FINAL DRAFT – CONFIDENTIAL

AN EVALUATION OF THE ECONOMIC IMPACTS ASSOCIATED WITH THE MACKENZIE VALLEY GAS PIPELINE AND MACKENZIE DELTA GAS DEVELOPMENT

Prepared For

Government of the Northwest Territories and

TransCanada PipeLines Limited

Prepared By

Wright Mansell Research Ltd.

May 13, 2002

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

OVERVIEW

This study provides an evaluation of the economic impacts associated with the development and production of natural gas reserves in the Mackenzie Delta and the construction and operation of a pipeline down the Mackenzie Valley to move the gas to markets. Evaluated over the period 2002-2033, and for two gas price scenarios, it is concluded that the overall Canadian impacts would be substantial and spread across all regions of the country. Some of these impacts are highlighted below, with the lower value showing the impacts under a $3 US/Mcf gas price scenario and the higher value showing the impacts for a $4 US/Mcf gas price scenario (prices at Chicago).

Increases In	2002 Cdn (In billions)
Canadian Gross Domestic Product	$40 to $57
Government Revenues	$12 to $23
Investment / Revenue	$44 to $61
Labour Income	$8

Increases in Total Employment	Person Years of Employment (157,000)
In NWT	58,000
In Alberta	38,000
In Ontario	28,000
In BC	15,000
In Quebec	9,000
In Saskatchewan, Manitoba, and Yukon	6,000
In Atlantic provinces	3,000

These impacts are also widely spread across most of the major sectors, including: business services; wholesale and retail trade; transportation, communication and utilities; construction; manufacturing; services incidental to mining / oil and gas; and the oil and gas sector.

It should also be emphasized that substantial impacts in addition to those estimated above can be anticipated. These include the following:

- Induced impacts arising from the spending of labour income generated by the project would add another $5 billion in GDP and 92,000 person years of employment for Canada.

- The reinvestment of corporate profits would add a further $16 billion to $27 billion in GDP and an additional 243,000 to 406,000 person years of employment.

- Further induced impacts would arise from additional oil and gas production and possibly the reinvestment of government revenues.

Other benefits associated with the project include:

- substantial opportunities for economic development in Canada's north;

- additional value added from upgrading of incremental gas liquids to petrochemical products;

- potential increases in discoveries in other areas along the route of the pipeline and potentially large increases in revenue from the sale of northern mineral rights;

- potential savings to households in communities in the Delta region or along the pipeline route;

- significant savings to gas users in Canada as the incremental gas supply keeps gas prices below what they would otherwise be; and,

- gains valued at up to $2.1 billion annually due to avoided greenhouse gas emissions.

BACKGROUND

On July 28, 1999, the Government of the Northwest Territories (GNWT) and TransCanada PipeLines Limited (TransCanada) signed a Memorandum of Understanding (MOU) identifying "an alignment of interests and a mutual desire to encourage the timely development of the natural gas reserves of the NWT and the construction of an economic, competitively priced, natural gas transmission infrastructure". Consistent with the mutual objective of this MOU, the two parties have jointly requested an assessment of the economic impacts associated with the development and production of gas reserves in the Mackenzie Delta and the construction and operation of a pipeline running from the Mackenzie Delta down the Mackenzie Valley to an interconnect with the TransCanada system in northern Alberta. This report, prepared by Wright Mansell Research Ltd. (WMR), is in response to that request.

The federal government opened up northern Canada to oil and gas exploration in the 1960s and exploration in the Mackenzie Delta area began in that decade. The majority of the exploration drilling in the region to date took place in the 1970s and 1980s in response to rapidly rising energy prices. Nearly 200 exploration wells have been drilled in the area with close to 30% of these wells being successful. The largest gas discoveries have been at Taglu, Parsons Lake and Niglintgak with estimated recoverable gas reserves of 3.0 Tcf, 1.8 Tcf and 0.9 Tcf respectively. Total discovered marketable reserves in the Mackenzie Delta / Beaufort Sea region are estimated to be 9 Tcf, with undiscovered resources believed to be in the range of 55 Tcf, making for an ultimate resource potential of 64 Tcf.

To date, gas development in the region has been constrained by relatively low gas prices and the lack of pipeline access to major gas markets. With expectations of stronger gas prices in the future, a joint venture between the Mackenzie Valley Pipeline Group (which includes Imperial Oil Resources, Shell Canada, Conoco Canada and ExxonMobil Canada) and the Aboriginal Pipeline Group (which represents the Aboriginal peoples of the NWT) has recently been formed and is committing $250 million to take a proposed gas development and pipeline construction project to the permit stage before the National Energy Board.

To complete this study, WMR requested and received information from both the GNWT and TransCanada with respect to estimated capital and operating costs in bringing Mackenzie Delta gas to market. These costs included the costs for the construction of a pipeline and field production facilities and the costs associated with the development of Mackenzie Delta gas reserves.

FINANCIAL FLOWS AND DIRECT IMPACTS OF THE PROJECT

- Mackenzie Delta field development is assumed to commence in 2004, while the construction of the Mackenzie Valley pipeline would begin in 2006. Gas flows are assumed to start in 2009 at an initial and sustainable rate of 1.2 Bcf/d (438 Bcf/yr). Operating impacts are assessed over a 25 year period (2009-2033) and in two scenarios corresponding to constant real gas prices in Chicago of $3US/Mcf and $4US/Mcf (all values in this report are expressed in year 2002 dollars)

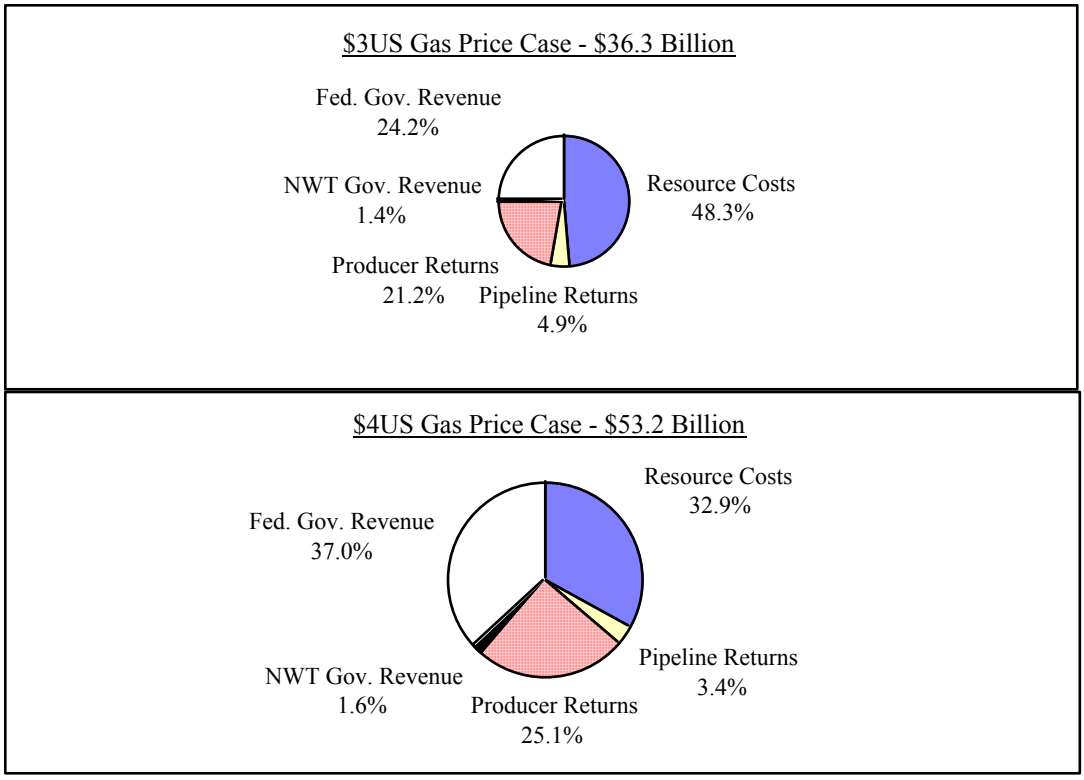
- Direct investment associated with the project is expected to be $7.6 billion (all subsequent dollar values shown here are in 2002 Canadian $ unless otherwise noted), with roughly $7.3 billion of investment occurring in the NWT. Total direct investment would include $3.3 billion for pipeline facilities. The majority of the investment (including all pipeline investment) would occur prior to 2009 and would peak between 2006 and 2008. The magnitude of the investment in these years is very large compared to current overall activity levels in the NWT and would almost certainly involve an influx of short-term workers into the region. Projects of this type and magnitude must be properly managed so as to avoid the introduction or amplification of economic instability.

- While most of the investment associated with the project would occur before the commencement of gas flows from the Mackenzie Delta, ongoing development expenditures would have to be made to ensure that there would be sufficient productive capacity to fill the pipeline over time. More than $2 billion of the overall project investment (or about $100 million per year) would occur during the operating period. The smaller magnitudes and sustainability of such investment represent impacts that could be much more easily absorbed by the NWT economy without any dislocation.

- The total direct revenues generated by the project would include netback revenues to producers (ie. revenues from the sale of the produced gas and condensate minus the transportation costs of moving the products to market) as well as the revenues from transporting these products to market. Overall direct revenues would range from $36.3 billion to $53.2 billion depending on the gas price scenario. The distribution of these revenues is illustrated below. The relative magnitude of these revenues in the NWT context is noteworthy. The average annual direct revenues of $1.5 billion per year in the $3US Gas Price scenario are equivalent to 60% of the value of total current annual output in the region.

- Roughly half of the overall revenues would go towards resource costs (the costs of labour, capital and other inputs to develop, produce, process and transport the gas) in the $3US Gas Price case. The remainder of the revenues would be split fairly evenly between private sector returns and government revenues, with each comprising roughly one quarter of total revenues

DISTRIBUTION OF PROJECT REVENUES: 2009-2033



- In the $4US Gas Price case, resource costs and pipeline returns would not change in absolute terms compared to the $3US case (but would fall in percentage terms), while producer returns ($13.4 billion) and government revenues ($20.6 billion) would be higher than in the $3US case given the larger netback revenues.

- The federal government would receive over 90% of the total government revenues in either gas price scenario or between $8.8 billion and $19.7 billion. The federal government would directly collect royalties on gas production and income taxes from both gas production and pipeline companies. In addition, due to current fiscal arrangements between the federal and NWT governments it is assumed that 80% of any revenue raised by the NWT government would result in a grant reduction to the territorial government and therefore an effective benefit to the federal government.

- The last of the direct economic impacts associated with the project involves the construction and operating employment that would be created. More than 22,000 person years of employment would be generated by the project - roughly 8,000

person years in pipeline construction and field development and about 14,000 person years in the operations of pipeline and producer facilities.

- Construction employment would overwhelmingly take place in the NWT but the sheer magnitude of the personnel requirements would result in many of these jobs being taken by people that would otherwise live outside the region. This resulting 'leakage' of impacts is an important consideration in the economic impact analysis.

- Operating employment is expected to be split between the NWT and Alberta (where the head offices of the gas producing and pipeline companies would likely be). However, unlike some of the construction phase employment impacts, the operating phase jobs in the NWT would be taken by NWT residents and these represent another long term sustainable benefit for the people of the region that is attributable to the project.

ECONOMIC IMPACTS OF THE PROJECT

- The direct and indirect impacts of the project on variables such as Gross Domestic Product (GDP or value added), labour income, government revenues and employment in the economies of the NWT, other Canadian regions, and Canada as a whole are evaluated. Separate evaluations of the impacts associated with four distinct portions of the project (pipeline construction, gas field development, pipeline operation and gas production) are presented. Furthermore, construction phase impacts are adjusted to take account of potential leakages of impacts from the NWT due to the considerations noted above. The overall impacts are shown in the table below for the $3US and $4US Gas Price scenarios.

- Overall Canadian impacts would be substantial and spread across all regions of the country. GDP would rise by between $40.2 billion and $57.1 billion depending on the gas price scenario. In addition, government revenues could be expected to increase anywhere from $12.1 billion to $23.4 billion as a result of the project. Further, an additional 157,000 person years of employment would be generated, with associated labour income of $7.7 billion.

- The impacts outside of the NWT would be identical in the two gas price cases. It is not likely that production costs would significantly change just because the gas price was higher. Consequently, the increased netback revenue that would be generated in the $4US case versus the $3US case would accrue almost exclusively to gas producers in the NWT and to the federal and NWT governments.

- Among the provinces, Alberta would receive the largest economic impacts. These impacts include those associated with the portion of the Mackenzie Valley pipeline that would lie in Alberta as well the expansion of existing pipeline infrastructure within the province that would be necessary to accommodate Mackenzie Delta

volumes. However, the bulk of the impacts would be indirect and relate largely to the proximity of Alberta to the NWT and to the expertise in the province's pipeline, oil and gas, and oil and gas service industries that would be drawn upon for this project. The most prominent impacts for Alberta would be in terms of additional employment (over 38,000 person years) and labour income (roughly $2.3 billion), which respectively comprise just under 25% and 30% of the expected total impact.

OVERALL DIRECT AND INDIRECT IMPACTS OF THE PROJECT: 2002-2033

(billions of 2002 Cdn$, employment in thousands of person years)

PROVINCES - BOTH GAS PRICE CASES	BC	Alta	Sk/Mn/Yu	Ont	Que	Atlantic	Total
Investment / Revenue		1.31					1.31
Gross Domestic Product	0.77	3.64	0.39	1.78	0.53	0.16	7.27
Labour Income	0.58	2.26	0.27	1.19	0.33	0.14	4.77
Federal Government Revenue	0.14	0.59	0.06	0.34	0.07	0.03	1.23
Terr./Prov. Government Revenue	0.07	0.33	0.04	0.23	0.07	0.01	0.75
Grant Reduction			-0.01				-0.01
Adjusted Terr./Prov. Gov't Revenue	0.07	0.33	0.03	0.23	0.07	0.01	0.74
Adjusted Federal Gov't Revenue	0.14	0.59	0.07	0.34	0.07	0.03	1.24
Total Government Revenue	0.21	0.92	0.10	0.57	0.14	0.04	1.98
Employment	15.04	38.23	5.97	27.83	8.91	2.77	98.75

NWT AND CANADIAN TOTAL		$3US GAS PRICE		$ 4US GAS PRICE	
	Provinces	NWT	Total	NWT	Total
Investment / Revenue	1.31	42.56	43.87	59.51	60.82
Gross Domestic Product	7.27	32.91	40.18	49.87	57.14
Labour Income	4.77	2.97	7.74	2.97	7.74
Federal Government Revenue	1.23	7.43	8.66	16.90	18.13
Terr./Prov. Government Revenue	0.75	2.70	3.45	4.50	5.25
Grant Reduction	-0.01	-2.16	-2.17	-3.60	-3.61
Adjusted Terr./Prov. Gov't Revenue	0.74	0.54	1.28	0.90	1.64
Adjusted Federal Gov't Revenue	1.24	9.59	10.83	20.50	21.74
Total Government Revenue	1.98	10.13	12.11	21.40	23.38
Employment	98.75	58.47	157.22	58.47	157.22

- Economic impacts in Ontario would rank second among the provinces in all categories. These would arise given the ability of the province to directly and indirectly supply manufactured inputs for the project, but also because of the extensive economic linkages the province has throughout Canada. B.C. would receive the next largest portion of impacts, but clearly all regions in Canada could be expected to benefit in some significant way as a result of the project.

- The largest impacts would be in the NWT. With respect to any of the measures shown in the table, impacts would be greater in the NWT than in any single province. Most notably the GDP and government revenue impacts in the NWT would dwarf those in other regions and would constitute more than 80% of the overall national impacts in both gas price cases. On an average annual basis over the 2002-2033 period, GDP in the NWT would be between $1 billion and $1.5 billion per year larger than in the absence of the project. This would be equivalent to an increase of between 40% and 60% over current levels in the region.

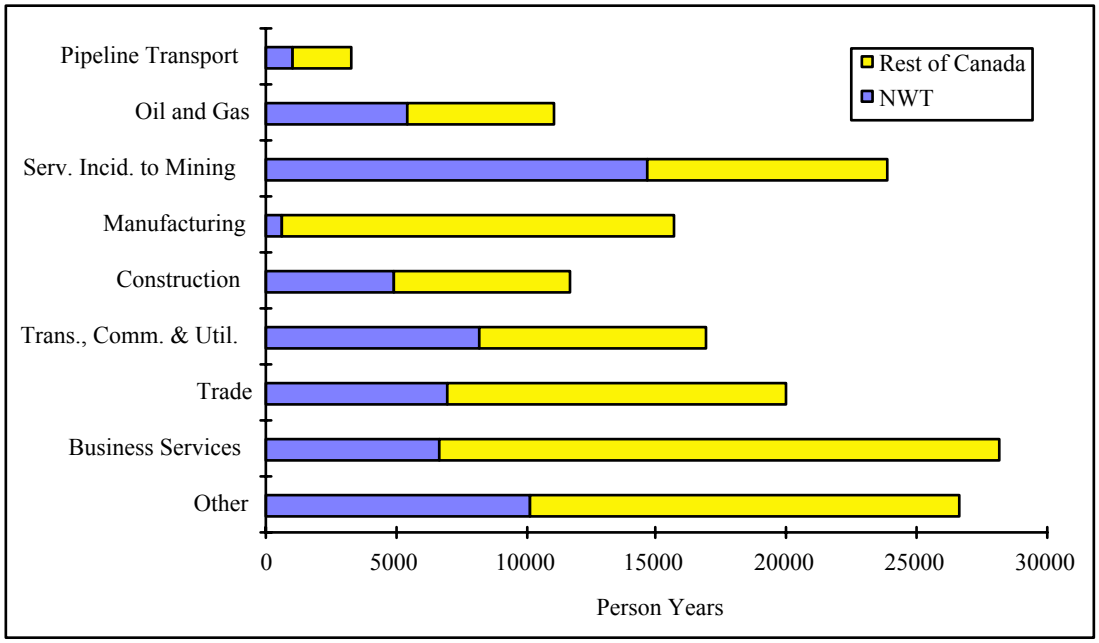
- Employment and labour income impacts in the NWT are also expected to be substantial. The overall employment impact of 58,000 person years translates into an average annual impact of more than 1800 jobs per year over the 2002-2033 period. This could largely eliminate unemployment in the region given current unemployment levels. However, it could be expected that many of the region's discouraged workers (who have dropped out of the labour force) would be drawn back into the labour force given the improved economic environment. Also, there would likely be labour force growth due to natural increase in population and net in-migration.

