. 6.1.1:** National Impact of Alaska Highway Pipeline Project - March 2002 |
| 9 | **Working Paper No. 6.1.2:** A Comparison: Impact Studies and Trans-Alaska Pipeline - March 2002 |
| 10 | **Working Paper No. 7.1.1:** Provincial Impacts of Alaska Highway Pipeline Project - March 2002 |
| 11 | **Working Paper No. 7.1.2:** The Impacts of the AHPP on the Yukon Economy - March 2002 |
| 12 | **Working Paper no. 7.2.1:** Interprovincial Input-Output Analysis of the Alaska Highway Pipeline Project - March 2002 |
| 13 | **Working Paper No. 7.2.3:** Assessment of Economic Impacts using the Local Area Model (LAM) - March 2002 |
| 14 | **Working Paper No. 7.2.5:** Government Revenue and Expenditure Model: Yukon - March 2002 |
| 15 | **Working Paper No. 7.2.7:** Alaska Highway Pipeline Project and Union Linkages - March 2002 |
| 16 | **Working Paper No. 7.2.8:** Alaska Highway Pipeline Project and the Environment - March 2001 |
| 17 | **Working Paper No. 7.4.1:** Human Resource Dimensions of the Alaska Highway Pipeline Project: Yukon - March 2002 |
| 18 | **Working Paper No. 7.6:** Alaska Highway Gas Pipeline and First Nations: Linkages - March 2002 |
| 19 | **Working Paper No. 8.1:** Cost-Benefit Analysis of the Alaska Highway Pipeline Project - March 2002 |