Canadian Energy Research Institute

Economic Impacts of New Oil Sands Projects in Alberta (2010-2035)

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ECONOMIC IMPACTS OF NEW OIL SANDS PROJECTS IN ALBERTA (2010-2035)

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Executive Summary

Introduction

For more than 40 years, there has been ongoing development within Alberta's oil sands industry with a view to advancing energy security and prosperity in North America. This development has slowed during times of recession and low oil prices, but it has never halted completely, indicating that energy security and prosperity are realizable goals. This report provides strategic insights by examining the impacts the oil sands industry has made on North American economies and how the industry will likely develop into the future. Two themes are central to the report: the oil sands' impact on Canadian provincial and national economies, and the oil sands' ripple effects on US state and federal economies. With a sophisticated, comprehensive Input-Output (I/O) model, we address the economic opportunities that find their source in Alberta's oil sands industry.

The first chapter of the report contains the Canadian Energy Research Institute's (CERI) realistic projections of oil sands initial capital investment, sustaining capital, and operating capital on an annual basis over the period 2010-2035. Chapter 2 explores the potential impact of new oil sands projects on these economies; not only does this chapter look at the potential monetary impact on these economies, it also considers the extent that employment will be created. Chapter 3 follows with an explanation of the input-output methodology that CERI has developed to analyze oil sands economics.

Background

Daily production from Alberta's oil sands is now approaching **1.7 million** barrels, exceeding the nation's conventional oil production and contributing significantly to its gross domestic product. Almost all of Canada's oil sands and conventional oil output goes to refineries in Canada and the United States, and the United States now imports twice as much oil from Canada as from any other country. The oil sands are making an increasing contribution to the close energy ties between Canada and the United States.

Within this report, input-output analysis is employed to quantify total economic impacts—direct, indirect and induced—of oil sands investment and production on various industries in Canada and the United States, and on various provinces, territories, and states. Direct impacts are those arising from spending on goods, services, and labour, and all of them occur within Alberta. Indirect impacts are those felt by suppliers of goods and services to oil sands construction and operations, their suppliers, etc. Induced impacts arise from the spending and re-spending of personal income derived from employment created by the direct, indirect, and also the induced impacts themselves.

Study Objective

The objective of this report is to evaluate the economic impacts of Alberta's oil sands projects in terms of GDP, employment, employee compensation, and government revenues.

Methodology

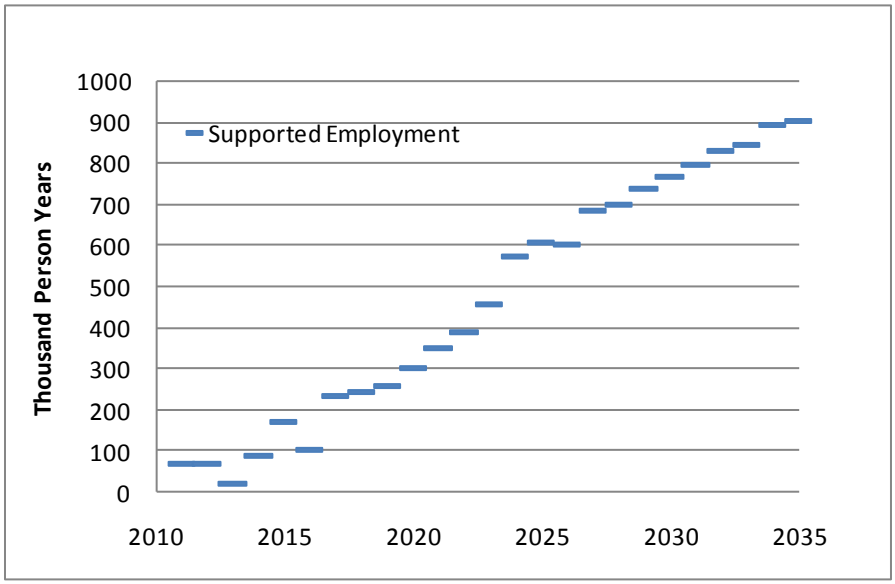
- CERI employs a multiregional Input Output (I/O) model to evaluate the economic impact of Alberta's oils sands projects on the US and Canadian economies. The new model is the US-Canada Multi-Regional I/O Model (*UCMRIO 2.0*) and is based on Statistics Canada's (StatsCan) and the US Bureau of Economic Analysis' (USBEA) I/O tables for 2006.
- The new CERI I/O model (*UCMRIO 2.0*) generates multipliers consistent with Statistics Canada both at the provincial and international level, and it includes induced impacts. Also, the model is capable of estimating US impacts at the state level; the estimates are consistent with the US BEA's RIMS II, and the commonly used I/O software IMPLAN.
- A two-step approach is taken to evaluate the economic impacts. First, future investments and operations in Alberta's oil sands industry are projected – this is reported separately under the *Realistic Scenario*.[1] Second, impacts are evaluated using the projections from the first step.
- The impacts are estimated separately for the investment and operation phases of the oil sands projects.
- The impacts reported in this document are the effects of additional activity (new projects). These figures should not be interpreted as the total contribution of the oil sands industry in the economy.
- There are uncertainties regarding the impacts on the US, therefore a range of estimates is provided. The range includes the *I/O Reference Case*, *Upper Bound Scenario*, and the *Plausible Scenario*. In the report, results from the ***Plausible Scenario***, which provide a mean for the other two scenarios, are discussed. Results of the other two scenarios are presented in Appendix A.

Estimated Impacts

- The estimated investments, reinvestments, and revenues from operation of the new oil sands projects are approximately **$2,077 billion** (2010 $Cdn)[2] during the period 2010-2035. This is also known as the "initial outlay" in this report. **$253 billion** is considered strategic initial capital for construction and **$1,824 billion** for operation, maintenance and sustaining capital.
- Total GDP impact of oil sands investment and operations over a 25-year period is estimated to be **$2,106 billion** for Canada, and **$521 billion** for the US. Impacts on economies outside of Canada and the United States are not considered.
- Employment in Canada (direct, indirect, induced) as a result of new oil sands investments is expected to grow from **75,000 jobs** in 2010 to **905,000 jobs** in 2035. This type of employment includes new and preserved jobs and also consists of full-time and part-time jobs (Figure E.1).

[1] CERI Study No. 122, "Canadian Oil Sands Supply Costs and Development Projects (2010-2044)," May 2011.
[2] Unless otherwise stated, all values are in Canadian dollars.

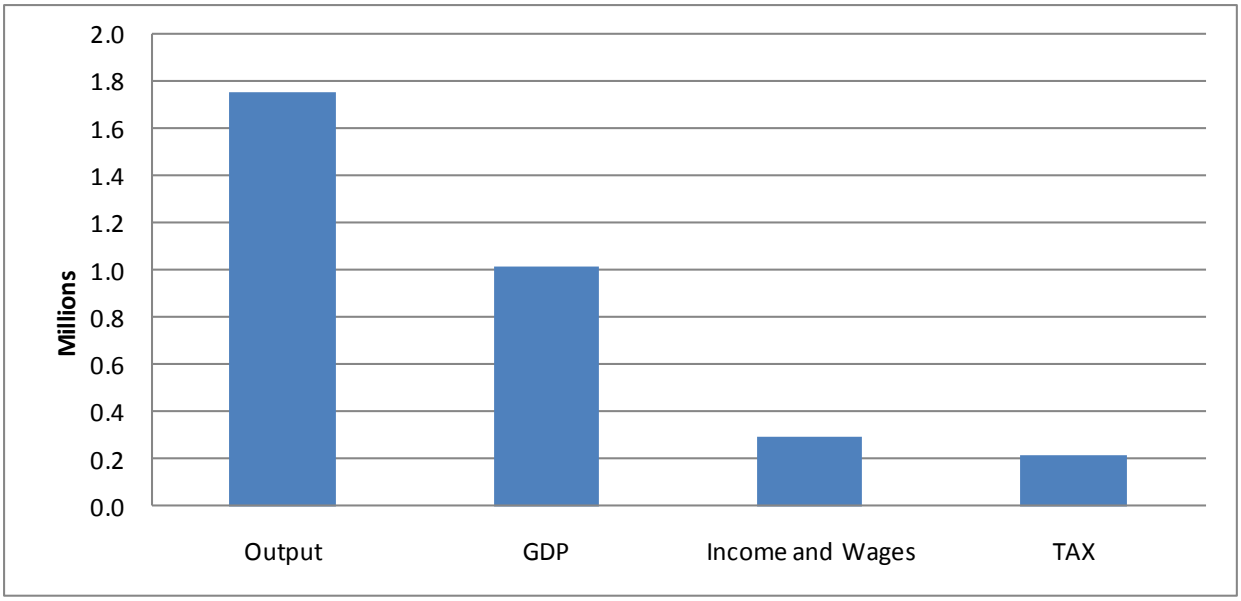
Figure E.1
Jobs Created and Preserved in Canada, 2010-2035
(x 1,000)



- Based on the combined impact analysis of Canada and the US, **76 percent** of the total GDP impact occurs in Alberta, **4 percent** occurs in other provinces and territories, and **20 percent** occurs in the United States (based on the *Plausible Scenario*).
- Total operations impacts by all three measures (direct, indirect, and induced) are larger than investment impacts, although on an annual basis the investment impacts are large, being concentrated in a much shorter period of time. The impacts of investment are less geographically concentrated than those of operations, reflecting the prominence of outlays on machinery and equipment manufactured beyond Alberta's borders during the investment phase and the sizeable outlays on Alberta-supplied inputs, such as natural gas, during the operating phase. Total GDP impacts for the investment and operation phases in Canada are **$231 billion** and **$1,875 billion**, respectively.
- Dividing total impacts by the corresponding oil sands investment or gross output in millions of dollars produces the provincial and territorial multipliers. For instance a **one million dollar** investment in the Alberta oil sands industry creates **$0.96 million dollars of GDP** and **4.8 person years of employment** in Alberta.
- **For every two jobs created in Canada, one job will be created in the US (investment and operation phases combined).**
- Canadian national multipliers are shown in Figure E.2. A tax multiplier is added to capture estimated tax revenue impacts accruing to all levels of government from income taxes, sales taxes, property taxes, CPP/EI contributions, customs duties, etc. Note, however, that Crown oil sands royalties payable to the Government of Alberta are not included in tax revenue impacts.
- The Canadian Government's share of taxes from total impact over the period 2010-35 is **$311 billion**. Alberta's share over the same time period is **$105 billion**. In addition to this amount, the Alberta government also receives **$350 billion** of oil sands royalties for a total of **$455 billion**. Note that this comparison is highly sensitive to the assumed oil price forecast.

- **For 1 direct job created in Alberta, about 1 indirect job and 1 induced job will be created in the rest of Canada.**

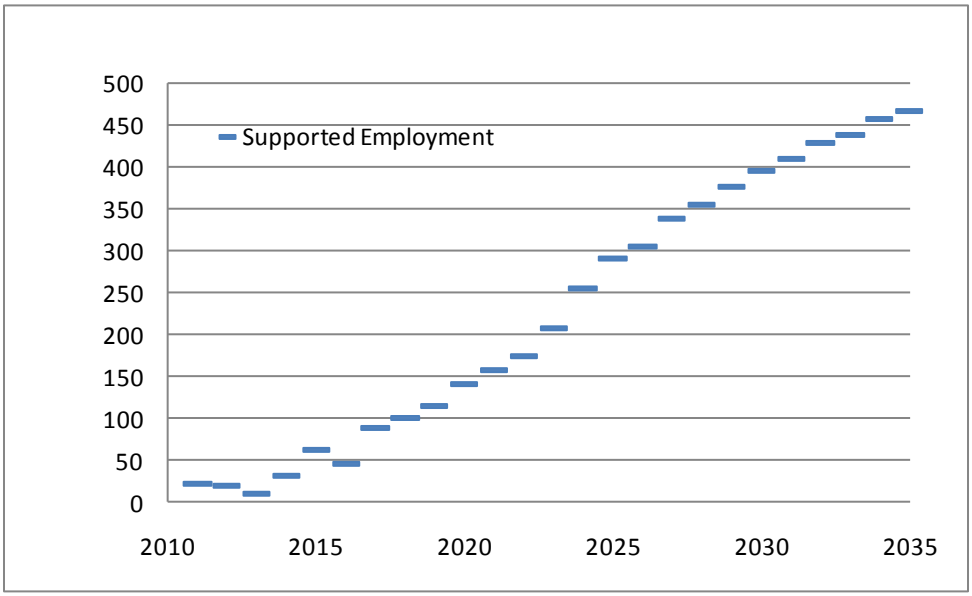
Figure E.2
Multipliers for Canada with Respect to a One Million Dollar Initial Outlay



- By 2023, projected royalty revenue from new oil sands projects will be approximately **$10.3 billion**. By 2035, the total royalty revenue from new projects will be about **$36 billion**, which equals the total forecasted Alberta government revenue in 2010-11.[3]
- A one million dollar change in final demand, in terms of investment or final consumption, generates **$1.01** and **$0.26 million** of GDP in Canada and the US, respectively.
- The "states" that benefit the most from Alberta's oil sands industry differ in investment and operation phases of the oil sands projects. States like California, Illinois, Texas, and New York, with big economies and large manufacturing sectors, receive the most benefit from oil sands projects in the investment phase.
- States like Illinois, Texas, Wisconsin, Washington, Ohio, Michigan, and Pennsylvania – which are closely involved with Canadian oil sands trade, refining, services incidental to refining, and storage or transportation of oil sands – receive the most benefit from the Alberta's oil sands industry at the operations phase.
- Total GDP impact of oil sands investment and operations over a 25-year period is estimated to be **$521 billion** for the US.
- Employment in the United States (direct, indirect, induced) as a result of new oil sands investments is expected to grow from **21,000 jobs** in 2010 to **465,000 jobs** in 2035. This type of employment includes new and preserved jobs and also consists of full-time and part-time jobs (Figure E.3).

[3]Government of Alberta Fiscal Update 2010-2011, February 2011. http://www.finance.alberta.ca/publications/budget/quarterly/2010_3rdq/report.pdf

Figure E.3
Jobs Created and Preserved in the US, 2010-2035
(x 1,000)



A Note about Economic Terms

There are a number of specialized economic terms within this study that bear a short explanation.

Economic effects/impacts – "effects" and "impacts" are synonymous terms.

- **Direct effects/impacts** – These are the employment and financial effects immediately associated with the development of new projects in the oil sands industry. All direct effects are allocated within the province of Alberta.
- **Indirect effects/impacts** – These are the employment and financial effects on industries that supply goods and services for the development of new oil sands projects.
- **Induced effects/impacts** – These are the employment and financial effects that occur in a region due to the economic activity in a particular sector. For example, an oil sands project worker will spend money in the economy by purchasing meals, clothes, and other various goods and services. Therefore, monies are spent and jobs are created in industries that are peripheral to the oil sands industry, and these are induced effects.
- **Total economic effects/impacts** – This is the sum of all impacts. Direct + Indirect + Induced = Total
- **Employment (Thousand Person Years)**: Thousands of jobs created and preserved every year. For instance if a new oil sands in situ project with a capacity of 10,000 bbl/day starts operation by hiring 60 people in the initial year, the employment is 0.06 thousand person years in the first year. If this new oil sands facility adds 5,000 bbl/day capacity in the second year and hires 25 more employees to operate the new facility, in the second year the In-situ project has created and preserved 0.085 thousand person years of employment. Of the 0.085 thousand person years of employment, 0.06 represents preserved jobs and 0.025 refers to new jobs.

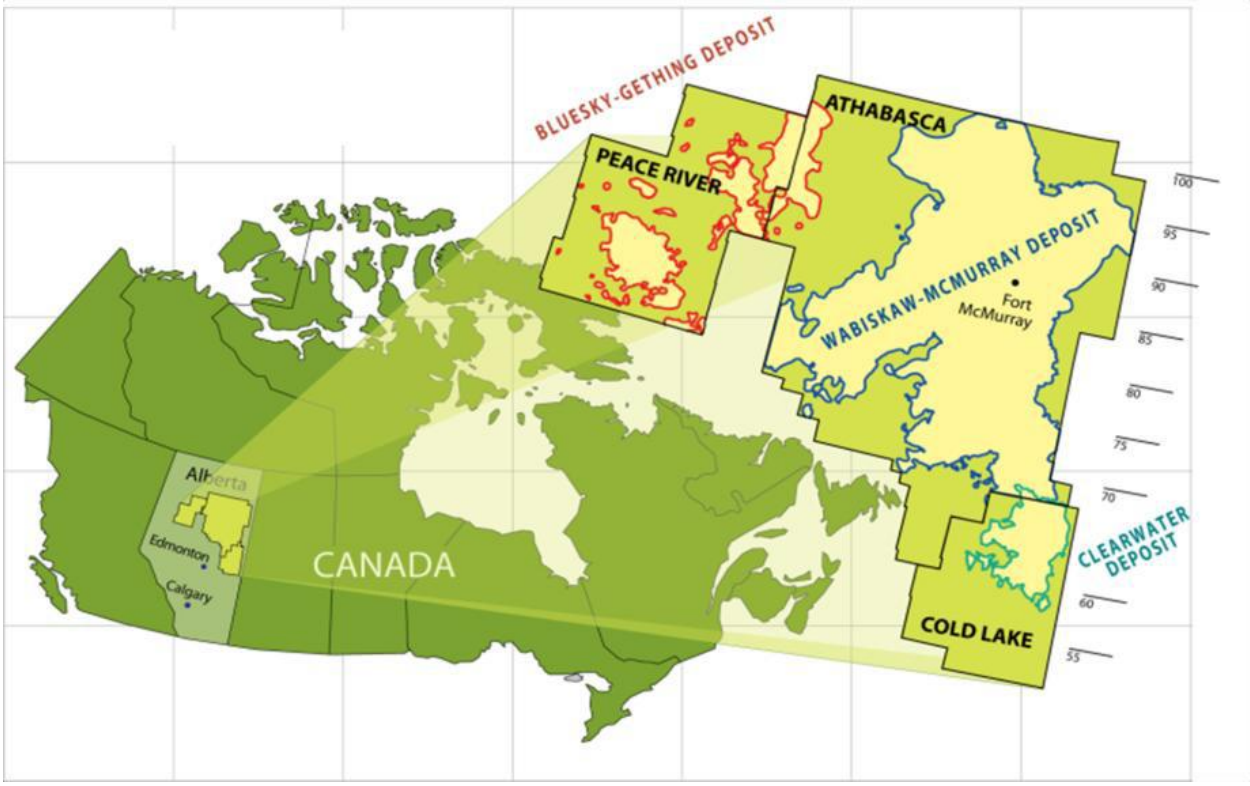
- **Job** – Thousand person years and jobs are used interchangeably throughout this report. Thousand person years is the unit for the number of people employed in a job for the year. A job is an occupation that one needs to do in order to be employed. This should not be confused with stating that a job is a position that one is hired into (i.e., as a plumber). For example, a company could hire 10 people in a year for the position as manager and not hire any managers for later years. For the first year, the total amount of positions was 10 and the total amount of person years for that year is 10. However, for the second year, the total amount of manager positions is still 10 but the person years are now 20 as 10 people have now worked for 2 years. While the definition of job and work may be subject to interpretation, for the purposes of this report the number 10,000 jobs and 10 thousand person years both denote that 10,000 people were employed for a year.
- **I/O model** - an input-output model demonstrates the interdependencies between different areas of a national economy or between areas of different economies. The CERI I/O model (*UCMRIO 2.0*) takes into account interdependencies between Canadian provincial and federal economies as well as US state and federal economies.
- **Multiplier** – This term refers to proportion. For example, if a $1 million increase in oil sands investment creates 5.6 jobs in Canada, the multiplier is 5.6 (as shown in Table 2.4 in the report).

Chapter 1
Oil Sands Projections – *Realistic Scenario*

Overview

The oil sands resources that exist in Alberta are contained within three areas (Peace River, Athabasca, and Cold Lake), as designated by the Government of Alberta, and illustrated in Figure 1.1. Eventually, the development of the resource will extend into the neighbouring province of Saskatchewan. The development of the oil sands in both provinces, no matter how transparent, will be carefully monitored by provincial and federal as well as international governments and environmental activists.

Figure 1.1
Alberta's Oil Sands Areas



Together these regions cover an area over 14.5 million hectares (ha), with the remaining established reserves comprising 169.9 billion barrels of an extremely heavy crude oil, referred to as bitumen.[1] Approximately 16 percent of the 169.9 billion barrels is currently under active development.

[1]The initial volume-in-place of bitumen has been estimated by the Alberta Energy Resources Conservation Board (ERCB) and is used to estimate the initial established reserves of bitumen – bitumen that is estimated to be recoverable given current technology and knowledge. (While the ERCB made significant changes to the in-place resource in 2009, there are no changes to the estimate of the initial established reserves of crude bitumen. The ERCB's latest estimates for the initial established reserves are used throughout this report as our estimates for the resource size.) Source: Alberta Energy Resources Conservation Board. "Alberta's Energy Reserves 2009 and Supply/Demand Outlook 2010-2019". 2010.

Of the recoverable bitumen remaining, 80 percent is estimated to be recoverable using in situ methods which target deposits that are too deep for mining. The remaining recoverable bitumen is anticipated to be recoverable using mining techniques. Table 1.1 provides a breakdown of the initial volume-in-place, initial established reserves, cumulative production, and remaining established reserves, to help further illustrate the vast potential in the area.

Table 1.1
In-Place Volumes and Established Reserves of Crude Bitumen in Alberta (10^9 barrels)

Recovery Method	Initial Volume-in-Place	Initial Established Reserves	Cumulative Production	Remaining Established Reserves
Total	1,802.7	176.7	6.9	169.8
Mining	130.8	38.7	4.5	34.2
In situ	1,671.9	138.0	2.4	135.5

Source: ERCB, "Alberta's Energy Reserves 2009 and Supply/Demand Outlook 2010-2019". 2010.

CERI Oil Sands Projections – *Realistic Scenario*

The projections presented in this chapter are taken from CERI's sixth annual update to "Canadian Oil Sands Supply Costs and Development Projects (2010-2044)". The projection period in the oil sands report extends for thirty five years, from the end of 2010 to the end of 2044 and presents the results for three plausible scenarios. However, the projections are only presented to 2035 in this report in order for CERI's *Realistic Scenario* to be consistent with other results presented in this report.

CERI's *Realistic Scenario* assumes that developed nations continue to recover from the recession and experience modest economic growth in 2011, bringing about a slow and steady growth in the demand for crude oil. The growth is tempered somewhat by geopolitical concerns in the Middle East and economic setbacks in some European nations. In this scenario, oil prices begin a slow and steady climb, thus sending a signal to oil sands proponents that the demand for crude oil is picking up and a period of ongoing growth for the foreseeable future will ensue.

CERI's methodology for projecting bitumen and SCO production volumes is based on the summation of all announced projects, with a wide variety of assumptions pertaining to project schedules and delays, technology, and state of development. The method by which projects are delayed, or the rate at which production comes on stream, is based upon CERI's past experience from monitoring the progress of various oil sands projects.