- The impacts on NWT government revenue would be modest, with increases ranging from $0.5 billion to $0.9 billion depending on the gas price scenario. On an average annual basis, these impacts would amount to between $15 million and $30 million per year and would represent less than a 4% increase above current annual territorial government revenues. These have the potential to be much larger, as shown by the unadjusted territorial government revenues depicted in the impact table. However, given the current fiscal arrangements between the NWT and federal governments, the vast majority of any additional government revenue accruing to the NWT government effectively is transferred back to the federal government via grant reduction.

- It was already noted with respect to direct impacts that the federal government stands to gain substantial revenue from this project. Including indirect impacts as well, the federal government would receive upwards of 90% of the total government revenues generated by the project. The increased revenues to the federal government range from $10.8 billion to $21.7 billion depending on the gas price scenario. This represents between 27% and 38% of the overall GDP impact in Canada.

- The economic impacts associated with the project would be widely distributed across Canada's regions. Further, as illustrated below, a diverse collection of industries and sectors in the economy would also be positively affected. The only direct employment impacts shown are those related to pipeline transport, oil and gas, and construction. Together, they constitute less than 20% of the overall employment impacts in both the NWT and the rest of Canada.

SECTORAL DISTRIBUTION OF TOTAL EMPLOYMENT IMPACTS IN THE NWT AND THE REST OF CANADA: 2002-2033



- For the rest of Canada, the roughly 99,000 person years of employment created by the project would be spread quite widely over a variety of sectors, with the largest impacts in business services (22% of the total) and manufacturing (15% of the total). The results reflect the fact that the quantity of expertise required for the design and construction of both the Mackenzie Valley pipeline and the Mackenzie Delta field facilities would not be available in the NWT. Similarly, the manufacturing industry in the NWT is currently very small, typically serves only local markets, and does not produce the types of items specifically required for this project. However, if the scale of the Mackenzie Delta field were to become sufficiently large in the future, it may become viable to produce various manufactured inputs for the industry locally.

- In the NWT, the largest indirect impacts would be in services incidental to mining (25% of the total) and in transportation, communications and utilities (14% of the total). It is noteworthy that even the sector that would experience the largest employment impacts in the NWT can be expected to have an overall employment share of less than 25%. The wide distribution of the employment impacts across a variety of sectors in the NWT makes it all the more likely that NWT residents would widely benefit from the project on a sustainable basis.

OTHER IMPACTS AND IMPLICATIONS OF THE PROJECT

- There is another category of economic impacts called induced impacts that relate to the spending of portions of labour income, corporate profits and government revenues generated by an activity. With respect to the spending of labour income created by the project, the induced GDP and employment impacts are roughly estimated to be as follows: an additional $0.7 billion and 9,700 person years in the NWT; and, an additional $5.4 billion and 92,100 person years in Canada. The induced employment impacts related to the spending of labour income would increase the overall employment impacts noted in the previous section by about 20% for the NWT and 60% for Canada.

- Another important source of induced effects relates to the reinvestment of corporate profits. In recent years, the percentage of oil and gas industry net revenue (that is, revenues minus royalties and operating costs) that has been spent on exploration and development in Canada has averaged close to 85%. Applying this percentage to the net revenues generated in the project and taking into consideration additional induced impacts related to the labour income that would be created in the exploration and development process, the total impacts associated with reinvestment of Mackenzie Delta net revenues could add a further $16 billion to $27 billion in terms of GDP, while additional employment impacts could range between 243,000 and 406,000 person years.

- Further induced impacts could be anticipated as the reserves that are discovered in the exploration and development process would eventually give rise to additional oil and gas production. Similarly, induced effects related to spending of government revenues could be expected to be quite pronounced given the $12 billion to $23 billion in government revenues that would be directly and indirectly generated by this project.

- It is anticipated that condensate from Mackenzie Delta gas fields would be extracted from the Mackenzie Valley pipeline fluid stream at Norman Wells. However, other natural gas liquids (NGLs) such as ethane, propane and butanes would remain entrained in the stream that would head south from Norman Wells and eventually into the TransCanada Alberta system. At some point these liquids could be extracted and this could provide opportunities to add value to the NGLs in Canada. In particular, the use of ethane as petrochemical feedstock for the production of ethylene and subsequently polyethylene represents one of the most effective ways of adding value to Canada's natural resources.

- To date, the amount of money raised in sales of mineral rights in the NWT has been minimal in comparison to that raised in other regions in Canada that have oil and gas resources. The main reason is that rights in the NWT have been issued by the federal government for work commitments and the winning bidders have not had to pay cash

bonuses (as is normally the case in southern Canada). The introduction of the Mackenzie Valley pipeline could be expected to change this situation, potentially in a rather dramatic fashion. The federal government and perhaps aboriginal bands could benefit substantially from cash bonuses should this occur.

- Portions of the southern and central NWT may also experience increased exploration activity should the Mackenzie Valley pipeline be completed. Areas that may contain gas reserves may currently be ignored from an exploration perspective simply because there is no way to deliver production to markets. This would change if the Mackenzie Valley pipeline could at some point be accessed by such supplies.

- Households in NWT communities along the Mackenzie Valley pipeline route or in the Mackenzie Delta could potentially realize a significant benefit if they could access Mackenzie Delta gas for home heating use. It is estimated that savings of between $350 and $650 per year might be realized by switching from diesel oil to natural gas. This represents between 25% and 35% of current heating costs.

- There could be benefits to Canadian gas consumers in general as a result of the introduction of Mackenzie Delta volumes into the North American market. For example, suppose that without the introduction of Mackenzie Delta gas to the North American market in 2009, gas prices would otherwise be $0.10/Mcf higher than in a case where the Mackenzie Delta gas was flowing to market. Given expected gas demand levels in Canada by 2010, this would translate into annual cost savings for Canadian gas consumers of $350 million per year.

- To the extent that the supply augmentation provided by Mackenzie Delta gas supplies could alleviate gas price increases and thereby help to promote a trend away from the use of higher greenhouse gas emitting fuels such as coal and oil in electricity generation and heating, additional benefits to society may be created. Assuming that the entire volume of Mackenzie Delta gas would be used to fire new electricity generation that in the absence of this gas would be fired by coal, society would benefit by somewhere between $250 million to $2.1 billion annually due to avoided greenhouse gas emissions.

- In summary, it can be anticipated that the project would have significant positive impacts on the overall Canadian economy and would generate major economic benefits for the NWT and other regions. These benefits would be widely distributed among the project stakeholders, as well as among industrial sectors and regions.

1. INTRODUCTION

On July 28, 1999, the Government of the Northwest Territories (GNWT) and TransCanada PipeLines Limited (TransCanada) signed a Memorandum of Understanding (MOU) identifying "an alignment of interests and a mutual desire to encourage the timely development of the natural gas reserves of the NWT and the construction of an economic, competitively priced, natural gas transmission infrastructure". Consistent with the mutual objective of this MOU, the two parties have jointly requested an assessment of the economic impacts associated with the development and production of gas reserves in the Mackenzie Delta and the construction and operation of a pipeline running from the Mackenzie Delta down the Mackenzie Valley to an interconnect with the TransCanada system in northern Alberta. This report, prepared by Wright Mansell Research Ltd. (WMR), is in response to that request.

1.1 BACKGROUND

The federal government opened up northern Canada to oil and gas exploration in the 1960s and exploration in the Mackenzie Delta area began in that decade. The majority of the exploration drilling in the region to date took place in the 1970s and 1980s in response to rapidly rising energy prices. Nearly 200 exploration wells have been drilled in the area with close to 30% of these wells being successful. The largest gas discoveries have been at Taglu, Parsons Lake and Niglintgak with estimated recoverable gas reserves of 3.0 Tcf, 1.8 Tcf and 0.9 Tcf respectively. Total discovered marketable reserves in the Mackenzie Delta / Beaufort Sea region are estimated to be 9 Tcf, with undiscovered resources believed to be in the range of 55 Tcf, making for an ultimate resource potential of 64 Tcf.[1]

[1] See National Energy Board, Canadian Energy Supply and Demand to 2025 (June 1999).

The first production from the region commenced in 1999 with gas from the Ikhil field being produced to serve consumer needs in nearby Inuvik. This to date represents the only gas production from the region as further development has been constrained by relatively low gas prices and the lack of pipeline access to major gas markets.

With higher recent gas prices, there has been renewed interest in the development of fields in the Mackenzie Delta. In 1999, the Northern Oil and Gas Directorate of the federal government's Department of Indian Affairs and Northern Development announced that rights to explore several different areas throughout the Mackenzie Delta region had been granted to two parties with work-bid commitments totaling over $180 million. Another call for bids in 2000 resulted in rights being granted for ten exploration parcels with work-bid commitments of just under half a billion dollars.

The increased interest in the region reflects the belief that future gas prices could finally justify the construction of a pipeline to connect Mackenzie Delta supplies to the overall North American gas market. A joint venture between the Mackenzie Valley Pipeline Group (which includes Imperial Oil Resources, Shell Canada, Conoco Canada and ExxonMobil Canada) and the Aboriginal Pipeline Group (which represents the Aboriginal peoples of the NWT) is committing $250 million to take the proposed gas development and pipeline construction project to the permit stage before the National Energy Board. The combined investment associated with the construction of a pipeline down the Mackenzie Valley to northern Alberta and the development of fields in the Mackenzie Delta that would provide gas to fill such a pipeline is estimated to be $7.6 billion Cdn.

1.2 STUDY OBJECTIVES

The industrial, regional and national economic impacts associated with the construction and operation of the Mackenzie Valley pipeline and Mackenzie Delta field development (referred to as the project hereafter) are likely to be very substantial. Consequently, they

are likely to form an important consideration in evaluating the public interest aspects of the project and in ensuring that its location, design and timing are such that the economic benefits are maximized and that any dislocations or other such costs are minimized. Recognizing this, the Government of the Northwest Territories and TransCanada PipeLines Limited asked Wright Mansell Research Ltd. to examine the economic impacts of the proposed project. This study is the response to that request.

The specific objectives in this study are to:

(i) analyze the financial flows generated, their distribution among the various stakeholders, and the direct or first-round impacts on variables such as investment, employment, and government revenues.

(ii) analyze the direct and indirect impacts on variables such as Gross Domestic Product (value added), labour income, government revenues and employment in the economies of the Northwest Territories (NWT), other Canadian regions, and Canada as a whole.

(iii) identify and comment on other potential impacts / benefits including:

- impacts on natural gas liquid supply in Canada and value added opportunities that could result.
- effects on mineral right values in the NWT and exploration interest in parts of the region outside the Mackenzie Delta.
- benefits to natural gas consumers in the NWT and in Canada overall arising from access to Mackenzie Delta gas supplies.
- benefits to society due to the potential replacement of less environmentally friendly energy sources such as coal with natural gas.

1.3 OUTLINE

Section 2 includes a summary of the assumptions used in the analysis and an outline of the key dimensions of the project. The financial flows associated with the project and their direct impacts on selected variables are also presented.

In Section 3, the regional economic impacts within Canada and overall Canadian economic impacts are described. Considerable attention is focused on the implications of the project for economic growth and development in the NWT.

Section 4 deals with other impacts that could be expected from the project. Issues related to natural gas liquids, mineral right values in the NWT, exploration interest in the NWT outside the Mackenzie Delta, consumer benefits due to augmented supply, and environmental benefits are discussed.

2. FINANCIAL FLOWS

The objective in this section is to translate the basic parameters of the project into a series of financial flows and direct economic impacts. These outline the magnitude and allocation of monetary flows to the participants and to the main components (purchase of inputs, returns, taxes etc.) within the various sectors. In addition to providing a measure of the direct (or first-round) impacts of the project, these financial flows serve as inputs to the analyses set out in subsequent sections.

2.1 ASSUMPTIONS

In order to estimate the financial flows and the various economic impacts, it is necessary to make assumptions concerning certain dimensions of the projects and the general economic environment. The assumptions employed are set out below.

Gas Volumes

The gas pipeline volumes from the Mackenzie Delta are assumed to be 1.2 Bcf/d, or 438 Bcf/yr. The flow of gas is assumed to begin in 2009 and economic impacts are evaluated over a 25 year operating period (or to 2033).

The Government of the Northwest Territories (GNWT) has provided detailed production profiles over the 2009-2033 period for the three 'anchor' gas fields underpinning the project - Parsons Lake, Niglintgak, and Taglu. The sum of these production profiles is shown in Appendix **Table A.1**. As planned, when gas flows commence in 2009, the anchor fields would be able to produce roughly 307 Bcf/yr of gas equivalent.[2]

[2] The proposed pipeline is a dual-phase pipeline. The Parsons Lake and Taglu fields are expected to produce gas and condensate. The condensate volume is converted to a gas equivalent in order to arrive at a combined volume figure.

This constitutes approximately 70% of the volume required to fill the Mackenzie Valley pipeline (438 Bcf/yr). It is assumed that the remaining volumes would come from other existing but undelineated small fields and yet to be discovered new fields (together referred to as 'other initial' fields). These fields are assumed to have a composite production profile that reflects the rate of decline in the combined anchor fields. This composite production profile (with initial production rate of 131 Bcf/yr) is also shown in Appendix **Table A.1**.

For this analysis, it is assumed that the gas from the other initial fields would not have substantial natural gas liquid (NGL) content. However, the fields that ultimately could be developed may in fact have quite significant natural gas liquid content and this could produce additional impacts beyond those which are explicitly modeled and described in Sections 2 and 3 of this report. For example, there could be value added opportunities in upgrading NGLs into petrochemicals. This possibility is discussed in Section 4.2.

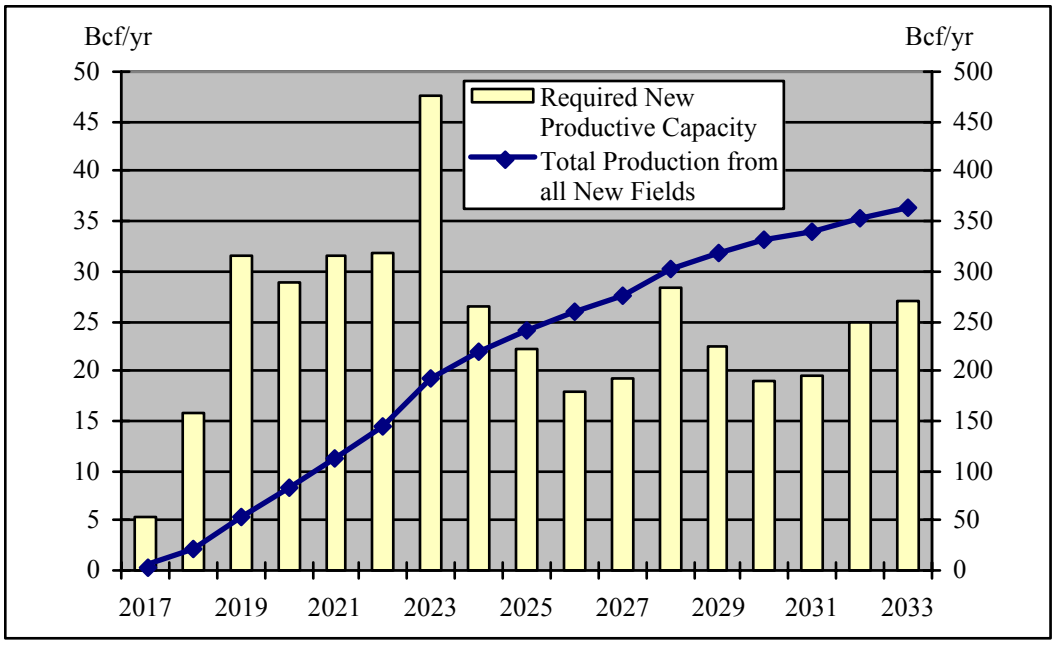
Production declines are expected to begin in the anchor fields (and the other initial fields that are assumed to be producing at the start of the project) after 8 years, so by 2017 additional gas volumes would be required to fill the pipeline. The additional annual productive capacity required because of declines in gas production are shown in **Table A.1** and also in **Figure 2.1** below.

The required productive capacity additions range from 5 Bcf/yr in 2017 to 48 Bcf/yr in 2023. Over the 17 year period where production declines can be anticipated, the average annual required additions to productive capacity are 25 Bcf/yr. For modeling purposes, it is assumed that just enough productive capacity would be brought on in any particular year so as to keep the pipeline full. Clearly in reality, there would be larger discoveries in certain years that would reduce the need for additional discoveries in subsequent years. However, since there is no way to anticipate exactly how the discoveries would unfold through time, the assumption noted above has been incorporated into the analysis. In addition, as with the other initial (non-anchor) fields, it is assumed that the production

declines through time would be proportional to those expected in the combined anchor fields and that the gas in these fields would have no liquid content.

FIGURE 2.1

REQUIRED NEW PRODUCTIVE CAPACITY BY YEAR AND TOTAL PRODUCTION FROM CUMULATIVE NEW PRODUCTIVE CAPACITY : 2017-2033



Gas Prices

Economic impacts are evaluated for two gas price scenarios. The gas price in Chicago in real (or constant year 2002 dollar) terms is assumed to be $3US/Mcf and $4US/Mcf under the respective scenarios. In each of these cases it is assumed that the real price

remains constant over time. Hereafter, these scenarios are referred to as the $3US Gas Price Case and the $4US Gas Price Case.

Exchange Rates and Inflation Rates

The US$/Cdn$ exchange rate is assumed to be $0.67US/Cdn$ throughout the period of analysis. Inflation in both countries is assumed to be 2% annually. Unless otherwise noted, dollar figures shown throughout the report are in 2002$.

Producer Netbacks

Producer netbacks are calculated relative to an AECO price. A price differential of $0.65 US/Mcf(2002$) is assumed between Chicago and AECO, resulting in AECO prices of $3.50 Cdn/Mcf in the $3US Gas Price case and $4.99 Cdn/Mcf in the $4US Gas Price case.

