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PROJECT

Socio-Economic Benefits From Petroleum Industry Activity In Newfoundland and Labrador 2003 and 2004

Petroleum Research Atlantic Canada

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Socio-Economic Benefits From Petroleum Industry Activity in Newfoundland and Labrador 2003 and 2004

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1.0 INTRODUCTION

Offshore petroleum activity in Newfoundland and Labrador started in the mid-1960s. 'Socio-economic Benefits from Petroleum Industry Activity in Newfoundland and Labrador' (Community Resource Services Ltd., 2003), a Petroleum Research Atlantic Canada (PRAC) report released in November 2003, concluded that the effects of the industry on the Province since then have been 'large, widely distributed, and long-term… it has made, and will continue to make, a very important contribution to the economy and society of Newfoundland and Labrador' (p.viii). This contribution was seen as including the industry's effect in diversifying the Province's economy, by both introducing a new sector, and developing capabilities that have found application in other industries and parts of the world. The report concluded that offshore petroleum activity is having a transforming effect on the economy of Newfoundland and Labrador.

This update has been prepared for PRAC by Jacques Whitford, with funding from PRAC, the Newfoundland and Labrador Department of Natural Resources, and the Canadian Association of Petroleum Producers. It builds on the 2003 report, the core of which was a macroeconomic analysis of impacts that only described the situation up to the end of 2002. This update provides more recent information and analysis by describing, for 2003 and 2004:

- Offshore petroleum industry activity and expenditures in Newfoundland and Labrador;
- The resultant direct, indirect and induced economic benefits to the Province; and
- Other benefits-related developments in such areas as infrastructure, education, training and research and development.

It also includes revised data and macroeconomic analysis for 1999 to 2002. However, it does not include any new or updated company case studies.

2.0 CONTEXT

Offshore petroleum activity in Newfoundland and Labrador started in 1963, and the first exploration well was drilled in 1966. Environmental challenges, jurisdictional conflicts and other factors meant that the industry developed slowly and with significant fluctuations in the scale of activity. The first commercial oilfield, Hibernia, was not discovered until 1979 and its development did not begin until 1990, with the first production in late 1997. A second field, Terra Nova, entered production in early 2002, and the development of a third, White Rose, started in 2002 with a view to production in late 2005. This forty-year history has seen the slow emergence of a new industry that is now having substantial effects on the economy of Newfoundland and Labrador.

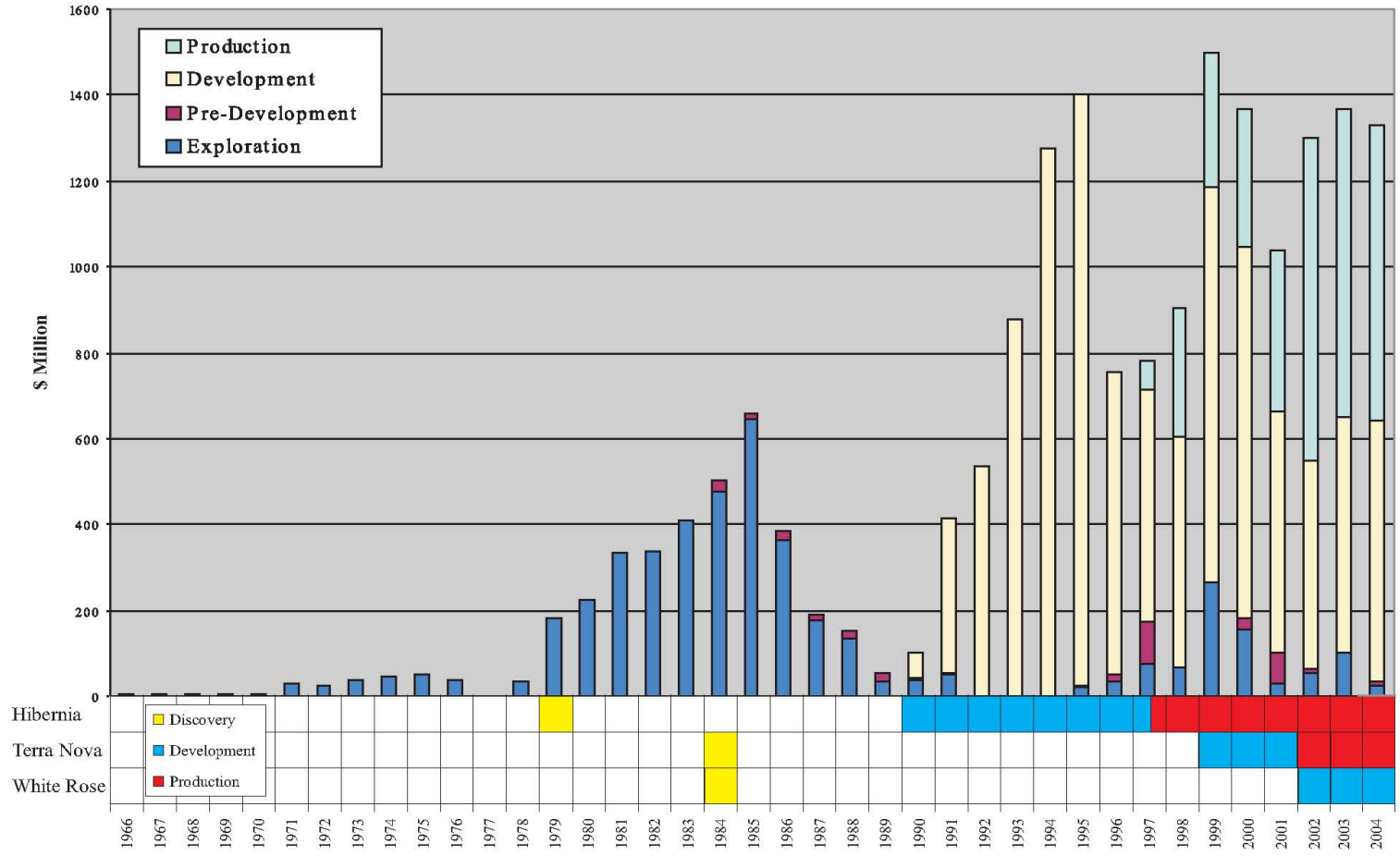
However, the last forty years have seen fluctuating levels of exploration, development and production activity (Figure 1). In the first case, the pace of exploration varied in response to levels of success, changing oil prices and the availability of government support (especially the Petroleum Incentives Program in the 1980s), with peaks of seismic and drilling activity in the mid-1970s, mid-1980s and late 1990s. This exploration led to the discovery of the Hibernia oilfield in 1979, the Hebron field in 1980, and the Terra Nova and White Rose fields in 1984, but there have been no commercial finds in more than a decade.