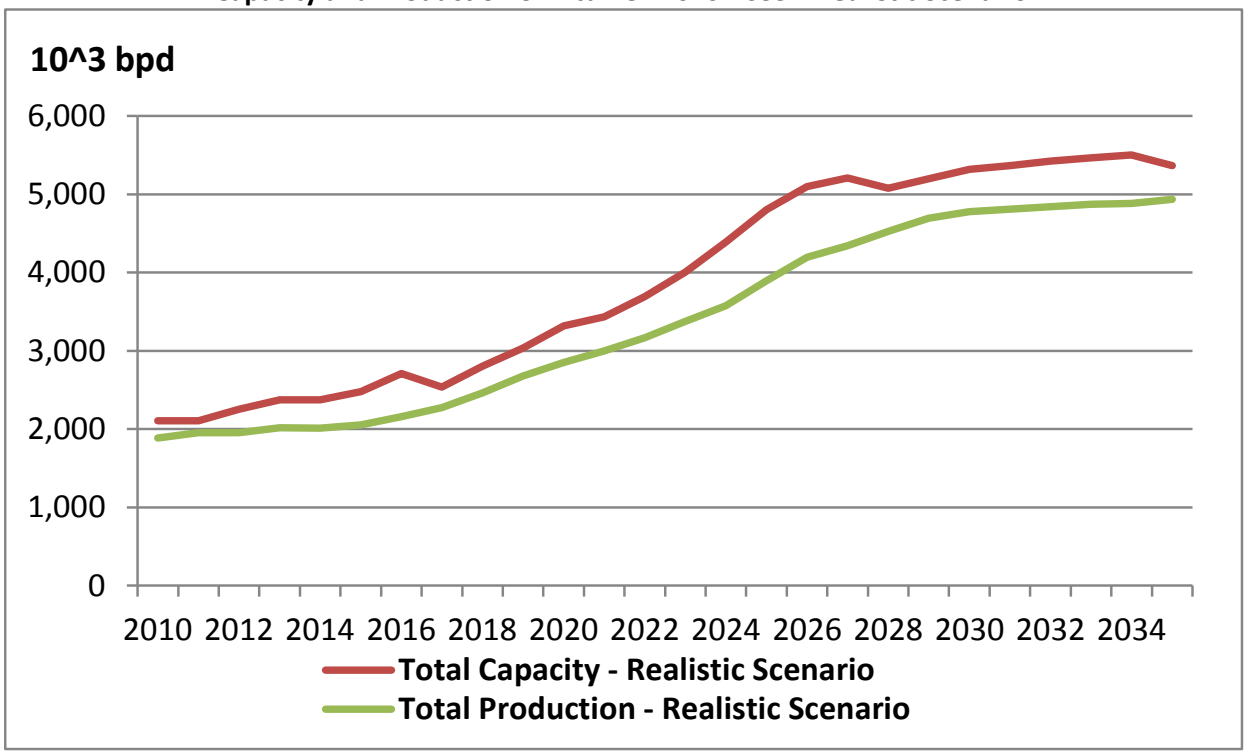
Projects further along the regulatory process are given shorter delays, and have higher probabilities of proceeding to their announced production capacity. Projects that have been announced, but have not yet entered the regulatory process with a disclosure document; receive lower probabilities of proceeding and longer delays. Projects that are suspended are assumed to be already approved but not yet constructed. Table 1.2 describes the project delays for the *Realistic Scenario*.

Table 1.2
***Realistic Scenario* Delays**

	Realistic Scenario					
	In Situ		**Mining**		**Upgrading**	
	Probability Fraction	Delay Years	Probability Fraction	Delay Years	Probability Fraction	Delay Years
Onstream	1.00	0	1.00	0	1.00	0
Under Construction	1.00	1	1.00	1	1.00	1
Suspended	0.90	3	0.90	3	0.90	3
Approved	0.90	4	0.90	4	0.90	4
Awaiting Approval	0.85	8	0.85	8	0.85	8
Announced	0.70	12	0.65	14	0.70	12
Cancelled	1.00	0	1.00	0	1.00	0

The more reasonable path for oil sands development follows CERI's *Realistic Scenario*, where oil sands development is slow to rebound. It is not until 2016 that the oil sands industry experiences its first spike in bitumen capacity. Following this spike is a period of relatively steady capacity growth from 2018 to 2035. In 2016, capacity reaches 2.7 MMBPD, and by the end of 2035 capacity increases to 5.4 MMBPD (see Figure 1.2).

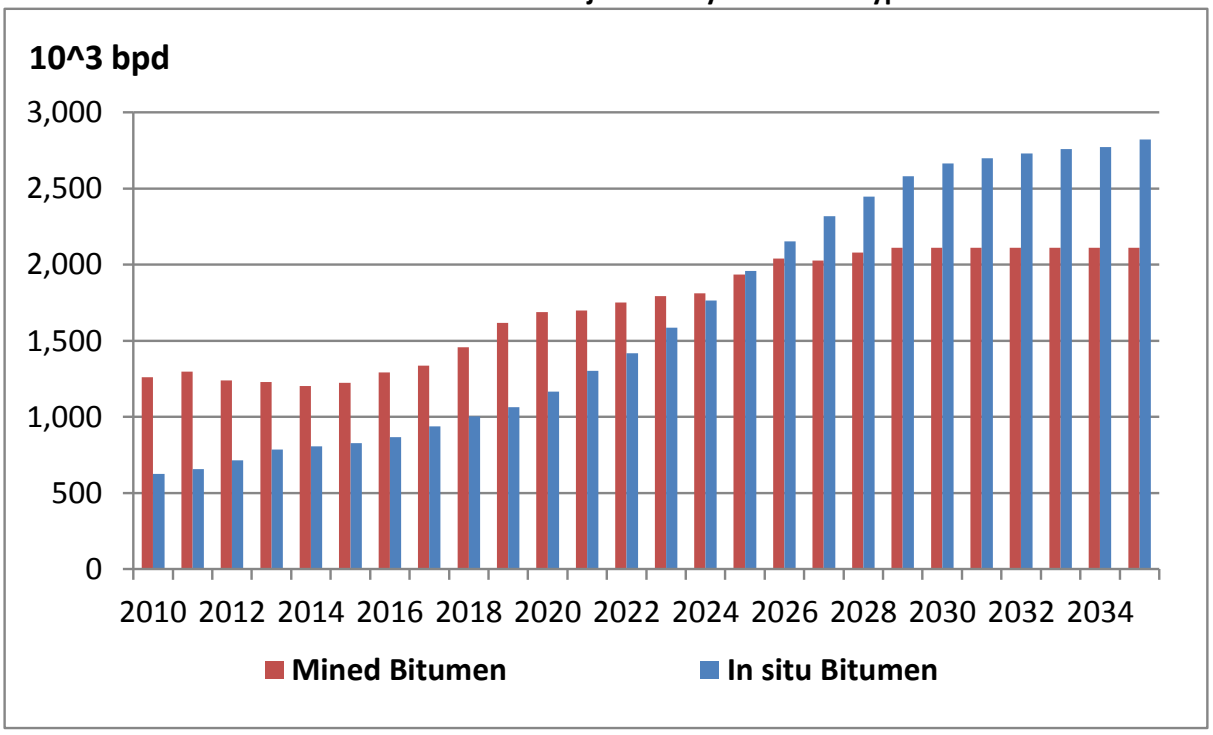
Figure 1.2
Capacity and Production of Bitumen 2010-2035 – *Realistic Scenario*



Illustrated in Figure 1.2 is the production profile as well as capacity volume. By 2035 production volume will reach 4.9 MMBPD under the *Realistic Scenario*. Production is projected to reach 2.1 MMBPD by 2015, and 4.8 MMBPD by 2030.

Production projections by extraction type are presented in Figure 1.3. Mined bitumen maintains a majority status of oil sands volumes until 2025, when in situ production volumes overtake mined bitumen. By the end of the projection period, in situ bitumen accounts for 57 percent of total production volumes, or 2.8 MMBPD, as compared to mined bitumen which produces 2.1 MMBPD.

Figure 1.3
Bitumen Production Projections by Extraction Type

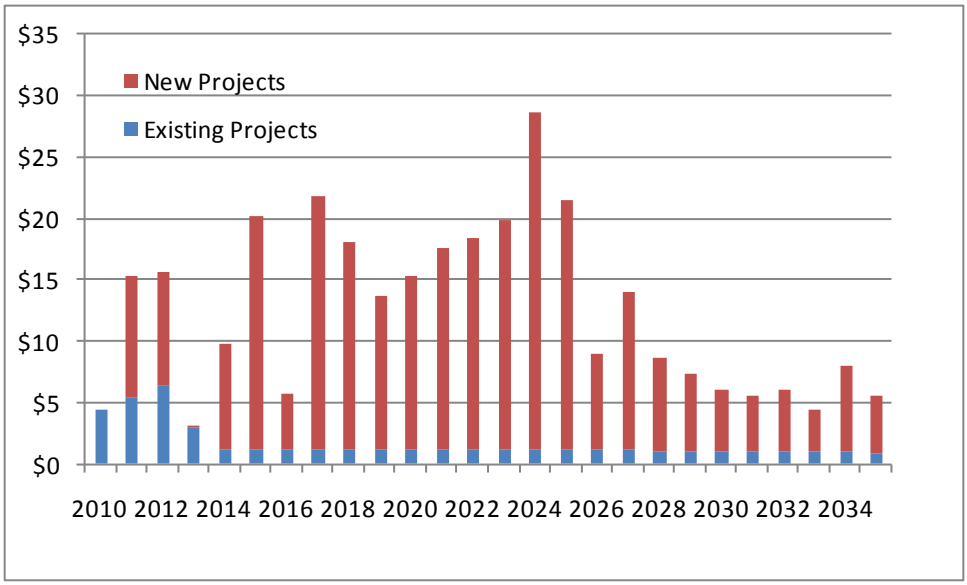


The *Realistic Scenario* is in line with expectations for pipeline capacity additions, and it is possible that the labour and capital markets in Alberta will be capable of handling this expansion without causing undue stress on the local economy. The period of sustained growth (2018 to 2034) will introduce challenges to the Alberta economy similar to those faced during the 2004 to 2008 period.

Achieving any of the levels of production requires a substantial number of inputs, of which capital (both strategic and sustaining) and natural gas are critical. Without the required capital, an oil sands project cannot be constructed. The project, with current technologies, cannot operate without an abundant and affordable supply of natural gas. And lastly, once the facility is operating there is an ongoing need for sustaining capital to ensure that production volumes stay at their design capacities.

Relying on design assumptions[2] and the associated capital required to construct a facility and sustain operations, CERI has estimated the total and annual financial commitments required for the oil sands. Initial and sustaining capital costs, under the *Realistic Scenario*, are illustrated in Figure 1.4.

Figure 1.4
Initial and Sustaining Capital (2010-2035)

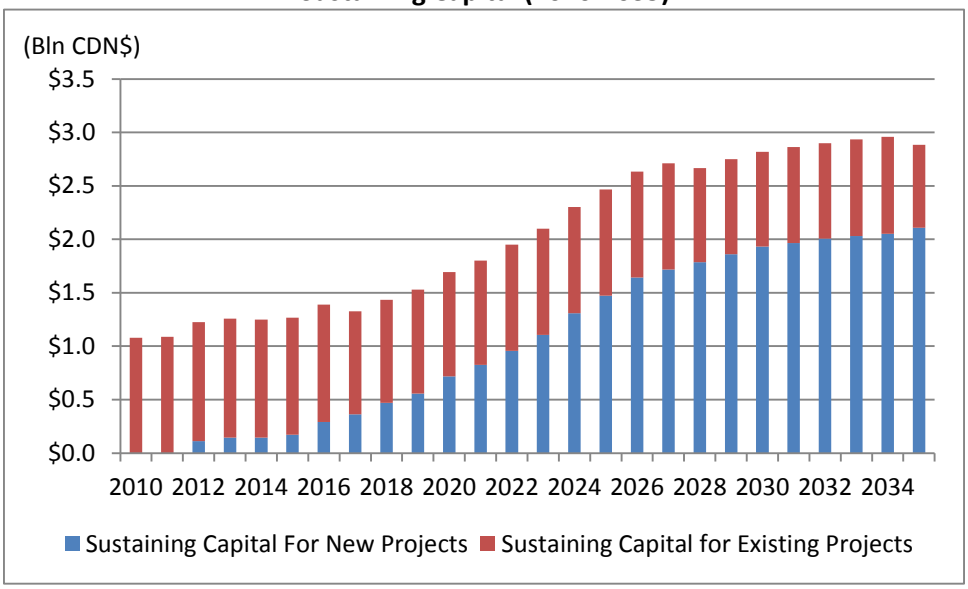


Over the 25-year projection period, the total initial capital required for new projects is projected to be **$253 billion** under the *Realistic Scenario*. New investment dollars start declining by 2030. This does not reflect a slowdown in oil sands investments but instead relates to CERI's assumptions for project start dates and announcements from the oil sands proponents; CERI does not include in its scenarios any future projects unless publically announced by the companies involved. Ongoing investment, in the form of sustaining capital, will take place on an annual basis.

The annual sustaining capital required for the oil sands (excluding royalty revenues, taxes, and fixed and variable operating costs) under the Realistic projection grows from a current amount of **$1 billion** in 2010 to **$2.9 billion** by 2035. Figure 1.5 presents the sustaining capital requirements broken into two categories: sustaining capital for existing projects and sustaining capital for new projects.[3]

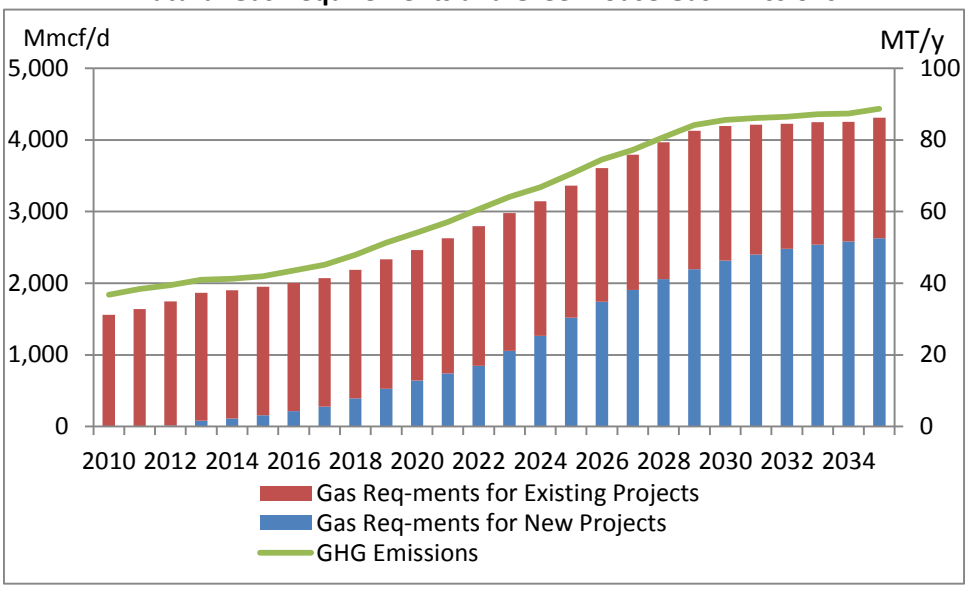
[2]CERI Study No. 122, "Canadian Oil Sands Supply Costs and Development Projects (2010-2044)", May 2011.
[3]New projects include those under construction, approved, suspended, awaiting approval, and announced.

Figure 1.5
Sustaining Capital (2010-2035)



By 2035, natural gas requirements will increase by at least twice the current levels. The *Realistic Scenario* indicates natural gas requirements of almost 4.3 BCFPD by 2035 (see Figure 1.6). Considering how aggressively shale gas production in the US has come on stream, and the potential for shale production in Canada, meeting the oil sands industry's future demand for natural gas appears to be a diminishing concern. In the *Realistic Scenario*, Canada and the US could be engaged in an energy exchange – Canadian oil for US natural gas – that further enhances the trade relationship between the two countries. The prospects for technology switching and efficiency improvements are substantial and will likely put downward pressure on the industry's natural gas requirements.

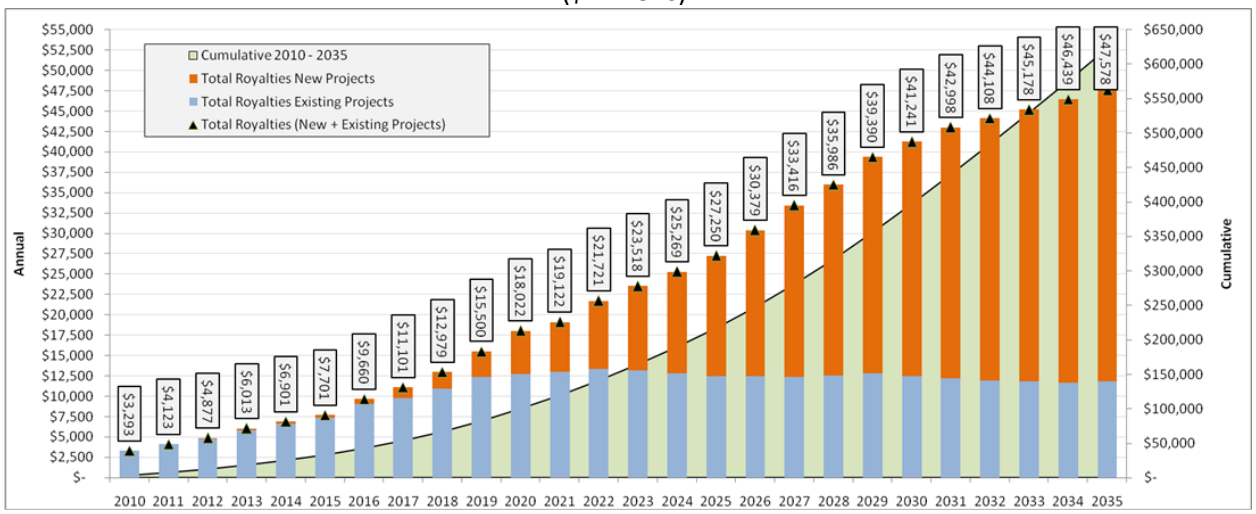
Figure 1.6
Natural Gas Requirements and Greenhouse Gas Emissions



One of the by-products of natural gas consumption is GHG emissions. Without equipment to "scrub" the emissions streams, and separate the GHG emissions, the emissions are released into the atmosphere. While technological innovation within the oil sands industry (in addition to carbon capture and storage) is expected to help reduce these emissions, Figure 1.6 above illustrates the GHG emissions under CERI's design assumptions. The emissions are expected to rise to 89 million tonnes per year by 2035, in tandem with natural gas requirements. The emissions presented above reflect point source emissions and do not take into account emissions associated with electricity purchases or the benefits of cogeneration. In other words, these figures represent absolute GHG emissions that result from the production of marketable bitumen and SCO from the oil sands industry.

Given the production projection as stated earlier, bitumen royalties from existing and new projects collected by the province will be **$3.2 billion** in 2010 and are forecasted to grow to **$47 billion** by 2035 as illustrated in Figure 1.7. The cumulative total of royalties collected by the Alberta government will exceed **$623 billion** over the next 25 years.

Figure 1.7
Annual and Cumulative Royalties Collected by the Alberta Government
Existing vs. New Oil Sands Projects, 2010-2035
($millions)



Summary

North America has returned to positive economic growth, and oil sands developers are returning to pre-recession activity levels. As the activity slowly ramps up, current trends and challenges in oil sands development need to be considered by governments and industry. CERI's *Realistic Scenario* strikes a balance between the environment and oil sands development through the inclusion of a modest emissions compliance cost. Natural gas costs, construction, and other operating costs are estimated to have a significant impact on oil sands developments.

Canadian crude oil supplies will continue to serve traditional markets in the US and Canada. The demand for Canadian crude oil in the US Midwest market will grow as heavy oil refining capacity in the region is added. However, growing volumes of Canadian bitumen supply means that new markets for these volumes must be found. The US Gulf Coast is one such market, and the TransCanada Keystone XL pipeline project, which is expected to be in service in 2012, will provide Canadian producers with increased access to this market.

The growing demand for crude oil in Asia could create a new market for Canadian crude oil. The Northern Gateway Pipeline Project from Edmonton, Alberta to the deepwater port located in Kitimat, British Columbia is being designed to provide 525,000 BPD of diluted bitumen (dilbit) and synthetic crude oil (SCO) export capacity. Crude oil would be shipped via this pipeline to the Pacific coast and then loaded on tankers for delivery to the US west coast and Far East markets.

Chapter 2
Impact of New Oil Sands Projects on US and Canadian Economies

Introduction

Production from the oil sands is approaching the 1.7 million bbl/day mark, making those operations central to Canada's energy industry and significant contributors to the nation's GDP. Of the oil that Canada exports, both conventional and unconventional, almost all goes to the United States. On the other side of the border, the US imports more oil from Canada than from any other country. The energy ties between these two nations are therefore tight, and the oil sands in particular are increasing in significance for both countries.

It is important to look beyond the energy industry to consider the impacts that the oil sands have elsewhere within the Canadian and US economies. The investments made in new oil sands projects and the monies spent on continuing operations create jobs that, in turn, generate ripple effects throughout both of these economies. Wealth is created – how much wealth and in which sectors of the economies are two questions that arise.

This section of the report utilizes the economic tool of I/O analysis to quantify the economic impacts of oil sands investment in the *Realistic Scenario*.[1] Specifically, this report measures the incremental impacts of oil sands industry development and the resulting impacts on all Canadian provinces and US states; direct, indirect, and induced impacts of current and future investments in the oil sands industry are observed.

Economic Impacts in Canada

Overall Economic Perspective

Table 2.1 presents the total impacts associated with both investment and operations in Alberta oil sands over 25 years. Most of the GDP impact stays in Canada. However, 94 percent of the Canadian impact occurs within Alberta, with the remaining 6 percent affecting the other provinces. Among those provinces, Ontario, British Columbia, and Quebec receive the highest impact.

The cumulative sum of additional Canadian GDP from 2010 to 2035, as a result of new oil sands projects, is estimated at **$2,106 billion** (Table 2.1). Employment in Canada (direct, indirect, induced) as a result of new oil sands investments is expected to grow from **75,000 jobs** in 2010 to **905,000 jobs** in 2035 (see Figure 2.5). This figure consists of part-time and full-time jobs and includes new jobs and preserved jobs. Employees will earn approximately **$25 billion** a year and will spend a fraction of their income on goods and services that will be produced in Canada. The new demand for goods and services is accounted for in Table 2.1 by induced effect.

[1] CERI Study No. 122, "Canadian Oil Sands Supply Costs and Development Projects (2010-2044)", May 2011.

Table 2.1
Economic Impact of Oil Sands in Alberta, 2010-2035 – Investments and Operation

Investments and Operation	$Million		Thousand Person Years
	GDP	Compensation of Employees	Employment
Alberta	1,989,565	555,387	10,041
British Columbia	28,481	15,710	420
Manitoba	4,422	2,386	68
New Brunswick	846	415	12
Newfoundland & Labrador	368	130	4
Northwest Territories	150	73	2
Nova Scotia	857	439	12
Nunavut	28	17	0
Ontario	62,921	36,265	858
Prince Edward Island	64	35	1
Quebec	13,845	7,746	208
Saskatchewan	4,855	2,106	58
Yukon Territory	39	24	1
Gabd*	0	0	0
Total Canada	**2,106,443**	**620,733**	**11,685**

*Gabd is short for Government Abroad (Canadian embassies, consulates, etc.)

The impacts shown in Table 2.1 have been calculated by applying the multipliers presented in Table 2.4 to the total direct outlay (including initial and sustaining) of **$2,079 billion** (**$283 billion investments** and **$1,796 operations**) during the investment and operating phases of the oil sands projects.

Relative GDP impacts by province and territory are also illustrated in Figure 2.1 on p. 13 – the provinces with the largest impacts being depicted in the strongest colours. Outside of Alberta, the provinces of Ontario, British Columbia, and Quebec experience the greatest economic impacts, being heavily industrialized with large populations.

Table 2.2 addresses the economic impacts (direct, indirect and induced) of oil sands investments, while Table 2.3 describes the corresponding impacts of oil sands operations. In general, investment impacts are more intense than operations impacts (more jobs, higher spending rates, etc.), but the duration of the investment period is much shorter than the duration of the operating period.