Transportation costs to AECO include the costs on the Mackenzie Valley pipeline plus an assumed receipt toll of $0.35 Cdn/Mcf (constant in real terms over the duration of the project) for access to the TransCanada Alberta System in northern Alberta. As shown in **Figure 2.2**, unit transportation costs for the Mackenzie Valley pipeline are estimated to start at roughly $1.39 Cdn/Mcf in 2009 and fall to $0.60 Cdn/Mcf by 2033.[3] The total cost of service on the Mackenzie Valley pipeline is estimated to be $11.7 billion (2002$) over the 25 year operating period.

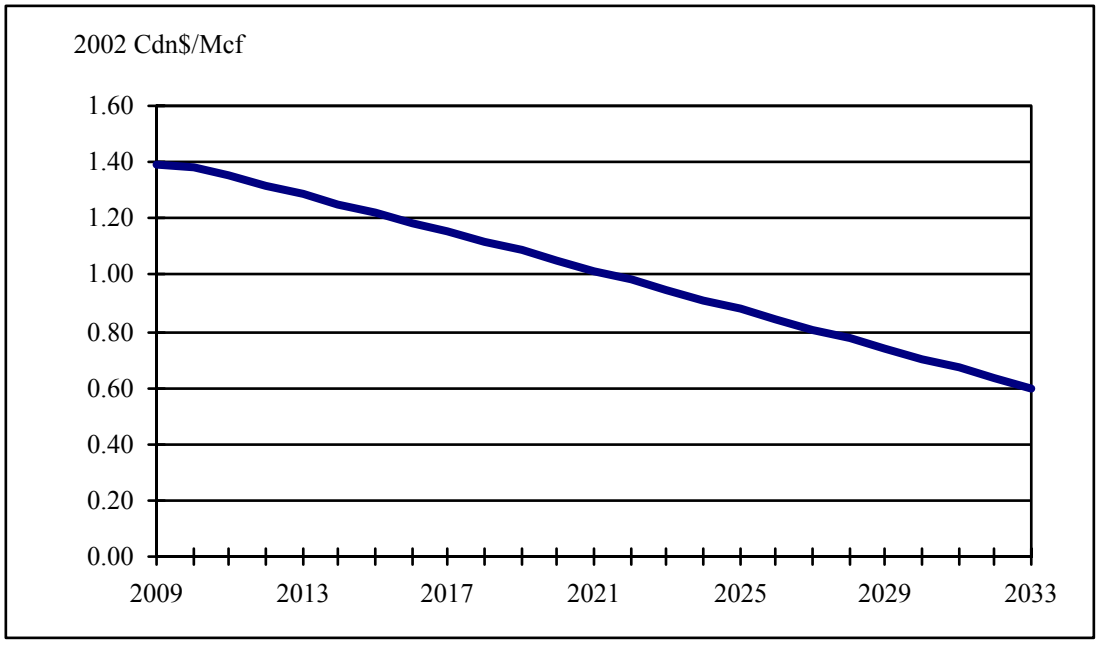
In terms of producer netbacks in the $3US Gas Price case, the foregoing assumptions translate into an initial producer netback of $1.76 Cdn/Mcf in 2009, rising to $2.55

[3] Unit toll estimates were provided by the study sponsors for the purposes of this report. These tolls were estimated using cost of service methodology.

Cdn/Mcf by 2033. In the $4US Gas Price case, producer netbacks would rise from $3.25 Cdn/Mcf in 2009 to $4.04 Cdn/Mcf by 2033.[4]

FIGURE 2.2

PROJECTED TOLLS ON THE MACKENZIE VALLEY PIPELINE : 2009-2033



---

[4] The netback price of condensate over the 2009-2033 period would also increase over time due to the declining toll. Given the very small proportion of overall netback revenue that would be comprised of condensate revenue, the per barrel price of condensate is simply approximated as ten times the per Mcf gas price. This approximation yields an average condensate price in the $3US Gas Price scenario of about $22Cdn per barrel. This is consistent with the assumed oil price for the scenario ($22US/bbl for WTI, equivalent to about $32Cdn/bbl Edmonton) netted back to the Mackenzie Delta (transportation costs for liquids moving from the Mackenzie Delta to Edmonton is estimated to be $10/bbl). Using the same procedure, average condensate netback for Mackenzie Delta producers in the $4US Gas Price case would be roughly $36/bbl and this would be consistent with the higher oil price (about $30US/bbl WTI) implicit in such a scenario.

Royalty Rates

Federal royalty rates on frontier gas are determined in the following manner. The royalty as a percentage of gross revenue is one percent when production begins, rising by one percentage point every 18 months to a maximum of five percent of gross revenue until payout.[5] After payout, the royalty is the greater of 30% of net revenue or 5% of gross revenue.[6] For the anchor fields (Parsons Lake, Niglintgak and Taglu), precise royalty rates by year were determined using the detailed data provided by the GNWT.

For the other initial fields and the productive capacity additions later in the project, average pre-payout and post-payout royalty rates for the anchor fields were used to estimate royalties. The payout period for the initial new fields was assumed to be the average of that estimated for the three anchor fields. For the productive capacity additions that would occur later in the project, netbacks would be higher at the start of production than for the anchor fields (because of lower Mackenzie Valley tolls). Consequently, the sensitivity of payout to starting netback price was assessed for the anchor fields and this information was used to adjust payout period for productive capacity brought on in 2017 and beyond.

Gas Development and Production Costs

Detailed capital and operating cost data for the three anchor fields (Parsons Lake, Niglintgak and Taglu) were provided by GNWT. The total capital cost associated with anchor field development is estimated to be $1.5 billion (2002$). Total annual operating costs for the three anchor fields are expected to be roughly $110 million and are assumed to remain constant in real terms. Capital and operating costs for the other initial fields

---

[5] Payout occurs where cumulative gross revenues equal cumulative cost base. Cumulative cost base is the total of allowable capital and operating costs. See http://inac.gc.ca/oil/roy (Department of Indian and Northern Affairs - Government of Canada website) for a detailed description of the royalty regime.

[6] Net revenue is gross revenue minus allowable capital and operating costs.

required, and for the additional productive capacity required later on in the project are estimated using the average cost-to-volume ratios for the combined anchor fields. In terms of capital costs, this translates into total field development expenditures of $4.3 billion over the life of the project.[7]

Tax Rates

It is assumed that the general federal corporate income tax rate in Canada will be 29.12%, prior to adjustments. The gas producers could deduct a 25% resource allowance, while the pipeline as well as other non-resource industries would be subject to recent changes in federal tax regulations that effectively reduce the federal rate to 22.12%. It is also assumed that the pipeline would be subject to the large corporations tax (0.23% of capital). The corporate income tax rates in the NWT and Alberta are assumed to remain at 14% and 13.5% respectively.

In establishing the annual revenue requirement that would be associated with the Mackenzie Valley pipeline, $15 million per year was included to cover items such as property taxes and other equivalent fees or land use costs. It is estimated that about one half of this figure would represent GNWT property taxes. In order to estimate property taxes paid by Mackenzie Delta gas producers, the typical proportion of operating costs that consisted of property taxes for oil and gas producers in the NWT over the last decade (4%) is assumed to apply to the Mackenzie Delta producers.[8]

---

[7] Impacts associated with exploration expenditures are not included in the analysis. For the anchor fields, the exploration spending has already occurred and thus will produce no additional impact. Further, for the other initial fields that would be required, it can be argued that the exploration activity that would produce the required reserves for the project would likely be in anticipation of the project rather than as a result of the project. Consequently, these expenditures would arguably occur even if no pipeline is ultimately built from the Mackenzie Delta to Alberta. The only exploration spending that would be legitimately incremental in nature would be any required later in the project life to keep the pipeline full. To the extent that such spending would be required, the impacts shown here in this analysis are understated.

[8] Data from Statistics Canada Catalogue 26-213.

Grant Reduction in the Territories

Government revenue raised in the NWT (and the Yukon) by the territorial government would affect the Formula Financing Grant from the federal government. It is assumed that for every $1 of territorial government revenue created by the pipeline and gas development projects, the net effect on territorial government revenue would be $0.20 with the $0.80 going to the federal government in the form of a grant reduction to the territorial government.

No attempt is made in this analysis to incorporate any possible changes to the formulas or arrangements regarding federal grants and transfers or incorporate new elements (such as First Nation royalties) that may arise as Mackenzie Delta resource development plans proceed.

Mackenzie Valley Pipeline Capital Costs

The capital cost of the Mackenzie Valley pipeline is estimated to be $3.1 billion (2002$). Pipeline materials and installation costs are expected to represent roughly 60% of the total cost while compression related materials and installation would amount to about 19% of total cost. The other significant component of the overall cost involves various indirect costs such as project development, pipeline engineering, project and construction management, and regulatory costs. In total, it is expected that these indirect costs would constitute close to 17% of the total cost. Given the relative length of the pipeline in the NWT vs Alberta and the fact that some cost components occur exclusively in the NWT, just over 96% of the capital costs are attributable to the NWT portion and just under 4% to the Alberta portion for cost of service purposes.[9]

[9] Only 40 miles of the 790 mile Mackenzie Valley pipeline would lie in Alberta.

Downstream Pipeline Requirements

TransCanada has indicated that given the current supply, demand and capacity situation on the TransCanada Alberta system, roughly $150 million in capital expenditures would be required to accommodate the Mackenzie Delta volumes. This figure is incorporated in the estimation of impacts. Further, the incremental cost of service associated with these expenditures (which TransCanada has indicated would be roughly $26 million per year (constant in real terms)) would also produce economic impacts and these are included in the analysis.

Downstream of Alberta, it is assumed that the volumes put into North American gas markets from the Mackenzie Delta fields could be accommodated by existing pipelines and / or this would not cause any tolling changes due to requirements for additional capacity. In the event that additional pipeline infrastructure is required, this could increase economic impacts in Canada significantly. Such impacts are beyond the scope of this study.

2.2 DIRECT INVESTMENT

Total direct investment by region and time frame is illustrated in **Figure 2.3** and described in more detail in Appendix **Table A.2**. The total direct investment associated with the project is estimated to be $7.6 billion ($2002). This is equivalent to just over 4% of the total investment in Canada in 2001.[10]

Pipeline construction costs would amount to $3.3 billion, while Mackenzie Delta field development costs over the period to 2033 would be $4.3 billion. Just under $300 million of the investment would occur in Alberta, with the remainder or $7.3 billion

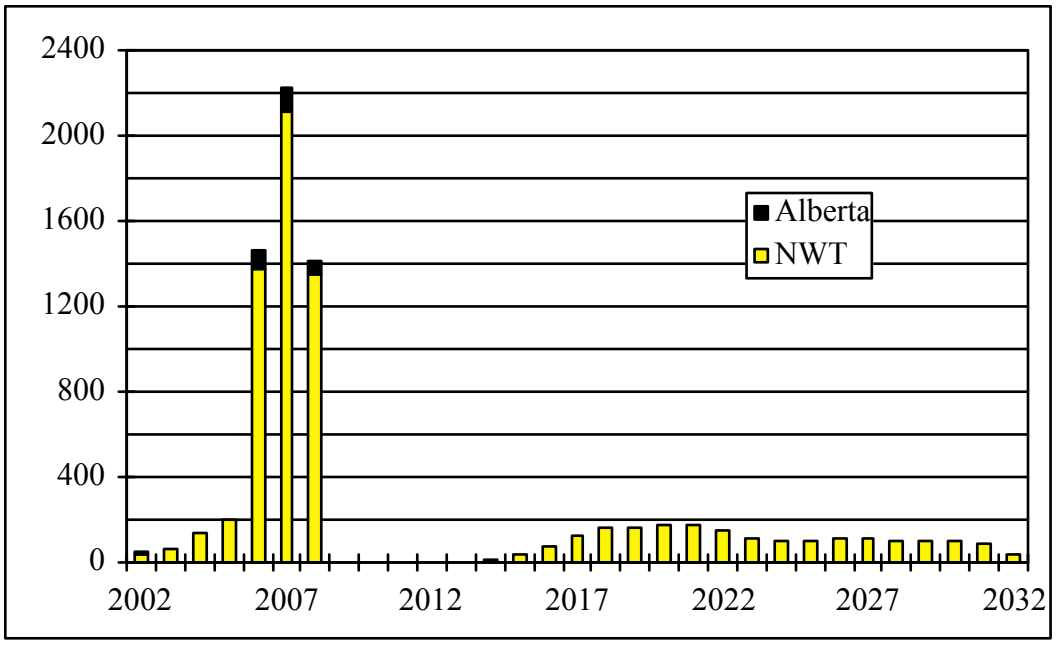
[10] See Canadian Statistics section of Statistics Canada website - www.statcan.ca.

taking place in the NWT. The latter figure is equivalent to roughly three times the total Gross Domestic Product (GDP) in the NWT in the year 2000. In fact, the investment in 2007 alone (the peak construction year of the project) is equivalent to 85% of the NWT's year 2000 GDP.

FIGURE 2.3

DIRECT INVESTMENT BY REGION: 2002-2032

(in millions of 2002 Cdn$)



The economic impacts arising from expenditures of these magnitudes can be expected to be large and diverse and should provide excellent opportunities for NWT residents. At the same time, however, projects of this type and magnitude must be properly managed so as to avoid the introduction or amplification of economic instability. For example, the labour requirements of the project between 2006 and 2008 almost certainly could not be

met exclusively by NWT residents, so an influx of short to medium term workers could be expected. This could create infrastructure and social pressures unless otherwise mitigated. These issues are discussed in more detail in Section 3.7.

Although the direct investment in the project would be concentrated in the 2006-2008 period, there is a significant percentage of the overall investment that would occur on an ongoing basis later in the analysis period. As described in the previous section, field development expenditures would be required essentially throughout the operating period of the project in order to ensure there was enough gas production to keep the pipeline full (although given the way this has been modeled, these expenditures are shown to begin in 2013 in **Figure 2.3** and **Table A.2**). In total, it is expected that about $2.1 billion in field development spending would be required during the operating period of the project, or roughly $100 million per year on average. The smaller magnitudes and sustainability of such investment represent impacts that could be much more easily absorbed by the NWT economy without any dislocations. This would provide the opportunity for the development of a truly propulsive industry that can set the stage for more broadly based economic prosperity in the NWT.

For example, the Alberta economy was very similar to the Saskatchewan economy until the late 1940s and the discovery of oil at Leduc. In fact, up until that point the population of Saskatchewan (between 800,000 and 950,000 in the 1930s and 1940s) exceeded that of Alberta. The development of the oil and gas industry has been the principal reason that Alberta currently has a population of over 3 million, while Saskatchewan's population remains barely above 1930s levels. Such an industry gives people an opportunity and a reason to either stay in a region or migrate to a region (with the intention of staying), since the industry requires but also develops highly educated, highly skilled and highly paid workers.[11] Such opportunities for NWT residents should develop with this project.

[11] Educational attainment levels in Alberta are currently the highest of any region in Canada. Further, average annual earnings in the oil and gas industry in Canada were just under $72,000 in 2001. This was more than double the average annual earnings across all industries in Canada of about $35,000 (see Statistics Canada Catalogue 72-002).

2.3 DIRECT REVENUES

Direct revenues associated with the project are summarized in **Figure 2.4**, with additional detail provided in Appendix **Table A.1**. Under the $3US Gas Price scenario, it could be expected that the operation of the Mackenzie Valley pipeline and the production of gas to fill the pipeline over 25 years would generate $36.3 billion (2002 Cdn$) in direct revenues. To put this figure into perspective, the annual average direct revenues over the operating period of the project (2009-2033) would be roughly $1.5 billion/year, an amount equivalent to almost 60% of the NWT's year 2000 GDP.

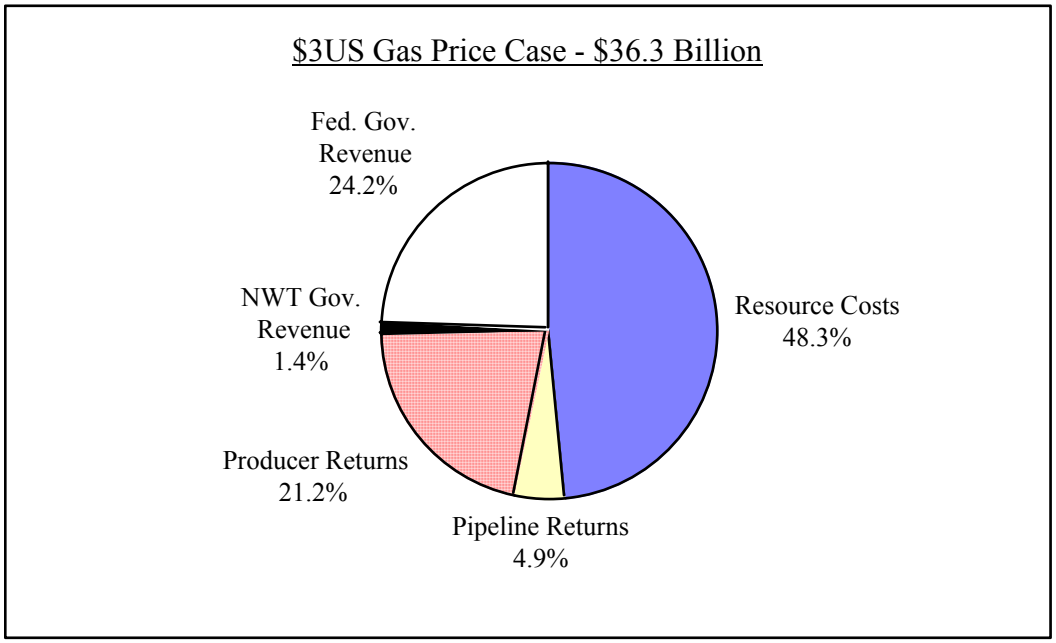
Roughly half of these revenues would go towards resource costs (the costs of labour, capital and other inputs to develop, produce, process and transport the gas). The remainder of the revenues would be split fairly evenly between private sector returns and government revenues, with each comprising roughly one quarter of total revenues.