As was noted above, the first oilfield development activity did not occur until 1990. Since then, there has been development work on three fields, all located in the Jeanne d'Arc Basin on the Grand Banks:

- Hibernia: The $5.2 billion development of this oilfield, including the construction of a concrete gravity based structure (GBS) and some topsides components at Bull Arm, Trinity Bay, started in 1990. The GBS and the topsides were mated in early 1997, and the complete platform was towed to the field in time for first oil production in November 1997.
- Terra Nova: In 1998, Petro-Canada decided to develop the Terra Nova field using a floating production storage and offloading (FPSO) vessel with a South Korean built hull but with much of the topsides fabrication and installation occurring at Bull Arm. The FPSO arrived at the field in August 2001 and produced first oil in January 2002. The total Terra Nova pre-production capital expenditures were about $2.8 billion.
- White Rose: Work developing this field started in 2002. The project has a total capital cost of $2.35 billion, with Husky Energy spending almost $2 billion prior to the start of production. It too is using an FPSO with a hull built in South Korea, but much of the topsides fabrication and installation work has occurred in Marystown, Placentia Bay. Some fabrication work, and the testing of some sub-sea components, also took place at Bull Arm.

The period covered by this update, 2003 and 2004, saw further growth in the Newfoundland and Labrador offshore petroleum industry, with continued production from Hibernia and Terra Nova, and work accelerating on developing the White Rose field. Overall, industry expenditures totaled over a billion dollars in both of these years, as they have every year since 1999 inclusive. The totals for 2003 and 2004 ($1.37 and $1.33 billion respectively) were greater than in 2002, but less than the record $1.50 billion in 1999. As has been the case since 2002, when the Terra Nova field started producing, more than half of all expenditures were associated with production activity.

Figure 1: Newfoundland and Labrador Offshore Activity and Area Expenditures (1966 to 2004)



Source: Canada-Newfoundland Offshore Petroleum Board

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The total oil production from the Hibernia and Terra Nova fields was 123 million barrels in 2003 and 115 million in 2004, compared to 104 million in 2002.

In other production-related developments during this period, March 2003 saw the Canada-Newfoundland Offshore Petroleum Board (subsequently renamed the Canada-Newfoundland and Labrador Offshore Petroleum Board (CNLOPB)) approve an increase in Hibernia maximum production rates from 180,000 to 220,000 barrels per day, on an annualized basis. In December 2003 the Hibernia B-16 36 well started producing, setting several Canadian and world records for extended reach wells.

Development activity saw slow growth, with expenditures rising from $470 million in 2002 to $551 in 2003 and $606 million in 2004, mostly as a result of work on developing the White Rose field. Offshore, White Rose drilling started in July 2003, and glory hole excavation was completed by September 2003. By July 2004 the riser buoy had been towed out and installed over the field. Onshore, the scale of work at Marystown also increased; the fabrication of the topsides components commenced in August 2003, and the FPSO vessel, which had been christened the SeaRose, left South Korea in February 2004 and arrived in Marystown in April. By July, the heavy lift campaign (to place the topsides components on the FPSO) was complete, with integration and commissioning beginning the next month. Other White Rose fabrication work took place in Bull Arm and at the NEWDOCK yard in St. John's.

While there was continued growth in production and development activity, the 2004 exploration expenditures were at their lowest since the mid-1990s. There was also little pre-development activity during 2003 and 2004; there was no such activity in 2003, and very little ($10.8 million) in the following year. However, the 2003-2004 period also saw developments that should lead to increased exploration. For example:

- The CNLOPB's 2003 land sale saw eight parcels in the Orphan Basin awarded to a consortium of Chevron, ExxonMobil and Imperial Oil, in exchange for bids, representing work expenditure commitments, totaling a record $673 million. A new provision of this Call for Bids was a requirement that 5% of the value of bid be spent on research and development and education and training in the Province.
- The results of the CNLOPB's 2004 land sale showed continued interest in the Jeanne d'Arc Basin, where the Hibernia, Terra Nova, White Rose and Hebron fields are located. Successful bids, worth a total of $71 million in work expenditure commitments, were made on all five parcels offered. The following companies participated in the successful consortia: Husky Oil, Petro-Canada, Norsk Hydro, Exxon Mobil, Chevron, Murphy Oil, and the Canada Hibernia Holding Corporation.

In another positive development for future exploration, in May 2004 ConocoPhillips Canada and the CNLOPB announced that they had reached agreement regarding the conversion of federal permits in the Laurentian Sub-Basin into new Exploration Licenses, permitting wildcat exploration of this area off the South coast of Newfoundland. This led, in August 2004, to regulatory approval being granted for a 2D seismic survey in the region. At the same time, ConocoPhillips announced that BHP Billiton had agreed to join it, and its existing partner Murphy Oil, in exploring the region.

The 2003-2004 period also saw a multi-stakeholder initiative that sought to ensure the health of the offshore petroleum industry in Newfoundland and Labrador and other parts of Atlantic Canada. The Atlantic Energy Roundtable, convened in late 2002, provides a forum for governments, offshore operators, supply and service companies, regulators and labour to work on issues of common interest. In particular, it has sought to achieve improvements in regulatory matters, and implement initiatives to

maximize local industrial opportunities. The issues addressed during 2003 and 2004 included: regulatory coordination and streamlining; the duty on imported mobile offshore drilling units; procurement and activity awareness; best practices for supply chain activity management; the responsiveness of offshore regulations to new technologies and practices; the flexibility of drilling regulations, so as to reduce costs; and, clarifying seismic requirements.

3.0 ECONOMIC BENEFITS, 2003 AND 2004

This section of the update provides a more detailed picture of the economic effects of offshore petroleum activity on the Province of Newfoundland and Labrador. It focuses on the impacts in 2003 and 2004; that is, since the research described in the report on 'Socio-economic Benefits from Petroleum Industry Activity in Newfoundland and Labrador'. However, it presents these findings in the context of a revised analysis of the impacts from 1999 to 2002.[1]

The analysis was prepared by the Economic and Statistics Branch, Department of Finance, Government of Newfoundland and Labrador. It examines the direct, indirect and induced effects of offshore petroleum industry activity. The full Department of Finance report is presented in Appendix 1.