Table 2.2
Economic Impact of Oil Sands in Alberta, 2010-2035 – Investments

Investments	$Million		Thousand Person Years
	GDP	Compensation of Employees	Employment
Alberta	210,795	80,548	1,592
British Columbia	5,136	2,820	74
Manitoba	936	497	14
New Brunswick	169	80	2
Newfoundland & Labrador	68	22	1
Northwest Territories	28	14	0
Nova Scotia	163	84	2
Nunavut	4	2	0
Ontario	10,086	5,924	140
Prince Edward Island	12	7	0
Quebec	2,421	1,381	37
Saskatchewan	1,239	536	15
Yukon Territory	6	4	0
Gabd*	0	0	0
Total Canada	**231,064**	**91,919**	**1,877**

*Gabd is short for Government Abroad (Canadian embassies, consulates, etc.)

Table 2.3
Economic Impact of Oil Sands in Alberta, 2010-2035 – Operations

Operations	$Million		Thousand Person Years
	GDP	Compensation of Employees	Employment
Alberta	1,778,770	474,839	8,449
British Columbia	23,346	12,890	346
Manitoba	3,486	1,889	54
New Brunswick	677	334	10
Newfoundland & Labrador	299	108	3
Northwest Territories	122	60	1
Nova Scotia	694	356	10
Nunavut	24	15	0
Ontario	52,835	30,341	718
Prince Edward Island	52	28	1
Quebec	11,424	6,364	171
Saskatchewan	3,616	1,570	44
Yukon Territory	33	20	1
Gabd*	0	0	0
Total Canada	**1,875,378**	**528,815**	**9,809**

*Gabd is short for Government Abroad (Canadian embassies, consulates, etc.)

Total operations impacts by all three measures are larger than investment impacts. Investment impacts are less geographically concentrated than those of operations. For example, 9 to 15 percent of total Canadian investment-phase impacts, and 5 to 14 percent of operating-phase impacts occur in provinces outside Alberta. This contrast stems from the greater outlays on machinery and equipment manufactured beyond Alberta's borders during the investment phase and the greater outlays on Alberta-supplied inputs such as natural gas during the operating phase.

A comparison between Table 2.2 and 2.3 reveals that one million dollars of investment in oil sands generates **$220,000** less GDP than the same amount of spending in the operations of the oil sands in Canada. But one million dollars of investment creates almost 1.2 more jobs than the comparable spending in the operations phase. Differences in wages, nature of industries, and origin of the investment capital goods could be the causes.

Figure 2.1
Total Economic Impact of Alberta's New Oil Sands Projects on Canadian Provinces and Territories

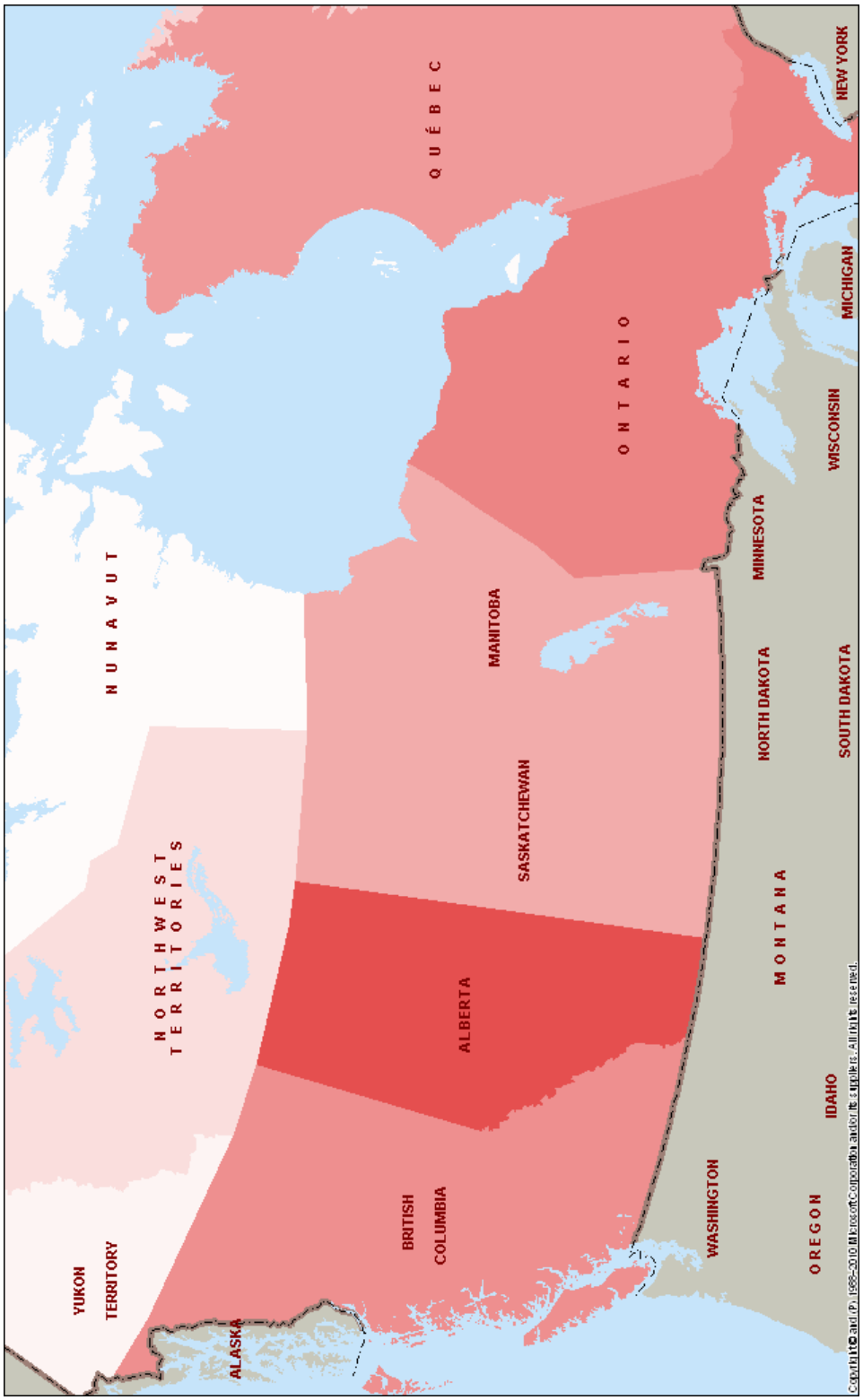


Table 2.4
Economic Input/Output Multipliers with Respect to Initial Outlay – Investments and Operations

Investments and Operations	Multiplier		Person Years
	GDP	Compensation of Employees	Employment*
Alberta	0.95782	0.26738	4.834
British Columbia	0.01371	0.00756	0.202
Manitoba	0.00213	0.00115	0.033
New Brunswick	0.00041	0.00020	0.006
Newfoundland & Labrador	0.00018	0.00006	0.002
Northwest Territories	0.00007	0.00004	0.001
Nova Scotia	0.00041	0.00021	0.006
Nunavut	0.00001	0.00001	0.000
Ontario	0.03029	0.01746	0.413
Prince Edward Island	0.00003	0.00002	0.001
Quebec	0.00667	0.00373	0.100
Saskatchewan	0.00234	0.00101	0.028
Yukon Territory	0.00002	0.00001	0.000
Gabd**	0.00000	0.00000	0.000
Total Canada	**1.01**	**0.30**	**5.6**

*Per million dollars of initial outlay
**Gabd is short for Government Abroad (Canadian embassies, consulates, etc.)

The GDP and employment multipliers of Table 2.4 are also presented in bar-chart format along with multipliers for gross output and taxes (see Figure 2.2). However, the figures are presented per million dollars of initial outlay in order to be comparable with employment multipliers.

By definition, gross output multipliers cannot be smaller than 1.0 because they express gross output (direct impact + indirect impact + induced impact) as a multiple of direct impact on gross output.

The tax multiplier is intended to capture direct, indirect, and induced impacts on all kinds of revenues accruing to federal, provincial, and municipal governments: personal and corporate income taxes; sales taxes (GST, HST, PST); property taxes; CPP/EI contributions; customs duties; etc. (excluding royalties).

Figure 2.2
Multipliers for Canada with Respect to One Million Dollar Initial Outlay

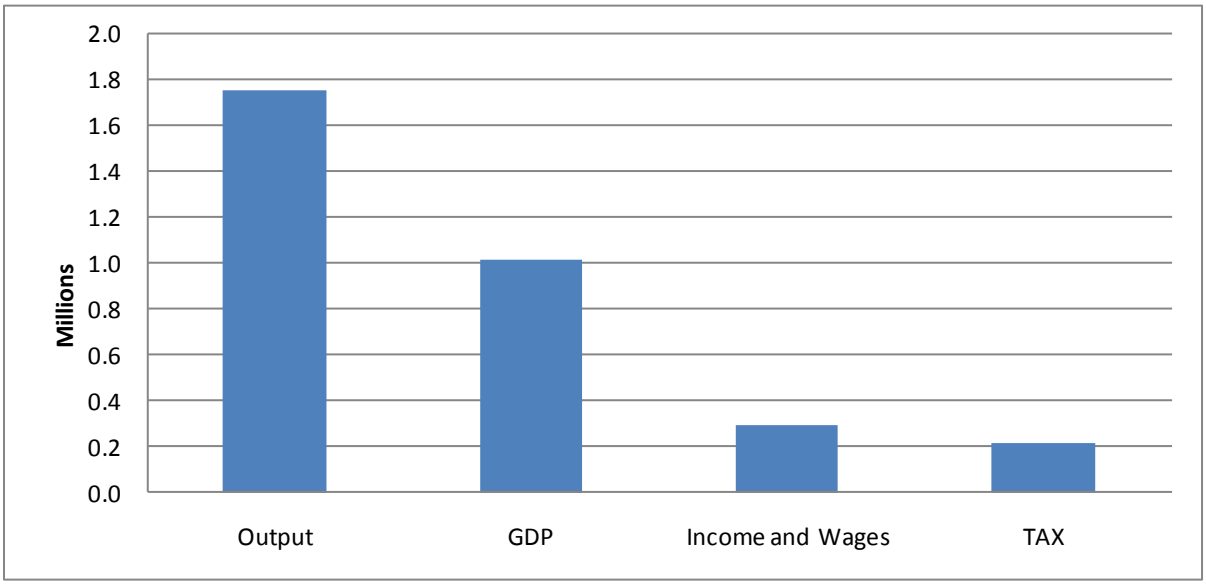
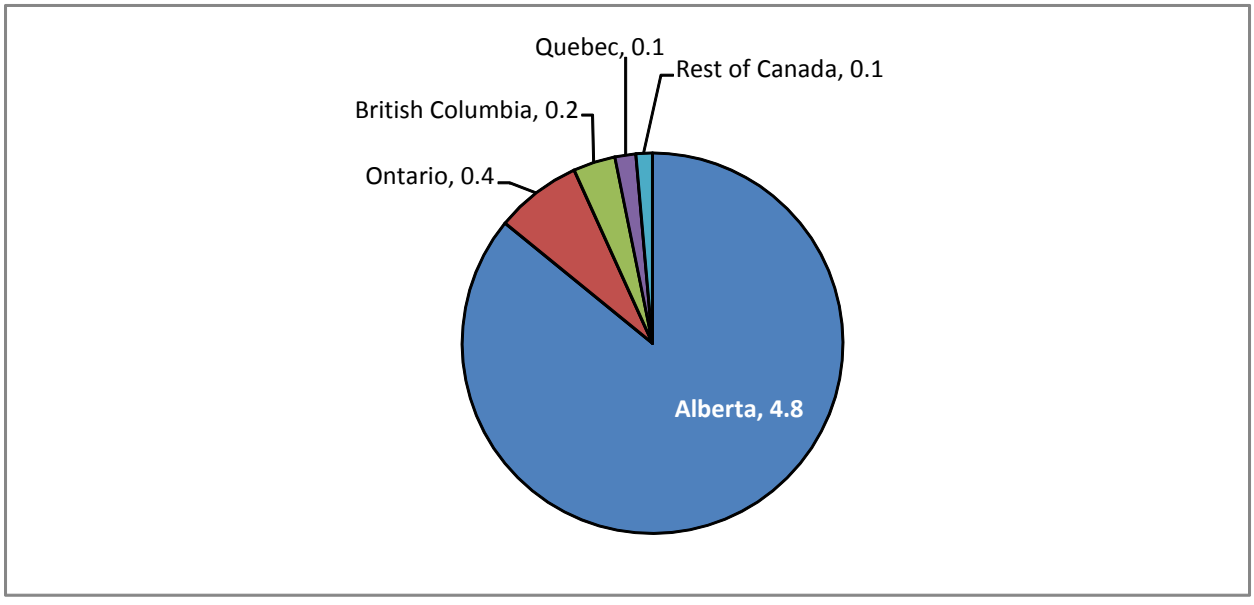


Figure 2.3 shows relative employment impacts by province and territory. The rankings by province and territory are similar to those of Figure 2.1.

Figure 2.3
Canadian Employment per Million Dollar Investment and Operation in the Alberta Oil Sands Industry



Job Creation Perspective

Table 2.5 summarizes the effects of new oil sands project development on job creation across all provinces and territories in Canada in the 2010-2035 period.

Table 2.5
Jobs as a Result of New Oil Sands Projects in Alberta, 2010-2035
Investments and Operations

Thousand Person Years	Direct	Indirect	Induced	Sum
Alberta	3974.8	3098.8	2967.3	10040.8
British Columbia	0.0	168.2	251.6	419.9
Manitoba	0.0	29.3	38.9	68.2
New Brunswick	0.0	5.0	6.9	11.9
Newfoundland & Labrador	0.0	1.4	2.1	3.5
Northwest Territories	0.0	0.9	0.9	1.8
Nova Scotia	0.0	4.4	7.8	12.2
Nunavut	0.0	0.2	0.3	0.5
Ontario	0.0	365.8	492.2	858.1
Prince Edward Island	0.0	0.4	0.7	1.1
Quebec	0.0	83.5	125.0	208.5
Saskatchewan	0.0	26.3	32.0	58.3
Yukon Territory	0.0	0.3	0.4	0.7

Tables 2.7 and 2.8 serve the same purpose, but focus rather on the effects on job creation by the two main phases of new oil sands project development, investment and production. Thus, the sum of the results in these tables is the equivalent of the results presented in Table 2.5.

In this particular instance, direct effects are calculated as the jobs created and preserved directly – construction jobs, administrative positions, or any other jobs directly related to the development of a particular oil sands project. Therefore, all direct effects occur within the province of Alberta, where a total of close to 4 million jobs are expected to be created and preserved over the 2010 to 2035 time period. Total direct jobs account for 34 percent of the total jobs expected to be supported (Direct + Indirect + Induced) across all regions – in Canada – as a result of the development of new oil sands projects.

Indirect job effects account for the potential of jobs created in the many industries that serve the oil sands industry, including the pipeline industry, the construction industry (which supplies goods and services to build camps and facilities for operations), the companies that build the trucks and shovels for mining operations, and any other related industries. Close to 3.8 million indirect jobs are expected to occur in Canada.

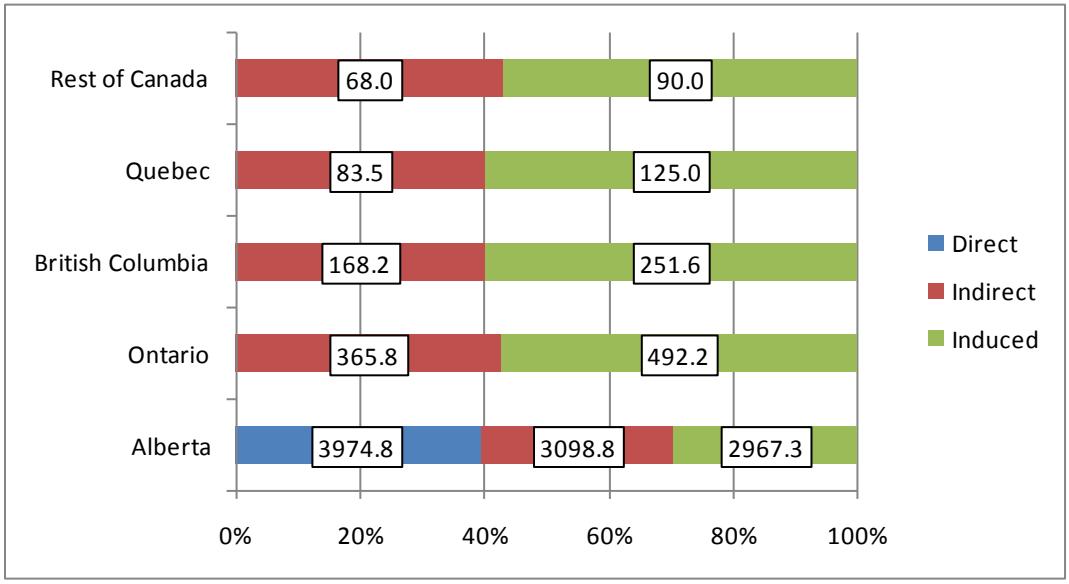
It is estimated that induced effects create or preserve close to 3.9 million jobs (34 percent of total) in Canada, so this is one of the greatest components of total employment. About 76 percent of the total Canadian induced jobs are expected to be created and preserved in Alberta, 13 percent in Ontario, 6 percent in British Columbia, and the remaining 5 percent in the rest of Canada.

Note that Alberta is the only province where the number of induced jobs is less than either the direct or indirect jobs. This indicates that induced jobs in other regions represent a greater proportion of the total number of jobs created in those regions. This is the case because Alberta is the region where the projects originate, but it is also important to note that all provinces and territories (as well as the US) benefit from the development of new oil sands projects.

In the Canadian context, jobs are created and preserved across every province and territory as an effect of new oil sands project development, with the provinces of Alberta, Ontario, and British Columbia being the largest recipients of these jobs. Ontario constitutes a large industrial manufacturing complex and a global financial centre, thus making the province crucial for required inputs and capital to the development of new oil sands projects. British Columbia, like Ontario, is one of Canada's largest economies (on a provincial basis). It also has a diversified economy with a strong natural resource extraction and agriculture base, as well as oil refineries and pipeline infrastructure.

Figure 2.4 identifies the breakdown of job creation across the different regions (and by effect type) as a result of the development of new oil sands projects between 2010 and 2035.

Figure 2.4
Percentage of Jobs by Component and Region, 2010-2035



While the information in Table 2.5 is an aggregation over 25 years, Figure 2.5 presents employment creation during 2010-2035. Figure 2.5 shows that employment in early years is low and is even declining as the oil sands project shifts from the Investment Phase to Operation Phase. At the early years of operation, employment declines as the labour intensive Investment Phase nears completion. As the production of oil sands grows and bitumen is exported, the oil sands industry supports more jobs over time. Employment in Canada (direct, indirect, induced) as a result of new oil sands investments is expected to grow from 75,000 jobs in 2010 to 905,000 jobs in 2035, which is a significant contribution to the Canadian economy.

Table 2.6 presents the total number of jobs created and preserved each year. For instance, in 2035, 905.6 thousand jobs will be created and preserved as a result of investments and operations in new oil sands projects. We can also estimate the number of incremental jobs over a period of time. The difference between figures in different columns produces the number of new jobs (incremental) in a specific period. For instance, the number of new jobs created from 2009 (2009 is not included) to 2020 in Canada due to new oil sands projects is simply 303.1 - 0 = 303.1 thousand jobs. Note that the investment and operations of the oil sands start in 2010, so at the beginning of 2010 the employment due to new projects is zero. Similarly, the number of new jobs during 2025 (2025 is not included) to 2035 is 905.6 - 607.2 = 298.4 thousand jobs.

Figure 2.5
Jobs Created and Preserved in Canada, 2010-2035
(x 1,000)

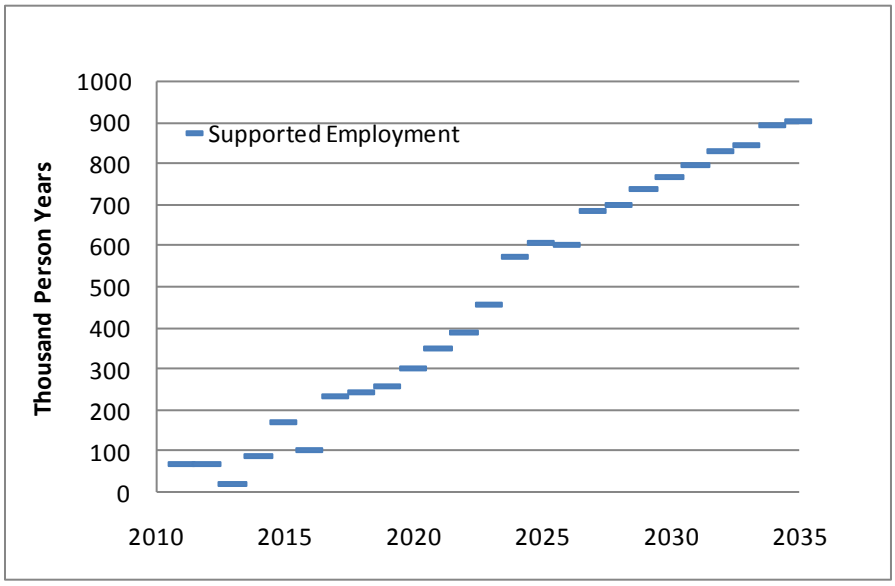


Table 2.6
Jobs Created and Preserved in Canada, 2010-2035

Thousand Person Years	2015	2020	2025	2030	2035
Alberta	144.0	258.9	520.8	658.9	779.5
British Columbia	6.8	11.4	22.1	27.1	32.1
Manitoba	1.3	2.0	3.7	4.3	5.1
New Brunswick	0.2	0.3	0.6	0.8	0.9
Newfoundland & Labrador	0.1	0.1	0.2	0.2	0.3
Northwest Territories	0.0	0.0	0.1	0.1	0.1
Nova Scotia	0.2	0.3	0.6	0.8	0.9
Nunavut	0.0	0.0	0.0	0.0	0.0
Ontario	12.9	22.6	44.8	56.1	66.4
Prince Edward Island	0.0	0.0	0.1	0.1	0.1
Quebec	3.4	5.6	11.0	13.5	15.9
Saskatchewan	1.3	1.8	3.2	3.5	4.2
Yukon Territory	0.0	0.0	0.0	0.0	0.1
Total Canada	**170.2**	**303.1**	**607.2**	**765.4**	**905.6**

Table 2.7 summarizes the effects of *investment in oil sands projects* from 2010 to 2035, in terms of total employment (direct, indirect and induced) across the different regions. It is important to remember that investment is the first phase of new project development (as presented in Table 2.7), with the second being operations (as illustrated in Table 2.8).

Over 779,000 direct jobs will be created and preserved in Alberta due to investment in new oil sands projects. This represents 44 percent of the total (direct, indirect, and induced) jobs that are expected to be created in the province due to investment in oil sands projects and 38 percent of the total jobs expected to be created across Canada.

Indirect jobs related to oil sands industry investment will amount to over 588,000 jobs. Alberta will see about 79 percent of total Canadian indirect jobs, followed by Ontario at 10 percent, British Columbia at 5 percent, and the remaining 6 percent across the rest of Canada.