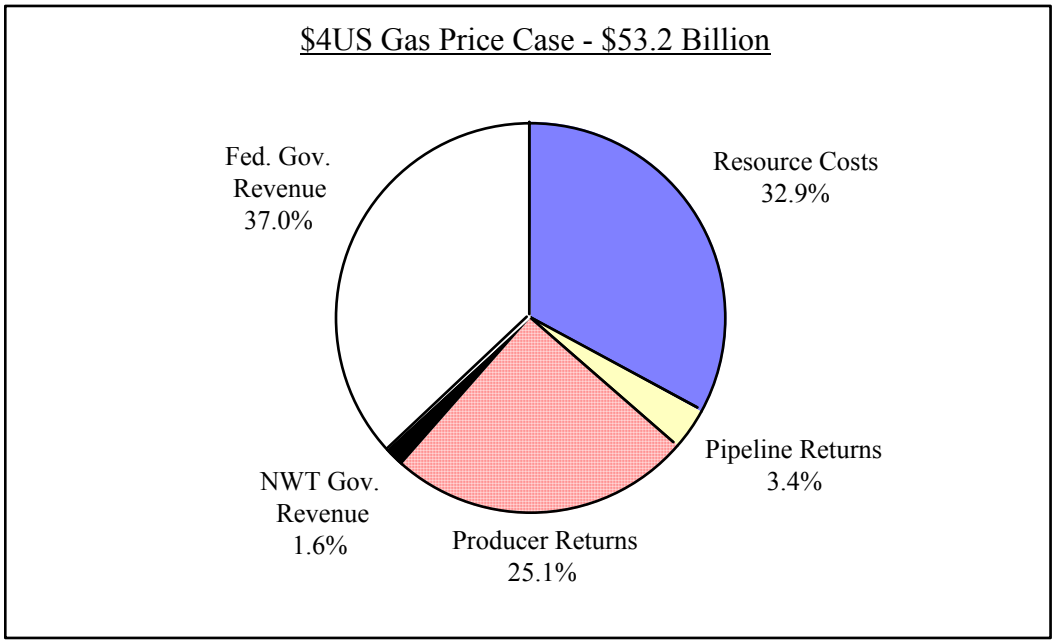
Producer returns in the $3US Gas Price scenario are expected to amount to $7.7 billion, while pipeline returns would be $1.8 billion. The NWT government would receive $0.5 billion after grant reduction was taken into account. This leaves the federal government with the largest share of any of the stakeholders in the project with estimated revenues of $8.8 billion.

That would also be the case in the $4US Gas Price scenario where the federal government would receive $19.7 billion or 37% of direct revenues. The additional $16.9 billion in total revenues that would be generated under this scenario compared to the $3US scenario would be split amongst the federal and NWT governments and the Mackenzie Delta gas producers (whose returns would nearly double to $13.4 billion). Resource costs and pipeline returns remain constant in absolute terms but decline in percentage terms. On an average annual basis, the direct revenues associated with the project would amount to more than $2.1 billion per year over the period 2009-2033.

FIGURE 2.4

DISTRIBUTION OF PROJECT REVENUES -
$3US & $4US GAS PRICE CASES, 2009-2033





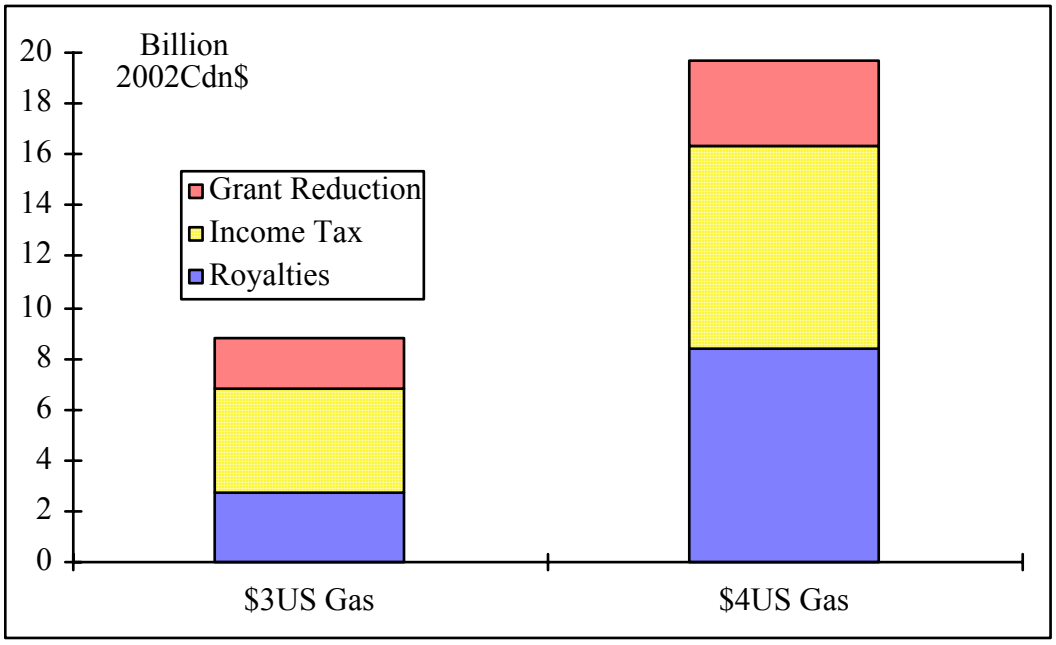
These could be expected to produce very significant impacts not only in the NWT but also in other regions in Canada. These impacts are examined in Section 3.

2.4 DIRECT GOVERNMENT REVENUES

Appendix **Table A.3** provides a detailed breakdown of government revenues by type for the various levels of government. Given the fact that federal government revenue would comprise more than 90% of the total direct government revenues in either gas price scenario, it is useful to examine the breakdown of that revenue. This is illustrated in **Figure 2.5**.

FIGURE 2.5

DISTRIBUTION OF DIRECT FEDERAL GOVERNMENT REVENUES : 2009-2033



Income taxes would make up the largest portion of direct federal government revenue in the $3US Gas Price case, accounting for $4.1 billion or 47% of the total. Royalties would amount to $2.7 billion in the $3US case, but jump substantially to roughly $8.4 billion in the $4US case and constitute the largest portion of direct federal government revenue in that scenario (43%). The higher producer netbacks in the $4US case would also boost federal income taxes to $7.9 billion. Similarly, income taxes collected by the NWT government would also be increased and, consequently, grant reduction would rise in the $4US scenario as more money would be refunded to the federal government. Of the incremental netback revenue generated in the $4US case versus the $3US case ($16.9 billion), $11.3 billion or more than two-thirds would go to the government sector, with the federal government collecting an additional $10.9 billion.

With respect to other levels of government, **Table A.3** shows that the NWT and Alberta governments would collect property taxes in either scenario amounting to $434 million and $76 million respectively. The Alberta government would also receive income tax revenues from the pipeline operation equaling $26 million for a total of $105 million in either scenario.[12] After grant reduction, NWT government revenue would amount to $487 million under the $3US case and $847 million under the $4US case. On an average annual basis over the 25 year operating period, this is equivalent to between $19 and $34 million per year for the two scenarios. Given that the annual NWT government revenues in recent years have been less than $1 billion, this is not an insignificant amount.[13]

[12] Because Alberta provincial government revenue is so small in terms of overall direct revenues, it would not have been noticeable in **Figure 2.4** as a separate category and was included in resource costs to ensure the total impact was accurate.

[13] See Territorial Government Finance section of the NWT Bureau of Statistics website - www.stats.gov.nt.ca.

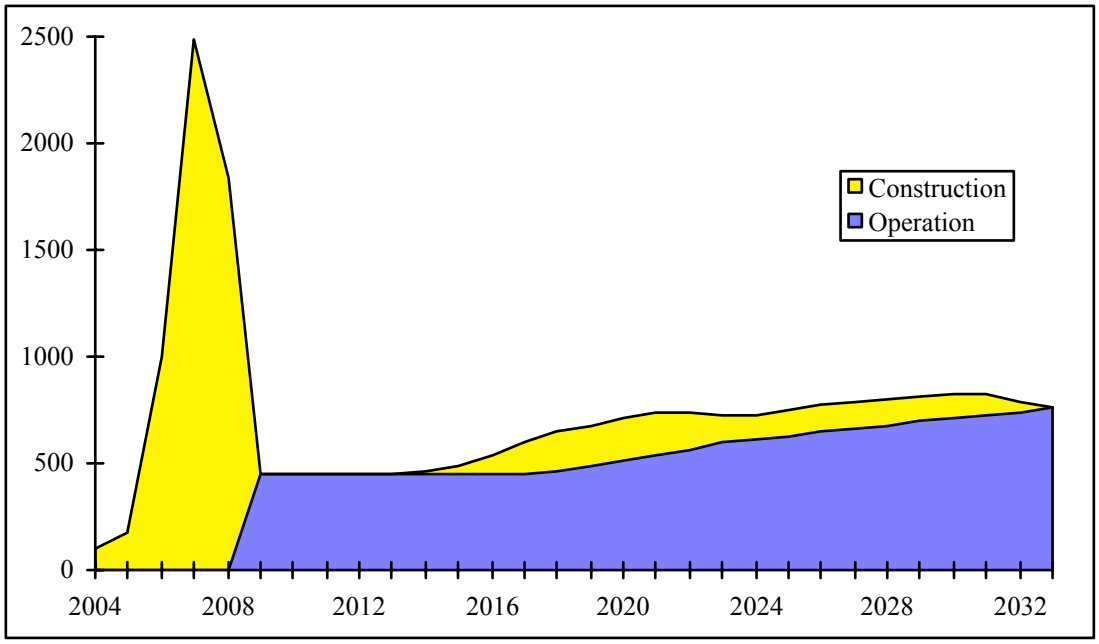
2.5 DIRECT EMPLOYMENT

The final dimension of the direct impacts associated with the Mackenzie Valley pipeline and Mackenzie Delta field development involves the direct employment that would be generated by the projects. Appendix **Table A.4** contains breakdowns by sector (pipeline vs producer), by project phase (construction vs operation) and by region (NWT vs Alberta). In addition, **Figure 2.6** illustrates the temporal distribution of direct employment impacts with a breakdown between employment related to construction and operations.

FIGURE 2.6

ANNUAL DIRECT CONSTRUCTION AND OPERATING EMPLOYMENT : 2004-2032

(in person years)



Construction employment would be concentrated in the period 2006-2008 when the bulk of the pipeline construction and the development of the anchor and other initial fields would take place. Approximately 2500 person years of employment would be created in 2007 along with more than 1800 person years in 2008. Between 2006-2008, it is estimated that pipeline construction alone would generate roughly 3100 person years of employment.

Also during that time frame, field development would create another 2300 person years of employment, or total construction employment of 5400 person years between 2006-2008. Given that over 90% of this impact would be located in the NWT and that last year the region had only 2000 officially unemployed people in total (many of whom would not have adequate skills to take the particular types of jobs that the project would create), a significant number of temporary workers from other parts of Canada would almost certainly have to be brought into the NWT to aid in pipeline construction and field development.[14]

Further, the extent of the requirement for labour 'imports' into the NWT during the peak construction phase is actually understated in **Figure 2.6** where annual direct employment impacts are summarized. Both pipeline and field development construction activities would have to be carried out primarily in the winter.[15] For example, in the winter of 2007 it is estimated that more than 1900 person years of direct employment would be generated in the NWT by the project. However, the 1900 person years would have to materialize over what could be a 125 day to 150 day season. As a result, since each person working during the season would only actually work less than half of a person

[14] Data from NWT Bureau of Statistics, Statistics Quarterly (December 2001). While the general pool of unemployed people in the NWT may be able to find work as labourers or camp workers quite readily during project construction, the project would also require welders, machine and heavy equipment operators, supervisors, inspectors, etc. who would all need to have sufficient training and skill to perform these jobs. It is highly unlikely that the total requirement for these types of positions could be filled by NWT residents.

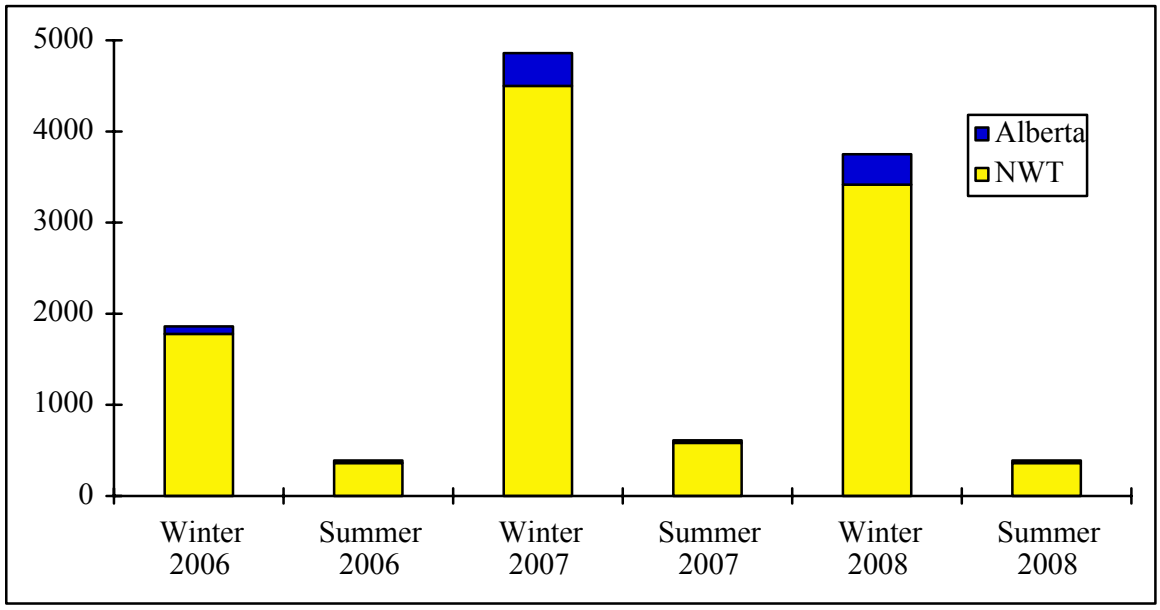
[15] During the peak construction years, the proportion of activity expected to be carried out in the winter exceeds 85%.

year, significantly more than 1900 people would be required. The personnel requirements by season are illustrated in **Figure 2.7**.

Thousands of workers would be required in the winter seasons of both 2007 and 2008 and this increases the extent to which workers from outside the NWT would have to brought in during the peak construction phase. This issue is addressed in detail in Section 3.7.

FIGURE 2.7

PERSONNEL REQUIREMENTS BY YEAR AND SEASON FOR MACKENZIE VALLEY PIPELINE CONSTRUCTION AND MACKENZIE DELTA FIELD DEVELOPMENT : 2006-2008



This issue could also arise with respect to the field development that would occur beyond the commencement of gas flows, although labour/skill shortages would likely not be

nearly as acute. It is estimated that 2300 person years of construction employment would be created beyond 2008 and **Figure 2.6** illustrates that the pattern over time is fairly stable. This would provide opportunities for NWT residents to participate on a more sustainable basis.

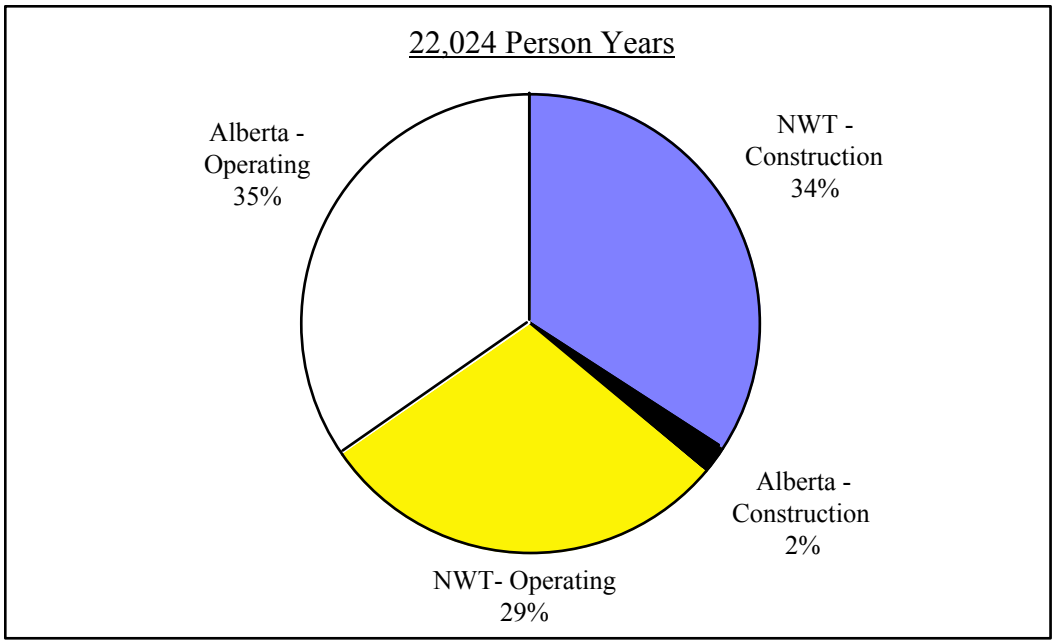
Long-term opportunities for NWT residents would also exist in the operations of the Mackenzie Valley pipeline and the Mackenzie Delta gas fields. In fact, direct employment related to operations is anticipated to exceed 14,000 person years over the 25 year operations period and represents 64% of the direct employment impact. **Figure 2.6** illustrates that operating employment could be expected to rise slightly over time as the number of gas fields that are producing in the Mackenzie Delta increases.

The operating employment associated with the project would consist of both field and head office employment, with head offices for both the gas producers and the pipeline expected to be in Alberta. Consultation with TransCanada and the gas producers indicated that many of the pipeline and gas field operations would be automated to the greatest extent possible resulting in less of a need for personnel in the NWT. Nevertheless, it is expected that there would be still be significant operating employment in the field. **Figure 2.8** depicts the geographical breakdown of all direct employment impacts (both construction and operating).

It is anticipated that there would be slightly more operating employment in Alberta (7600 person years) than in the NWT (6400 person years). The average annual direct operating employment in the NWT amounts to about 250 jobs per year which should be easily accommodated by the NWT labour force. These would be long-term positions that specifically require residence in the NWT. Training may be required for many of these positions but these impacts would not leak out of the region.

FIGURE 2.8

DIRECT EMPLOYMENT BY REGION AND TYPE : 2004-2033



3. DIRECT AND INDIRECT ECONOMIC IMPACTS

In addition to the direct impacts outlined in the previous section, the Mackenzie Valley pipeline and Mackenzie Delta field development could be expected to generate a wide variety of indirect impacts in the NWT and throughout Canada. This section deals with the indirect and total impacts in Canada overall and in individual regions.