3.1 Direct Impacts

The analysis of the total economic impacts of offshore petroleum activity on Newfoundland and Labrador is based on its direct impacts during the years 1999 to 2004 (Table 1), established using information from ExxonMobil, Petro-Canada, Husky Energy, the CNLOPB and Statistics Canada.

Table 1 Direct Impacts of Offshore Oil Industry on Newfoundland and Labrador, 1999 to 2004

	1999	2000	2001	2002	2003	2004
Capital Costs ($ Millions)						
Exploration	264	156	31	56	101	24
Development	923	890	532	470	551	606
Production	188	181	338	516	474	457
Total	**1,375**	**1,227**	**901**	**1,042**	**1,126**	**1,087**
Employment (person years)						
Development	1,083	1,976	1,508	408	1,508	2,192
Production & Services to Production	1,874	1,895	2,251	2,928	3,361	3,380
Total	**2,957**	**3,871**	**3,759**	**3,336**	**4,869**	**5,572**
Barrels of oil production (Millions)	**36.4**	**52.8**	**54.3**	**104.3**	**122.9**	**114.8**
Operating costs ($ Millions)	**148**	**140**	**136**	**234**	**241**	**233**
Wages/salaries & employee benefits ($ Millions)						
Development	62	150	126	29	109	158
Production & Services to Production	121	116	139	195	231	231
Total Labour Income	**183**	**266**	**265**	**224**	**340**	**389**

These data can be divided into those related to production, which show a pattern of steady increase in contribution to the provincial economy, and those on exploration and development activity, which exhibit large fluctuations over time. In the former case, production in 2003 and 2004 continued at over 100 million barrels per year, a level first achieved in 2002 with the start of production from the Terra Nova field. The capital and operating costs associated with production have also remained at about the level first achieved when Terra Nova came into production.

[1] The changes in the 1999-2002 impacts result from revisions to previously released Statistics Canada labour market data, and the release of new Statistics Canada input/output data for the years 2000 and 2001.

Production-related employment and wages, salaries and benefits in 2003 and 2004 were 15 to 20 percent greater than those in 2002, and much greater than in previous years. In terms of employment, there were about 1900 person-years of employment (i.e., the equivalent of 1900 people working full-time for the entire year, although there will in fact have been more people involved in any one year, some of them for less than a complete year) in production and services to production activity in 1999 and 2000. This climbed to 2251 person-years in 2001 and, rapidly, to 2928 person-years in 2002. A further increase saw the employment level stabilize at nearly 3400 person-years in 2003 and 2004. In parallel, the value of wages, salaries and benefits related to production grew from $121 million in 1999 to $195 million in 2002, an increase of 61%. There was a further increase thereafter, to a total of $231 million in both 2003 and 2004. There will be further growth in operations employment and wages, salaries and benefits when the White Rose field starts producing in late 2005.

The direct economic impacts of exploration and development activity have both fluctuated significantly. In the former case, the pace of exploration in any region of the world is hostage to a number of variables, including oil and gas prices, rig availability, and exploratory success. As has already been seen, the rate of exploration in Newfoundland and Labrador has fluctuated considerably, peaking in the early 1980s. During the period under examination here, the capital costs of exploration fell from a peak of $264 million in 1999 to $31 million in 2001, recovering to $101 million by 2003, but then falling again to $24 million in 2004. This was the lowest level of exploration since 1995, and lower than all but five of the previous 33 years.

There is similar fluctuation in the value of development activity, albeit at the much larger numbers that are associated with major construction projects. The fluctuations reflect the fact that while Terra Nova construction activity peaked in 1999 and 2000, this work was completed by mid 2001, and development work on the White Rose oilfield did not become significant until 2003. As such, 2002 saw a lull of activity between Newfoundland's second and third offshore oilfield development projects.

Thus, in 2002, the capital costs of development activity fell below $500 million, development employment to barely 400 person-years, and development activity wages, salaries and benefits to only $29 million. In 2003 and 2004, White Rose project work resulted in a recovery to the levels that had been associated with the Terra Nova project development during the 1999 to 2001 period. While the capital costs of development activity lagged behind those in, especially, 1999 and 2000, 2004 saw the highest development employment and wages, salaries and benefits levels for the 1999 to 2004 period, although they still fell short of the levels associated with Hibernia construction in the mid-1990s.

Development's share of all Newfoundland and Labrador offshore petroleum industry activity has fluctuated over time. During the 1999 to 2004 period, its importance peaked in 2000, when it was responsible for 73% of all capital costs, and 51% of all employment. By 2002, during the lull between the Terra Nova and White Rose development projects, it accounted for only 45% of capital costs and 12% of employment. As work increased on White Rose, development's share of capital costs rose again, to 49% in 2003 and 56% in 2004, while its share of employment increased to 31% in 2003 and 39% in 2004. Thus, development activity, with its very variable impacts on the economy given the lags and troughs between projects, is becoming less important relative to production, which has much more stable effects. However, operations expenditures for existing fields will decline over time, as development drilling winds down and there are increased economies of scale in operations activity.

In looking at the total scale of industry activity, total expenditures (i.e. capital plus operating costs) peaked at $1523 million in 1999, fell to $1037 million in 2001, and then recovered to $1367 million in

2003 and $1320 in 2004. The capital costs declined from $1375 million in 1999 to $901 million in 2001, but then increased to $1126 in 2003 and fell slightly to $1087 million in 2004. The importance of development activity is such that the total direct employment and the total value of direct wages, salaries and benefits, both peaked in 2000, at 3871 person-years and $266 million respectively. There was then a post-Terra Nova development decline, but the total direct employment and value of direct wages, salaries and benefits increased again thereafter, as a result of White Rose construction and Terra Nova production activity, reaching 5572 person-years and $389 million in 2004.

3.2 Indirect Impacts

The above figures relate solely to the direct expenditures and employment by the petroleum industry. However, these expenditures involve purchases of goods and services from other industrial sectors in Newfoundland and Labrador, including business services, air and marine transportation, wholesaling, storage, and architectural, scientific and engineering services. This leads to the employment of additional workers and payment of further wages, salaries and benefits. The Department of Finance's Newfoundland and Labrador Input-Output Model (NALIOM) was used to calculate the indirect multiplier effects of this respecting employment, gross domestic product (GDP), and labour income.

Accounting for these indirect linkages resulted in average total annual direct and indirect real GDP impacts of approximately $1.8 billion and an annual average direct and indirect employment impact of about 8300 person-years over the 1999-2004 period. The direct and indirect GDP effects peaked, at approximately $2.0 billion, in 2002 because oil production levels were very high. The direct and indirect GDP impacts were particularly large ($2.6 billion) in 2004 because oil production levels were high and White Rose construction was at its peak.