Table 2.7
Jobs as a Result of New Oil Sands Projects in Alberta, 2010-2035 – Investments

Thousand Person Years	Direct	Indirect	Induced	Sum
Alberta	707.4	466.2	418.4	1592.0
British Columbia	0.0	30.3	43.3	73.6
Manitoba	0.0	6.2	7.7	13.9
New Brunswick	0.0	0.9	1.3	2.2
Newfoundland & Labrador	0.0	0.2	0.4	0.6
Northwest Territories	0.0	0.2	0.2	0.3
Nova Scotia	0.0	0.8	1.4	2.3
Nunavut	0.0	0.0	0.0	0.1
Ontario	0.0	60.5	79.4	140.0
Prince Edward Island	0.0	0.1	0.1	0.2
Quebec	0.0	15.3	21.7	37.0
Saskatchewan	0.0	6.8	7.7	14.5
Yukon Territory	0.0	0.0	0.1	0.1

Induced jobs related to investment in oil sands projects are expected to amount to 582,000 jobs across Canada.

Table 2.8 summarizes the expected effects of increased *oil sands operations* on employment across Canada during the 2010 to 2035 time period. Close to 10 million jobs are expected to be created and preserved across Canada due to increased oil sands production, with 98 percent of these jobs expected to occur in Alberta.

Table 2.8
Jobs as a Result of New Oil Sands Projects in Alberta, 2010-2035 – Operations

Thousand Person Years	Direct	Indirect	Induced	Sum
Alberta	3267.3	2632.6	2548.9	8448.8
British Columbia	0.0	137.9	208.4	346.3
Manitoba	0.0	23.1	31.2	54.3
New Brunswick	0.0	4.1	5.6	9.7
Newfoundland & Labrador	0.0	1.1	1.8	2.9
Northwest Territories	0.0	0.7	0.7	1.4
Nova Scotia	0.0	3.5	6.4	9.9
Nunavut	0.0	0.2	0.2	0.4
Ontario	0.0	305.3	412.8	718.1
Prince Edward Island	0.0	0.3	0.6	0.9
Quebec	0.0	68.2	103.3	171.4
Saskatchewan	0.0	19.5	24.2	43.8
Yukon Territory	0.0	0.2	0.4	0.6

Overall, the results are similar to the previous tables in terms of geographical distribution of effects (highest in Alberta, followed by Ontario, British Columbia, and other provinces and territories).

An important observation here in regards to the Canadian provinces is that the total percentage of jobs created (not the actual number of jobs) in the provinces outside Alberta – as a portion of total jobs created across all regions – is higher for investments in oil sands projects (15.2 percent) compared to the production phase (13.9 percent). There is, as a result, a larger number of jobs created in the other provinces due to increased oil sands production compared to investment in oil sands projects, but a higher proportion of the total jobs created throughout the other provinces due to investment rather than production. This is also applicable and more noticeable with the US jobs presented in the next section. Oil sands project developments are more dependent on capital goods and labour from the United States during the initial stages (investment and construction) of development than during the operations (i.e., production) phase.

Table 2.9 summarizes the multiplier effects across Canada (from 2010 to 2035) as a result of investment and operations in the oil sands industry.

Table 2.9
Job Multipliers with Respect to Initial Outlay, 2010-2035
Investments and Operations

Jobs/$million	Direct	Indirect	Induced	**Sum**
Alberta	1.9	1.5	1.4	4.8
British Columbia	0.0	0.1	0.1	0.2
Manitoba	0.0	0.0	0.0	0.0
New Brunswick	0.0	0.0	0.0	0.0
Newfoundland & Labrador	0.0	0.0	0.0	0.0
Northwest Territories	0.0	0.0	0.0	0.0
Nova Scotia	0.0	0.0	0.0	0.0
Nunavut	0.0	0.0	0.0	0.0
Ontario	0.0	0.2	0.2	0.4
Prince Edward Island	0.0	0.0	0.0	0.0
Quebec	0.0	0.0	0.1	0.1
Saskatchewan	0.0	0.0	0.0	0.0
Yukon Territory	0.0	0.0	0.0	0.0
Total Canada	1.9	1.8	1.9	5.6

The multipliers above capture the effect of a unit change in demand ($1 million of investment or additional export), on the number of jobs created at each level, in each region. The overall multiplier indicates that for every $1 million of investment or additional demand for bitumen, close to 6 jobs are created.

The overall direct multiplier across all regions is 1.9, thus for every $1 million of initial capital outlay, 1.9 jobs are created, all in Alberta.

The overall indirect multiplier across all regions stands at 1.8 and indicates that for every $1 million of initial activity, less than 2 jobs are created across Canada – mainly in Alberta, Ontario, and British Columbia.

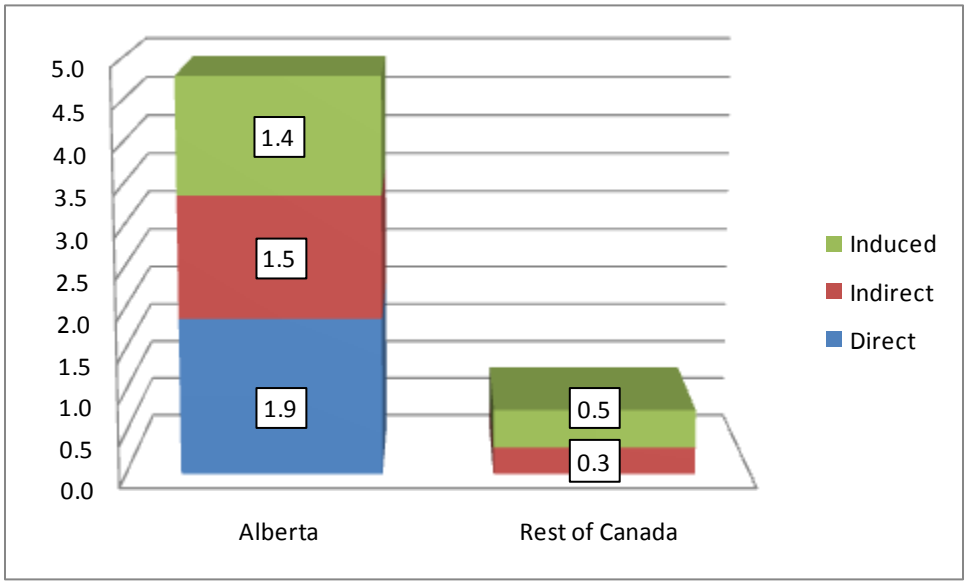
At 1.9, the overall induced multiplier suggests that a $1 million sale in the oil sands industry yields almost 2 jobs – 1.4 in Alberta, and less than 1 in Ontario, British Columbia, and the rest of Canada.

In summary, a $1 million sale in the oil sands industry yields almost 6 jobs in Canada, of which 1/3 are direct, 1/3 are indirect and 1/3 are induced.

Overall, according to the multiplier, of the 5.6 jobs created by every $1 million of capital or demand outlay from the oil sands industry (across all regions), close to 5 jobs are created and preserved in Alberta, and 1 more across Canada.

Figure 2.6 provides a visual representation of the calculated multipliers of $1 million of capital outlay from the oil sands industry on job creation, by component and by region.

Figure 2.6
Oil Sands Industry Multipliers on Job Creation by Component and Region
(#jobs/million dollar)



Overall Tax Perspective

Note that all of the tax estimates presented in this subsection include direct, indirect and induced impacts. Table 2.10 provides an elaboration of the tax impacts alluded to in Figure 2.2. Generally speaking, taxes on income are considered direct taxes, while taxes on expenditures (such as GST, HST, and PST) and all taxes deductible by corporations for income tax purposes (such as property taxes) are considered indirect taxes. The tax impact on a province includes taxes generated by economic activity within a province payable to federal, provincial, and municipal governments. The lion's share of these tax impacts would be felt by Alberta, followed by Ontario, British Columbia, and Quebec. About **$444 billion** will be collected in all forms of taxes, except royalties, over 25 years in Canada due to new oil

sands projects. Ninety-two percent of this tax will be paid in Alberta, of which 68% is the share of the federal government and 32% is the share of the provincial governments. The portion of Table 2.10 tax revenues accruing to the federal government is itemized in Table 2.11. Provincial and municipal government tax revenues are indicated in Table 2.12. The multipliers applied to gross oil sands outlays in order to generate Table 2.10 are shown in Table 2.13.

The proportionate shares of tax impacts accruing to the federal government on the one hand and to provincial and municipal governments on the other is shown in Figure 2.7. The provincial percentage is smallest in Alberta, largely because of the low provincial corporate tax rate.

Table 2.10
Tax Receipts as a Result of Alberta Oil Sands Investment and Operation, 2010-2035
Federal and Provincial-Municipal

CAD Million	Indirect Tax	Personal Income Tax	Corporate Tax	**Sum**
Alberta	123790	189932	93755	407477
British Columbia	3766	3108	704	7578
Manitoba	675	484	79	1239
New Brunswick	120	92	20	231
Newfoundland & Labrador	37	27	13	77
Northwest Territories	14	8	8	29
Nova Scotia	136	106	26	268
Nunavut	2	2	0	4
Ontario	9962	7513	3119	20594
Prince Edward Island	11	8	1	20
Quebec	2535	1996	580	5111
Saskatchewan	830	449	274	1553
Yukon Territory	4	3	0	7

Table 2.11
Tax Receipts as a Result of Alberta Oil Sands Investment and Operation, 2010-2035
Federal

CAD Million	Indirect Tax	Personal Income Tax	Corporate Tax	Sum
Alberta	103983	135400	62602	301985
British Columbia	1852	2150	447	4449
Manitoba	293	283	46	622
New Brunswick	52	54	12	119
Newfoundland & Labrador	14	15	8	37
Northwest Territories	6	6	5	17
Nova Scotia	56	61	15	132
Nunavut	1	2	0	3
Ontario	4544	4861	1866	11272
Prince Edward Island	4	4	1	9
Quebec	1037	1034	325	2396
Saskatchewan	358	277	157	792
Yukon Territory	2	2	0	4

Table 2.12
Tax Receipts as a Result of Alberta Oil Sands Investment and Operation, 2010-2035
Provincial-Municipal

CAD Million	Indirect Tax	Personal Income Tax	Corporate Tax	Sum
Alberta	19806	54533	31152	105491
British Columbia	1914	958	257	3129
Manitoba	383	202	33	617
New Brunswick	67	38	8	113
Newfoundland & Labrador	23	12	5	40
Northwest Territories	7	2	3	12
Nova Scotia	80	45	11	136
Nunavut	1	0	0	2
Ontario	5418	2652	1253	9323
Prince Edward Island	7	3	1	11
Quebec	1498	962	254	2715
Saskatchewan	472	172	117	761
Yukon Territory	2	1	0	3

Table 2.13
Tax Receipt Multipliers with Respect to Initial Outlay – Federal and Provincial-Municipal

CAD Million	Indirect Tax	Personal Income Tax	Corporate Tax	Sum
Alberta	5.96%	9.14%	4.51%	19.62%
British Columbia	0.18%	0.15%	0.03%	0.36%
Manitoba	0.03%	0.02%	0.00%	0.06%
New Brunswick	0.01%	0.00%	0.00%	0.01%
Newfoundland & Labrador	0.00%	0.00%	0.00%	0.00%
Northwest Territories	0.00%	0.00%	0.00%	0.00%
Nova Scotia	0.01%	0.01%	0.00%	0.01%
Nunavut	0.00%	0.00%	0.00%	0.00%
Ontario	0.48%	0.36%	0.15%	0.99%
Prince Edward Island	0.00%	0.00%	0.00%	0.00%
Quebec	0.12%	0.10%	0.03%	0.25%
Saskatchewan	0.04%	0.02%	0.01%	0.07%
Yukon Territory	0.00%	0.00%	0.00%	0.00%

Figure 2.7
Tax Receipts by Province and Type

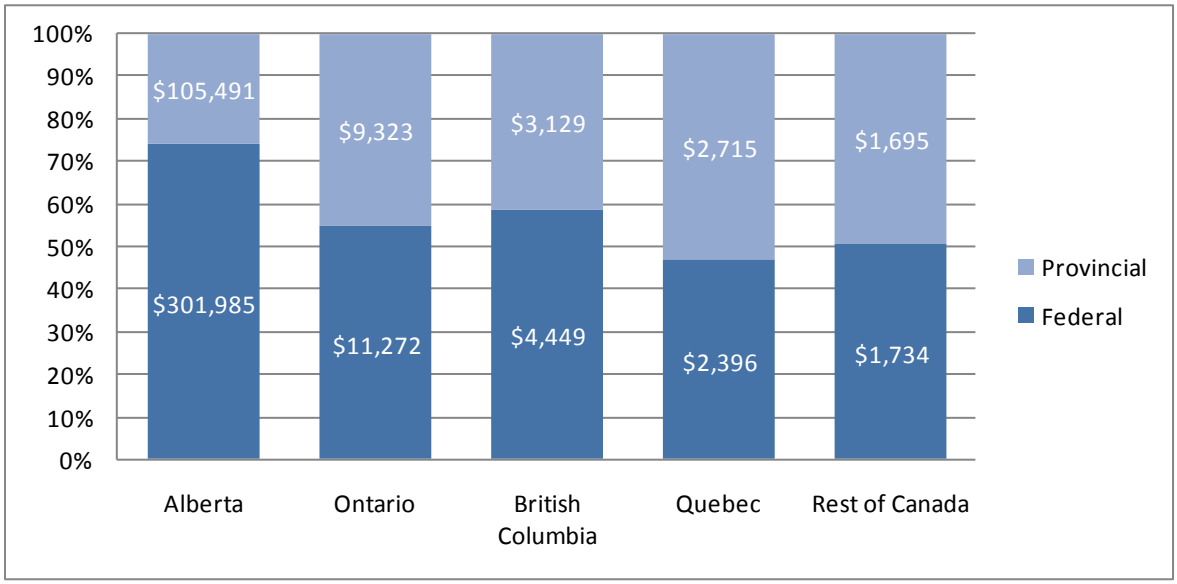
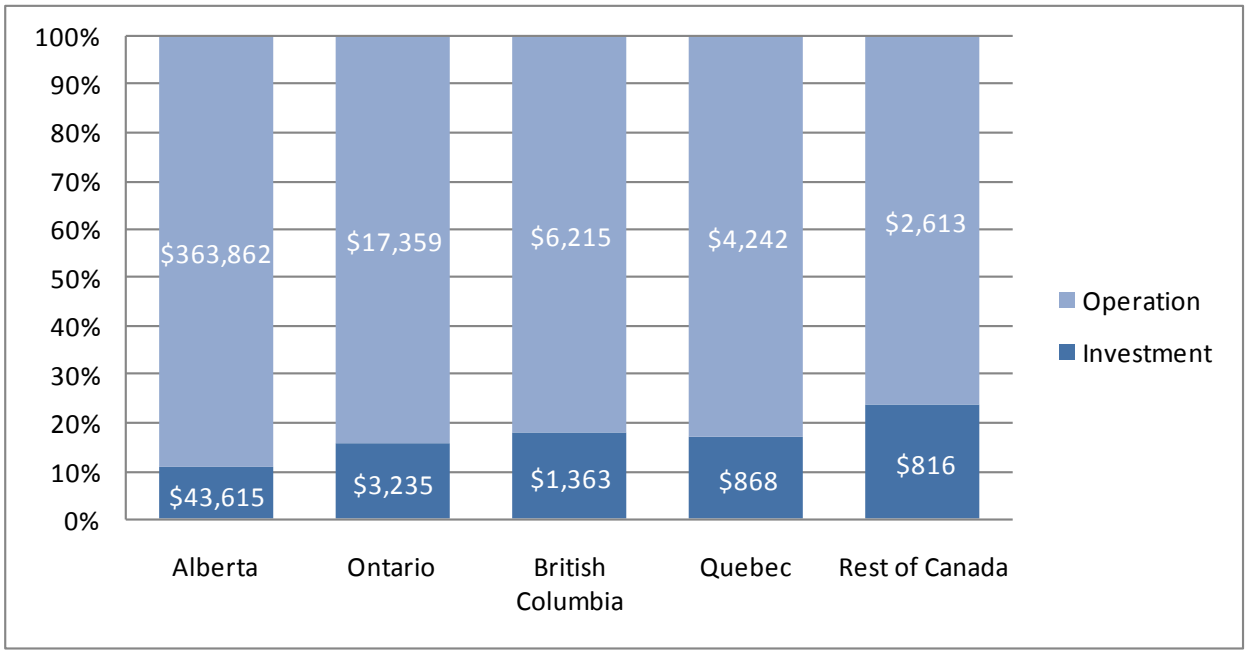


Figure 2.8 shows the split between tax impact of investment and of operations. The tax impact in Alberta is concentrated most heavily in operations, largely because of the greater local sourcing of purchased inputs during the operating phase compared to the investment phase.

Figure 2.8
Tax Receipts by Source and Region



Oil Sands Royalty from New Projects

Projected royalty income from projects that are not yet on stream (new projects) is shown in Figure 2.9. By 2023, projected royalty revenues from these projects will be **$10.3 billion**. By 2035, royalty revenues will grow to about **$36 billion** (Table 2.14). This is slightly higher than the total **$34 billion** provincial revenue forecasted for the 2010-2011 fiscal year in the latest (as of time of writing) provincial budget update.[2] Over the 2010 to 2035 time period, cumulative royalties from new oil sands projects are expected to contribute close to **$350 billion** to provincial revenues.

[2]Government of Alberta. Budget 2010, Third Quarter Fiscal Update 2010-2011. http://www.finance.alberta.ca/publications/budget/quarterly/2010_3rdq/report.pdf (Accessed on May 10, 2011).

Figure 2.9
Royalty Income from New Oil Sands Projects, 2010-2035

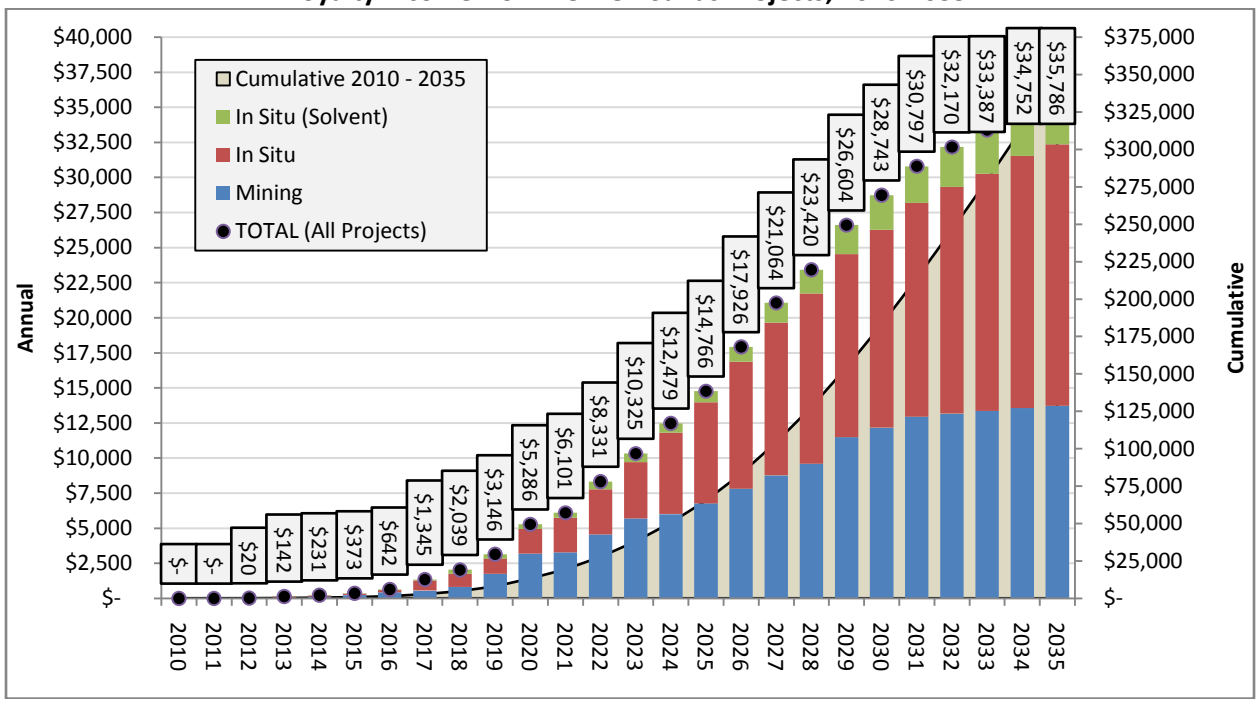


Table 2.14
Royalty Income by Type and Year

$CAD Million	2015	2020	2025	2030	2035
Mining	237	3,186	6,767	12,166	13,732
In Situ	101	1,767	7,205	14,109	18,627
In Situ (Solvent)	36	334	794	2,468	3,427
Total Annual	**373**	**5,286**	**14,766**	**28,743**	**35,786**
Cumulative	**767**	**13,226**	**65,228**	**182,985**	**349,877**

The steepest part of the curve in Figure 2.9 occurs in the mid-2020s. In general, a project begins to pay a relatively modest gross revenue royalty during its pre-payout years; its royalty jumps sharply after achieving payout (including all project costs, capital depreciation, and a return allowance), at which point the royalty is based on the higher of net or gross revenues according to the corresponding rates as established by the Alberta government.

The number of project phases[3] in pre-payout status peaks at 65 in 2023 in CERI's oil sands royalty projection. The number of post-payout project phases climbs each year to reach 116 by the year 2035 because in each year the number of project phases reaching payout exceeds the number of projects ceasing production. The project phases expected to reach payout in the 2023 to 2027 period are:[4]

[3]Please note that we are referring to project phases, not projects per se. An oil sands project might have as many as five or six phases.
[4]The format is Project Name, Company, Phase, Expected Onstream Date.

- Algar Lake (Grizzly) Grizzly Oil Sands Stage 1 - Module 1 2013
- Algar Lake (Grizzly) Grizzly Oil Sands Stage 1 - Module 2 2015
- Axe Lake Oilsands Quest Inc. Commercial 2016
- BlackGold Harvest Operations Corp. Phase 2 2015
- Christina Lake Cenovus Energy Inc. Phase 1e 2014
- Christina Lake Regional Project MEG Energy Corp. Phase 3 a 2016
- Clearwater East Alberta Oilsands Inc. Pilot 2011
- Clearwater West Alberta Oilsands Inc. Pilot 2012
- Cold Lake Imperial Oil Limited CSP Pilot 2013
- Cold Lake Imperial Oil Limited Phases 14-16 2015
- Firebag Suncor Energy Inc. Phase 5 2016
- Firebag Suncor Energy Inc. Phase 6 2016
- Foster Creek Cenovus Energy Inc. Phase 1g 2016
- Foster Creek Cenovus Energy Inc. Phase 1h 2017
- Gemini Koch Industries Phase 1 2014
- Germain Laricina Energy Ltd. Phase 1 2012
- Great Divide Connacher Oil and Gas Limited Expansion 2012
- Hangingstone Japan Canada Oil Sands Ltd. Phase 1 2014
- Harper Sunshine Oilsands Ltd. Phase 1 2014
- Horizon (Mining) Canadian Natural Resources Limited Phase 2 - Tranche 3 2016
- Horizon (Mining) Canadian Natural Resources Limited Phase 3 - Tranche 4 2018
- Jackfish Devon Energy Corporation Phase 3 2015
- Kai Kos Dehseh Statoil ASA Corner 2014
- Kai Kos Dehseh Statoil ASA Corner Expansion 2016
- Kai Kos Dehseh Statoil ASA Leismer Commercial 2012
- Kai Kos Dehseh Statoil ASA Leismer Expansion 2013
- Kai Kos Dehseh Statoil ASA Thornbury 2015
- Kearl Lake Imperial Oil Limited Phase 3 2019
- Kirby (Enerplus) Enerplus Resources Fund Phase 1 2014
- Kirby (Enerplus) Enerplus Resources Fund Phase 2 2019
- Lindbergh Pengrowth Energy Trust Pilot 2012
- Long Lake Nexen Inc. Phase 2 2016
- Long Lake Nexen Inc. Phase 3 2020
- May River Petrobank Energy and Resources Ltd. Phase 1 2012
- Narrows Lake Cenovus Energy Inc. Phase 1a 2016
- Peace River Royal Dutch/Shell Carmon Creek Phase 1 2015
- Peace River Royal Dutch/Shell Carmon Creek Phase 2 2018
- Red Earth North Peace Energy Corp. Pilot Expansion 2012
- Seal Pilot (Baytex) Baytex Energy Trust Phase 1 2011
- Sunrise Husky Energy Inc. Phase 2 2017
- Sunrise Husky Energy Inc. Phase 3 2019
- Taiga OSUM Oil Sands Corporation Phase 1 2014
- Taiga OSUM Oil Sands Corporation Phase 2 2016
- Thickwood/MacKay River Athabasca Oil Sands Corp. Phase 1 2014
- TriStar (In Situ) Value Creation Inc. Pilot 2012
- West Ells Sunshine Oilsands Ltd. Phase 1 2012
- West Ells Sunshine Oilsands Ltd. Phase 2 2013

US Economic Impacts

Investments and operations of the new oil sands projects in Alberta make important contributions to the US economy. In fact, the US economy receives the second largest impact from Alberta's oil sands after Alberta. In this subsection we have quantified the contribution of Alberta oil sands to the US national and state economies in terms of output, GDP, compensation of employees, and employment.