3.1 METHODOLOGY

The effects of the project can be expected to be widely distributed geographically and extend well beyond the NWT and northern Alberta where the project is physically located. In addition, industries other than just the pipeline and gas production industries are likely to experience changes because of the project. In order to determine the ultimate effects, it is necessary to take into account the many complex sectoral and regional interactions that exist in the economy.

Many of the direct inputs involved in the projects would be purchased from other regions and from outside Canada. Purchases from foreign suppliers represent 'leakages' from a Canadian perspective and will produce no additional impacts in the domestic economy. However, if demand for direct inputs is satisfied by Canadian suppliers, this creates various indirect impacts in Canada. For example, demand for pipe in the NWT could lead to increased steel pipe production in Saskatchewan. This, in turn, would lead to additional purchases of inputs from Saskatchewan, other regions in Canada and foreign sources.

The standard method of measuring the net impacts after all complex actions and reactions are complete involves the use of an interregional input-output model. An input-output model simulates the effect on the economy when overall output of an industry changes in a specific region or when final demand for a particular commodity changes in a specific region (these changes are referred to as shocks). The Statistics Canada Interprovincial

Input-Output Model (1996 Version) is utilized in this study to estimate economic impacts. The model offers a high level of disaggregation (679 commodities, 243 industries and 12 regions) and, hence, offers the flexibility to allow the incorporation of project specific information to the greatest extent possible.

This type of analysis relies on several fundamental assumptions. First, production technologies are assumed to be fixed. In other words, each industry is assumed to use the same proportions of inputs to produce its output regardless of the quantity of outputs produced. Consequently, any impacts calculated will reflect the average effect in a region, in contrast to the marginal effect of a particular project which quite possibly could differ. For example, the introduction of what may be a new industry to a region or the large scale expansion of an existing industry may significantly affect the inter-industry relationships within and outside the region. This is an important issue in this analysis because some of the industries that are being 'shocked' in the analysis are not yet highly developed.

Second, increases in demand from different sectors are assumed to have no effect on the prices of goods. For this assumption to apply it is critical that infrastructure and supporting industries would be able to respond to increases in demand without incurring any significant increases in average costs should expansion be necessary.

Third, the input-output model is by nature a static model with all of the relationships estimated for a specific, past time period. To the extent there have been significant changes in the relationships in the economy since the estimation period, the model results may not provide the most accurate representation of what would actually happen in the current or future environment.

It should also be noted that input-output models can also be used to estimate so called induced effects. The direct and indirect effects created by a project will produce additional labour income, government revenues and corporate profits which can then be spent / reinvested and this will set off another round of impacts. These induced effects are not explicitly considered in the detailed quantitative analysis of this section but could be expected to be quite pronounced, especially in terms of the additional oil and gas exploration, development and ultimately production that may arise through the reinvestment of profits accruing to gas producers. Further, the government revenue impacts would be very significant and this could allow governments to either spend more in the economy or to pay down debt and perhaps set the stage for lower tax rates in the future - something that would also produce additional induced impacts. Finally, the spending of labour income in general would set off even more impacts. The potential induced impacts associated with the project are discussed in Section 4.1 and in certain cases, rough approximations of the magnitudes of such impacts are provided.

In this evaluation of the direct and indirect impacts associated with the Mackenzie Valley pipeline and Mackenzie Delta field development, there are three industries (as defined by Statistics Canada) that would experience changes depending on the project phase (construction vs operation) and the sector (pipeline vs gas production) that is being considered. These industries are oil and gas facility construction, natural gas pipeline transportation, and oil and gas production. **Table 3.1** illustrates the input structure of these industries for Canada.[16] The numbers shown are per $100 of industry output and illustrate input usage by industry. For example, for every $100 spent on oil and gas facility construction, **Table 3.1** indicates that $25.26 would go towards purchases of services incidental to mining.

TABLE 3.1

DISTRIBUTION OF INDUSTRY INPUTS AND EXPENDITURES PER $100 OF INDUSTRY OUTPUT* : CANADA - 1996

Input/Expenditure Item	Oil & Gas Facility Construction	Natural Gas Pipeline Transportation	Oil & Gas Production
PURCHASED INPUTS			
Services Incidental to Mining	25.26		6.06
Natural Gas		1.25	
Steel Pipes and Tubes	9.17		
Metal Tanks	1.07		
Fittings	1.00		
Valves	4.08		
Construction and Mining Machinery	1.09		2.05

[16] It should be noted that for a number of reasons, adjustments may be necessary to either the shock given to an input-output model or the results produced by the model. First, it may be that the level of aggregation in the model, even in its most detailed form, is not sufficient to accurately portray what would happen in a particular scenario. This is especially important for pipeline construction because this type of construction is lumped into the oil and gas facility construction category (i.e. along with the drilling of oil wells, the construction of oil and gas production facilities, etc.) in the Statistics Canada model. Material inputs differ significantly in pipeline construction versus general oil and gas facility construction and this must be taken into account when shocking the input-output model. Second, if an industry is not well developed in a particular region, results from the input-output may not provide a reasonable portrayal of the impacts of a project. This is often apparent by observing the extent to which the actual direct impacts expected from a project differ from the calculated direct impacts in the input-output model. To account for these differences, adjustments may be required either to the shock given to the model or the final results produced by the model.

Measuring and Controlling Instruments	1.98		
Repair Construction, Machinery & Equipment Repair		1.36	1.97
Finance, Insurance and Real Estate	1.74	2.24	2.32
Wholesale Margins	2.70		
Electric Power			1.86
Architectural, Engineering & Scien. Services	9.75		
Other Business Services**	1.55	2.29	4.79
Operating Supplies***	6.27	2.05	5.11
Travelling/Entertainment		1.22	
Other Purchased Inputs	6.10	4.53	4.19
Total Purchased Inputs	71.76	14.94	28.35
DIRECT GDP			
Labour Income	23.15	13.45	8.30
Operating Surplus****	2.79	65.59	61.39
Indirect Taxes	2.31	6.02	1.96
Total Direct GDP	28.24	85.06	71.65

* Inputs where value is less than 1% of output placed into Other Purchased Inputs unless otherwise noted
** Architectural, Engineering & Scientific Services for Pipeline and Oil and Gas Production included here
*** Includes Rentals of Machinery and Equipment, Spare Parts, Maintenance and Office Supplies
**** Includes interest, depreciation, depletion allowances, royalties, income taxes and after tax profit

Source : Statistics Canada Input-Output Division

The key difference between oil and gas facility construction and either natural gas pipeline transportation or oil and gas production is the overall percentage of purchased inputs (other than direct labour) that make up the total value of output. In oil and gas facility construction, purchased inputs comprise almost 72% of the value of output, compared to roughly 28% in oil and gas production and only 15% in natural gas pipeline transportation. All of the indirect impacts that are calculated by an input-output model are related to these purchased inputs.

Consequently, a large proportion of construction phase impacts would be indirect whereas operation phase impacts would be dominated by direct impacts associated with the high proportion of direct GDP that is typical of the industries involved on the operations side. In addition, during the construction phase there is the potential for far more leakages from the domestic economy in the form of imports than in the operations phase because of the high proportion of purchased inputs.

The Statistics Canada model contains coefficients which reflect the average import content of the purchases made by a given industry. Given input from TransCanada regarding probable material sourcing (ie. domestic vs imported) for pipeline construction and knowledge of the import coefficients inherent in the model, it was expected that the model would provide reasonable estimates for import content for virtually all key materials in pipeline construction (i.e. pipe, coatings, valves, fittings, metering equipment, etc.). The only exception was with respect to the compressors required for the Mackenzie Valley pipeline. TransCanada indicated that these would be imported (whereas the model would predict that some of the demand for compressors in the NWT would be met by domestic industry), so the shock to the model was adjusted to reflect this expectation.

The results of the evaluation of economic impacts associated with the construction and operation of the Mackenzie Valley pipeline and Mackenzie Delta gas fields are outlined in the next four subsections.

3.2 PIPELINE CONSTRUCTION IMPACTS

Table 3.2 summarizes the impacts associated with the construction of the Mackenzie Valley pipeline in the NWT and northern Alberta as well as of the expansion of the TransCanada Alberta system to accommodate Mackenzie Delta volumes. Capital expenditures would amount to $3.3 billion (2002 Cdn$) and this would generate an increase in Canadian Gross Domestic Product (GDP) of $2.1 billion. The overall GDP intensity ratio (GDP / capital cost) of 0.65 reflects the fact that a significant portion of the materials required for the pipeline would have to be imported. Total direct and indirect imports would amount to $1.1 billion or 34% of the total investment involved in this phase of the project.

TABLE 3.2

IMPACTS OF MACKENZIE VALLEY PIPELINE CONSTRUCTION : 2002-2008*

(millions of 2002 Cdn$, employment in person years)

	NWT	BC	Alta	Sk/Mn/Yu	Ont	Que	Atlantic	Total
Capital Costs	3017		266					3283
Gross Domestic Product	879	93	604	145	302	93	11	2127
Labour Income	636	68	402	74	199	58	8	1444
Federal Government Revenue	146	17	103	19	57	13	2	357
Terr./Prov. Government Revenue	78	9	45	14	36	13	1	197
Grant Reduction	-63			-1				-63
Adjusted Terr./Prov. Gov't Revenue	16	9	45	13	36	13	1	134
Adjusted Federal Gov't Revenue	208	17	103	20	57	13	2	420
Total Government Revenue	224	26	148	33	94	26	3	554
Employment	11354	1621	7931	1871	4272	1516	218	28782

* Expected leakages of economic impacts from the NWT to other regions due to labour market constraints are not incorporated in this table

The overall labour income impacts of $1.4 billion represent roughly two-thirds of the overall GDP impacts and this proportion varies little across the various regions. Similarly, the ratio of the total government revenues ($0.6 billion overall) to GDP is consistently about one quarter for Canada as a whole and for the individual regions.

More than 40% of the overall GDP impact would be felt in the NWT, a percentage which may seem surprisingly low given that over 90% of the capital costs are attributable to the region. However, for small economies like that of the NWT, many of the indirect impacts (especially those related to manufactured materials) are transferred to other regions. Ontario, for example, could be expected to supply much of the pipe and other materials used in the project. Furthermore, many of the costs relating to project engineering, development and management that are allocated to the NWT would likely be sourced in Alberta. In addition, the head office of the pipeline company is assumed to

be in Alberta. These factors contribute to a wide distribution of pipeline construction impacts across regions of Canada.

Despite the factors noted above, the NWT would still experience the greatest impacts of any region and the magnitudes of these impacts relative to the size of the economy are impressive. The GDP impact is equivalent to about 35 % of the region's 2000 GDP level while the employment impact is equivalent to roughly 55% of the NWT's total employment in 2001.

However, it must be noted that the values shown in **Table 3.2** do not reflect the potential leakages of impacts from the NWT due to regional labour force constraints during the peak construction phases of the project (as discussed in Section 2.5). This issue is addressed in detail in Section 3.7 and the NWT impacts as well as the impacts in other regions shown in **Table 3.2** are adjusted to reflect the degree to which labour from other regions would ultimately contribute to the project requirements in the NWT.

3.3 FIELD DEVELOPMENT IMPACTS

The impacts associated with the development of the Mackenzie Delta gas fields over the period 2004-2032 are shown in **Table 3.3**. Capital expenditures of roughly $4.3 billion would produce a GDP impact of over $3.2 billion. The GDP impact relative to the capital expenditures would be higher than in the construction of the Mackenzie Valley pipeline since proportionally not as many materials are involved. Consequently, there are fewer direct and indirect imports (23% of capital costs) than in the pipeline construction case (34% of capital costs).

TABLE 3.3

IMPACTS OF MACKENZIE DELTA GAS FIELD DEVELOPMENT : 2004-2032*

(millions of 2002 Cdn$, employment in person years)

	NWT	BC	Alta	Sk/Mn/Yu	Ont	Que	Atlantic	Total
Capital Costs	4330							4330
Gross Domestic Product	2068	155	279	58	470	186	22	3239
Labour Income	1505	114	167	38	306	115	15	2260
Federal Government Revenue	385	29	45	9	89	26	3	586
Terr./Prov. Government Revenue	126	15	22	8	58	25	3	255
Grant Reduction	-101			-2				-102
Adjusted Terr./Prov. Gov't Revenue	25	15	22	6	58	25	3	153
Adjusted Federal Gov't Revenue	486	29	45	10	89	26	3	688
Total Government Revenue	511	44	67	16	147	51	6	841
Employment	27867	3170	4561	1069	7210	3029	449	47354

* Expected leakages of economic impacts from the NWT to other regions due to labour market constraints are not incorporated in this table

---

Another noteworthy difference between these results and those for pipeline construction is the degree to which the impacts would be concentrated in the NWT. Between 55% and 70% of the employment, labour income and GDP impacts would be in the NWT. However, unlike in the construction phase of the pipeline projects, these impacts would be spread over nearly 30 years so there is a much greater chance of northern residents reaping sustainable benefits from field development. As the industry becomes established in the Mackenzie Delta region, it could become one of the key industries in the local economy. Nevertheless, it must be stressed that the impacts shown in **Table 3.3** are adjusted in Section 3.7 to reflect potential leakages of impacts from the NWT to other regions of Canada that arise from labour supply constraints in the NWT.

The impacts shown in **Table 3.3** for the rest of Canada follow a pattern observed in pipeline construction. Indirect impacts tend to be concentrated in larger provinces and those closer to the NWT. In addition, it can be observed that labour income impacts tend to constitute between 65% and 75% of the total GDP impacts in any region. This is in stark contrast to the impacts arising from the operation phase of the pipeline and from natural gas production.

3.4 PIPELINE OPERATION IMPACTS

Table 3.4 illustrates the economic impacts associated with the operation of the Mackenzie Valley pipeline over the period 2009-2033 as well as the incremental cost of service on the TransCanada Alberta system to accommodate Mackenzie Delta volumes over the same time frame. The total cost of service over the period would be roughly $11.7 billion, with the overall GDP impact equalling $11.4 billion. The GDP intensity ratio (GDP / direct output) of 0.97 is very high and reflects the fact that in pipeline operations, most of the cost of service is direct GDP (direct value added).

With only limited inputs being purchased by the pipeline companies during the operating phase, there would be little need for imports of materials. Overall imports related to pipeline operations would amount to only $0.2 billion over the entire 25 year operating period. Further, given that the bulk of the GDP impact would be direct, it would also be concentrated in the regions where the pipeline services would be provided. Consequently, the NWT and Alberta would receive 96% of the GDP impacts associated with pipeline operations.

Government revenue impacts for this portion of the project also follow the same pattern, with about 84% of the government revenues shown in **Table 3.4** being government revenues that would be directly created by the operation of the pipelines (the property and income taxes payable by the Mackenzie Valley pipeline and TransCanada). Total government revenues would amount to $2.2 billion. It is noteworthy that the grant reduction that arises for the NWT under current fiscal arrangements is much more significant than was shown in either of the construction phase impact tables.

TABLE 3.4

IMPACTS OF MACKENZIE VALLEY PIPELINE OPERATION : 2009-2033

(millions of 2002 Cdn$, employment in person years)

	NWT	BC	Alta	Sk/Mn/Yu	Ont	Que	Atlantic	Total
Direct Output	10666		1047					11714
Gross Domestic Product	9748	135	1252	19	219	59	8	11441
Labour Income	401	99	326	12	148	37	5	1028
Federal Government Revenue	1015	25	163	3	42	8	1	1257
Terr./Prov. Government Revenue	736	13	159	2	27	8	1	947
Grant Reduction	-589			-1				-590
Adjusted Terr./Prov. Gov't Revenue	147	13	159	2	27	8	1	357
Adjusted Federal Gov't Revenue	1604	25	163	3	42	8	1	1847
Total Government Revenue	1751	38	321	5	69	17	2	2204
Employment	8166	2807	4845	350	3701	1063	159	21091

Employment and labour income impacts would also be largest in the NWT and Alberta, but it can be observed that the degree to which the NWT impacts exceed the Alberta impacts is much smaller with respect to these impacts compared to the GDP or government revenue impacts. This reflects the assumption that roughly two thirds of direct pipeline operating employment for the Mackenzie Valley pipeline would be in an Alberta head office with one third out in the field. Further, it can also be observed that the overall employment and labour income impacts are more balanced across Canada than might be expected looking at the GDP impacts. **Table A.4** illustrates that only 3200 person years of direct employment would be created by pipeline operations. As a result, the bulk of the employment impacts shown in **Table 3.4** would be indirect and these tend to be more widely dispersed geographically.

In total, the $11.7 billion in pipeline cost of service would generate about $1.0 billion in labour income (or about 9% of GDP) and roughly 21,000 person years of employment over 25 years. Relative to the construction phase impacts, these impacts are quite modest. For example, Mackenzie Delta field development is estimated to create 47,000 person years of employment given a capital expenditure of about $4.3 billion.

However, in contrast to the construction phase impacts, it is reasonable to assume that essentially all of the labour income and employment impacts shown for the operating phase in the NWT would in fact be felt by residents of the region. Once this factor is taken into account, the labour income and employment impacts associated with the operating phase are clearly significant in the overall picture and represent sustainable long term impacts that are arguably more beneficial to an economy than the more concentrated impacts during the peak construction phase.

3.5 GAS PRODUCTION IMPACTS

Impacts relating to the production of Mackenzie Delta gas are shown in **Table 3.5** for the two gas price cases. The impacts in the provinces are identical under both gas price scenarios since the indirect impacts are just associated with purchases of inputs by the gas producers and not the changes in value added at the wellhead (the latter shows up as value added in the NWT). Since production costs are not assumed to change with a change in the gas price, the indirect impacts do not change.