3.3 Total Impacts

The above data on direct and indirect economic impacts are key inputs to the simulation of the overall effects of the petroleum industry on the economy of the Province, using the Department of Finance's Newfoundland and Labrador Econometric Model (NALEM). This provides measures of the total (i.e. direct, indirect and induced) effect of the offshore petroleum industry on a wide range of indicators, including GDP, employment, personal income, consumer spending and population change (Table 2).

Unsurprisingly, the overall pattern of change in total impacts reflects that already observed with respect to the direct and indirect effects of the industry, with most measures having risen to record levels after lull between the development of the Terra Nova and White Rose fields. In 2003, all measures showed increased benefits over the previous year, and in the case of most measures, record levels of benefit (1999 to 2003) were achieved. In 2004, there was a substantial additional increase over 2003 in the benefits received, with record levels being reached in respect of all 11 measures.

As has been widely publicized, this included a substantial increase in the industry's contribution to the Province's GDP. This increased from 13.0% in 1999 to 14.4% in 2001, and then climbed to 21.5% in 2002. There has been slow further increase since then, to 23.9% in 2003 and 24.3% in 2004. The latter represented a GDP contribution of $3.821 billion, up from only $1.522 billion in 1999.

Table 2 Economic Impacts of Offshore Oil Industry on Newfoundland and Labrador, 1999 to 2004

	1999	2000	2001	2002	2003	2004	Average
Real GDP ($1997 Millions)	1,522	1,774	1,643	3,133	3,711	3,821	2,601
Share of Total (%)	13.0	14.4	13.2	21.5	23.9	24.3	18.4
Personal Income ($ Millions)	489	726	667	511	815	967	696
Share of Total (%)	4.6	6.5	5.8	4.3	6.6	7.6	5.9
Labour Income ($ Millions)	420	624	573	439	700	830	598
Share of Total (%)	7.2	9.8	8.6	6.3	9.6	11.0	8.8
Other Income ($ Millions)	69	102	94	72	115	136	98
Share of Total (%)	1.5	2.2	2.0	1.6	2.4	2.8	2.1
Disposable Income ($ Millions)	384	571	526	402	643	763	548
Share of Total (%)	4.6	6.5	5.8	4.3	6.6	7.6	5.9
Retail Sales ($ Millions)	186	276	255	195	312	370	266
Share of Total (%)	4.2	5.8	4.9	3.6	5.4	6.4	5.1
Housing Starts	60	89	82	63	100	119	85
Share of Total (%)	4.4	6.1	4.6	2.6	3.7	4.1	4.3
Employment ('000s)	9.5	13.1	11.7	8.9	14.5	17.3	12.5
Share of Total (%)	4.7	6.6	5.7	4.3	6.8	8.0	6.0
Labour Force ('000s)	6.3	8.7	7.8	5.9	9.6	11.5	8.3
Share of Total (%)	2.6	3.6	3.2	2.4	3.8	4.5	3.3
Unemployment Rate (%)	-1.8	-2.6	-2.2	-1.6	-2.7	-3.1	-2.3
Population ('000s)	1.7	4.8	7.8	10.8	13.0	16.0	9.0
Share of Total (%)	0.3	0.9	1.5	2.1	2.5	3.1	1.7

While, in GDP terms, the offshore petroleum industry is responsible for almost a quarter of the Newfoundland and Labrador economy, this exaggerates the real importance of the industry. The Province's GDP represents the business and labour income earned within its geographic boundaries. However, as is the case with virtually all types of external investment in a small economy, much of the business income earned in the petroleum industry accrues to non-resident companies. For this reason, business income directly related to the industry generally does not accrue to residents and therefore is not reflected in the personal incomes and related measures. Personal income impacts reflect only income received by residents, which in this study is comprised primarily of wages and salaries. Consequently, the personal income impact is smaller than that on the GDP.

That said, the effects on incomes, employment and other such measures, especially in 2003 and 2004, are remarkable. For example, in 2004 the industry generated 11.0% of the Province's labour income, or $830 million. It also generated 7.6% of personal and disposable incomes (up from 6.6% in 2003), resulting in 6.4% of all retail sales and 4.1% of housing starts. In the former case, the industry was responsible for an additional $370 million in retail sales in the Province in 2004. In the latter case, the macroeconomic analysis indicates that the presence of the industry led to a total of 119 housing starts in 2004. On average, over the six year period covered by this study, it resulted in an average of 85 new starts a year (for a total of more than 500 homes), with associated impacts on architects, designers, builders, landscapers, decorators and those involved in the manufacture and sales of home furnishings, appliances and the like.

There has been a steady increase in the total amount of employment (direct, indirect and induced) generated by the industry since 2002. In that year, it was responsible for 8900 person-years of work, or

4.3% of the Province's total employment. In 2003, this rose to 14,500 person-years and 6.8%, while by 2004 it reached 17,300 person-years and 8.0%. In the latter year, this petroleum industry related employment resulted in the Province's labour force being 11,500 larger than it would otherwise have been, reducing the provincial unemployment rate by 3.1 percentage points from what it would otherwise have been.

The increased prosperity associated with offshore petroleum activity has also resulted in the Province's population being larger than it would otherwise have been, because increased economic activity and employment generally reduces out-migration and increases in-migration. Net migration is modeled in NALEM as a function of the difference in average wages and employment rates between Newfoundland and Labrador and Canada. Both these differences were smaller than they would have been in the absence of petroleum industry activity, resulting in a provincial population that was approximately 13,000 larger than it would otherwise have been in 2003, and 16,000 larger in 2004. However, it should be noted that it is difficult to model, and there is a high margin of error associated with the estimated population impact.

4.0 INFRASTRUCTURE, EDUCATION AND TRAINING, AND RESEARCH AND DEVELOPMENT

This section of the update provides information about selected offshore petroleum industry effects during 2003 and 2004. In particular, it examines the impacts the industry had on infrastructure, education and training, and research and development.

4.1 Infrastructure

As was described in the original Benefits Report, petroleum industry activity has resulted in, or contributed to, the development of a wide range of construction, fabrication, supply, service, education, training, and research and development infrastructure. Some of it is in use for oilfield operations, while these and other facilities are also being used for other oil and non-oil industry activity. The capital cost of these facilities was about $1.2 billion. Building them has provided a major boost to the local construction industry, generating demands for materials and equipment, as well as engineering, project management and construction services. Furthermore, this infrastructure is important to petroleum companies considering further projects in Atlantic Canada. It reduces the cost, and hence increases the likelihood, of such projects. It also increases Newfoundland and Labrador's participation in them, by increasing the Province's ability to be involved in construction, fabrication and operations activities.