CERI has defined three Scenarios for the US impacts:

a) *I/O Reference*
b) *Upper Bound*
c) *Plausible*

In the *I/O Reference Scenario*, US economic impacts are only estimated based on I/O analysis. As discussed in Chapter 3, I/O analysis assumes that the structure of Canadian and US economies, as well as their interrelationship, remains static. In the case of bitumen trade between Canada and the US, this assumption does not hold. The share of bitumen/SCO export in total production is expected to increase in the future. The base year for I/O tables and the trade flow matrix is 2006; therefore, the I/O projections are influenced by the old trade pattern which is subject to change in the future. Therefore, bitumen exports projection based on a 2006 trade flow table would be an underestimation. CERI addresses this structural change by estimating the high range impact. CERI defines the *Upper Bound Scenario* to account for increased bitumen exports and its impact on the US economy. In this scenario, the new oil sands projects will not only create new jobs through additional demand for US goods and services, but they will also preserve jobs which are currently supported by US crude oils imports from other countries arriving by sea. Since this estimation does not employ the I/O methodology, it does not include spillover import effects from the US to Canada, and vice versa. Imports would moderate the total effect, and therefore this scenario provides an upper bound for the US impact.

Since the *I/O Reference* and *Upper Bound* scenarios represent the lower and upper bounds, respectively, they do not fully capture the impact trajectory that is likely to occur. To provide a more feasible estimation of impacts, CERI developed a mid-range case, called a *Plausible Scenario*. This scenario provides estimations between the *I/O Reference* and the *Upper Bound* scenarios.

Table 2.15 presents the total annual impacts, consisting of indirect and induced for all investments and operations activities in several years for all three scenarios. By increasing the investment and operations of oil sands in Alberta, the impact on the US economy also increases. In 2025, and with regard to the *I/O Reference* scenario**,** $11.9 billion in GDP, due to new oil sands projects in Alberta, will be created in the US. The table also presents the *Upper Bound* and *Plausible* scenarios for GDP and Gross Output. In the *Upper Bound Scenario,* for instance, the impact on US GDP is $41 billion in 2025, but the most *Plausible Scenario*, accounting for the above mentioned problems, estimates **$26.6 billion** GDP impact. Interpretation of Table 2.16 is similar to Table 2.15, with the exception that figures in the second table are cumulative impacts between the start and end years. As a result, 1,085 thousand part-time and full-

time jobs will be created and preserved in the US during the period 2021-2025 according to the *Plausible Scenario*. This figure is 517 thousand person years under the *I/O Reference Case*.[5]

Table 2.15
US Output and GDP Impacts – National

National Gross Output and GDP Impacts ($CAD million)		2011	2015	2020	2025
I/O Reference Case	Output	4,259	9,656	13,901	25,602
	GDP	1,946	4,431	6,438	11,904
Plausible Scenario	Output	4,259	12,670	27,855	57,269
	GDP	1,946	5,829	12,911	26,593
Upper Bound Scenario	Output	4,259	15,684	41,809	88,936
	GDP	1,946	7,228	19,383	41,281

Table 2.16
US Employment Impact - National

National Impacts (Thousand Person Years)	2010-2011	2012-2015	2016-2020	2021-2025
I/O Reference Case	21.2	91.8	262.7	517.3
Plausible Scenario	21.2	124.2	489.3	1085.4
Upper Bound Scenario	21.2	156.6	716.0	1653.4

These three scenarios generate different impacts at the state level. Table 2.17 presents the top ten states that benefit from the Alberta oil sands industry under the above mentioned three scenarios. The composition of the top ten states changes by time and scenario. As expected, the *Plausible* and *Upper Bound* Scenarios highlight the economic impact on states with the closest ties to the Alberta oil sands industry, but the *I/O Reference Case* stresses the induced impacts from big state economies. Also, we see that during 2015 to 2025, as the oil sands projects shift from the construction to the operations phase, the economic impact on states like California, Texas, New York, and Florida decreases as the demand for capital goods declines. Instead, states like Illinois, Wisconsin, Ohio, Washington, and Michigan benefit more.

[5] Note that *total impact* cannot be estimated by adding the *US Upper Bound or Plausible Impact* to *Canadian Impact*. While the *US Upper Bound* and *Plausible* estimations give more weight to bitumen/SCO exports to the US, they also implicitly mean less domestic consumption of bitumen/SCO in Canada. This means fewer impacts for Canada, or low range estimation, which have not been estimated here.

Table 2.17
Top 10 States by GSP Impact

Ranking	I/O Reference Case		Plausible Scenario		Upper Bound Scenario	
	2015	2025	2015	2025	2015	2025
1	California	California	California	Illinois	Illinois	Illinois
2	Texas	Illinois	Illinois	California	California	California
3	Illinois	Texas	Texas	Texas	Texas	Wisconsin
4	New York	New York	New York	Wisconsin	Wisconsin	Texas
5	Ohio	Ohio	Ohio	Ohio	New York	Ohio
6	Florida	Wisconsin	Wisconsin	New York	Ohio	Washington
7	Michigan	Florida	Florida	Washington	Michigan	New York
8	Pennsylvania	Michigan	Michigan	Montana	Florida	Montana
9	North Carolina	Pennsylvania	Pennsylvania	Michigan	Washington	Michigan
10	Wisconsin	Washington	Washington	Florida	Pennsylvania	Florida

Since the *Plausible Scenario* provides a reasonable trajectory between the *I/O Reference Case* and the *Upper Bound Scenario*, we present the results of this scenario in more detail here. The results for *I/O Reference Case* and *Upper Bound Scenario* are presented in Appendix A.

Table 2.18 presents the total economic impact at the state level of investments and operations in the Alberta oil sands industry over 25 years. The table includes both investment and operation phases as well as indirect and induced effects. California, Illinois, Texas, New York, Wisconsin, Ohio, Florida, Michigan, Pennsylvania, and Washington are the top 10 states that benefit more from investments and operations in new oil sands projects. These 10 states receive 60% of the US economic impact. Illinois, Texas, Wisconsin, Washington, Ohio, Michigan, and Pennsylvania are closely involved with Canadian oil sands trade, refining, services incidental to refining, and storage or transportation of oil sands. California, New York, and New Jersey, in addition to the rest of the above states, are big economies which provide capital goods for the oil sands industry in Alberta, or they produce goods and services for final consumption in the US. In our analysis, production of goods and services for final consumption in the US is captured by induced effects. A good example of this type of demand for goods and services could be the demand for home heating fuel oil and fuel for personal vehicles.

Two types of states receive the highest impacts in the US: First are the states with large-scale refining of bitumen or SCO; second are big economies with large manufacturing sectors. As a result of 2,077 billion dollars of initial investment and operations during 2010-2035 in Alberta, **521 billion dollars** of GDP will be created. Employment in the United States (direct, indirect, induced) as a result of new oil sands investments is expected to grow from **21,000 jobs in 2010 to 465,000 jobs in 2035** according to the *Plausible Scenario*. These employees will be compensated 248 billion dollars in terms of wages and salaries for their contribution to the economy. This scenario suggests that as the export of bitumen/SCO to the US increases, Alberta's oil sands will displace US crude oil imports from other sources. Therefore, Canadian oil sands would support more jobs than the I*/O Reference Case* (see Appendix A) projection with a revised trade flow pattern.

Table 2.18: Total Economic Impact of Alberta Oil Sands in US by State, 2010-2035 - *Plausible Scenario*

	$Million		Thousand Person Years
	GDP	Compensation of Employees	Employment
Alabama	5,069	2,522	71
Alaska	1,919	409	9
Arizona	6,675	3,262	84
Arkansas	2,904	1,361	42
California	57,877	26,823	569
Colorado	11,493	5,410	122
Connecticut	6,518	3,195	57
Delaware	1,738	646	14
District of Columbia	1,717	1,055	15
Florida	19,233	9,319	254
Georgia	10,634	5,507	139
Hawaii	1,429	653	20
Idaho	1,547	782	25
Illinois	57,347	27,948	570
Indiana	9,871	4,866	117
Iowa	4,308	1,896	56
Kansas	6,875	3,337	81
Kentucky	4,813	2,355	67
Louisiana	12,481	3,876	93
Maine	1,285	671	22
Maryland	6,561	3,357	78
Massachusetts	10,022	5,632	108
Michigan	17,092	9,001	201
Minnesota	7,943	4,091	98
Mississippi	2,889	1,386	44
Missouri	6,659	3,505	95
Montana	9,926	4,676	101
Nebraska	2,290	1,076	32
Nevada	3,269	1,562	42
New Hampshire	1,731	944	23
New Jersey	13,194	6,682	129
New Mexico	2,355	833	26
New York	28,829	14,516	262
North Carolina	12,210	5,431	140
North Dakota	834	354	12
Ohio	24,145	12,133	277
Oklahoma	5,288	2,151	62
Oregon	6,103	2,861	73
Pennsylvania	15,547	7,979	189
Rhode Island	1,273	624	15
South Carolina	4,427	2,354	68
South Dakota	991	391	15
Tennessee	7,441	3,774	104
Texas	48,585	19,151	441
Utah	2,995	1,447	41
Vermont	677	348	10
Virginia	9,658	4,896	114
Washington	15,270	7,449	163
West Virginia	1,512	731	22
Wisconsin	24,407	11,983	263
Wyoming	1,394	351	10
Total US	**521,250**	**247,565**	**5688**

CERI also presents the US regional impacts to help readers compare figures with different studies. One of them is the US Bureau of Economic Analysis' (BEA) classification of Economic Regions, and the other is the US Department of Energy's (DoE) definition of Petroleum Administration for Defence Districts (PADDs). Tables 2.19 and 2.20 present these classifications for the *Plausible Scenario*.

The BEA Regions are:

- **Far West:** Alaska, California, Hawaii, Nevada, Oregon, and Washington
- **Great Lakes:** Illinois, Indiana, Michigan, Ohio, and Wisconsin
- **Mideast:** Delaware, District of Columbia, Maryland, New Jersey, New York, and Pennsylvania
- **New England:** Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont
- **Plains:** Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota
- **Rocky Mountain:** Colorado, Idaho, Montana, Utah, and Wyoming
- **Southeast:** Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia
- **Southwest:** Arizona, New Mexico, Oklahoma, and Texas

PADDs are:

- **PADD I (East Coast):** Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, Florida, Georgia, North Carolina, South Carolina, Virginia, and West Virginia
- **PADD II (Midwest):** Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, and Wisconsin
- **PADD III (Gulf Coast):** Alabama, Arkansas, Louisiana, Mississippi, New Mexico, and Texas
- **PADD IV (Rocky Mountain):** Colorado, Idaho, Montana, Utah, and Wyoming
- **PADD V (West Coast):** Alaska, Arizona, California, Hawaii, Nevada, Oregon, and Washington

Table 2.19
Total Economic Impact of Alberta Oil Sands by US Economic Region
Plausible Scenario

2010-2035	$CAD Million		Thousand Person Years
	GDP	Compensation of Employees	Employment
Far West region	85,867	39,756	876
Great Lakes	132,863	65,931	1,429
Mideast	67,586	34,235	687
New England	21,506	11,415	237
Plains	29,899	14,650	388
Rocky Mountain	27,356	12,667	300
Southeast	93,272	43,513	1,159
Southwest	62,902	25,398	612
Total US	521,250	247,565	5,688

Table 2.20
Total Economic Impact of Alberta Oil Sands by US PADD
Plausible Scenario

2010-2035	$CAD Million		Thousand Person Years
	GDP	Compensation of Employees	Employment
PADD I	146,766	73,889	1,661
PADD II	180,304	88,861	2,050
PADD III	74,283	29,130	717
PADD IV	27,356	12,667	300
PADD V	92,541	43,019	960
Total US	521,250	247,565	5,688

Table 2.21 presents calculations of potential value added (i.e., additions to GDP) in each US state through oil sands operations and investment. The value added is presented for 2011, 2015, 2020, 2025, 2030, and 2035 for the *Plausible Scenario*. These figures are based on 2010 constant dollars with a parity exchange rate assumption.

Illinois is set to receive the greatest indirect economic impact from oil sands operations and investment in 2025. Illinois is a refining and transportation hub, with pipelines feeding Canadian product throughout the Midwest and into the Eastern seaboard. The many refineries in the Chicago area are gradually being converted to accept heavier slates of crude, making them appropriate for the increased volumes of product that will likely be transported from the oil sands in coming years. A major state like Illinois also sees considerable induced impact from oil sands operations and investment. Other states that will profit on a large scale from the oil sands include California, Texas, Wisconsin, and Ohio.

Washington State is an interesting case. Though it ranks only 14th among US states in Gross State Product (GSP)[6] it is a major refining center and receives the 7th largest value added increase from the oil sands in 2025 (see Table 2.17). Washington will eventually benefit from its position on the Canadian border and import of Canadian crude through the Trans Mountain Pipeline.

[6]See: http://usgovernmentrevenue.com/state_rev_summary.php?chart=Z0&year=2010&units=d&rank=a

Table 2.21: Gross State Product (GSP) by State by Year – *Plausible Scenario*

Value added by state (GSP) ($CAD Million)	2011	2015	2020	2025	2030	2035
Alabama	24.8	61.7	105.4	205.0	253.8	298.5
Alaska	7.4	18.6	32.4	63.1	79.0	93.0
Arizona	30.9	79.5	143.6	283.3	359.3	422.8
Arkansas	13.3	33.6	58.9	115.2	144.2	169.7
California	261.4	670.7	1209.8	2383.8	3020.9	3555.8
Colorado	30.4	119.8	335.7	719.0	1033.5	1221.5
Connecticut	29.3	73.9	129.6	253.5	317.5	373.6
Delaware	6.6	17.9	35.3	71.0	93.0	109.7
District of Columbia	6.1	18.7	42.2	87.3	119.3	140.7
Florida	79.5	213.0	410.1	820.8	1066.8	1256.8
Georgia	44.8	118.0	221.5	440.5	567.1	668.0
Hawaii	5.0	14.9	32.5	66.8	90.4	106.7
Idaho	8.6	20.6	32.8	62.6	75.0	88.0
Illinois	91.7	579.6	2030.6	4476.6	6680.0	7903.2
Indiana	52.2	127.0	209.1	402.5	489.7	575.4
Iowa	22.7	53.9	85.1	161.8	192.6	226.1
Kansas	15.8	71.1	215.8	467.3	681.6	805.9
Kentucky	24.2	59.7	100.9	195.6	241.0	283.3
Louisiana	40.1	125.0	289.0	599.0	824.2	973.1
Maine	5.5	14.6	27.5	54.7	70.5	83.1
Maryland	27.9	74.9	144.3	288.9	375.6	442.5
Massachusetts	48.3	120.6	208.1	405.7	504.3	593.2
Michigan	74.1	212.6	447.3	912.7	1221.7	1440.3
Minnesota	37.4	94.7	167.5	328.6	413.0	485.9
Mississippi	12.5	33.3	63.8	127.3	165.2	194.6
Missouri	30.7	77.7	137.4	269.4	338.5	398.3
Montana	3.3	92.0	405.6	914.7	1404.1	1662.6
Nebraska	10.6	26.7	46.6	91.1	113.9	134.0
Nevada	11.7	32.8	67.3	136.4	181.2	213.6
New Hampshire	9.2	22.2	36.2	69.7	84.4	99.2
New Jersey	53.2	141.8	271.1	541.6	702.1	827.2
New Mexico	11.0	27.2	46.2	89.7	110.9	130.4
New York	118.6	313.7	592.4	1180.5	1523.3	1794.4
North Carolina	59.2	145.3	243.4	470.4	577.1	678.5
North Dakota	4.3	10.5	17.6	34.0	41.7	49.0
Ohio	81.4	276.0	689.8	1452.1	2036.4	2404.6
Oklahoma	24.5	61.1	105.1	204.3	253.7	298.5
Oregon	40.6	90.7	125.3	228.8	250.7	293.1
Pennsylvania	70.0	179.2	322.3	634.5	803.0	945.2
Rhode Island	5.5	14.3	26.7	53.0	68.1	80.2
South Carolina	22.1	54.8	92.9	180.3	222.4	261.5
South Dakota	4.9	12.1	20.4	39.7	48.9	57.5
Tennessee	38.0	92.9	154.2	297.5	363.3	427.0
Texas	200.0	538.7	1046.0	2094.4	2730.3	3217.5
Utah	13.2	34.5	64.5	128.2	164.7	194.0
Vermont	3.3	8.3	14.3	27.9	34.8	40.9
Virginia	40.2	108.0	208.6	417.6	543.3	640.1
Washington	36.2	157.7	470.3	1016.1	1477.6	1747.0
West Virginia	6.4	17.1	32.6	65.1	84.4	99.5
Wisconsin	42.3	252.9	869.2	1912.2	2845.4	3366.1
Wyoming	2.6	13.6	25.7	51.0	65.8	77.6
Total US	**1943.4**	**5829.4**	**12910.6**	**26592.6**	**36149.0**	**42649.0**

Table 2.22 shows the level of employment to each of the 50 US states as a result of oil sands operations and investment for the *Plausible Scenario*. The states that benefit most in terms of value added also see substantial total employment increase. Rates of employment increase rapidly with each passing year. By the end of 2015, California sees the most benefit in the *Plausible Scenario*. According to the Scenario, 6,700 new part-time and full-time jobs will be created between 2010 and 2015 in California. California not only contributes to the construction phase (2010-2015) of oil sands projects by exporting of capital goods, but it is also a big economy and benefits more from the induced impacts of consumption. Illinois sees slightly less benefit in early years, with 6,200 incremental jobs in the period between 2010 and 2015, but receives more benefit than any state by 2025 as Alberta oil sands projects enter into the operational phase (i.e., 48,200 incremental jobs will be created between 2010-2025). In states of this size, induced impacts to the economy provide significant ripple effects, creating employment in numerous industries not directly related to the energy sector.

Texas – an economy that revolves around the oil and gas industry and can offer both refining capacity and equipment to the oil sands – receives a total of 21,400 person years of employment increase by 2025.

Table 2.22: Jobs Created and Preserved – *Plausible Scenario*

Thousand Person Years	2015	2020	2025	2030	2035
Alabama	0.8	1.3	2.5	3.0	3.5
Alaska	0.1	0.2	0.5	0.7	0.8
Arizona	0.9	1.7	3.2	4.1	4.8
Arkansas	0.4	0.7	1.4	1.7	2.0
California	6.7	12.6	25.0	32.2	37.9
Colorado	1.3	3.7	7.8	11.2	13.3
Connecticut	0.7	1.3	2.6	3.3	3.9
Delaware	0.2	0.3	0.7	0.9	1.1
District of Columbia	0.2	0.4	0.9	1.3	1.5
Florida	2.6	4.9	9.6	12.3	14.5
Georgia	1.5	2.6	5.2	6.5	7.7
Hawaii	0.2	0.4	0.8	1.0	1.2
Idaho	0.3	0.4	0.8	0.9	1.1
Illinois	6.2	21.9	48.2	72.0	85.1
Indiana	1.4	2.3	4.5	5.5	6.5
Iowa	0.6	1.0	1.9	2.2	2.6
Kansas	0.8	2.4	5.2	7.5	8.9
Kentucky	0.8	1.2	2.3	2.8	3.3
Louisiana	1.0	2.8	5.9	8.4	9.9
Maine	0.2	0.4	0.7	0.9	1.0
Maryland	0.9	1.6	3.2	4.2	4.9
Massachusetts	1.3	2.2	4.4	5.5	6.5
Michigan	2.4	5.0	10.2	13.5	16.0
Minnesota	1.1	1.9	3.7	4.7	5.5
Mississippi	0.5	0.8	1.6	2.0	2.3
Missouri	1.0	1.7	3.3	4.0	4.7
Montana	1.0	4.4	9.9	15.2	18.0
Nebraska	0.3	0.6	1.1	1.3	1.6
Nevada	0.4	0.8	1.6	2.1	2.4
New Hampshire	0.3	0.4	0.8	1.0	1.1
New Jersey	1.4	2.8	5.7	7.5	8.8
New Mexico	0.3	0.5	1.0	1.2	1.4
New York	3.0	6.0	12.1	15.9	18.8
North Carolina	1.6	2.7	5.2	6.4	7.5
North Dakota	0.1	0.2	0.4	0.5	0.6
Ohio	3.1	7.7	16.1	22.4	26.4
Oklahoma	0.7	1.2	2.3	2.8	3.3
Oregon	1.0	1.4	2.6	2.8	3.3
Pennsylvania	2.1	3.7	7.2	9.0	10.6
Rhode Island	0.2	0.3	0.6	0.8	0.9
South Carolina	0.7	1.2	2.3	2.7	3.2
South Dakota	0.2	0.3	0.5	0.6	0.7
Tennessee	1.2	1.9	3.6	4.3	5.0
Texas	5.1	10.5	21.4	28.6	33.7
Utah	0.4	0.8	1.5	1.9	2.3
Vermont	0.1	0.2	0.4	0.4	0.5
Virginia	1.2	2.3	4.7	6.1	7.1
Washington	1.7	5.1	11.1	16.0	19.0
West Virginia	0.2	0.4	0.8	1.0	1.2
Wisconsin	2.9	9.5	20.9	30.9	36.6
Wyoming	0.1	0.2	0.5	0.6	0.8
Total US	**63.5**	**140.8**	**290.1**	**394.5**	**465.5**

Figure 2.10 shows the employment status during 2010-2035. The employment in early years is low and is even declining until 2013 as the projects shift from investment phase to operations. In the early years, the number of jobs created at the operation phase is less than the number of jobs lost at the investment phase, due to completion of construction. Therefore, total employment has a declining trend in the first three years. After that we observe a growing trend in employment. A positive difference between employments in two consecutive years indicates new job creation, while a negative difference means job loss.