TABLE 3.5

IMPACTS OF MACKENZIE DELTA GAS PRODUCTION : 2009-2033

(millions of 2002 Cdn$, employment in person years)

PROVINCES - BOTH GAS PRICE CASES	BC	Alta	Sk/Mn/Yu	Ont	Que	Atlantic	Total
Direct Output							
Gross Domestic Product	289	847	73	791	190	29	2219
Labour Income	208	701	46	541	119	20	1635
Federal Government Revenue	54	165	11	155	27	4	416
Terr./Prov. Government Revenue	28	66	9	104	27	4	239
Grant Reduction			-2				-2
Adjusted Terr./Prov. Gov't Revenue	28	66	7	104	27	4	237
Adjusted Federal Gov't Revenue	54	165	13	155	27	4	418
Total Government Revenue	82	231	20	260	54	8	655
Employment	6041	11117	1281	12647	3301	553	34939

NWT AND CANADIAN TOTAL		$3US GAS PRICE		$ 4US GAS PRICE	
	Provinces	NWT	Total	NWT	Total
Direct Output		24544	24454	41499	41499
Gross Domestic Product	2219	21161	23380	38116	40335
Labour Income	1635	1373	3008	1373	3008
Federal Government Revenue	416	6049	6465	15514	15930
Terr./Prov. Government Revenue	239	1803	2042	3606	3845
Grant Reduction	-2	-1442	-1445	-2885	-2887
Adjusted Terr./Prov. Gov't Revenue	237	361	597	721	958
Adjusted Federal Gov't Revenue	418	7492	7910	18399	18817
Total Government Revenue	655	7852	8507	19120	19775
Employment	34939	25049	59988	25049	59988

The impacts in the provinces would be dominated by those occurring in Alberta and Ontario. Depending on the impact being examined, anywhere from 68% to 76% of the provincial total is comprised of impacts in those two provinces. GDP and labour income impacts would be higher in Alberta than Ontario, while government revenue and employment impacts would be more prominent in Ontario versus Alberta. As with most of the impact results shown thus far, **Table 3.5** illustrates that the third largest impacts amongst the provinces would be received by B.C.

While total employment and labour income impacts related to gas production in the rest of Canada would slightly exceed those in the NWT, GDP and government revenue impacts would be orders of magnitude larger for the NWT, even in the lower ($3US) gas price scenario. Although gas production does involve higher operating costs and, consequently, more indirect imports than pipeline operation, leakages from the local economy are quite small (even in the case of the NWT) and the ratio of GDP to value of production is over 85% in the Territories in the $3US gas price case.

As the gas price and netback revenue rises, so do GDP, the returns to producers and government revenues. For example, in the $4US gas price scenario, close to half of the

$41 billion in netback revenue would ultimately go to governments, with the federal government receiving the largest proportion or nearly $19 billion. Grant reduction in that scenario would amount to almost $3 billion over the 25 year period.

It should be noted that the GDP and government revenue impacts associated with Mackenzie Delta gas production tend to dominate the overall project impacts that are described in the next section, even in the $3US gas price case. Also, like the pipeline operation impacts, all impacts associated with gas production in the Mackenzie Delta that are indicated as NWT impacts in **Table 3.5** would remain in the region and would provide a sustainable long term benefit to the residents of the NWT.

3.6 Unadjusted Overall Impacts

The results described in the previous sections for the various elements of the project can be combined in order to illustrate overall impacts. For example, overall construction phase impacts are shown in **Table 3.6**. The total GDP impact in Canada associated with the construction of the Mackenzie Valley pipeline and Mackenzie Delta field development would be $5.4 billion (2002$) with labour income impacts amounting to $3.7 billion. Governments would receive roughly $1.4 billion as a result of project construction and over 76,000 person years of employment would be generated.

TABLE 3.6

UNADJUSTED TOTAL CONSTRUCTION IMPACTS : 2002-2033*

(millions of 2002 Cdn$, employment in person years)

	NWT	BC	Alta	Sk/Mn/Yu	Ont	Que	Atlantic	Total
Capital Costs	7347		266					7613
Gross Domestic Product	2947	248	884	204	773	279	33	5366
Labour Income	2142	182	569	112	504	172	23	3704
Federal Government Revenue	531	46	148	27	146	40	5	943
Terr./Prov. Government Revenue	204	24	67	21	94	38	4	452
Grant Reduction	-163			-2				-166

Adjusted Terr./Prov. Gov't Revenue	41	24	67	19	94	38	4	287
Adjusted Federal Gov't Revenue	694	46	148	30	146	40	5	1109
Total Government Revenue	735	70	215	49	240	77	9	1395
Employment	39220	4791	12493	2940	11481	4545	666	76136

* Expected leakages of economic impacts from the NWT to other regions due to labour market constraints are not incorporated in this table

---

As noted in Sections 3.2 and 3.3, a portion of the impacts that are attributed to the NWT during the construction phase of the project would likely be felt by residents of other regions as labour from outside the NWT is brought in to meet project requirements. An estimation of these effects follows in Section 3.7 along with an adjusted version of **Tables 3.2, 3.3 and 3.6**. Although the total construction impacts for Canada shown in **Table 3.6** will still be applicable, the ultimate distribution of the impacts by region will differ from that shown in **Table 3.6** and will account for the expected leakages of economic impacts from the NWT to other regions that arise from labour market constraints in the NWT.

TABLE 3.7

UNADJUSTED OVERALL IMPACTS : 2002-2033*

(millions of 2002 Cdn$, employment in person years)

PROVINCES - BOTH GAS PRICE CASES	BC	Alta	Sk/Mn/Yu	Ont	Que	Atlantic	Total
Investment / Revenue		1313					1313
Gross Domestic Product	671	2983	296	1783	528	70	6331
Labour Income	489	1597	170	1193	328	48	3825
Federal Government Revenue	125	476	41	344	75	10	1071
Terr./Prov. Government Revenue	65	292	33	226	73	9	697
Grant Reduction			-5				-5
Adjusted Terr./Prov. Gov't Revenue	65	292	28	226	73	9	692
Adjusted Federal Gov't Revenue	125	476	46	344	75	10	1076
Total Government Revenue	190	767	74	569	149	19	1768
Employment	13639	28455	4570	27829	8909	1378	84780

NWT AND CANADIAN TOTAL		$3 GAS PRICE		$ 4 GAS PRICE	
	Provinces	NWT	Total	NWT	Total

Investment / Revenue	1313	42557	43871	59512	60825
Gross Domestic Product	6331	33856	40187	50811	57142
Labour Income	3825	3916	7741	3916	7741
Federal Government Revenue	1071	7595	8665	17059	18130
Terr./Prov. Government Revenue	697	2744	3441	4547	5244
Grant Reduction	-5	-2195	-2200	-3637	-3643
Adjusted Terr./Prov. Gov't Revenue	692	549	1241	909	1602
Adjusted Federal Gov't Revenue	1076	9790	10866	20697	21772
Total Government Revenue	1768	10339	12107	21606	23374
Employment	84780	72435	157216	72435	157216

* Expected leakages of economic impacts from the NWT to other regions due to labour market constraints are not incorporated in this table

---

The same qualification applies to the results shown in **Table 3.7** concerning overall project impacts. GDP impacts across Canada as a result of the construction and operation of the Mackenzie Valley pipeline and the Mackenzie Delta gas fields would range from $40.2 billion to $57.1 billion depending on gas price. In addition, government revenues could be expected to increase anywhere from $12.1 billion to $23.4 billion as a result of the project. Finally, an additional 157,000 person years of employment would be generated with associated labour income of $7.7 billion.

3.7 LEAKAGES OF IMPACTS FROM THE NWT DUE TO LABOUR MARKET CONSTRAINTS

The results shown throughout Section 3 to this point reflect impacts that would occur in Canada's various geographic regions if there were sufficient indigenous labour supplies. That is, these labour income and employment impacts would only accrue to citizens of a particular region should there be sufficient people in the region with sufficient skills to fill all of the jobs that would be created there. For the NWT it is necessary to re-examine these impacts given the small and widely dispersed population. As of October 1, 2001, the population of the NWT was approximately 40,600.[17]

---

[17] Data from NWT Bureau of Statistics, Statistics Quarterly (December 2001).

Working age population (15-64) in the NWT averaged 29,800 in 2001 with a labour force of 22,800.[18] The NWT participation rate (labour force as a percentage of working age population) of 76% is significantly higher than the national average of 66%. Although the region has a large number of people in the labour force relative to the population, unemployment is a significant problem in the NWT. In 2001, the unemployment rate in the NWT was 8.6% and higher than the national rate of 7.2%. The NWT unemployment rate has typically exceeded the national rate by an even larger amount.

The additional employment opportunities associated with the pipeline and gas development projects considered in this analysis would certainly be useful in ameliorating the unemployment problem in the region, especially during the operating phase when more of the employment is of a long-term, stable nature. However, the magnitude and labour requirements of the projects in the construction phase are so large that not even the significant unemployed labour pool in the NWT could be expected to fill all of the jobs necessary. Some of this would be due to skill issues, but the sheer numbers of workers required is a factor as well. **Table 3.8** illustrates the personnel requirements between 2006 and 2008 in the various regions where pipeline construction and gas industry development would take place.

TABLE 3.8

PERSONNEL REQUIREMENTS BY SEASON DURING THE PEAK CONSTRUCTION PHASES OF THE PIPELINE PROJECT : 2006-2008*

(persons)

	Winter 2006	Summer 2006	Winter 2007	Summer 2007	Winter 2008	Summer 2008
NWT	1784	355	4488	579	3418	352
Alberta	82	28	367	68	327	27

[18] Data from NWT Bureau of Statistics, Statistics Quarterly (December 2001). Labour force and unemployment rate data from the same source and from www.statcan.ca.

* Estimates include field development labour requirements

The project would create employment for between 1800 and 4500 people in the NWT alone during the Winter seasons of 2006 to 2008. Summer personnel requirements would be substantially lower ranging from 350 to 600 people. Clearly there would be significant opportunities for local participation in the construction of the projects during all seasons. The extent depends on the size, location and mobility of the unemployed labour pool in the Territories, along with skill requirements for the various positions.

Employment figures for the NWT indicate that total construction employment in the region in recent years has been far below the peak requirements of the project.[19] It is difficult to predict the extent to which opportunities in the construction phase of the project would draw from existing workers in the construction industry. In addition, there would certainly be a number of people drawn into the industry; this would include people who would be working elsewhere in the absence of the project or perhaps people who would be otherwise unemployed or simply out of the labour force.

To further explore these issues, it is useful to examine the characteristics of the labour force in the NWT.[20] A labour force survey conducted in 1999 provides insights on unemployment levels, characteristics of discouraged workers (those who have dropped out of the labour force and are not counted in the unemployment statistics) and labour mobility. Of the population 15 and over, about 6417 were not in the labour force and 3169 were unemployed (in total 9586 people of working age were not working). More than half of those not working (or 4860) indicated they wanted a job. A major problem for many of these people could be location, since 2629 or about 54% of the total resided in places other than the larger centres of Yellowknife, Hay River, Inuvik and Fort Smith.

---

[19] For example, average construction employment in the NWT in 2001 was 1762. Data from NWT Bureau of Statistics, Statistics Quarterly (December 2001).

[20] Data from http://www.stats.gov.nt.ca (1999 Labour Force Survey for the Northwest Territories).

However, of all the people 15 years and over, more than 50% indicated that they would move to another community to take a job.

Although it is impossible to come up with a definitive estimate of potential local participation based on this information, one estimate may be around 2500 people (this represents the proportion of those not working who wanted to work and who would be willing to move). Skill requirements, however, would be a major issue as to whether these people would be employable in the project, although those currently not working do not necessarily have to take project jobs. They could potentially take the jobs of the currently employed who in turn would work in project construction. Nevertheless, perhaps the prime candidates for work in the project would be unemployed construction workers.

If it is assumed that the unemployment rate and the ratio of discouraged workers to unemployed in construction match those in the NWT overall, roughly 400 people in the NWT may be available and have appropriate skills for project employment. Given the temporal pattern of the employment created by the project, this would translate into a maximum of 23% of pipeline construction employment and 32% of field development employment (during the peak construction phase 2006-2008) - assuming, for example, that if 250 jobs were available, all would taken by NWT residents.

This is probably not reasonable since a significant portion of the jobs would require very specific job skills that may not be readily available in the NWT. Therefore, assuming that the maximum proportion of jobs in any season taken by NWT residents would be 50%, the percentages noted above drop to roughly 17% and 22% respectively. These percentages are used to adjust NWT construction impacts for the period prior to 2009.

For ongoing gas field development beyond the peak construction period, it is quite possible that local participation in field development employment would exceed 50%. Local workers may begin working in this industry at the entry level with limited skills, but would gain experience and would also have an incentive to continue in the industry given the more sustainable employment opportunities. Some workers could be

permanently employed with the ongoing development activity, although seasonality could be an issue.

Since it is not certain that local participation would increase over time, the assumption of 50% maximum local participation in direct field development employment is also used for the period beyond 2008. It should be noted that the winter season project requirements would be small enough later in the project such that this assumption sets the limit on local employment in every year past 2008.

Nevertheless, utilizing this assumption results in local participation in direct field development employment averaging 35% over the entire analysis period. This percentage is also applied to indirect employment in services incidental to mining (more commonly known as the oil and gas service industry) as calculated in the Input-Output model when estimating the employment leakages from the NWT. This represents another area where the labour pool in the NWT would likely not be sufficient to entirely meet the needs of the project.

With regard to other indirect employment that would be created in the NWT during the construction (and operation) phases, it could be expected that the local pool of unemployed and discouraged workers would adequately supply all project requirements. Compared to the construction employment in the project, the indirect employment is not subject to as intense seasonal variations, does not require as specialized skills, and would not require nearly as many people to move to take a job (much of the general service industry indirect employment would be in larger centres).

Given these considerations, values for construction phase impacts adjusted for leakages from the NWT are provided in **Table 3.9** for pipeline construction, field development and total construction. These values can be compared to the unadjusted impacts shown in **Tables 3.2, 3.3 and 3.6** respectively. Overall, this analysis indicates that 14,000 person

years of employment that would be geographically hosted by the NWT would in fact be taken by non-NWT residents.

This employment (as well as all other associated impacts) must be allocated in some way across the other regions. Since roughly 12,000 of the 14,000 person years estimated to leak out of the NWT would be related to field development and the oil and gas service activities, the impacts are allocated based on the regional shares of overall oil and gas exploration and development activity over the last decade. As a result, most of the leakages from the NWT are allocated to Alberta.

For the operations phase, provision has already been made for the division of direct employment between the field and the Alberta head office for both the pipelines and the producers. Consequently, jobs in the NWT field would be taken by NWT residents. Further, as noted earlier, the NWT labour force is expected to be able to meet all indirect employment requirements created in the region by project operations.

TABLE 3.9

CONSTRUCTION IMPACTS AFTER ADJUSTMENTS FOR LEAKAGES FROM THE NWT : 2002-2033

(millions of 2002 Cdn$, employment in person years)

PIPELINE CONSTRUCTION	NWT	BC	Alta	Sk/Mn/Yu	Ont	Que	Atlantic	Total
Capital Costs	3017		266					3283
Gross Domestic Product	669	114	751	166	302	93	32	2127
Labour Income	427	89	548	95	199	58	28	1444
Federal Government Revenue	110	21	128	22	57	13	5	357
Terr./Prov. Government Revenue	68	10	53	15	36	13	2	197
Grant Reduction	-54			-1				-55
Adjusted Terr./Prov. Gov't Revenue	14	10	53	14	36	13	2	142
Adjusted Federal Gov't Revenue	164	21	128	23	57	13	5	412
Total Government Revenue	178	31	180	37	94	26	8	554
Employment	9174	1839	9457	2089	4272	1516	436	28782

FIELD DEVELOPMENT	NWT	BC	Alta	Sk/Mn/Yu	Ont	Que	Atlantic	Total

Capital Costs	4330							4330
Gross Domestic Product	1334	228	794	132	470	186	95	3239
Labour Income	771	187	681	112	306	115	89	2260
Federal Government Revenue	260	41	133	21	89	26	16	586
Terr./Prov. Government Revenue	89	18	47	11	58	25	6	255
Grant Reduction	-71			-2				-73
Adjusted Terr./Prov. Gov't Revenue	18	18	47	9	58	25	6	182
Adjusted Federal Gov't Revenue	331	41	133	23	89	26	16	659
Total Government Revenue	349	60	180	32	147	51	22	841
Employment	16077	4349	12814	2248	7210	3029	1627	47354

TOTAL CONSTRUCTION	NWT	BC	Alta	Sk/Mn/Yu	Ont	Que	Atlantic	Total
Capital Costs	7347		266					7613
Gross Domestic Product	2003	342	1544	298	773	279	127	5366
Labour Income	1198	276	1230	206	504	172	117	3704
Federal Government Revenue	370	62	260	43	146	40	21	943
Terr./Prov. Government Revenue	157	28	100	26	94	38	9	452
Grant Reduction	-126			-2				-128
Adjusted Terr./Prov. Gov't Revenue	31	28	100	24	94	38	9	324
Adjusted Federal Gov't Revenue	496	62	260	46	146	40	21	1071
Total Government Revenue	527	91	361	70	240	77	30	1395
Employment	25251	6188	22271	4337	11481	4545	2063	76136

Given these considerations, it is assumed that all operating phase impacts in the NWT would remain in the region. Adjusting for the construction phase impacts, the overall economic impacts of the Mackenzie Valley pipeline and Mackenzie Delta field development are summarized in **Table 3.10**.

TABLE 3.10

OVERALL IMPACTS AFTER ADJUSTMENTS FOR LEAKAGES FROM THE NWT : 2002-2033

(millions of 2002 Cdn$, employment in person years)

PROVINCES - BOTH GAS PRICE CASES	BC	Alta	Sk/Mn/Yu	Ont	Que	Atlantic	Total
Investment / Revenue		1313					1313
Gross Domestic Product	765	3643	390	1783	528	164	7274

Labour Income	583	2258	265	1193	328	142	4768
Federal Government Revenue	141	588	57	344	75	26	1231
Terr./Prov. Government Revenue	70	325	38	226	73	14	745
Grant Reduction			-5				-5
Adjusted Terr./Prov. Gov't Revenue	70	325	32	226	73	14	739
Adjusted Federal Gov't Revenue	141	588	62	344	75	26	1236
Total Government Revenue	211	913	94	569	149	40	1976
Employment	15036	38234	5967	27829	8909	2775	98750

NWT AND CANADIAN TOTAL		$3US GAS PRICE		$ 4US GAS PRICE	
	Provinces	NWT	Total	NWT	Total
Investment / Revenue	1313	42557	43871	59512	60825
Gross Domestic Product	7274	32913	40187	49868	57142
Labour Income	4768	2972	7741	2972	7741
Federal Government Revenue	1231	7434	8665	16899	18130
Terr./Prov. Government Revenue	745	2697	3441	4499	5244
Grant Reduction	-5	-2157	-2162	-3600	-3605
Adjusted Terr./Prov. Gov't Revenue	739	539	1279	900	1639
Adjusted Federal Gov't Revenue	1236	9592	10828	20498	21735
Total Government Revenue	1976	10131	12107	21398	23374
Employment	98750	58466	157216	58466	157216

Even after adjustments for employment leakages from the region, all impacts would be larger in the NWT than in any single province. Most notably the GDP and government revenue impacts in the NWT would dwarf those in other regions and would constitute more than 80% of the overall national impacts in both gas price cases. On an average annual basis over the 2002-2033 period, GDP in the NWT would be greater by between $1 billion and $1.5 billion per year than in the absence of pipeline and gas development. This would represent an increase of between 40% and 60% over current levels in the region.