There was only a limited further requirement for infrastructure in 2003 and 2004. Some of it was required to increase the efficiency of existing infrastructure. For example, in 2003-2004, A. Harvey & Company spent about $12 million redeveloping Piers 15 and 16 at its supply base in St. John's Harbour, providing an additional three fully serviced berths to handle increased supply boat requirements. In 2004, the company spent an additional $2.5 million on a 44-tonne mobile harbour crane, to further increase the quality and flexibility of the service it provides to the offshore petroleum industry. Similarly, in 2003, the Bull Arm Site Corporation spent $1.5 million to install a huge (39 m2) vertical lift door at the Grand Module Hall at the Bull Arm Fabrication Yard. It replaced removable panels that provided only a slow and inefficient and method of access and egress for large modules and structures.

New research and development infrastructure was also put in place at Memorial University of Newfoundland, including the Landmark Graphics Visualization Centre, which cost about $20 million and is the first of its kind at a university. It provides a theatre setting in which up to 20 researchers can collaborate and view data in 4D (three spatial dimensions plus a temporal one). This will revolutionize how offshore oil and gas reservoirs are studied and understood, allowing researchers to analyze images of large volumes of data and conduct detailed simulations.

Also on the St. John's campus of Memorial University, significant additions were made to autonomous underwater vehicle (AUV), flow simulation and core analysis laboratories. The AUV developments saw the start of upgrading one vehicle, and arrangements being made to acquire a second. New equipment and facilities also increased capabilities of the flow laboratory, which examines flow within well bores, and the core analysis laboratory, which is concerned with permeability and other reservoir issues.

As part of a 2003 White Rose FPSO training contract (see below), the Centre for Marine Simulation at the Marine Institute will receive access to a Siemens process control simulator, owned by Husky Energy. In November 2004, the Marine Institute also received a custom-made model of the SeaRose FPSO topsides, worth about $1 million. Donated by White Rose project contractor AMKC, it will assist in the provision of training to both offshore petroleum industry clients and ship design students.

In November 2003, the Marine Institute opened its Safety and Emergency Response Training Centre, located in Stephenville. Developed with $1.04 million in funding from the Atlantic Canada Opportunities Agency, it is designed to deliver certified safety and emergency training for the oil and gas, aviation, fish harvesting, and marine transportation sectors in Atlantic Canada. In October 2004 it was announced that the Centre would be expanded to accommodate increased demand for offshore petroleum and marine related safety training.

In another development that is largely attributable to offshore petroleum activity, Continental Airlines introduced non-stop service between St. John's and New York (Newark) in June 2004. These flights were as a result of the increased traffic between St. John's and Houston, Texas, Continental's headquarters and principal hub. In announcing the service, Bob Cortelyou (VP, Scheduling, Continental Airlines) explained that one of the main reasons for introducing it was so that 'the host of oil and energy companies doing business in St. John's will have better access to Houston, the US oil and energy capital' (Continental, 2004).

4.2 Education and Training

Individuals and companies in Newfoundland and Labrador have also benefited from education and training resulting from the Province's petroleum industry. It is working at the technological frontier, seeking to find and produce oil and gas in a harsh environment and increasingly deep waters, using wells of record lengths and production systems of great complexity. This has required the development of new education and training programs and facilities at Memorial University, the Marine Institute, the College of the North Atlantic (CNA), and private training institutions. There has also been a rapid growth in cooperative education placements, scholarships and awards, and on-the-job training. This has produced a highly skilled local workforce, able to design, maintain and operate offshore systems in a safe and environmentally responsible manner. Local firms have also benefited from the expertise and experience they gained through involvement in the petroleum industry, and further increases in these capabilities and benefits can be expected.

The years 2003 and 2004 largely saw a further development and consolidation of programs already in place. For example, in January 2004 Memorial University's Oil and Gas Development Partnership, established in September 2000, embarked on its first ever Master of Oil and Gas Studies program. This is an executive development program specifically designed for senior level employees who are destined for the executive positions in the oil and gas industry, its service sector and relevant government agencies and departments.

Also during this period, the Memorial's Department of Earth Sciences was able to add new undergraduate programming in the petroleum and sedimentary basin area, and to greatly increase its capacity for graduate study in petroleum geology and sedimentology, and in exploration seismology. The Faculty of Engineering initiated Oil and Gas as an undergraduate option for all discipline streams, and it too has greatly increased its capacity for oil and gas related graduate research.

The teaching capabilities of Memorial University have also been further strengthened by the appointment of new faculty, who will also be active in research and development (see below). There was also increasing undergraduate interest in petroleum-related opportunities. For example, in 2003 there were 30 Bachelor of Engineering graduates who had completed the Oil and Gas Option; in 2004, this rose to 47 graduates.

During the 2003-2004 period a new scholarship was introduced at the CNA Prince Philip Drive Campus. This Society of Petroleum Engineers scholarship provides $500 each for two full time second or third year students enrolled in the Petroleum Engineering Technology program.

However, the end of 2003 saw the discontinuation of the Atlantic Accord Career Development Awards Program. Established in 1996, this was a widely used and beneficial initiative; for example, it provided financial support to 920 undergraduate Engineering students at Memorial University. This, not least, greatly assisted them in taking work term placements in the oil industry in such places as Calgary, Houston and Aberdeen. It also provided over $1 million in assistance to 49 Engineering graduate students.

In June 2003, the Marine Institute of Memorial University was awarded a contract to develop and deliver courses for operations personnel on the SeaRose, the White Rose FPSO. Under this contract, the Marine Institute is to deliver approximately 4,500 training days at its St. John's, Foxtrap and Southside campuses. The Marine Institute will also be responsible for managing the SeaRose FPSO training program, including the administration and logistical coordination of subcontracted training partners, facilities, equipment and other resources that will be used during the program.

In the Fall of 2004 the Burin Campus of CNA undertook a sizeable pipe welding contract for Keiwit Offshore Services. Worth approximately $120,000, this saw 15 students undertake about 250 hours of training. At about the same time, the Burin Campus also introduced a new Industrial Instrument Mechanic pre-employment program, in response to industry needs. There are 15 places in this nine-month program.