Figure 2.10
Jobs Created and Preserved in the US, 2010-2035
(x 1,000)

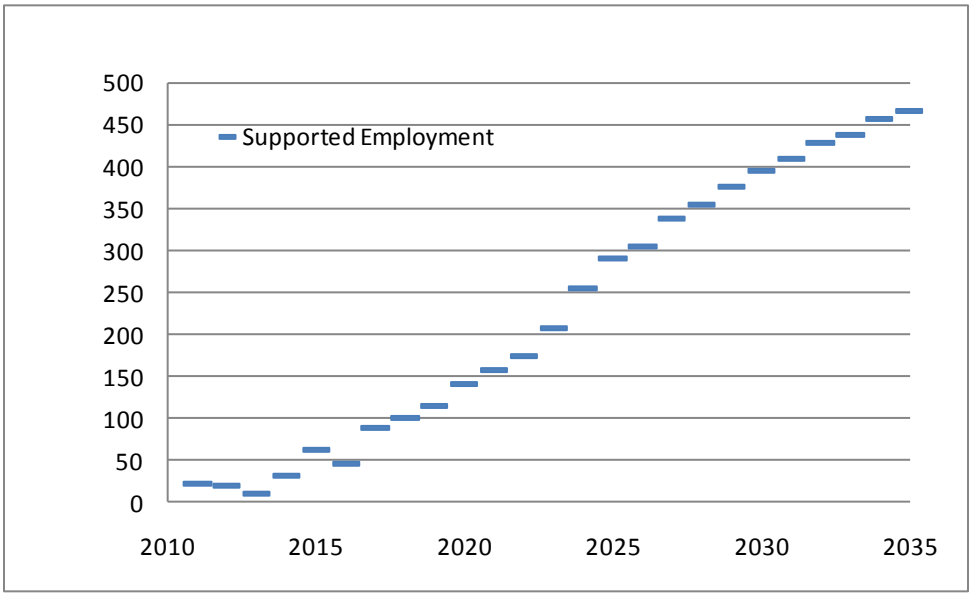


Figure 2.11 illustrates relative GDP impacts state by state as a result of investment in the Alberta oil sands; the states with the largest impacts are depicted in the strongest colours. States like California, Texas, New York, and Illinois experience the greatest economic impacts, being heavily industrialized with large populations. These states are the main suppliers of imported capital goods for the oil sands industry in Alberta. Figure 2.12 illustrates the same concept as Figure 2.11 but refers to oil sands operations. States like Illinois, Ohio, Wisconsin, Michigan, and Washington are highlighted in addition to heavily industrialized states like California, Texas, and New York. These states see higher impacts because of their close ties with the Canadian energy industry. Figures 2.11 and 2.12 are consistent with the statistics presented in Tables 2.19 and 2.20.

Figure 2.11
Impact of New Investment in Alberta's Oil Sands Projects, State by State Over 25 Years

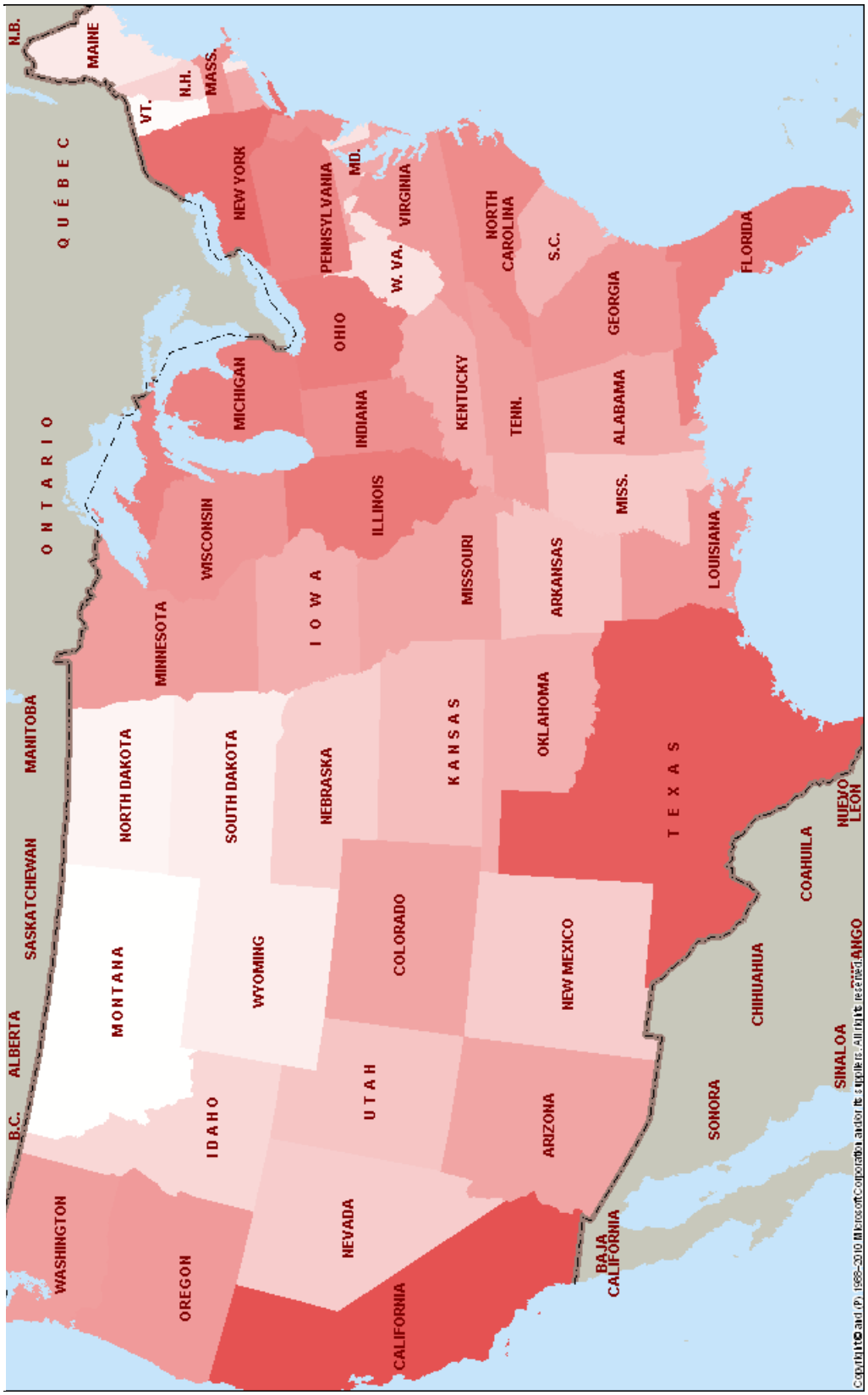
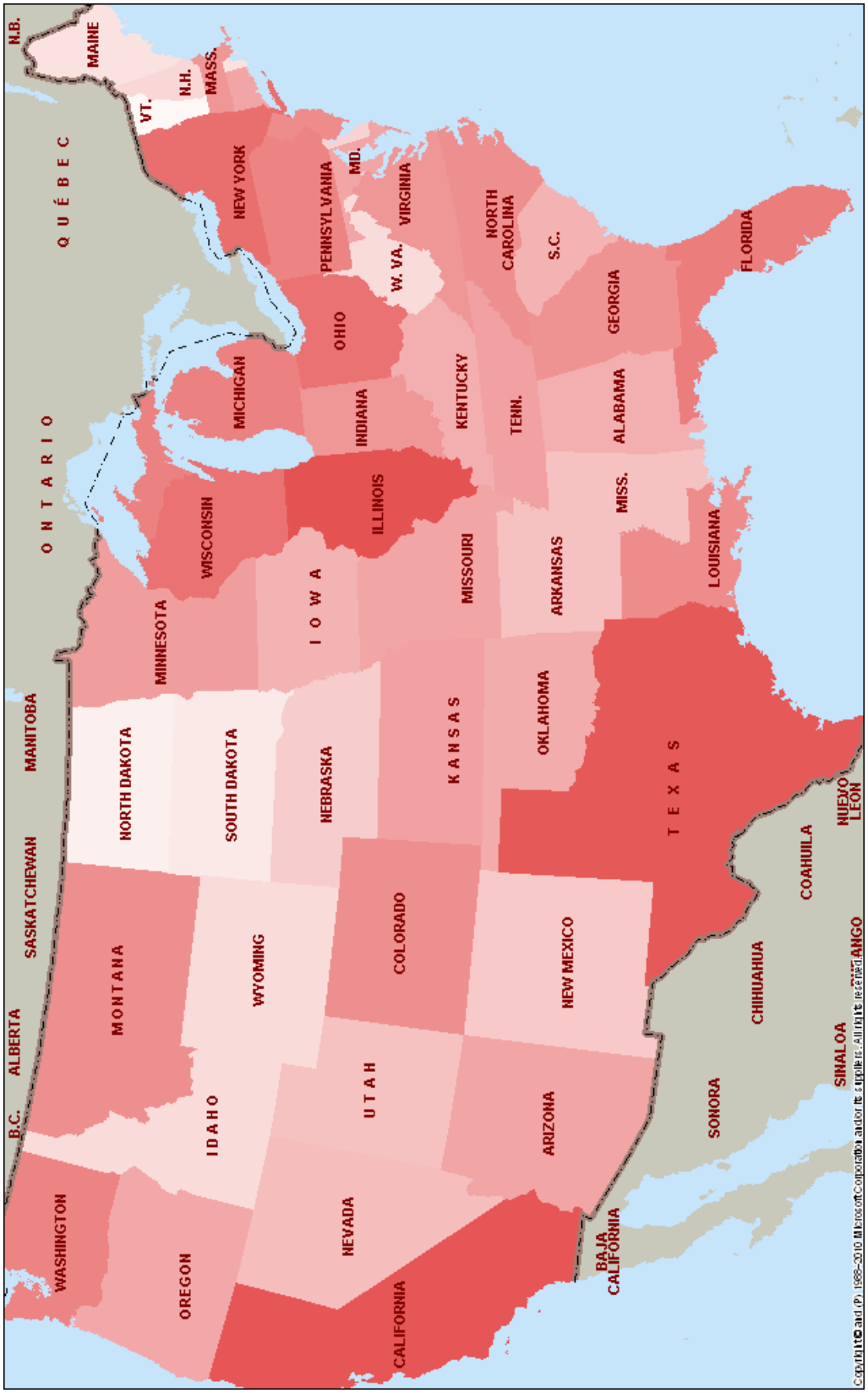


Figure 2.12
Impact of New Operations in Alberta's Oil Sands Projects, State by State Over 25 Years



Chapter 3
Input-Output Methodology

What is an Economic Input-Output Model?

W. Leontief [1937] describes the Input-Output (I/O) model as a computable version of Walras General Equilibrium; this model is more often linked to classical theories, such as those of Quesnay's Tableau Économique and Marx's reproduction equations. The focus on the entire economy gives I/O analysis a macroeconomic flavour, but its technique and foundations are more microeconomic. The production and consumption functions are derived from microeconomic analysis. Therefore, some people argue that I/O is at the interface of the two and categorize it as "mesoeconomics".[1]

In Canada, the first national I/O table was published in 1969 for the reference year 1961. After 1996 Statistics Canada improved the provincial and economic statistics by using sub-national surveys and other improved sources and methods. The reliability of the tables was improved beginning with the reference year 1997. Since 1997, the Input-Output and the interprovincial trade flow tables have been compiled and published annually for each province and territory in Canada. The national level I/O table is the simple aggregation of the provincial and territorial tables. After 1996, industries in the I/O tables were classified using the North American Industry Classification System (NAICS).

I/O accounts consist of three tables: Make (output), Use (input), and Final Demand. They are available at four different levels:

1. **W**orksheet level: includes 299 industries, 170 final demand categories, and 725 commodities
2. **L**ink level: includes 113 industries, 120 final demand categories, and 476 commodities
3. **M**edium level: includes 64 industries, 37 final demand categories, and 109 commodities
4. **S**mall level: includes 25 industries, 13 final demand categories, and 57 commodities

At the **W**, **L,** and **M** levels of detail, some of the entries in national matrices are confidential. Consequently, data are provided to users after suppressing the confidential information at the **S** level.

The Final Demand table shows transactions in goods and services for final use in the economy, as well as for all exports (irrespective of whether those exports are reserved for final demand elsewhere). A transaction is considered to be for final use if the good or service is exported or purchased for final consumption or capital investment. While purchases by households (other than housing itself) are considered to be final use, businesses, government, and other entities purchase services and commodities both for final and intermediate uses. Their intermediate purchase is reflected in the Use table and their final use appears in the Final Demand table.

[1] The term is a combination of "meso" which means "middle" and "economics".

The Use table presents the intermediate purchases by industries for production of their goods and services. Such purchases are non-capital expenditures of the industries, and include property tax, indirect taxes, wages and salaries, and subsidies.

The Make table records the values of production of goods and services in each industry. The term industry covers all entities in the economy except for households.

The following simple equation illustrates the relationship between the products in the I/O matrices:

Products in Make matrix = Products in Use matrix + Products in Final Demand matrix

Impact Analysis Modeling

Any activity that leads to increased production capacity in an economy has two components: construction (or development) of the capacity, and operation of the capacity to generate outputs. The first component is referred to as investment, while the second is either production or operation. Both activities affect the economy through purchases of goods and services, as well as labour. Figure 3.1 illustrates the overall approach CERI uses to assess economic impacts resulting from these activities.

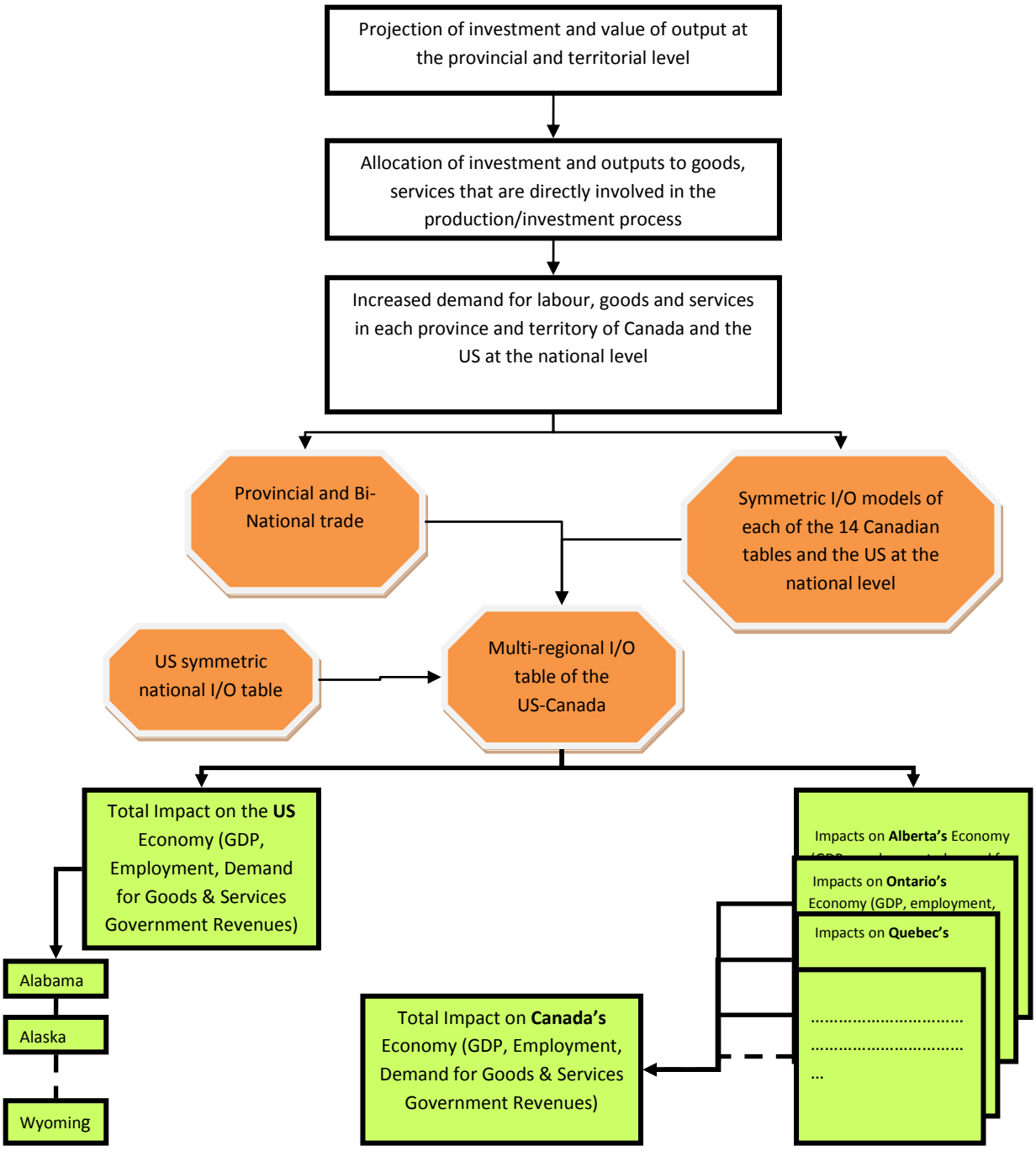
The first step is to estimate and forecast the value of investment (i.e., construction or development expenditure) and production (sales). The total investment or development expenditures are then disaggregated into purchases of various goods and services directly involved in the production process (i.e., manufacturing, fuel, business services, etc.) as well as labour required, using the expenditure shares. Similarly, the value of total production (output or sales) from a production activity (i.e., conventional oil production, petroleum refinery, etc.) is allocated to the purchase of goods and services, payment of wages, payments to government (i.e., royalty and taxes), and other operating surplus (profits, depreciation, etc.).

The forecasted values of investment and production are then used to estimate demand for the various goods and services, and labour used in both development and production activities. These demands are met through two sources: (i) domestic production, and (ii) imports. Domestic contents of the goods and services are calculated using Statistics Canada's (StatsCan) data.

The estimated bi-national trade flow tables, developed by CERI, are used to derive import or export of each type of good and service for all 15 provinces and territories in Canada (including Government Abroad) and the United States (US) at the national level. The value of goods and services used by a particular industry and produced in a different province or territory in Canada (or a state in the US) can then be calculated. This method captures the trade supply chains among all trading partners in Canada and the US, as well as their feedback effects. The latter are changes in production in one region that result from changes in intermediate and final demand in another region, which are in turn brought about by demand changes in the first region.

In this exercise, the investment and operation dollars are initially determined on a project basis. For example, in the case of the oil sands industry, the dollars are allocated to Mining and Extraction, In Situ, Integrated Mining and Upgrading, and the Stand-Alone Upgrading categories. Investment and operations spending stimulate Alberta's economy in various sectors simultaneously, including the Oil Sands, Construction, Refinery, and Manufacturing sectors. The relationship between the oil sands and the pipeline and refining industries is captured in the base economy, and thus inducement on the supply side results in impacts on these industries. Investment in Alberta also impacts the US economy; these impacts can be identified at the sector level. The US Bureau of Economic Analysis (USBEA) data is used to link these impacts at both the state and industry levels in the US. Thus, refinery upgrades required in order to handle heavier oil sand crudes are not reflected by the model, but generic refinery upgrades are implicitly accounted for in the indirect impact of investment in oil sands development upon activity in the refinery sector (both in Canada and the US). No direct shocks are made to the US sectors.

Figure 3.1
Overall Bi-National Multi-Regional I/O Modeling Approach



CERI's US-Canada Multi-Regional I/O Model (*UCMRIO 2.0*)

This section discusses the multi-stage process to build the *UCMRIO 2.0* model. An earlier version of the model was developed in 2008, as a Multi-regional I/O model for the US and Canada for examining the economic impacts of the Canadian petroleum industry on Canada's provinces and territories. CERI's *UCMRIO 2.0* model builds on the Multi-regional I/O model for Canada. The models' structures are defined in the System of National Accounts (SNA) terminology as industry-by-industry, or "industry technology", and share the following advantages:

- Compatibility with economic theory;
- Recognition of the institutional characteristics in each industry;
- Preservation of a high degree of micro-macro link;
- Maximization of the use of detailed information from the Supply (Make) and Use Tables (SUTs);
- Comparability with other types of statistics; and
- Transparency of compilation method, resource efficiency, support for a wider and more frequent compilation of input-output tables internationally.

Further, the *UCMRIO 2.0* is different from its predecessor in the following aspects:

- The I/O tables have been updated to the most recent available base year of 2006; the previous update was from 2003 data. In particular, the oil and oil sands industries have been adjusted to represent more current conditions. In the new model, the manual method of constructing I/O tables was replaced by using the *balanced symmetrical I/O* tables from StatsCan. This provides consistency between provincial I/O tables and interprovincial trade flow matrix. The ultimate source of all *UCMRIO 2.0* input-output tables and trade flow matrix is StatsCan.
- The new model also includes a new provincial table, labelled as Government Abroad,[2] which accounts for the impacts of Canadian military bases, commercial offices, and embassies abroad, on the Canadian economy.
- The trade flow matrix has been enhanced, thus allowing for more accurate mapping of the trade relations between Canadian provinces and the US. For instance, the oil sands industry, which is one of the industries in the Canadian I/O tables, does not exist in the US tables. Therefore, during mapping of the trade flow matrix, it was verified that Alberta's exports of oil sands were delivered to refineries in the US, rather than to a non-existent US oil sands industry. Mapping the trade flow represents a significant improvement in the model and it is an important contribution to ensure that the appropriate provinces/states and industries are impacted. Better mapping of the energy industry trade flows creates better mapping of the impacted sectors, and regions in Canada and the US.

Overall, the model formulation and approach have been enhanced to capture the relations among various sectors and local economies of different regions with increased precision. This set of procedures

[2]Government Abroad includes activities that are part of the Canadian economy but do not have a natural and unambiguous spatial boundary. They are classified as a fourteenth region, for purposes of provincial and territorial input-output tables. Examples include activities of Canadian embassies, the armed forces stationed abroad, and activities relating to offshore oil and gas extraction. These activities form a part of Canadian GDP, but are not assigned to any of the 13 provinces and territories.

is well documented, frequently cited, and commonly practiced in I/O literature. The new model's structure is similar to the old version, however this latest edition of CERI's I/O model allows for more flexibility, representing a more accurate picture and improved final results.

Building the Model

The following steps show how the bi-national *UCMRIO 2.0* has been developed, and how one can trace direct, indirect, and induced effects of the Canadian energy sector on the Canadian and US economies. The model provides insights at the provincial level for Canada and at the state level for the US.

Compilation of the bi-national *UCMRIO 2.0* has the following steps:

1. StatsCan provides S level Symmetrical I/O tables (SIOTs) and Final Demand tables for 13 provinces and territories plus Government Abroad. Therefore, there are 14 regional tables for Canada plus one national table. Provincial data are only available at the S level due to confidentiality of more disaggregated data for some sectors in various provinces. The I/O tables used are at *producer's prices*, meaning that CERI did not construct symmetrical tables from the Use and Make tables as the compiled tables were available. The base year for the I/O tables is 2006.[3]
2. SIOTs are balanced, so the use of inputs in the economy is equal to the production of outputs.
3. The US national Use and Make tables (2006) were sourced from the USBEA. These tables are at *producer's price*, and consist of 67 sectors and 13 final demand categories. CERI compiled the US SIOT table and carefully combined industry sectors in order to arrive at 29 industry sectors, consistent with Canadian S level aggregation.

   The intermediate and final demand part of the US SIOT table is constructed as follows:

   $$B=V(\text{diag}(q-m))^{-1}U \text{ and } F=V(\text{diag}(q-m))^{-1}Y$$

   Where,

   B: Transformed intermediate part of use table to symmetric I/O table
   F: Transformed final demand part of use table for symmetric I/O table
   V: Transpose of make table excluding imports
   U: Intermediate demand part of use table
   Y: Final demand part of use table
   q: Vector of total supply of products
   m: Vector of imports by products
   diag(q-m): Matrix with q-m on the diagonal

   By using these equations, the rectangular commodity by industry Use and Make tables are transformed to a symmetrical square I/O table and its corresponding final demand matrix.

[3]Use tables show the inputs to industry production and commodity composition of final demand. Make tables show the commodities that are produced by each industry.