As a percentage of the overall GDP impact, total government revenues range from 30% of GDP in the $3US Gas Price case to 40% of GDP in the $4US Gas Price case. The federal government would receive upwards of 90% of the total government revenues generated by the project, ranging from $10.8 billion to $21.7 billion depending on the gas price scenario.

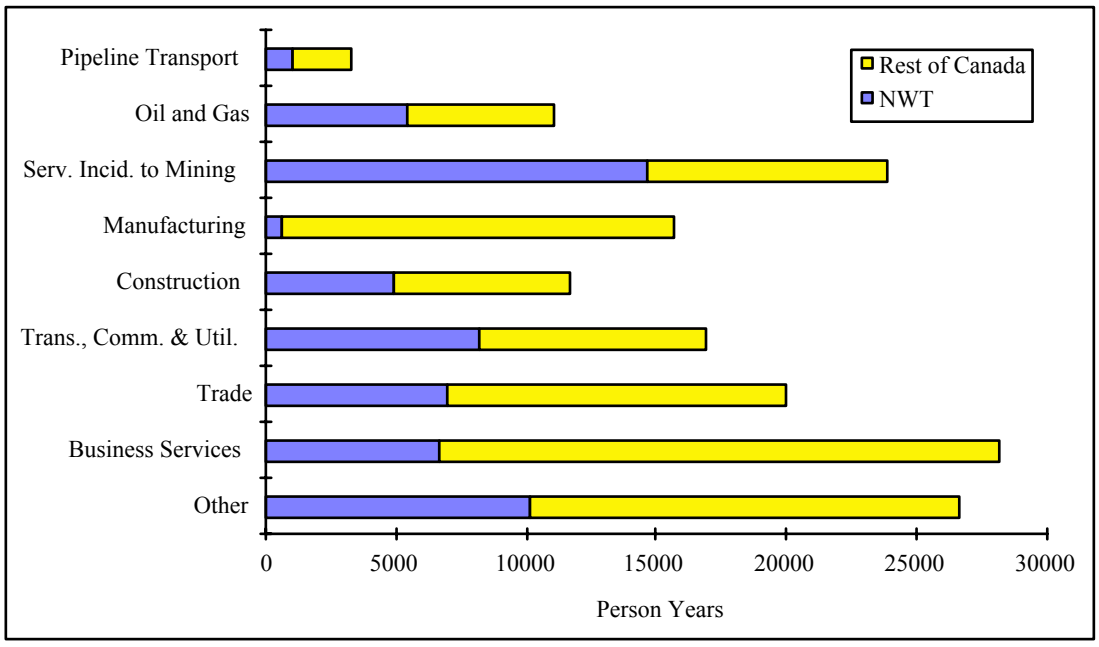
Employment and labour income impacts in the NWT are also expected to be substantial. The overall employment impact of 58,000 person years translates into an average impact of more than 1800 jobs per year over the 2002-2033 period. This could largely eliminate unemployment from the region given unemployment levels in recent years, although it could be expected that many of the region's discouraged workers would be drawn back into the labour force given the improved economic environment. Also, there would likely be labour force growth through natural increase in the population over time and through net in-migration as well.

Employment and labour income impacts for the rest of Canada as a whole would exceed those in the NWT, primarily as a result of indirect effects. Alberta would be the principal beneficiary of the project among the provinces (with employment impacts exceeding 38,000 person years) followed by Ontario and B.C. In general, however, it can be observed that the overall impacts would be spread widely over all regions of Canada.

Employment impacts can also be expected to be widely distributed across various sectors of the economies of both the NWT and the rest of Canada. **Figure 3.1** illustrates the distribution of employment associated with the construction and operation of the Mackenzie Valley pipeline and Mackenzie Delta gas fields.

FIGURE 3.1

SECTORAL DISTRIBUTION OF TOTAL EMPLOYMENT IMPACTS IN THE NWT AND THE REST OF CANADA : 2002-2033



For the rest of Canada (that is, excluding the NWT), the roughly 99,000 person years of employment created by the project would be spread quite widely over a variety of sectors, with the largest impacts in business services (22% of the total) and manufacturing (15% of the total). This seems reasonable in that the quantity of expertise required for the design and construction of both the Mackenzie Valley pipeline and the Mackenzie Delta field facilities would simply not be available in the NWT. Similarly, the manufacturing industry in the NWT is currently very small, typically serves only local markets, and does not produce the types of items specifically required in this type of project (i.e. large and small diameter pipe, valves, fittings, metering equipment, vessels, wellheads, etc.). However, if the scale of the Mackenzie Delta field were to become sufficiently large in the future, it may become viable to produce various manufactured inputs for the industry locally.

It can also be noted that the only direct employment impacts shown in **Figure 3.1** are those related to pipeline transport, oil and gas, and construction. Together, they constitute less than 20% of the overall employment impacts in both the rest of Canada and in the NWT.

However, the composition of the indirect employment created by the project in the NWT differs quite a bit from what is shown in **Figure 3.1** for the rest of Canada. In the NWT, the largest indirect impacts would be in services incidental to mining (25% of the total) and in transportation, communications and utilities (14% of the total). It is noteworthy that even the sector that would experience the largest employment impacts in the NWT can be expected to have an overall employment share of less than 25%. The wide distribution of the employment impacts across a variety of sectors in the NWT makes it all the more likely that NWT residents would widely benefit from the project on a sustainable basis.

4. OTHER IMPACTS AND IMPLICATIONS

There are a variety of impacts relating to the construction and operation of the Mackenzie Valley pipeline and Mackenzie Delta gas fields beyond those explicitly modeled in Sections 2 and 3 that could be quite significant. These impacts as well as other potential implications of the project are discussed in this section.

4.1 INDUCED ECONOMIC IMPACTS

As noted in Section 3.1, there is another category of economic impacts called induced impacts that relate to the spending of portions of labour income, corporate profits and government revenues generated by an activity. The induced impacts related to the spending of labour income are often incorporated in input-output analysis. For example, the GNWT has an input-output model that can produce 'closed' model results that include this type of induced impact.

The ultimate impact resulting from the spending of labour income associated with an activity depends on the perspective taken. For example, in a small region within a country, a large proportion of consumer spending would be on items that were not produced in that region and this would tend to limit the induced impacts generated in that region. However, if the perspective is broadened to the country, it is more likely that consumer spending would be on items that were produced in the country and larger induced impacts could be expected on a country-wide basis vs the regional basis.

For the NWT, it appears that the induced GDP associated with any activity is approximately equal to between 20% and 30% of the direct plus indirect labour income generated by the project.[21] In comparison, for Alberta this ratio rises to about 45% and for Canada as a whole, our experience suggests that the ratio is closer to 70%.[22] Further,

[21] These percentages were derived using various results presented in Canadian Energy Research Institute, A Comparison of Natural Gas Pipeline Options for the North, October 2000.

[22] In Alberta Treasury's Alberta Economic Multipliers, intensity ratios are presented for the open (direct + indirect impacts only) and closed (direct + indirect + labour spending related induced impacts) versions of the Alberta input-output model. The difference in GDP intensity ratios for any given industry under the open and closed models is consistently about 45% of the direct and indirect labour income. The percentage

using the same sources, the ratios of induced employment per million dollars of induced GDP in the NWT, Alberta and Canada are approximately 13, 19 and 17 respectively.

Given the results presented in **Table 3.10** that reflect the direct and indirect impacts associated with the project and the percentages and ratios noted above, induced GDP and employment impacts related to the spending of labour income would be as follows: an additional $0.7 billion and 9,700 person years in the NWT; an additional $1.0 billion and 19,300 person years in Alberta; and, an additional $5.4 billion and 92,100 person years in Canada. The induced employment impacts related to the spending of labour income would increase the overall employment impacts shown in **Table 3.10** by about 20% for the NWT, 50% for Alberta and 60% for Canada.

Another important source of induced effects relates to the reinvestment of corporate profits. The oil and gas industry in particular reinvests a very high proportion of overall earnings in the form of exploration and development expenditures. In the last decade, the percentage of net revenue (that is, revenues minus royalties and operating costs) that has been spent on exploration and development in Canada has averaged close to 85%.[23] Given the values shown in **Figures A.1 and A.2** for the Mackenzie Delta gas producers in the $3US and $4US Gas Price cases, it could be expected that between $14 and $24 billion would be reinvested over the life of the project on exploration and development somewhere in Canada.

The overall economic impacts associated with this activity would be roughly proportional (given the respective capital costs) to those shown in **Table 3.3** for Mackenzie Delta field development. For Canada as a whole, between $11 billion and $18 billion in GDP impacts would be generated and employment impacts ranging from 155,000 to 259,000 person years could be expected. The additional induced GDP impacts related to spending of the labour income associated with this additional exploration and development would

---

for the national economy was derived from several studies that WMR has performed over the last few years.

[23] Data from the Canadian Association of Petroleum Producers Statistical Handbook. The average is for the 1991-2000 period.

amount to between $5 billion and $9 billion, with additional induced employment ranging from 88,000 to 147,000 person years. In total then, the direct, indirect and induced impacts associated with reinvestment of Mackenzie Delta net revenues would range from $16 billion to $27 billion in terms of GDP, while the employment impacts would be between 243,000 and 406,000 person years.

Further impacts could be anticipated as the reserves that are discovered in the exploration and development process would eventually give rise to additional oil and gas production. The estimation of these effects requires more detailed modelling and is beyond the scope of this study. Similarly, induced effects related to spending of government revenues could be expected to be quite pronounced given the $12 billion to $23 billion in government revenues that would be directly and indirectly generated by this project.

4.2 VALUE ADDED OPPORTUNITIES USING MACKENZIE DELTA LIQUIDS

It is anticipated that condensate from Mackenzie Delta gas fields would be extracted from the Mackenzie Valley pipeline fluid stream at Norman Wells. However, other natural gas liquids (NGLs) such as ethane, propane and butanes would remain entrained in the stream that would head south from Norman Wells and eventually into the TransCanada Alberta system. At some point these liquids could be extracted at either Cochrane or Empress and this could provide opportunities to add value to the NGLs.

In particular, the use of ethane as petrochemical feedstock for the production of ethylene and subsequently polyethylene represents one of the most effective ways of adding value to Canada's natural resources. Furthermore, it has been one of the best examples of successful diversification in Canada. Alberta's ethane based petrochemical industry is now a world scale producer of ethylene and polyethylene and represents one of the key manufacturing industries in the province. Despite the fact that a significant portion of the Alberta's ethane supply is now exported on the Alliance pipeline without any upgrading into value added products in Canada, Alberta's ethane based petrochemical industry

remains competitive and would surely welcome the opportunity to access additional NGL supplies.

4.3 MINERAL RIGHT VALUES AND EXPLORATION OPPORTUNITIES IN THE NWT

Oil and gas producers in Canada have paid less than $100 million for mineral rights in the NWT over the last 20 years.[24] Over the same period, these producers have spent nearly $16 billion on the acquisition of mineral rights in Alberta. The main reason for the very low total in the NWT is that rights have been issued by the federal government for work commitments and the winning bidders have not had to pay cash bonuses (as is normally the case in Alberta or anywhere else in southern Canada). The introduction of the Mackenzie Valley pipeline could be expected to change this situation, potentially in a rather dramatic fashion. The federal government and perhaps aboriginal bands could benefit substantially from cash bonuses should this occur.

Access to an actual pipeline would also improve the expected profitability of any investment in the NWT. This impact would likely be most pronounced with respect to properties in the Mackenzie Delta but there is the possibility of opening up other potential supply sources. Portions of the southern and central NWT (ie. Colville Hills) that may contain gas reserves may currently be ignored from an exploration perspective simply because there is no way to deliver production to markets from these areas. If the Mackenzie Valley pipeline could at some point be accessed by such supplies, increased exploration activity may result. This type of activity could be very beneficial to the overall NWT economy as well as to smaller communities in the NWT because the scale of activity would not have to be particularly large to have a significant economic impact. It is the type of activity that, should new discoveries be made, can also give rise to a longer-term sustainable local industry.

4.4 BENEFITS TO NWT RESIDENTS OF ACCESS TO NATURAL GAS

[24] Data from Canadian Association of Petroleum Producers Statistical Handbook.

Households in NWT communities along the Mackenzie Valley pipeline route could potentially realize a significant benefit if they could access Mackenzie Delta gas for home heating use. Currently heating oil (diesel oil) is the fuel of choice for heating the homes of many NWT residents and in 1996, the average annual bill for heating oil in Yellowknife was about $1200.[25] Heating oil prices so far in 2002 have been very close to what they were in 1996. Consequently, this figure is used to determine the potential savings by households that would switch to natural gas heating should the project proceed.

The average annual cost noted above must be adjusted to take into account where conversions to natural gas would likely take place in the NWT. It seems unlikely that consumers in Yellowknife would be able to access Mackenzie Delta gas for heating, given the distance between the city and the proposed Mackenzie Valley pipeline and the fact that any proposed lateral that would connect Yellowknife would have to pass through lengthy sections of surface bedrock. The most likely areas to see local natural gas service would be larger communities in the Mackenzie Delta and directly along the pipeline route.

Both Inuvik and Norman Wells currently have residential natural gas service. As noted in Section 1, Inuvik is served by gas from Ikhil that is approximately 50 km from Inuvik. The GNWT has indicated that the gas price for Inuvik consumers is roughly 85% of that for diesel oil on a heating equivalent basis. However, the fact that there is only a 15% saving using gas versus diesel oil may largely be due to unusually high infrastructure costs in that particular situation - namely, the requirement of a 50km dedicated pipeline from the gas field to Inuvik. In cases where the gas supply was much closer to the population centre and essentially only distribution infrastructure would be required to provide service, it is possible that savings could be much greater.

---

[25] Data from a Statistics Canada 1996 Family Expenditure Survey for Yellowknife.

For example, Fort Simpson and Fort Good Hope both lie directly on the proposed pipeline route. Further, it is possible that within the Mackenzie Delta region itself new fields would be discovered that are very close to population centres like Tuktoyaktuk or Aklavik.[26] In these cases the markup over the netback price in the gas field might not be as large as what is currently observed at Inuvik.

In order to establish a range of values, potential consumer savings in Fort Simpson and Tuktoyaktuk are evaluated. These centres are used because amongst the communities that might be candidates for natural gas service to consumers, they respectively have the lowest and highest cost of living. Compared to Yellowknife, the cost of living in Fort Simpson is about 15% higher while in Tuktoyaktuk it is roughly 40% higher.[27] In addition, Tuktoyaktuk is significantly further north than Yellowknife and measurably colder on average. As a result, it could be expected that average fuel use in Tuktoyaktuk would be slightly higher than in Yellowknife. Given these considerations, it is estimated that current annual diesel oil costs would range from about $1400 to $1850 per year.

The expected cost of gas to residential consumers in the NWT is estimated by taking the netback gas price in the Mackenzie Delta and adding on a markup which would be mainly distribution margin but could include items like municipal fees as well.[28] In the

---

[26] Population in the various communities designated as potential candidates for natural gas service were as follows for the year 2000: Aklavik - 748; Fort Good Hope - 747; Tuktoyaktuk - 979; and Fort Simpson - 1273 (population data from NWT Bureau of Statistics, Statistics Quarterly (December 2001). While it may seem that it would be unlikely that any party would find it worthwhile to set up a gas distribution network in such small communities, Norman Wells with a population of 882 in the year 2000 currently has such infrastructure. The only other community of similar size in the Mackenzie Delta region is Fort McPherson with population of 910 in the year 2000. However, this community is smaller than Inuvik (population 3451 in the year 2000) and over 100 km from the proposed pipeline route (or further away from a gas source than Inuvik is from Ikhil).

[27] Data from NWT Bureau of Statistics, Statistics Quarterly (December 2001).

[28] The estimated markup is based on information contained in National Energy Board Canadian Energy Supply and Demand 1993-2010 (December 1994) regarding fieldgate prices of gas and the price of gas to residential consumers in B.C. and the Territories. It is assumed that in real terms the markups evident there had remained constant over time. Converting to 2002$, the resulting markup is just over $4/GJ. While the information may appear dated, the current markup by ATCO in Calgary is virtually identical. For service in Fort Simpson and Tuktoyaktuk, this markup is inflated by the cost of living differential between those communities and Edmonton (the basis of all of the aforementioned cost of living comparisons). In addition, for Fort Simpson the cost of moving Mackenzie Delta gas along the Mackenzie Valley pipeline to Fort Simpson is also included in the estimated price to consumers.

$3 US Gas Price case, this would translate into an average gas price for residential consumers of between $8.75/GJ and $9.25/GJ. Given the annual heating requirements for the typical household, savings of between $350 and $650 per year could be realized by switching to natural gas. This represents between 25% and 35% of current heating costs. It is uncertain as to whether these magnitudes of savings would justify the cost of switching from an oil furnace to a gas furnace.

4.5 GAINS TO CANADIAN GAS CONSUMERS

There could be benefits to Canadian gas consumers in general as a result of the introduction of Mackenzie Delta volumes into the North American market. Between now and the anticipated start-up date of Mackenzie Delta flows in 2008, it is widely anticipated that there will be a significant increase in North American natural gas demand. The Energy Information Agency (EIA) of the U.S. Government's Department of Energy (DOE) projects that American demand will rise by approximately 4.7 Tcf/yr between 2000 and 2010, or equivalently, show an average growth rate of about 1.9% per year.[29] Canada's National Energy Board (NEB) based one of its latest projections of US natural gas demand on a Gas Research Institute (GRI) forecast and predicts a growth of somewhere between 3 and 4 Tcf in annual demand in the American market over the next 10 years.[30]

For Canada, the NEB forecasts end use demand for natural gas will rise by between 0.4PJ to 0.6 PJ over the 2000-2010 period, or at annual average rates of between 1.4% and 2.1%. Natural Resources Canada (NRC) projects that both U.S. and Canadian demand will grow 2.5% per year to 2010.[31]

---

[29] See U.S. Department of Energy, Energy Information Agency, Annual Energy Outlook 2000 (December 17, 1999) - http://www.eia.doe/gov/oiaf/aeo.