4.3 Research and Development

In addition to education and training initiatives, a significant amount of petroleum industry research and development work is being done in Newfoundland and Labrador. Each year, operators, contractors, government agencies, industry groups and research organizations support or participate in a wide range of studies related to petroleum activities in Newfoundland and Labrador. This has included work in such areas as engineering and design, operational studies and environmental investigations, primarily at Memorial University, the Marine Institute and the Institute for Ocean Technologies. It helps sustain and further build the local research and development community, assisting it in serving local interests in the petroleum and other industries. It has also helped develop Newfoundland and Labrador as a center of excellence in such topics as cold oceans engineering, distance technologies and marine science.

As with infrastructure and education and training, 2003 and 2004 saw further consolidation and growth in local offshore petroleum related research and development capabilities. For example, Memorial University further developed its expertise related to various aspects of offshore petroleum activity. The Department of Earth Sciences made appointments in the areas of seismology, sedimentology, reservoir quality and carbonate reservoirs, and joint appointments, with the Faculty of Engineering and Applied

Science, in reservoir seismology and reservoir engineering. In Engineering and Applied Science, there were new appointments in control systems, underwater vehicles, asset integrity, safety engineering, chemical engineering and gas processing. These Memorial University appointments included three Canada Research Chairs.

In September 2003, EnerSea Canada, in partnership with Memorial University, announced the establishment of the Centre for Marine Compressed Natural Gas. The Centre, located on Memorial's St. John's campus, is the world's first centre for marine compressed natural gas (CNG) research and development. It conducts independent research and development in CNG marine transportation and related issues with the goal of advancing technologies capable of delivering gas from offshore locations where pipelines are impractical. It seeks to address the technical challenges associated with developing a complete transportation system (gas processing, loading/offloading, storage and safety practices) for global applications, including for harsh offshore environments such as those in Atlantic Canada.

The Centre's partners include CNG technology providers, shipping companies, classification societies, natural gas infrastructure providers, offshore technology companies, petroleum producers, universities, research organizations and the Governments of Newfoundland and Labrador and Nova Scotia. In March 2004, the Centre received $4 million from the Atlantic Innovation Fund; matching funds from its member companies will allow the Centre to meet its first phase budget of $8 million. Its activities include an annual Marine CNG Forum; the first, held in June 2004, attracted over 60 delegates from eight countries.

In 2004, the Marine Institute received approval for a $9 million research and development program dealing with the modeling and simulation of harsh environments, thus allowing a further expansion in the activities and capabilities of the Centre for Marine Simulation.

The Centre for Cold Ocean Resources Engineering (C-CORE), on the campus of Memorial University, further expanded its capabilities in 2004 with the commissioning of its $400,000 earthquake actuator. This resulted in St. John's being the home of Canada's only geotechnical centrifuge facility with earthquake modeling capabilities. These will be of particular value for modeling and understanding the risks of earthquakes for offshore petroleum facilities, including deepwater platforms and pipelines.

Petroleum Applications of Wireless Systems (PAWS) provides an example of collaborative inter-provincial research. This multi-million dollar initiative is jointly operated by three Atlantic Canadian education institutions: the College of the North Atlantic, Cape Breton University, and the University of New Brunswick. With support from industrial partners, the PAWS teams are developing and commercializing wireless smart sensor systems that will replace wired technology in offshore platforms and land-based refineries. This type of technology can have applications in a wide range of industries.

5.0 CONCLUSION

In 2003 and 2004, there was a further consolidation and expansion of the Newfoundland and Labrador offshore petroleum industry, and further growth in its contribution to the Province's economy. By 2004, it was responsible for almost a quarter of the Newfoundland and Labrador GDP, with the Province's total labour income being 12% higher than it would have been without offshore petroleum industry activity. The industry was also having very significant positive effects on such things as retail sales, the unemployment rate, housing starts and the size of the provincial population.

The period covered by this update has also seen the continuation of a pattern whereby production activity is becoming increasingly important, resulting in greater stability in the levels of industry activity and related economic benefits. This, allied to the increased involvement of local companies and individuals in export work, and in work in other industries, indicates that the petroleum industry is making an important, and increasing, contribution to economic diversification and sustainability.

It is to be hoped that this pattern of economic growth and increased diversification and sustainability will continue. There are certainly prospects for new offshore petroleum activity associated with: the Hebron oilfield project; satellite field developments in the Jeanne d'Arc Basin; exploration in the Orphan Basin, Laurentian Sub-basin and elsewhere; and, the development of natural gas reserves, using CNG or alternative transportation technologies. The infrastructure and education, training, and research and development activity and expertise described above, together with expanding supply and services company capabilities, should result in Newfoundland and Labrador capturing a yet greater proportion on the benefits from such new industry activity.

However, the low level of exploration in 2003 and 2004 is a matter for concern, especially because there has not been a new commercial find since the 1980s. Furthermore, notwithstanding the diminished importance of development relative to production activity, a failure to proceed with developing Hebron, the last major development project currently available, would be a major real and psychological blow to the local petroleum industry and the economy as a whole.

6.0 REFERENCES

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APPENDIX A

The Macroeconomic Impacts of
The Offshore Oil Industry
On the Economy of
Newfoundland and Labrador
Update 2005

THE MACROECONOMIC IMPACTS OF THE OFFSHORE OIL INDUSTRY ON THE ECONOMY OF NEWFOUNDLAND AND LABRADOR
Update 2005

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I Introduction

The purpose of this study is to provide updated estimates of the overall economic impact the offshore oil industry has had on the provincial economy. Impacts on key indicators such as Gross Domestic Product (GDP), incomes, and employment are examined for the period 1999 to 2004 as requested by the steering committee overseeing the 2005 update to the Newfoundland and Labrador oil industry benefits study. The original study was published in 2003. Revised impacts for the years 1997 to 2002 are presented as well as new information for 2003 and 2004. The following sections describe the economic models used in the analysis, the data used as input, and the approaches followed in applying the models. The paper ends with a presentation and discussion of the results. Because the oil industry is expanding and is experiencing year-to-year fluctuations in development and production related activity, this impact assessment measured the benefits of the offshore oil industry over six years and then looked at the average impacts over the period.

II Economic Models

Two Department of Finance models are used in combination in this impact assessment: NALEM (Newfoundland and Labrador Econometric Model) and NALIOM (Newfoundland and Labrador Input-Output Model).

NALEM is a detailed model of the relationships between key economic variables in the provincial economy and is used by the government of Newfoundland and Labrador for economic forecasting and to assess the economic impacts created by major development projects as well as government policy changes. Additional information is provided on the next page.