4. In order to highlight the energy sectors in the US and Canadian provincial SIOTs, CERI disaggregated the "Mining and Oil and Gas Extraction'' industry to five subsectors including: Conventional Oil, Oil Sands, Natural Gas and LNG, Coal, and Other Mining. In the same fashion, the manufacturing sector is broken into Refinery, Petrochemical, and Other Manufacturing.
5. Whereas the trade flow between Canadian provinces and territories is provided by StatsCan, the trade flow pattern between the individual provinces and the US is not available. The data was gathered from a variety of sources and compiled by CERI into a trade flow pattern between the two countries. CERI is confident that the developed mapping portrays an accurate trade flow pattern, which is crucial for generating a credible impact analysis for the US in particular.
6. In the *UCMRIO 2.0*, an exchange rate is needed in order to link data from US and Canada to a common currency. We use the average exchange rate between the US and Canadian dollar for the base year 2006 to convert the trade flow matrix to Canadian dollars. However, parity is assumed for the exchange rate projection (see section on Exchange Rates in Chapter 2).
7. We combine 15 SIOTs (13 provincial tables, 1 for Government Abroad and 1 for the US at the national level) to compile one bi-national I/O matrix. The bi-national matrix is then merged with the trade flow matrix, and inverted to generate direct, indirect, and induced effect multipliers (see section on Multipliers).

Industries in the *UCMRIO 2.0*

The classification of industries in both the US and Canada is identical. Table 3.1 provides a brief description of these sectors or commodities.

Table 3.1
Sectors/Commodities in CERI US-Canada Multi-Regional I/O Model

Serial No.	Sector or Commodity	Examples of activities under the sector or commodity
1	Crop and Animal Production	Farming of wheat, corn, rice, soybean, tobacco, cotton, hay, vegetables and fruits; greenhouse, nursery, and floriculture production; cattle ranching and farming; dairy, egg and meat production; animal aquaculture
2	Forestry and Logging	Timber tract operations; forestry products: logs, bolts, poles and other wood in the rough; pulpwood; custom forestry; forest nurseries and gathering of forest products; logging.
3	Fishing, Hunting and Trapping	Fish and seafood: fresh, chilled, or frozen; animal aquaculture products: fresh, chilled or frozen; hunting and trapping products
4	Support Activities for Agriculture and Forestry	Support activities for crop, animal and forestry productions; services incidental to agriculture and forestry including crop and animal production, e.g., veterinary fees, tree pruning, and surgery services, animal (pet) training, grooming, and boarding services

Serial No.	Sector or Commodity	Examples of activities under the sector or commodity
5	Conventional Oil[4]	Conventional oil, all activities e.g., extraction and services incidental to conventional oil
6	Oil Sands	Oil sands, all activities e.g., extraction and services incidental to oil sands
7	Natural Gas and NGL	Natural gas, NGL, all activities e.g., extraction and services incidental to natural gas and NGL
8	Coal	Coal mining, activities and services incidental to coal mining
9	Other Mining	Mining and beneficiating of metal ores; iron, uranium, aluminum, gold and silver ores; copper, nickel, lead, and zinc ore. Mining; non-metallic mineral mining and quarrying; sand, gravel, clay, ceramic and refractory, limestone, granite mineral mining and quarrying; potash, soda, borate and phosphate mining; all related support activities
10	Refinery	Petroleum and coal products; motor gasoline and other fuel oils; tar and pitch, LPG, asphalt, petrochemical feed stocks, coke; petroleum refineries
11	Petrochemical	Chemicals and polymers: resin, rubber, plastics, fibres and filaments; pesticides and fertilizers; etc.
12	Other Manufacturing	Food, beverage and tobacco; textile and apparel; leather and footwear; wood products; furniture and fixtures; pulp and paper; printing; pharmaceuticals and medicine; non-metallic mineral, lime, glass, clay and cement; primary metal, iron, aluminum and other metals; fabricated metal, machinery and equipment, electrical, electronic and transportation equipment, etc.
13	Construction	Construction of residential, commercial and industrial buildings; highways, streets, and bridges; gas and oil engineering; water and sewer system; electric power and communication lines; repair construction
14	Transportation and Warehousing	Roads, railways; air, water & pipeline transportation services; postal service, couriers and messengers; warehousing and storage; information and communication; sightseeing & support activities
15	Transportation Margins	Transportation margins
16	Utilities	Electric power generation, transmission, and distribution; natural gas distribution; water & sewage
17	Wholesale Trade	Wholesaling services and margins
18	Retail Trade	Retailing services and margins
19	Information and Cultural Industries	Motion picture and sound recording; radio, TV broadcasting and telecommunications; publishing; information and data processing services

[4]Statistics Canada reports the oil, gas, coal, and other mining as one sector due to some confidentiality issues. CERI uses an in-house developed approach to disaggregate this sector into to five sectors: oil sands, conventional oil, natural gas + NGL, coal, and other mining.

Serial No.	Sector or Commodity	Examples of activities under the sector or commodity
20	Finance, Insurance, Real Estate and Rental and Leasing	Insurance carriers; monetary authorities; banking and credit intermediaries; lessors of real estate; renting and leasing services
21	Professional, Scientific and Technical Services	Advertising and related services; legal, accounting and architectural; engineering and related services; computer system design
22	Administrative and Support, Waste Management and Remediation	Travel arrangements and reservation services; investigation and security services; services to buildings and dwellings; waste management services
23	Educational Services	Universities; elementary and secondary schools; community colleges and educational support services
24	Health Care and Social Assistance	Hospitals; offices of physicians and dentists; misc. ambulatory health care services; nursing and residential care facilities; medical laboratories; child and senior care services
25	Arts, Entertainment and Recreation	Performing arts; spectator sports and related industries; heritage institutions; gambling, amusement, and recreation industries
26	Accommodation and Food Services	Traveler accommodation, recreational vehicle (RV) parks and recreational camps; rooming and boarding houses; food services and drinking establishments
27	Other Services (Except Public Administration)	Repair and maintenance services; religious, grant-making, civic, and professional organizations; personal and laundry services; private households
28	Operating, Office, Cafeteria and Laboratory Supplies	Operating supplies; office supplies; cafeteria supplies; laboratory supplies
29	Travel, Entertainment, Advertising and Promotion	Travel and entertainment; advertising and promotion
30	Non-Profit Institutions Serving Households	Religious organizations; non-profit welfare organizations; non-profit sports and recreation clubs; non-profit education services and institutions
31	Government Sector	Hospitals and government nursing and residential care facilities; universities and government education services; other municipal government services; other provincial and territorial government services; other federal government services including defence

US-Canada Trade Table and Model Structure

This section discusses the construction of the trade flow matrix, an important component to the modeling process. The trade flow matrix connects the US I/O table to the Canadian I/O tables, and depicts a trading pattern between each Canadian province or territory and the US. The trade flow table for *UCMRIO* depicts the export/import flows of each Canadian province with the US and with each other. In particular, the Alberta trade flow table shows the import (export) flows of Alberta from (to) other Canadian provinces and territories, as well as the US. It is important to mention that the industry

specification of this table is the same as SIOTs, and thus covers the trade flows among all sectors of the economies.

The following is a brief discussion of the modeling.

Based on a standard I/O model notation, and considering total gross outputs vector (**X**), and final demand vector (**FD**), the following relationship in I/O context holds as:

$$\mathbf{AX+FD = X \rightarrow (I-A)X=FD \rightarrow \ X= (I-A)^{-1}FD \rightarrow \ X= L.FD}$$

Where; **A** is the matrix of input coefficients (n×n), **I** is identity matrix (n×n) and **L** is the Leontief inverse matrix (n×n). This is the core formula of the Leontief quantity model. This relationship estimates direct and indirect impacts for a single economy (i.e. no trade flow). We can expand this model to include induced effects by endogenising the most important component of local final demand, namely private consumption. This captures the economic impact of increased consumption due to earned wages from new jobs. After endogenising the private consumption expenditure we arrive at the following relationship:

$$\mathbf{X= (I-A-PCE)^{-1}FD^*}$$

We use **PCE** for private consumption expenditure matrix and **FD*** for the exogenous part of the final demand.

We can extend the model to involve other economies (regions) by incorporating the interregional trade flow matrix **C**(n×n). After several steps of calculation, we arrive at the final interregional formula:

$$\mathbf{X= (I-C.A-C.PCE)^{-1}C.FD^*}$$

In order for the above equation to have a finite solution, (I-C.A-C.PCE) must be a nonsingular matrix.[5] As is the case for standard I/O models, the impact of an industry, such as the oil sands industry, is calculated by modeling the relationship between total gross outputs and final demand as follows:

$$\mathbf{\Delta X= (I-C.A-C.PCE)^{-1}C.\Delta FD^*} \qquad \textbf{(Equation 1)}$$

Where:

ΔX -- Changes (or increases) in total gross outputs of the US and all provinces and territories, at the sectoral level, due to construction and operation of projects (i.e., oil sands). Dimension n=465 so this vector is a 465×1 vector.

I – is a 465×465 identity matrix, unity for diagonal elements and zero for off-diagonal elements.

[5]For further information on Interregional I/O analysis please see Hertwich and Peters (2010), Miller and Blair (2009), CERI Study No. 120 (2009), Oosterhaven and Stelder (2008), and Sim, Secretario, and Suan (2007).

A – is a 465×465 block diagonal matrix of technical coefficients at the sectoral level for the US and Canada. It is composed of 15 blocks so that each block is a 31×31 matrix corresponding to the US and each province's (or territory`s) input technical coefficient matrix.[6] An element of such a matrix is derived by dividing the value of a commodity used in a sector by the total output of that sector. The element represents requirements of a commodity in a sector in order to produce one unit of output from that sector.

PCE – is a 465×1 vector at the sectoral level for Canada and the US. Each of its elements measures the private consumption expenditure share of a sector's total gross output by jurisdiction (province, territory or the US).

C – is a 465×465 transposed matrix of multiregional trade coefficients. It includes import and export shares of a sector's total output in the US and province or territory. Each element on the row of this matrix measures the share of export to a particular sector in the US or a province from a given sector in another province or territory or the US.[7]

ΔFD* – is a 465×1 vector of changes (or increases) in the exogenous part of final demand at the sectoral level. Outputs from Canada and the US resulted from any change in the final demand components in the US or any province or territory, including commodities directly demanded (or purchased) for the construction and development of any sector.

The calculation of total impact is based on the multiplication of direct impact and the inverted matrix. Based on the direct impact on a sector, Equation 1 above is used to estimate all the direct, indirect, and induced effects on all sectors in all provinces, particularly in terms of changes in consumption, imports, exports, production, employment, and net taxes. The direct impact is referred to as Δ**FD*** in Equation 1. The change in final demand (Δ**FD***) consists of various types of investment expenditures, changes in inventories, and government expenditures. In the current model, the personal expenditures are not part of the final demand and have been endogenised to accommodate the induced impact.

Direct impacts are quantitative estimations of the main impact of the programs, in the form of an increase in final demand (increase in public spending, increase in consumption, increase in infrastructure investment, etc). The assumption of increased demand includes a breakdown per sector, so that it can be translated into the following matrix notation:

Direct, indirect, and induced impacts:

$$\Delta X = (I - C.A - C.PCE)^{-1} C.\Delta FD^* \qquad \text{(Equation 2)}$$

[6] In other words, one can say all 14 Canadian tables (13 provinces and 1 Government abroad) and one US input technical coefficients matrices are stacked together in construction of a diagonal block matrix at the national level.

[7] In particular, this matrix is a bridge matrix which connects the US, or any province, to other provinces through import and export coefficients. See Miller and Blair (2009).

Direct and indirect impacts:

$$\Delta X = (I-C.A)^{-1}C.\Delta FD \qquad \text{(Equation 3)}$$

The difference between Equation 2 and 3 is referred to as the induced impact of any changes in final demand components.

Once the impact on output (change in total gross outputs) is calculated, the calculation of impacts on GDP, household income, employment, taxes, and so forth, are straightforward. In particular, as previously mentioned, the base year for the I/O tables used in this report is 2006. CERI utilizes the tax information derived from these tables and federal and provincial tax information from the *Finances of the Nation*, where these numbers reflect the tax structure of the Canadian economy in the year 2006.[8] CERI acknowledges that there have been changes, and there would be imminent changes to the corporate income tax structure and the goods and services sales tax (GST) since 2006. The new tax regime will result in changes in estimated tax figures as business responds to the new incentives. Therefore tax estimates should be interpreted on a 2006 basis.

These impacts are estimated at the industry level using the ratio of each (GDP, employment, etc.) to total gross outputs. Using the technical Multi-Regional I/O table, CERI is able to perform the usual I/O analysis at the provincial and national levels.

Disaggregation of National Results for the US

To report the US economic impacts down to the state level, CERI constructed a series of disaggregating coefficients. This process allows CERI to illustrate the economic impacts of the oil sands developments in Canada, on each US state's economy.

The USBEA publishes detailed information on the sectoral GDP, employment, and compensation of employees for the US states.[9] **CERI used the base year data (year 2006)** to establish a series of coefficients to disaggregate the national figures to state levels. For instance, to disaggregate national agricultural GDP among all states, CERI uses a set of 51 share coefficients, one for each state and the District of Columbia, in order to disaggregate the national numbers. It is evident that the sum of these coefficients is equal to unity and they depict the share of each state in the GDP of the US economy.

This approach, which has been used in *UCMRIO 1.0,* is not without its flaws. The main concern was that the model splits the impact of the Canadian Energy Industry (Oil Sands, Conventional Oil, and Natural Gas) among the US states based on only the size of their economies. As a result, large economies such as California, Texas, New York, and Florida will be affected more than the rest of the states, and impacts on states like Illinois, Michigan, Ohio and Washington, which are smaller but have the larger share of the total US-Canada energy trade, will be understated. CERI was able to address this problem in the new *UCMRIO 2.0.*

[8] Canadian Tax Foundation; Finances of the Nation; 2006, 2007 and 2008.
[9] See http://www.bea.gov/regional/gsp and http://ww.bea.gov/regional/spi.

In *UCMRIO 2.0,* we employed a disaggregation method, which provides impacts for the states with the strongest ties to the Canadian energy sector through identifying who are the main Canadian partners among the US states. In particular, we map the supply of capital goods and services from the US states to the Canadian energy industry, as well as demand for Canadian natural gas and oil by state. As a result, CERI was able to disaggregate the indirect impacts of the Canadian energy sector on the US economy. For the induced effects in the US, we assume that the income earned by US employees who work for businesses that are involved with the Canadian oil and gas industry will be spent on commodities that will be produced uniformly throughout the US. Following this procedure, we use the relevant share coefficients to estimate the sectoral employment, and compensation of employees.

Interpretation of the US Impacts

The impacts of the Canadian Energy Sector on the US economy consist of the amount of GDP, employment, government revenue, household income, and export volumes that is generated in the US as a result of new spending, or export in the Canadian energy sector. For example, one additional dollar in Canadian oil sands production which will be consumed in Canada or the US requires inputs from other linked industries and primary input sources like labor and capital. These input sources and linked industries are either in Canada or the US.[10] The linked industries in the US also require inputs from other linked industries in Canada and the US in order to produce goods and services that were demanded in the first place. There will be further subsequent rounds of spending, and this will continue with the amount of money circulating getting smaller at each successive round of activity as money leaks out of the economy in the form of savings and imports, until the amount of money circulating in the economy as a result of the initial energy spending becomes negligible. However, during this process, jobs will be created in the US, and income earned from these jobs will be spent on all sorts of commodities. As a result, the impact on the US economy is the result of the initial one dollar of gross output in Canada.

The model assumes that a fraction of the new Canadian oil sands production will be imported by US refiners. Thus, newly produced Canadian barrels either displace a fraction of the US import of crude oil from the rest of the world or constitute a supply that prevents US refining capacity from having to lie idle. In the latter case, the imported barrels from Canadian oil sands will create and/or support part of the GDP, jobs, etc., currently supported by the imported oil from other origins. This replacement support is not captured by the conventional I/O analysis to the full extent. The fixed economic structure of I/O tables in base year 2006 constrains the magnitude of impact. It implies that the marginal response of the US industries as a result of oil sands production in Alberta is equivalent to the average relationship observed in the base year. CERI predicts that Canadian oil sands could essentially replace US imports of foreign oil from the rest of the world. This means more oil trade between Canada and the US, and implies a different trade flow pattern in the future compared with the base year. As a result, CERI utilizes a procedure to capture this "upper bound support effect", which recognizes the economic impacts of the Canadian oil sands industry when all new bitumen/SCO barrels could be exported to the US. This estimation only provides an upper limit for the impacts on US.

[10] We do not study impacts on Rest of the World (ROW), because it is exogenous according to our assumption.

UCMRIO 2.0 Multipliers

Table 3.2 summarizes the I/O multipliers, which have been employed to investigate the impacts of the oil and gas industry on the US and Canadian economies. *UCMRIO 2.0* multipliers are consistent with *StatsCan*, *RIMS II* and *IMPLAN*.[11] Note that the *UCMRIO 2.0* is a bi-national multiregional model, so it is capable of estimating the cross border spillover impacts. Therefore, we report two types of multipliers for our model. The *UCMRIO 2.0* multipliers indicate that most of the economic impact from a new shock stays in the country of origin. One dollar investment in oil sands in Alberta has a relatively higher impact on the economy in the US compared to the impact on the Canadian economy of $1 investment in the US oil industry (i.e. 0.24 vs. 0.05). Almost 90 percent of the impact stays in Canada when the oil industry in Canada is stimulated; this compares to 98 percent of impacts remaining in the US when the oil industry in the US is shocked. This finding is consistent with existing literature. For Instance, Japan's Ministry of Economy, Trade and Industry (METI) compiled a US-Japan I/O table in 2005 in order to analyze interdependence among various industries in both countries. One of their findings was that, on average, 98 percent of total economic impact of a change in final demand stays in the country of origin.[12]

Table 3.2
Oil and Gas I/O Multipliers for Canada and the US

Country/State of the Original Shock		Output	Value Added (GDP)	Source
Alabama (Offshore Oil and Gas)		1.5		Joseph R. Mason - RIMS II
Kansas (Oil and Gas)		1.5		Timothy R. Carr - RIMS II
Louisiana (Offshore Oil and Gas)		1.79		Joseph R. Mason - RIMS II
Mississippi (Offshore Oil and Gas)		1.53		Joseph R. Mason - RIMS II
Ohio (Oil and Gas)		1.97		Kleinheinz & Associates
Oklahoma (Oil and Gas production)		1.61	1.03 (est.)	Mark C. Snead - IMPLAN
Pennsylvania (Oil and Gas)		1.56		Pennsylvania Economy League - IMPLAN
Texas (Offshore Oil and Gas)		2.07		Joseph R. Mason - RIMS II
PADD II- United States (Oil and Gas)		2.12	1.16	BEA-RIMS II
United States (Offshore Oil and Gas)		2.39		Joseph R. Mason - RIMS II
Canada (Mining , Oil and Gas)		1.52	1.04	Statistics Canada
United States (Oil)	- US national impact - Canada impact	2.78 0.05	1.5 0.03	CERI-*UCMRIO 2.0*
Canada (Oil/Oil Sands)	- Canada impact - US national impact	1.77 0.24	1.00 0.11	CERI-*UCMRIO 2.0*

All multipliers are Type II, according to RIMS II definition and with respect to initial outlay.

[11]For more information on Regional Input-Output Modeling System (RIMS II) see https://www.bea.gov/regional/rims/. For Impact Analysis for Planning (IMPLAN) see http://implan.com/V4/Index.php.
[12]See http://www.meti.go.jp/english/statistics/tyo/kokusio/index.html

Data Sources

This section briefly reviews data sources used to compile data for Canada and the US. As previously mentioned, the annual US I/O tables are available through the USBEA. The *Make, Use, and Final Demand* tables are quite detailed at the industry level and have been available since 1947. The 85-industry, 365-industry, and 596-indusry are just a few examples of table formats issued by the USBEA. Statistics are in compliance with the definitions of the 1997 North American Industrial Classification System (NAICS).

The *Use* table shows the inputs to industry production and the commodities that are consumed by final users. The *Make* table, on the other hand, depicts the commodities that are produced by each industry. In this report we use the *Make and Use* table to construct the US symmetric I/O table consistent with the Canadian Multi-provincial I/O tables developed by CERI.

The National Accounts and I/O tables in Canada were also developed at the end of the Second World War. Tables in the present format, however, were first published in 1969 for the base year 1961. The I/O accounts are one of four main accounts that are published by Canada's System of National Economic Accounts (CSNEA), the others being income and expenditure accounts, financial and wealth accounts, and balance of payments accounts.

The I/O accounts are calculated at the national, provincial, and territorial level on an annual basis only.[13] These tables are available at different levels of aggregation[14] on the Canadian Socio-Economic Information Management System (CANSIM) Tables 381-0009 to 381-0014. Provincial I/O data are also available on an occasional basis.

The framework of both the US and the Canadian I/O system is complementary and consists of the following three basic tables:

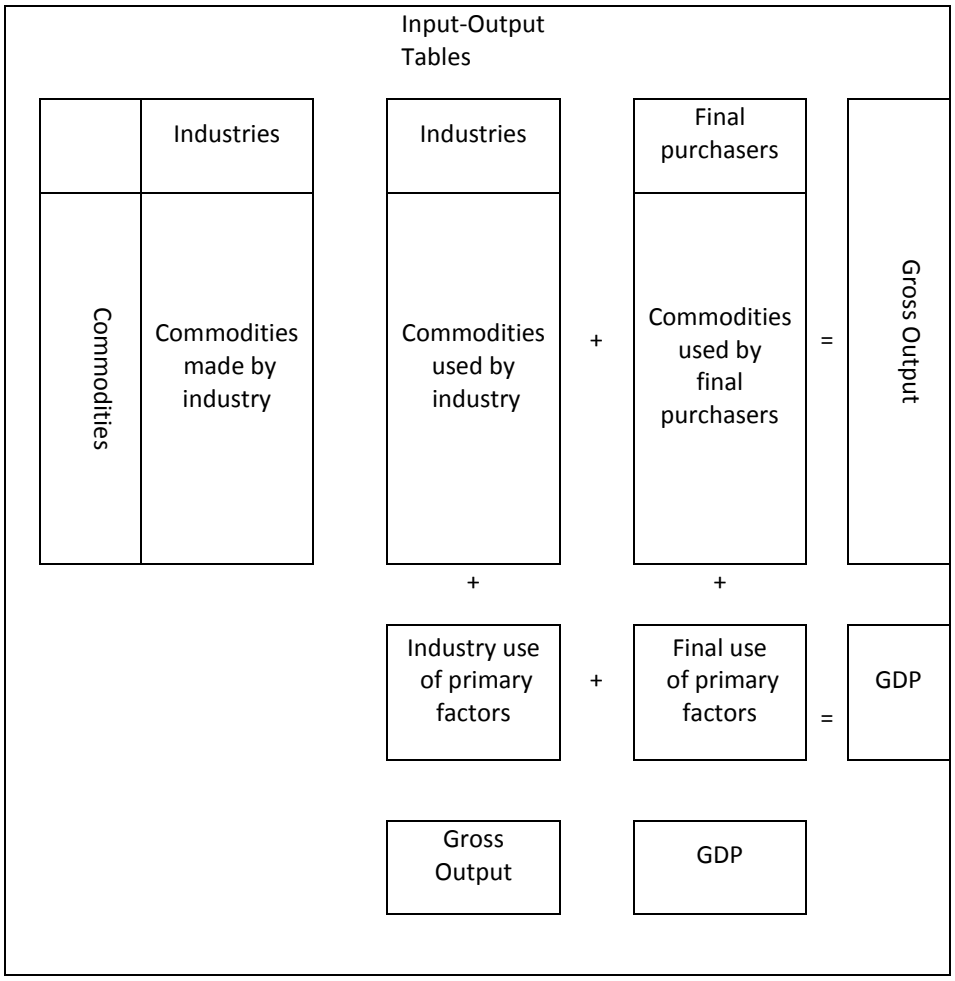
- Gross output of commodities (goods and services) by producing industries;
- Industry use of commodities and primary inputs (the factors of production, labour and capital, plus other charges against production, such as net indirect taxes); and
- Final consumption and investment, plus any direct purchases of primary inputs by final demand sectors.