[30] See National Energy Board, Canadian Energy Supply and Demand to 2005 (June 1999) - http://www.neb.gc.ca/energy/sd99. The range represents results over the NEB's Case 1 and Case 2.

[31] See Natural Resources Canada, Canadian Natural Gas Review of 1999 and Outlook to 2010 (May 2000).

Although rising demand is expected to be coupled to some extent with rising supply, tightening of the natural gas market is expected to produce price increases over the period. The EIA forecasts a rise in the Lower-48 Wellhead price of about $0.43 US/Mcf (1998$) between 2000 and 2010. The NEB indicates that Alberta plantgate prices could rise by between $0.05 Cdn/GJ and $0.40Cdn/GJ over the same period. Rising prices could potentially place limits on the amounts of growth in the natural gas market and also negatively impact consumers of natural gas.

Such effects could be alleviated by supply augmentation, perhaps through the introduction of Mackenzie Delta gas to market. No detailed analysis has been performed with respect to this possibility but as an illustration, suppose that without the introduction of Mackenzie Delta gas to the North American market in 2009, gas prices would otherwise be $0.10/Mcf higher than in a case where the Mackenzie Delta gas was flowing to market. Given expected gas demand levels in Canada of 3.5 Tcf by 2010, this would translate into annual cost savings for Canadian gas consumers of $350 million per year.[32]

4.6 REDUCTIONS IN GREENHOUSE GAS EMISSIONS

Under the Kyoto Protocol, Canada and other industrialized countries agreed in principle to cut greenhouse gas (GHG) emissions (emissions of carbon dioxide (CO2), methane and nitrous oxide) below 1990 levels by 2008-2012.[33] Currently, GHG emissions in Canada are substantially higher than 1990 levels and some significant progress on the emission reduction front would have to made if target levels are to be reached by the end of the decade.[34]

---

[32] Demand estimate from Natural Resources Canada, Canadian Natural Gas Review of 1999 and Outlook to 2010 (May 2000).

[33] The Kyoto Protocol was signed in December 1997. Canada agreed to reduce GHG emissions to 6% below 1990 levels by 2008-2012. The agreement has not been ratified,

[34] The increase in GHG emissions over the period 1990-1997 was approximately 13%.

To this end, the replacement of coal with natural gas in electricity generation could provide major reductions in GHG emissions. For example, in Canada in 1995, roughly 88 MT of CO2 equivalent were emitted by the electricity generators that burned coal, compared to only 10 MT of CO2 equivalent from those burning natural gas.[35] To a large extent this reflects the higher amount of electricity generated via coal versus natural gas (a ratio of about four to one in 1995) but it is also due to the fact natural gas combustion does not produce as many GHG emissions per unit of energy as coal.[36] Depending on the type of coal, CO2 emissions per energy equivalent are anywhere between 64% and 90% higher than for natural gas. This is somewhat offset by the fact that the ratio of total natural gas production to marketable gas production typically is somewhere between 1.15 to 1.2 in Canada.[37] However, even with this factor incorporated, GHG emissions per unit of energy equivalent are significantly higher for coal than for natural gas.

Over the past few years, there has been a trend in North America towards proportionally greater gas fired electricity generation versus coal fired generation. In Alberta for example, a substantial portion of the electricity generation capacity added over the last few years is gas fired. This trend could be halted if the relative price of natural gas (that is, relative to coal prices) rises substantially over time.

Consequently, to the extent that the supply augmentation provided by Mackenzie Delta gas supplies can alleviate gas price increases and thereby help to promote a trend away from the use of higher GHG emitting fuels in electricity generation (and in heating as well), additional benefits to society may be created. Estimates have been made of the value of preventing GHG emissions in the context of an emission permit trading system.[38] Assuming that the entire volume of Mackenzie Delta gas would be used to fire

---

[35] See Natural Resources Canada,, *Canada's Energy Outlook 1996-2000* (April 1997).

[36] The CO2 emissions per TJ of natural gas equal 49.68 T. Depending on the type of coal, CO2 emissions range from 81.6 to 94.3 T/TJ. The CO2 emissions for gasoline and oils range from 68 T/TJ to 74 T/TJ. Data from A.P. Jaques, *Canada's Greenhouse Gas Emissions : Estimates for 1990*, Environment Canada (December 1992).

[37] See Canadian Association of Petroleum Producers (CAPP) *Statistical Handbook*.

[38] See Charles River Associates*, Report of the Upstream Oil and Gas Working Group of the Industry Issues - Table to the National Climate Change Secretariat*. It is estimated that the value per tonne of CO2

new electricity generation that in the absence of this gas would be fired by coal, society would benefit by somewhere between $250 million to $2.1 billion annually due to avoided GHG emissions.

---

equivalent in 2010 could range from $25.74 Cdn - $130.59 Cdn, depending on whether credit would be given to international reductions in GHG emissions.

APPENDIX

In this appendix, diagrams which trace the financial flows in the two gas price scenarios are presented (**Figures A.1 and A.2**). While each figure has a common format, it is instructive to explain the flows with reference to a particular scenario - in this case, the $3US scenario shown in **Figure A.1**.

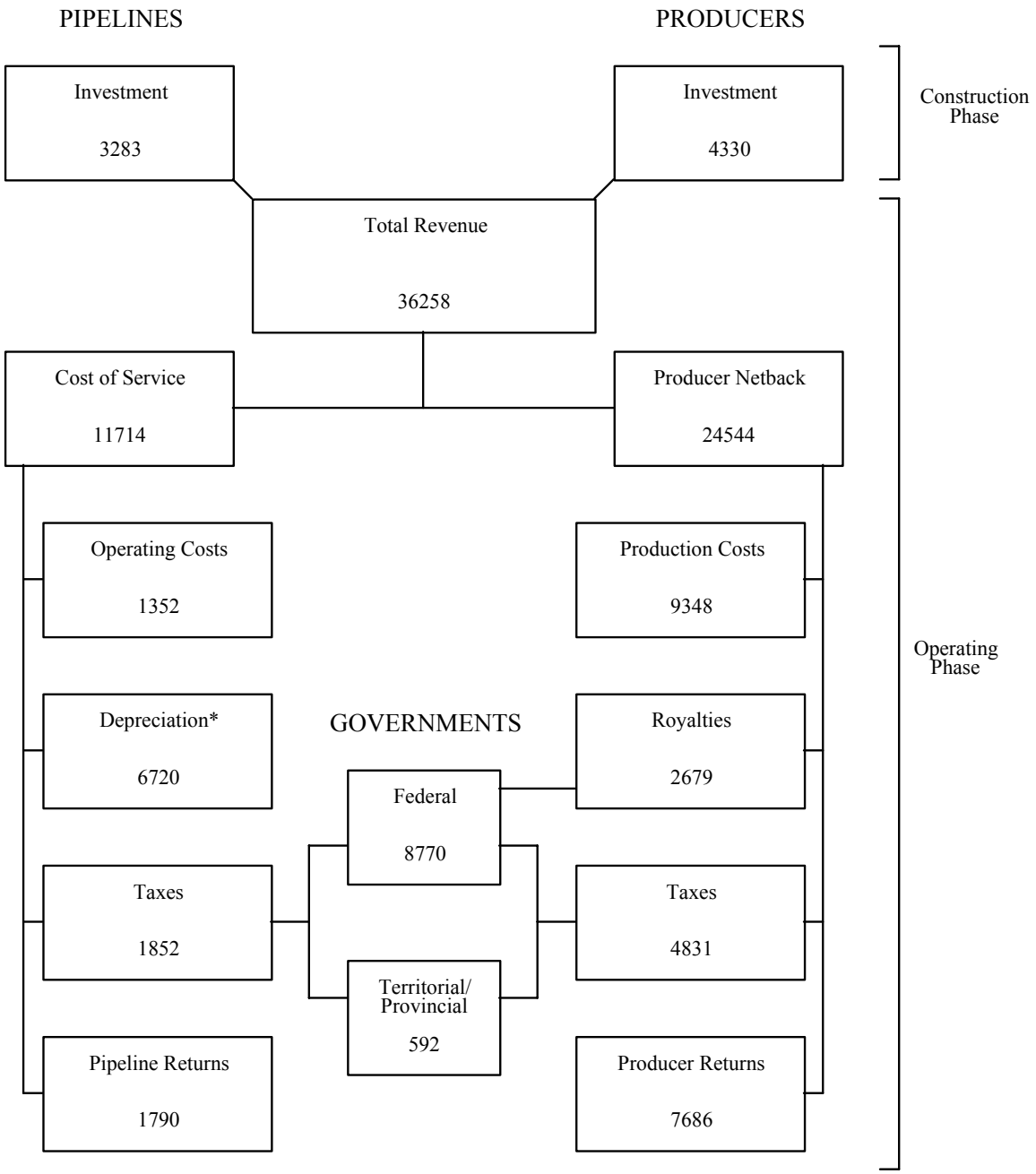
Initially, it should be observed that the pipeline sector is represented on the left hand side of the figure while the producer sector is depicted on the right hand side. The integration of these contributors is portrayed in the central boxes which measure the generation of income from the sale of gas and by-products and the allocation of taxation and royalty revenue to governments.

More specifically, if one starts at the top of **Figure A.1**, there is a construction phase in which investment in pipeline and production facilities creates an opportunity for producers to sell gas. The pipeline sector receives a cost of service ($11.714 billion 2002Cdn$) over the 25 year operating phase of the project which is distributed among operating costs, depreciation, income and property taxes and a return. In the producer sector, after paying for the cost of service, the netback revenue ($24.544 billion) is allocated to operating and other production costs, royalties, income and property taxes, and a return. From these activities, the government sector receives property taxes, income taxes and royalties totaling $9.362 billion. These are allocated to according to jurisdiction.

FIGURE A.1

FINANCIAL FLOWS : $3US GAS PRICE CASE, 2002-2033

(millions of 2002 Canadian dollars)

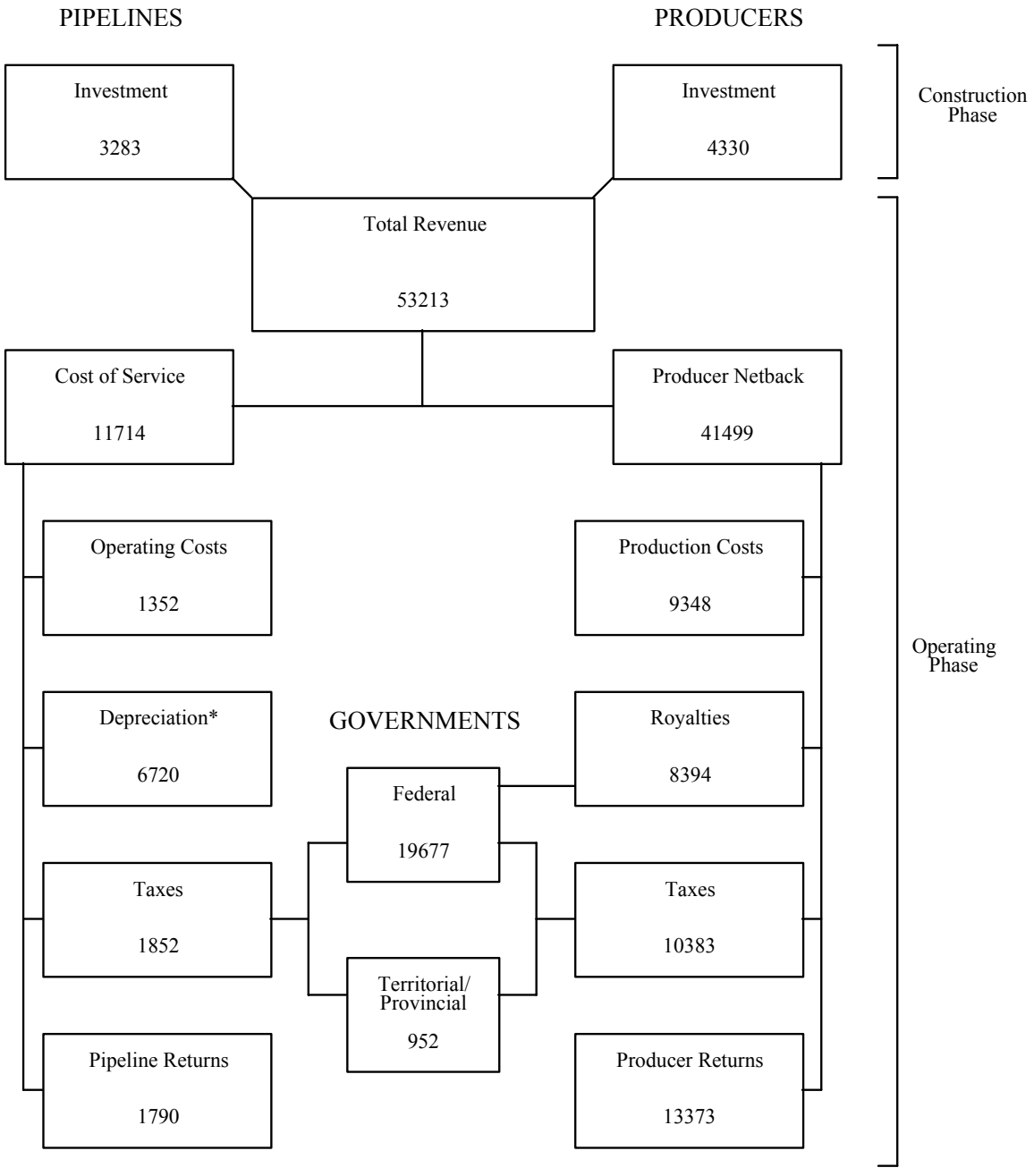


* includes interest expense

FIGURE A.2

FINANCIAL FLOWS : $4US GAS PRICE CASE, 2002-2033

(millions of 2002 Canadian dollars)



* includes interest expense

TABLE A.1

ANNUAL PRODUCTION FROM ANCHOR FIELDS, OTHER INITIAL FIELDS, AND LATER NEW DISCOVERIES : 2009-2033

(Bcf/yr)

	Anchor Fields	Other Initial Fields	Anchor + Other Initial Fields	Additional Annual Productive Capacity Required	Production from Later New Discoveries	Total Production
2009	307	131	438			438
2010	307	131	438			438
2011	307	131	438			438
2012	307	131	438			438
2013	307	131	438			438
2014	307	131	438			438
2015	307	131	438			438
2016	307	131	438			438
2017	303	130	433	5	5	438
2018	292	125	417	16	21	438
2019	270	115	385	32	53	438
2020	250	107	356	29	82	438
2021	227	97	325	32	113	438
2022	205	88	293	32	145	438
2023	172	74	245	48	193	438
2024	153	66	219	26	219	438
2025	138	59	197	22	241	438
2026	126	54	179	18	259	438
2027	113	48	162	19	276	438
2028	95	41	136	28	302	438
2029	83	36	119	23	319	438
2030	75	32	107	19	331	438
2031	68	29	98	19	340	438
2032	60	26	85	25	353	438
2033	52	22	74	27	364	438
Total	5130	2204	7335	419	3615	10950

Note: Volumes for anchor fields are Bcf equivalent.

TABLE A.2

DISTRIBUTION OF INVESTMENT BY SECTOR, REGION AND YEAR : 2002-2033

(millions of 2002 Cdn$)

	Mackenzie Valley			TransCanada Pipelines		Producers	Total in Region		
Year	NWT	Alta	Total	Alta	Total	NWT	NWT	Alta	Total
2002	43	2	45		45		43	2	45
2003	63	2	65		65		63	2	65
2004	48	2	50		50	88	136	2	138
2005	48	2	50		50	155	203	2	205
2006	889	34	923	47	970	488	1377	82	1459
2007	1252	48	1300	67	1367	856	2108	115	2222
2008	674	26	700	36	736	671	1345	62	1407
2009									
2010									
2011									
2012									
2013						3	3		3
2014						11	11		11
2015						32	32		32
2016						77	77		77
2017						129	129		129
2018						157	157		157
2019						160	160		160
2020						173	173		173
2021						178	178		178
2022						155	155		155
2023						113	113		113
2024						102	102		102
2025						106	106		106
2026						118	118		118
2027						118	118		118
2028						105	105		105
2029						102	102		102
2030						106	106		106
2031						89	89		89
2032						40	40		40
2033									
2002-08	3017	116	3133	150	3283	2258	5275	266	5541
2014-32						2072	2072		2072
2002-33	3017	116	3133	150	3283	4330	7347	266	7613

TABLE A.3

DISTRIBUTION OF DIRECT GOVERNMENT REVENUES : 2009-2033*

(millions of 2002 Cdn$)

$3 GAS PRICE CASE	Property Tax	Income Tax	Royalties	Total
Federal		4144	2679	6823
Alberta	76	29		105
NWT	434	2000		2434
- Grant Reduction	-378	-1600		-1947
Adjusted NWT	87	400		487
Adjusted Federal	347	5744	2679	8770
Total	510	6173	2679	9362

$4 GAS PRICE CASE	Property Tax	Income Tax	Royalties	Total
Federal		7894	8394	16288
Alberta	76	29		105
NWT	434	3802		4236
- Grant Reduction	-378	-3042		-3389
Adjusted NWT	87	760		847
Adjusted Federal	347	10936	8394	19677
Total	510	11725	8394	20629

* Personal income taxes on direct labour income not included

TABLE A.4

DIRECT EMPLOYMENT BY CATEGORY AND REGION : 2004-2033

(person years)

PIPELINE SECTOR	NWT	Alberta	Total
Pipeline Construction	2641	413	3054
Pipeline Operation	1000	2200	3200
Pipeline Total	3641	2613	6254

PRODUCER SECTOR	NWT	Alberta	Total
Field Development	4880		4880
Producer Operating	5445	5445	10890
Producer Total	10325	5445	15770

COMBINED SECTORS	NWT	Alberta	Total
Construction	7521	413	7934
Operations	6445	7645	14090
Total	13966	8058	22024