The NALIOM model simulates the relationships between commodity outputs and commodity inputs at an industry level under the assumption of linearity (i.e., that the proportion of factor inputs used per dollar of output remains constant). NALIOM provides estimates of the GDP, employment and labour income impacts for 727 types of commodity purchases distributed over 300 industries. The model's strength lies in its ability to capture backward linkages (i.e., indirect impacts that arise from the production of intermediate inputs by other industries).

NALIOM is used in this study to obtain the indirect oil industry impacts. These indirect impacts are combined with the direct, or first round, impacts to be used as data input to NALEM. NALEM is able to capture the induced impacts (i.e., impacts related to the spending of workers who are directly or indirectly employed as a result of oil industry activity). The direct, indirect and induced impacts are then summed to determine the total economic impacts of the offshore oil industry on the provincial economy.

A Brief Description of the Newfoundland and Labrador Econometric Model (NALEM)

NALEM is a *macroeconomic* model of the economy designed to capture the major and most important economic relationships in the provincial economy, but not the minute details of every aspect of economic activity. NALEM provides a representation of the current structure (i.e., basic economic relationships) of the provincial economy. As this structure changes (e.g., EI program changes, tax harmonization, collapse of the groundfishery, development of the oil and gas industry, etc.), the model is modified to capture the new or changed economic relationships.

NALEM contains over 370 mathematical equations and 600 data series which are designed to represent key aspects of the provincial economy, and to capture the relationship between certain socioeconomic variables. For example, the level of consumer spending is related to the level of income which consumers have at their disposal. Anything which affects consumers' disposable income (e.g., higher/lower income taxes, reduced EI benefits, job losses/gains, etc.) can be expected to have an impact on the level of consumer spending. Thus, certain NALEM equations are designed to measure or quantify (i.e., "*model*") the relationship between major categories of consumer spending and income levels, which in turn are linked to other variables in the model. For example, changes in consumer spending can in turn affect government revenues, employment levels, investment spending, and so on; NALEM is designed to capture these linkages. NALEM is organized into 10 different sectors. Consumer spending, residential construction, business investment, government spending, exports, and imports comprise the six expenditure sectors essential to the determination of GDP and other key economic indicators. The remaining four sectors cover income and output, demographic and labour market activity, prices and wages, and government revenue. The government revenue sector deals with the revenues of all levels of government.

NALEM is used to produce annual forecasts for all of the main indicators of provincial economic activity including GDP, personal income, labour force, employment, consumer spending and exports. Forecasts for detailed components and determinants of the main economic indicators are also available. Forecasts of economic indicators which are largely determined by factors outside of the provincial economy (e.g., interest rates, exchange rates, certain commodity prices, etc.) are generally obtained from external sources such as national forecasting agencies.

NALEM has been in use since 1990 and is maintained by the Economic Research and Analysis Division.

III Data Used as Input

Data from Statistics Canada as well as industry sources were used as direct inputs for the analysis. The highlights are summarized in the table below:

Table 1
Direct Impacts of Offshore Oil Industry

	1999	2000	2001	2002	2003	2004
Capital Costs ($ Millions)						
Exploration	264	156	31	56	101	24
Development	923	890	532	470	551	606
Production	188	181	338	516	474	457
Total	**1,375**	**1,227**	**901**	**1,042**	**1,126**	**1,087**
Employment (person years)						
Development	1,083	1,976	1,508	408	1,508	2,192
Production & Services to Production	1,874	1,895	2,251	2,928	3,361	3,380
Total	**2,957**	**3,871**	**3,759**	**3,336**	**4,869**	**5,572**
Barrels of oil production (Millions)	**36.4**	**52.8**	**54.3**	**104.3**	**122.9**	**114.8**
Operating costs ($ Millions)	**148**	**140**	**136**	**234**	**241**	**233**
Wages/salaries & employee benefits ($ Millions)						
Development	62	150	126	29	109	158
Production & Services to Production	121	116	139	195	231	231
Total Labour Income	**183**	**266**	**265**	**224**	**340**	**389**

IV Model Simulations

IV.1 Indirect Impacts from NALIOM

To estimate the impacts on suppliers to the oil companies or indirect impacts, the NALIOM was used to obtain multipliers for employment, GDP and labour income for specific business lines. The primary business lines included services incidental to mining and oil and gas; miscellaneous business services; air transport; water transport; wholesaling; storage; and architectural, scientific, and engineering services. Annual direct and indirect real GDP impacts averaged roughly $1.8 billion and annual direct and indirect employment impacts averaged roughly 8,300 person years. In the most recent year, 2004, direct and indirect GDP impacts were larger ($2.6 billion) because oil production levels were high and construction activity on the White Rose project was at its peak. Direct and indirect impacts are key inputs necessary for the NALEM model simulation.

Table 2
Economic Impacts of Offshore Oil Industry, 1999-2004

	1999	2000	2001	2002	2003	2004	Average
Real GDP ($1997 Millions)	1,522	1,774	1,643	3,133	3,711	3,821	2,601
Share of Total (%)	13.0	14.4	13.2	21.5	23.9	24.3	18.4
Personal Income ($ Millions)	489	726	667	511	815	967	696
Share of Total (%)	4.6	6.5	5.8	4.3	6.6	7.6	5.9
Labour Income ($ Millions)	420	624	573	439	700	830	598
Share of Total (%)	7.2	9.8	8.6	6.3	9.6	11.0	8.8
Other Income ($ Millions)	69	102	94	72	115	136	98
Share of Total (%)	1.5	2.2	2.0	1.6	2.4	2.8	2.1
Disposable Income ($ Millions)	384	571	526	402	643	763	548
Share of Total (%)	4.6	6.5	5.8	4.3	6.6	7.6	5.9
Retail Sales ($ Millions)	186	276	255	195	312	370	266
Share of Total (%)	4.2	5.8	4.9	3.6	5.4	6.4	5.1
Housing Starts	60	89	82	63	100	119	85
Share of Total (%)	4.4	6.1	4.6	2.6	3.7	4.1	4.3
Employment ('000s)	9.5	13.1	11.7	8.9	14.5	17.3	12.5
Share of Total (%)	4.7	6.6	5.7	4.3	6.8	8.0	6.0
Labour Force ('000s)	6.3	8.7	7.8	5.9	9.6	11.5	8.3
Share of Total (%)	2.6	3.6	3.2	2.4	3.8	4.5	3.3
Unemployment Rate (%)	-1.8	-2.6	-2.2	-1.6	-2.7	-3.1	-2.3
Population ('000s)	1.7	4.8	7.8	10.8	13.0	16.0	9.0
Share of Total (%)	0.3	0.9	1.5	2.1	2.5	3.1	1.7

IV.2 NALEM Simulation

A model simulation of NALEM was used to obtain the total economic impacts of the offshore oil industry during the reference period, including the induced impacts. A model simulation was performed for the 1999-2004 period using both direct inputs and indirect impacts calculated from NALIOM. NALEM allowed the calculation of impacts on a broad array of indicators such as personal income, consumer spending, population, etc. that are not available from NALIOM.