Figure 3.2 is a schematic of the I/O system, and combines features of both the US and Canadian system and the more traditional single matrix presentation.

[13]The I/O tables and models, published annually by Statistics Canada, are entitled "The Input-Output Structure of the Canadian Economy". This document covers the basic concepts related to the I/O tables. Each year, two years of data are reported; the latest year is considered preliminary and the previous one is considered final. There are also many documents which are available on request from the I/O division.

[14]The I/O Tables of this publication are stored in CANSIM at the Small (S) level, Medium (M) level and Link (L) level of aggregation.

Figure 3.2
Schematic of the Input-Output System



Source: A User Guide to the Canadian System of National Accounts, Statistics Canada, Catalogue No. 13-589E, November 1989.

Assumptions and Limitations

The main assumption of any I/O analysis is that the economy is in equilibrium. Despite partial equilibrium analysis, it is assumed in the general equilibrium (GE) approach that the economy as a whole is in equilibrium. This is a realistic assumption in the long run, as it is difficult to imagine an economy remaining in disequilibrium for a long period of time.

A second important assumption in I/O analysis is the linear relationship between inputs and outputs in the economy. Each sector uses a variety of inputs in a linear fashion in order to produce various final products under the assumption of fixed proportions. Though the form of the "Leontief production function" is simple, it could be viewed as an approximation of the real world's production function. Unlike other production functions, the Leontief production function contains no provision for substitution among inputs. A very interesting aspect of this assumption is the constant return to scale (CRS) property of the Leontief production function, which turns out to be a proven property in the real

world economy. Though the linearity of the production function gives a constant average and marginal products, these are justified if the analysis focuses on the long run rather than the short run.

Although the I/O approach has been widely used around the world for economic impact assessment, there are certain limitations that should be noted. I/O matrices are limited to the estimation effect on demand, rather than supply. Therefore, they do not take into account important objectives such as lasting effects on productive potential. Most effects on supply, which are likely to lead to a sustainable increase in the growth rate of assisted sectors (or provinces/states) and enable them to catch up with more developed sectors (or provinces), are completely disregarded. Some of these overlooked points include: the creation of new productive capacity, improvement of the training and education of the workforce, construction of infrastructure, productivity gains throughout the economy, spread of technological progress, and intensity of high-tech activities in the productive sector. All these effects on supply can transform productive capacity in a lasting and irreversible manner. These cannot be estimated using this multi-regional I/O tool.

In particular, several other well-known limitations of the I/O approach are discussed below:

Static relationships. I/O coefficients are based on value relationships between one sector's outputs to other sectors. The relationship and, thus, the stability of coefficients, could change over time due to several factors including:

- Change in the relative prices of commodities;
- Technological change;
- Change in productivity; and
- Change in production scope and capacity utilization.

Since these attributes cannot be incorporated in a static I/O model, these models are primarily used over a short-run time horizon, where relative prices and productivity are expected to remain relatively constant. Hence, over a longer period, static I/O models are not the best tools for economic impact analysis. GE models or macroeconomic models accounting for the factors mentioned above could be more appropriate. Moreover, I/O models and other static macroeconomic models and general equilibrium models do not account for sectoral dynamics and adjustment in an economy.

Unlimited resources or supplies. The I/O approach simplistically assumes that there are no supply or resources constraints. In reality, increasing economic activities in a particular sector of the economy may put pressure on wages and salaries in the short run. However, in the long run, the economy adjusts through the mobility of the factors of production (i.e., labour and capital).

Lack of capacity to capture price, investment, and production interactions. An I/O model is incapable of representing the feedback mechanism among price change, investment, and production. For example, an increase in oil price provides a signal to investors to increase investment. The increase in investment would add productive capacity (more drilling) and also the production. However, this type of interaction cannot be modeled in a simple I/O model.

Chapter 4
Conclusions

This report has evaluated the economic impacts of Alberta's oil sands projects with a specific focus on GDP, employment, employee compensation, and government revenues, finding that the benefits will be substantial and felt throughout the North American continent. According to CERI's *Realistic Scenario* for the oil sands, overall investment is set to increase over the next several years after a lull caused by the 2008-09 economic recession. This increased investment will have immediate and direct effects on the provincial economy of Alberta, but as all oil sands production for the foreseeable future will be upgraded, refined, and used within North America, ripple effects will be felt throughout the provincial, state, and national economies of Canada and the United States.

After Alberta, the Canadian provinces that will benefit the most from oil sands investment are Ontario, British Columbia, and Quebec. This means that there will be more jobs and a higher level of GDP within these areas than elsewhere. Similarly, in the United States, the greatest economic impact will be felt in Illinois, California, Texas, Wisconsin, and Ohio.

Following are some noteworthy findings:

- Total GDP contributions of new oil sands projects to Canada from 2010 to 2035 is estimated at $2,106 billion.
- Employment in Canada (direct, indirect, and induced) as a result of new oil sands projects is expected to grow from 75,000 full and part-time jobs created and preserved in 2010 to 900,000 jobs in 2035.
- Total contribution of new oil sands projects to Alberta GDP from 2010 to 2035 is estimated at $1,989.57 billion.
- Close to 40 percent of all new oil sands employment in Alberta will be direct, with approximately 30 percent indirect, and 30 percent induced.
- About $444 billion will be collected in all forms of taxes, except royalties, over 25 years in Canada due to new oil sands projects. Most of this, approximately $407 billion, will be collected from within the province of Alberta.
- Projected royalty income from projects not yet on stream will be $10.3 billion by 2025, growing to $36.0 billion by 2035.
- According to CERI's *Plausible Scenario* for the United States, increase in GDP for 2011 as a result of new oil sands projects will be $1.95 billion, increasing to $26.59 billion by 2025.
- Employment impact in the US in 2010-11 as a result of new oil sands projects is estimated at 21,000 full and part-time jobs created and preserved, increasing to 465,000 jobs by 2035.

Appendix A
Impacts on the US Economy – *I/O Reference* and *Upper-Bound* Scenarios

Table A.1
Total Economic Impact of Alberta Oil Sands in the US by State, 2010-2035
I/O Reference Case

	$CAD Million		Thousand Person Years
	GDP	Compensation of Employees	Employment
Alabama	2,129	1,062	30
Alaska	806	172	4
Arizona	2,803	1,374	36
Arkansas	1,219	574	18
California	24,305	11,301	241
Colorado	4,827	2,279	52
Connecticut	2,737	1,346	24
Delaware	730	272	6
District of Columbia	721	444	7
Florida	8,076	3,926	108
Georgia	4,465	2,320	59
Hawaii	600	275	8
Idaho	650	330	11
Illinois	24,082	11,775	242
Indiana	4,145	2,050	50
Iowa	1,809	799	24
Kansas	2,887	1,406	34
Kentucky	2,021	992	29
Louisiana	5,241	1,633	40
Maine	539	283	9
Maryland	2,755	1,414	33
Massachusetts	4,209	2,373	46
Michigan	7,178	3,792	85
Minnesota	3,336	1,724	42
Mississippi	1,213	584	19
Missouri	2,796	1,477	40
Montana	4,168	1,970	43
Nebraska	961	453	14
Nevada	1,373	658	18
New Hampshire	727	398	10
New Jersey	5,541	2,815	55
New Mexico	989	351	11
New York	12,106	6,116	111
North Carolina	5,127	2,288	59
North Dakota	350	149	5
Ohio	10,139	5,112	118
Oklahoma	2,220	906	26
Oregon	2,563	1,205	31
Pennsylvania	6,529	3,362	80
Rhode Island	535	263	7
South Carolina	1,859	992	29
South Dakota	416	165	6
Tennessee	3,125	1,590	44
Texas	20,403	8,069	187
Utah	1,258	610	18
Vermont	284	147	4
Virginia	4,056	2,063	48
Washington	6,413	3,138	69
West Virginia	635	308	10
Wisconsin	10,250	5,049	112
Wyoming	585	148	4
Total US	**218,891**	**104,304**	**2413**

Table A.2
Total Economic Impact of Alberta Oil Sands in the US by State, 2010-2035
Upper Bound Scenario

	$CAD Million		Thousand Person Years
	GDP	Compensation of Employees	Employment
Alabama	8,010	3,981	113
Alaska	3,031	646	15
Arizona	10,546	5,150	132
Arkansas	4,588	2,149	66
California	91,449	42,345	897
Colorado	18,160	8,541	193
Connecticut	10,299	5,044	91
Delaware	2,746	1,020	21
District of Columbia	2,713	1,665	24
Florida	30,389	14,712	400
Georgia	16,802	8,694	219
Hawaii	2,257	1,030	31
Idaho	2,444	1,235	39
Illinois	90,612	44,121	899
Indiana	15,597	7,681	184
Iowa	6,806	2,993	88
Kansas	10,864	5,268	127
Kentucky	7,605	3,717	106
Louisiana	19,721	6,119	147
Maine	2,030	1,060	35
Maryland	10,367	5,299	123
Massachusetts	15,836	8,892	171
Michigan	27,007	14,209	317
Minnesota	12,550	6,458	155
Mississippi	4,565	2,189	69
Missouri	10,521	5,533	150
Montana	15,684	7,383	160
Nebraska	3,618	1,699	50
Nevada	5,166	2,467	66
New Hampshire	2,735	1,491	36
New Jersey	20,847	10,549	203
New Mexico	3,721	1,315	41
New York	45,552	22,916	413
North Carolina	19,293	8,574	221
North Dakota	1,317	560	20
Ohio	38,150	19,154	437
Oklahoma	8,355	3,396	97
Oregon	9,643	4,516	116
Pennsylvania	24,565	12,597	297
Rhode Island	2,011	985	24
South Carolina	6,995	3,716	107
South Dakota	1,566	617	23
Tennessee	11,757	5,958	164
Texas	76,768	30,234	694
Utah	4,733	2,285	65
Vermont	1,070	550	17
Virginia	15,261	7,730	179
Washington	24,128	11,759	257
West Virginia	2,389	1,154	35
Wisconsin	38,565	18,917	414
Wyoming	2,203	554	15
Total US	**823,609**	**390,827**	**8963**

Table A.3
Total Economic Impact of Alberta Oil Sands by US Economic Region
I/O Reference Case

2010-2035	$CAD Million		Thousand Person Years
	GDP	Compensation of Employees	Employment
Far West region	36,058	16,750	372
Great Lakes	55,794	27,778	606
Mideast	28,382	14,424	292
New England	9,031	4,810	100
Plains	12,556	6,172	165
Rocky Mountain	11,488	5,337	127
Southeast	39,168	18,333	492
Southwest	26,415	10,701	260
Total US	218,891	104,304	2,413

Table A.4
Total Economic Impact of Alberta Oil Sands by US Economic Region
Upper Bound Scenario

2010-2035	$CAD Million		Thousand Person Years
	GDP	Compensation of Employees	Employment
Far West region	135,675	62,762	1,380
Great Lakes	209,932	104,083	2,251
Mideast	106,790	54,046	1,083
New England	33,981	18,021	373
Plains	47,242	23,128	612
Rocky Mountain	43,224	19,998	473
Southeast	147,375	68,692	1,826
Southwest	99,389	40,095	964
Total US	823,609	390,827	8,963

Table A.5
Total Economic Impact of Alberta Oil Sands by US PADD
I/O Reference Case

2010-2035	$CAD Million		Thousand Person Years
	GDP	Compensation of Employees	Employment
PADD I	61,632	31,131	705
PADD II	75,716	37,439	870
PADD III	31,194	12,273	304
PADD IV	11,488	5,337	127
PADD V	38,861	18,125	407
Total US	218,891	104,304	2,413

Table A.6
Total Economic Impact of Alberta Oil Sands by US PADD
Upper Bound Scenario

2010-2035	$CAD Million		Thousand Person Years
	GDP	Compensation of Employees	Employment
PADD I	231,900	116,647	2,617
PADD II	284,891	140,283	3,231
PADD III	117,372	45,986	1,130
PADD IV	43,224	19,998	473
PADD V	146,221	67,912	1,513
Total US	823,609	390,827	8,963

Appendix B
Glossary of Terms

ATHABASCA OIL SANDS. Alberta's largest and most accessible source of bitumen is contained in an area encompassing more than 30,000 square kilometres. The Athabasca deposit is one of three oil sands areas located in the province (the other two are the Peace River and Cold Lake deposits). The Athabasca deposit alone contains over one trillion barrels of bitumen. Total reserves of bitumen in Alberta are estimated at more than 1.7 trillion barrels, enough to satisfy current world demand for over 50 years.

BARREL. A volumetric unit of measure for crude oil and petroleum products equivalent to approximately 0.159 cubic metres. A barrel contains 42 U.S. gallons or close to 159 litres.

BARRELS PER DAY (b/d). Average flow rates based on operating 365 days a year, after allowing for varying inputs/outputs and regular scheduled downtime for maintenance and repairs.

BITUMEN. A naturally occurring viscous mixture, mainly of hydrocarbons heavier than pentanes, that has a viscosity greater than 10,000 millipascal-seconds (mPa.s) measured at original temperature in the deposit and atmospheric pressure, on a gas-free basis. Bitumen may contain sulphur and other non-hydrocarbon compounds. This type of oil is too heavy or thick to flow or be pumped without being heated or diluted. In its natural state is typically not commercially recoverable through standard methods. The hydrocarbon residue from distillation of some crude oils is also known as bitumen.

CONSTANT DOLLARS. Value of a currency expressed in inflation-adjusted terms. Also known as “real” dollars. Used for estimating a value over time assuming a future rate of inflation.

CONSUMPTION. Meanings of consumption can vary, but a commonly accepted definition is that a consumed product is one that has been purchased.

CURRENT PRICES. A valuation at current prices is expressed at the prices prevailing during the period being referred to, and without adjustments for inflation. Also known as “nominal” prices.

DIRECT IMPACT. The total monetary value of investment and/or production. The direct impact in the context of this study is the sum of development expenditures (or investment dollars) in the oil sands industry and the sales value of production (or output) from the oil sands industry.

EMPLOYMENT MULTIPLIER. The ratio of total employment impact in the overall economy to the corresponding initial outlay. In this report, the employment multiplier of the oil sands industry indicates the amount of employment generated (or jobs created) in the entire economy due to investment and operation activities in the oil sands industry.

ESTABLISHED RESERVES (CANADA). Those reserves recoverable under current technology and present and anticipated economic conditions, specifically proved by drilling, testing, or production (‘proved reserves’), plus that judgment portion of contiguous recoverable reserves that are interpreted to exist,

from geological, geophysical or similar information, with reasonable certainty ('probable reserves'). Established reserves typically are comprised of proved reserves plus one-half probable reserves. The term can also be used in the context of *production from established reserves*.

GDP MULTIPLIER. The ratio of total GDP impact in the overall economy to the initial outlay (change in final demand) due to investment or operations. In this report, the GDP multiplier of the oil sands industry indicates the amount of GDP added in the entire economy due to activities in the oil sands industry.

GROSS DOMESTIC PRODUCT (GDP). An overall aggregate measure of economic activity. The total unduplicated value of the final goods and services produced in the economic territory of a country (or region) during a given period. GDP can be measured in three ways including the output, income, and expenditure approaches.

GROSS STATE PRODUCT (GSP). A measurement of the economic output of a state (sub-national entity). It is the sum of all value added by industries within the state and corresponds to the gross domestic product or GDP at the national level.

GROSS OUTPUT. Monetary value of production (sales) of an economic sector or industry.

IN SITU. In situ (Latin for "in place") methods such as steam or solvent injection through horizontal or vertical wells are required where deep oil sands deposits cannot be surface mined.

INCOME MULTIPLIER. The ratio of total income impact in the overall economy to the initial outlay (change in final demand, due to investment or operations). In this report, the income multiplier of the oil sands industry indicates the amount of labour income earned in the entire economy due to activities in the oil sands industry.

INCOME TAX. A tax levied on net annual personal or corporate income.

INCREMENTAL IMPACTS. These are additional or marginal economic impacts.

INDIRECT IMPACT. Subsequent purchases by suppliers of materials (goods) and services to sustain direct expenditure or impact. In this report, it refers to impact associated with the industries and economic entities that supply goods and services directly for the development of oil sands projects.

INDIRECT TAX. A tax collected on the final value (sales) of goods and services, collected by an intermediary entity such as the provider of goods and services, and paid to the government. Includes sales tax, fuel tax, import duty and tax, and excise tax on tobacco and alcohol.

INDUCED IMPACT. Impact from workers in the oils sands sector spending their additional income on consumer goods and services. This additional income is stimulated by direct and indirect impacts.

INPUTS. Various resources that are put into an economic system and that eventually result in outputs. Bitumen, for example, is an input; diesel fuel is an output.

INTEGRATED MINING PLANT. A mining operation where oil sands are extracted from open pits and separated (processed) into sand and bitumen. The bitumen is then upgraded (through chemical processes) into a lighter crude with a higher economic value product known as synthetic light crude oil (SCO).

LABOUR INCOME. The sum of wages and salaries paid to employees, plus supplementary labour income.

NOMINAL DOLLARS. Value of currency expressed as dollars of the day, i.e., not adjusted for inflation. Also known as "current" dollars.

OIL SANDS. A naturally occurring mixture of sand, water, clay and other minerals, and bitumen. The term is also used to describe a designated area in Alberta.

Defined in the *Mines and Minerals Act* as sands and other rock materials containing crude bitumen; the crude bitumen contained in those sands and other rock materials and any other mineral substance (except natural gas) associated with the above-mentioned crude bitumen, sands or rock materials.

BITUMEN MINING. The process of extracting the bitumen from the oil sands. The extraction can be done through open-pit mining when the resource is close to the surface (usually at depths lower than 75 metres). When the resource is found in deeper deposits, in situ processes are required.

OUTPUTS. The goods or services that result from economic activity. Bitumen can be considered an economic input that results in outputs like diesel fuel and gasoline.

OUTPUT MULTIPLIER. The ratio of total impact to the direct impact. In this report, the output multiplier of the oil sands industry indicates that for every dollar invested (or produced) in the oil sands industry, a dollar amount equivalent to x times greater (hence the name multiplier) than the amount of dollars originally invested (depending on the multiplier magnitude) is generated in the overall economy.

PADD. Acronym representing Petroleum Administration Defence Districts. This is a geographical division of the United States that was first undertaken after the end of World War II. The original purpose was to allocate better refinery fuel output. Today, the PADD divisions remain in place and are a useful designation for data collection and interpretation purposes. There are 5 PADDs (with PADD 1 subdivided into three divisions) encompassing all 50 states and the District of Columbia.

PRODUCTION. Production denotes supply of an output. Bitumen production provides a raw material to be refined by a consumer.

PROPERTY TAX. Includes taxes on ownership or use of land, structures, and other assets used in the production process, as well as taxable properties owned by households.

ROYALTY. The owner's share of the value of the extracted resource. Where the government owns the land (crown lands), royalties are revenues retained by the government on behalf of the general public and paid by the operator. Where the land is privately owned, the landowner receives a share of the

resource (royalty) from the operators but the owner must pay the government taxes on such revenue, as collected through freehold taxes.

STRATEGIC CAPITAL. The capital required under the initial phase of the project (i.e., construction).

SUSTAINING CAPITAL. The capital required to maintain the initial level of production.

TRADE FLOW MATRIX. A means to delineate the trade flows and changes in those flows between different areas of an economy or several economies. Trade flow matrices are central to I-O analysis to represent economic interdependencies.

UPGRADING. The conversion of heavy bitumen into a lighter crude oil by increasing the ratio of hydrogen to carbon, either by removing carbon (coking) or adding hydrogen (hydro-processing)

Bibliography

Canadian Energy Research Institute, "Canadian Oil Sands Supply Costs and Development Projects (2010–2044)", Study No. 122, April 2011.

Canadian Energy Research Institute, "Economic Impacts of the Petroleum Industry in Canada", Study No. 120, July 2009. http://www.ceri.ca/docs/CERIIOSummaryReport.pdf

Carr, T.R., "2001 Kansas Oil & Gas Production and Value", Kansas Geological Survey, 2002. http://www.kgs.ku.edu/PRS/publication/ofr2002-38/2001KS-Oil-Gas.pdf

Hertwich, E. Peters, G., "Multiregional Input- Output Database", *OPEN-EU,* June 2010.

Kleinheinz & Associates, "Ohio's Natural Gas and Crude Oil Exploration and Production Industry

Economic Impact Study", Ohio Oil and Gas Energy Education Program, January 2008. http://www.oogeep.org/downloads/file/Publications/Value%20Study%202008.pdf

Leontief, Wassily, "Implicit Theorizing: A Methodological Criticism of the Neo-Cambridge School*", Quarterly Journal of Economics 51*, 1 (1937), pp. 337-351.

Mason, J.R., "The Economic Cost of a Moratorium on Offshore Oil and Gas Exploration to the Gulf Region", Louisiana State University, July 2010.

Miller, R., Blair, P., "Input-Output Analysis: Foundations and Extensions", Cambridge University Press, Second Edition 2009.

Ministry of Economy, Trade and Industry (METI),"The 2000 Japan-U.S. Input-Output Table", Economics and Industrial Policy Bureau, *METI* (Japan), October 2005. http://www.meti.go.jp/english/statistics/tyo/kokusio/index.html

Oosterhaven, J. Stelder, D., "Regional and Interregional IO Analysis", *University of Groningen*, August 2007. http://www.regroningen.nl/irios/doc/Regional%20IO%20Analysis.pdf

Pennsylvania Economy League of Southwestern Pennsylvania, LLC, "The Economic Impact of the Oil and Gas Industry in Pennsylvania", November 2008. http://www.alleghenyconference.org/PEL/PDFs/EconomicImpactOilGasInPA1108.pdf

Price Waterhouse Coopers, "The Economic Impacts of the Oil and Natural Gas Industry on the U.S. Economy: Employment, Labor Income and Value Added," American Petroleum Institute, September 2009. http://www.api.org/Newsroom/upload/Industry_Economic_Contributions_Report.pdf

Sim, B., Secretario, F., Suan, E., "Developing an Interregional Input-Output Table for Cross-Border Economies: an Application to Lao People's Democratic Republic and Thailand", *Asian Development Bank*, July 2007.

Snead, M.C., "The Economic Impact of Oil and Gas Production and Drilling on the Oklahoma Economy", Oklahoma State University, October 2002. http://spears.okstate.edu/files/documents/caer/Research/State_Impact.pdf

Statistics Canada, "The Input-Output Structure of the Canadian Economy, 2006 – 2007." November 2010. http://www.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=15-201-X&lang=eng

_____. "A User Guide to the Canadian System of National Accounts", Catalogue No. 13-589E, November 1989.

The IMPLAN System, "Multi-Regional Analysis", http://implan.com/V4/Index.php

The US Bureau of Economic Analysis, "Input-Output Accounts Data; Make and Use Tables for 2006". http://www.bea.gov/industry/index.htm#annual

_____. "Regional Input-Output Modeling System (RIMS II)," http://www.bea.gov/regional/rims/index.cfm

Treff, K. Perry, D., "Finances of the Nation 2006", Canadian Tax Foundation, Toronto, Ontario, 2007.

_____. "Finances of the Nation 2007," Canadian Tax Foundation, Toronto, Ontario, 2008.

Treff, K. Ort, D., "Finances of the Nation 2008," Canadian Tax Foundation, Toronto, Ontario, 2009.