V Macroeconomic Results

The macroeconomic impacts which are presented at the end of this paper point to a substantial impact on the provincial economy. Real gross domestic product was, on average, roughly $2.6 billion per year higher over the 1999 to 2004 period and $3.8 billion higher in 2004 as a result of offshore oil activity. The oil industry and its indirect and induced impacts generated approximately 24% of the province's real GDP in 2004. GDP represents the business and labour income earned within the geographic boundaries of the province.

It should be noted, however, that much of the business income earned in the oil industry accrues to non-resident companies. This is the case with virtually all types of external investment in a small economy. Thus, business income directly related to the industry generally would not accrue to residents and therefore does not get reflected in the personal income impact. Personal income impacts reflect only income received by residents which in this study is comprised primarily of wages and salaries. Consequently, the personal income impact is smaller than the GDP impact.

Personal income was roughly $700 million per year higher over the reference period as a result of the oil industry (6.0% of total personal income). The impact was somewhat higher in 2004 at $967 million due to the fact that construction activity on the White Rose was at its peak. The income impacts mainly reflect the boost to labour income resulting from the oil industry's high wage jobs as well as labour income from spinoff employment (indirect and induced). Annual personal disposable income, which is personal income after payment of direct taxes (income tax, EI, CPP premiums), was on average $550 million higher over the 1999 to 2004 period. Consequently consumer spending on goods and services was $440 million higher. Retail sales (a component of consumer spending) were $266 million higher.

The estimated annual employment impact averaged roughly 12,500 over the reference period (6% of total employment). On average, the unemployment rate was 2.3 percentage points lower. The decline in unemployment would have been greater except that increased employment, higher average wages and higher population encouraged more labour force participation. The rise in the labour force was about two-thirds as large as the gain in employment.

Population impacts are more difficult to model. Any increase in economic activity and employment in the province will tend to reduce out-migration and increase in-migration. Net migration is modelled in NALEM as a function of the difference in average wages and employment rates between Newfoundland and Canada. Both of these differences were smaller than they would have been in the absence of oil industry activity. Changes in migration led to a population that was roughly 16,000 higher in 2004. It should be noted, however, that since migration is a difficult variable to predict there is a high margin of error associated with the estimated population impact. A number of other indicators are affected by changes in population including the labour force, the unemployment rate and housing starts.

Despite the uncertainty surrounding population impacts, the analysis does show that offshore oil industry is making a substantial contribution to the Newfoundland and Labrador economy, particularly in relation to GDP and employment. The contribution to the economy from oil production will continue to grow in the coming years as the White Rose production begins, but the development activity will decline in the near term as White Rose development activity comes to an end. Exploration activity is expected to continue and other projects are also expected to be developed in the coming years.

Table 3
Economic Impacts of Offshore Oil Industry by Sector, 1999-2004

	1999	2000	2001	2002	2003	2004	Average
Real GDP ($1997 Millions)							
Development	617	427	343	228	323	506	407
Production Plus Services	905	1,347	1,300	2,906	3,388	3,315	2,194
Total	1,522	1,774	1,643	3,133	3,711	3,821	2,601
Share of Total (%)	13.0	14.4	13.2	21.5	23.9	24.3	18.4
Personal Income ($ Millions)							
Development	241	496	396	100	342	497	346
Production + Services	247	230	271	411	473	469	350
Total	489	726	667	511	815	967	696
Share of Total (%)	4.6	6.5	5.8	4.3	6.6	7.6	5.9
Labour Income ($ Millions)							
Development	207	427	340	86	294	427	297
Production + Services	212	197	233	353	406	403	301
Total	420	624	573	439	700	830	598
Share of Total (%)	7.2	9.8	8.6	6.3	9.6	11.0	8.8
Other Income ($ Millions)							
Development	34	70	56	14	48	70	49
Production + Services	35	32	38	58	67	66	49
Total	69	102	94	72	115	136	98
Share of Total (%)	1.5	2.2	2.0	1.6	2.4	2.8	2.1
Disposable Income ($ Millions)							
Development	190	390	312	79	270	393	272
Production + Services	194	180	214	323	373	370	276
Total	384	571	526	402	643	763	548
Share of Total (%)	4.6	6.5	5.8	4.3	6.6	7.6	5.9
Retail Sales ($ Millions)							
Development	92	189	151	38	131	190	132
Production + Services	94	87	104	156	181	179	134
Total	186	276	255	195	312	370	266
Share of Total (%)	4.2	5.8	4.9	3.6	5.4	6.4	5.1
Housing Starts							
Development	30	61	49	12	42	61	42
Production + Services	30	28	33	50	58	58	43
Total	60	89	82	63	100	119	85
Share of Total (%)	4.4	6.1	4.6	2.6	3.7	4.1	4.3
Employment ('000s)							
Development	4.9	9.0	6.9	1.8	6.5	9.4	6.4
Production + Services	4.6	4.1	4.8	7.0	8.0	7.9	6.1
Total	9.5	13.1	11.7	8.9	14.5	17.3	12.5
Share of Total (%)	4.7	6.6	5.7	4.3	6.8	8.0	6.0
Labour Force ('000s)							
Development	3.2	6.0	4.6	1.2	4.3	6.2	4.3
Production + Services	3.0	2.7	3.2	4.7	5.3	5.2	4.0
Total	6.3	8.7	7.8	5.9	9.6	11.5	8.3
Share of Total (%)	2.6	3.6	3.2	2.4	3.8	4.5	3.3
Unemployment Rate (%)							
Development	-0.9	-1.8	-1.3	-0.3	-1.2	-1.7	-1.2
Production + Services	-0.9	-0.8	-0.9	-1.3	-1.5	-1.4	-1.1
Total	-1.8	-2.6	-2.2	-1.6	-2.7	-3.1	-2.3
Population ('000s)							
Development	0.9	3.3	4.6	2.2	5.8	8.7	4.3
Production + Services	0.8	1.5	3.2	8.6	7.2	7.3	4.8
Total	1.7	4.8	7.8	10.8	13.0	16.0	9.0
Share of Total (%)	0.3	0.9	1.5	2.1	2.5	3.1	1.7