Socio-economic Benefits from Petroleum Activity in Newfoundland and Labrador, 2015 - 2017

Prepared for: Petroleum Research Newfoundland and Labrador (PRNL)

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Introduction

In November 2003, Petroleum Research Atlantic Canada (PRAC) released a report on the **'Socio-Economic Benefits from Petroleum Industry Activity in Newfoundland and Labrador'** (Community Resource Services Ltd. (CRS), 2003) during the 1999 to 2002 period. The report found that the socio-economic effects of the Newfoundland and Labrador offshore petroleum industry 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). The report also concluded that offshore petroleum activity had helped transform the provincial economy. Updates to this report for 2003 and 2004 (Jacques Whitford 2005), 2005-2007 (Stantec 2009), 2008-2010 (Stantec 2012), and 2011-2014 (Stantec 2015) reinforced these conclusions and determined that production activity, exporting and diversification into other industries had become increasingly important components of the industry, resulting in a more stable pattern of activity and subsequent economic benefits.

The socio-economic effects of the Newfoundland and Labrador offshore petroleum industry have been 'large, widely distributed, and long-term'.

This further update has been prepared for Petroleum Research Newfoundland and Labrador (PRNL) by Stantec Consulting Ltd (Stantec), with funding from PRNL and the support of the Newfoundland and Labrador Department of Natural Resources. It builds on the earlier reports, providing information and analysis for 2015, 2016, and 2017 on:

- **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 (R&D).**

This study also summarizes the involvements of a range of companies with the offshore petroleum industry in Newfoundland and Labrador, and the ways in which interactions with the industry have led them variously to develop new goods and services, hire new personnel, provide them with further training, acquire new facilities and equipment, and improve quality, health, safety, and environmental policies, practices and performance. It also considers the way in which the resultant increases in experience and capabilities have led to them winning related work in other jurisdictions, and undertaking work in other industries, both locally and outside the province.

NL companies interactions with the oil and gas industry has led to the development of new goods and services, employment, further training and increased performance.

It should be noted that this study is only concerned with the effects of upstream offshore petroleum activity itself; it does not document the substantial royalties oil companies paid to the Government of Newfoundland and Labrador. These amounted to approximately **$943.9 million during the 2017-2018 fiscal year and almost $2.5 billion over the study period.** (GNL nd Public Accounts, Consolidated Statement (YE, March 31)). The provincial government also receives income and consumption taxes from labour income generated by the offshore petroleum industry, and corporate income taxes paid on oil company profits; however, that information is confidential and hence not available for this study.

Oil companies working in Newfoundland and Labrador also make substantial contributions to local charities and community groups. During the study period, these included the following:

The Rooms, St. John's, NL.

Chevron Open Minds at The Rooms

Chevron Open Minds at The Rooms is an innovative school program where students, teachers and community experts come together for a week of experiential learning at The Rooms, Newfoundland and Labrador's largest public cultural space. Interaction with historic artifacts, natural history specimens, archival records and art stimulate inquiry and critical thinking in authentic ways. Between 2009 and 2017, 4,252 students, 210 teachers, and hundreds of parent volunteers attended the program. Chevron Canada has invested more than $1 million in Open Minds at The Rooms since it began in 2009. Research has shown that for every $1 invested in Open Minds, approximately $4 of value is created in the community.

Husky and the Eastern Newfoundland Science and Technology Fair

Husky Energy is the title sponsor of the annual **Husky Energy Eastern Newfoundland Science and Technology Fair,** an event that nurtures curiosity, creativity and confidence. Hundreds of students participate each year and are eligible to win various scholarships and awards. Projects aim to solve problems and answer questions that are prominent with today's youth, especially in the areas of health, environment and technology. Finalists who earn the "Husky Energy Best in Show" awards get to represent Eastern Newfoundland at the Canada Wide Science Fair. Husky also invites the finalists to present their work to our employees, which gives students a chance to practice their presentations and an opportunity to teach and inspire adults.

ExxonMobil Canada and United Way

ExxonMobil Canada continues to host the top performing Workplace Campaign for United Way Newfoundland and Labrador, **raising $250,000 in 2017 and over $3 million since 2005.** United Way of Newfoundland and Labrador stated in its most recent annual report that "ExxonMobil inspires its employees to be philanthropic – they represent 49% of our Leadership Donors (individuals who donate $1000+ for a given campaign year). This is a true testament to their dedication of ensuring that they are giving back to the communities in which they work and live." Funding provided by ExxonMobil Canada and its employees provides services that strengthen individuals, families, and communities, and contribute to United Way Newfoundland and Labrador's support to over 48,300 individuals across 117 communities.

Suncor and the Community Sector Council

Through its private, non-profit charitable organization, **Suncor Energy Foundation (SEF)**, the company invests in communities where it operates to build a better future and ensure these vibrant communities remain

sustainable and resilient. In 2015, SEF began a **$2.1-million, multi-year partnership with the Community Sector Council Newfoundland and Labrador (CSC NL)** to build a stronger non-profit sector at time when community groups are facing increased demand for services and increased costs of providing services. An independent, non-profit organization, CSC NL is dedicated to promoting social and economic well-being and to assisting other community sector organizations build their own capacity and capabilities. In 2017, CSC NL held a series of workshops for such groups on liability protection, social media strategies, governance, and performance measurement and evaluation.

Equinor and Local Arts and Culture

Equinor supports youth and local communities in Newfoundland and Labrador through engagement in arts and culture, donations to Science Technology Engineering or Mathematics (STEM), and sports. In addition to sponsoring Techsploration, which enables young girls to learn about opportunities and gain experience in STEM, and Arts Smarts, bringing arts and education together in the province, **Equinor is the presenting sponsor of the Newfoundland and Labrador Folk Festival.** The three-day, annual festival boasts a line-up of Canadian and local artists, as well as activities for families, including folk-inspired instrument and youth music workshops aimed at keeping the tradition of folk music alive in the province. As part of the Festival, Equinor also sponsors an interactive youth workshop in collaboration with the headlining children's entertainer, in addition to the Equinor MusicNL NewFound Talent Contest for musicians 19 and under.

Newfoundland and Labrador Folk Festival 2018

Nalcor Energy's Bull Arm Donations

During December 2017 Nalcor Energy kicked off Coming Together for Our Communities, a community investment initiative with numerous not-for-profit organizations and community groups across Newfoundland and Labrador. As a result of the close out of the Bull Arm Fabrication lease agreement with ExxonMobil, Nalcor gained ownership of the site living quarters, which included kitchen, housing, and office items. The Bull Arm team saw the opportunity to reach out to not-for-profit organizations that provide food and shelter services. **Nalcor received 23 donation applications and all 23 organizations benefited from this holiday giving program.** The Gathering Place, Choices for Youth, Jimmy Pratt Memorial Outreach Centre, and Home Again Furniture Bank are some of the not-for-profits that received kitchen equipment and household items, allowing them to expand and continue to serve hot meals and to furnish housing giving families a safe and deserving place to call home.

Oil companies make substantial contrbutions to local charities and community groups.

Context

Offshore petroleum activity in Newfoundland and Labrador began in 1963, with the first exploration well being drilled in 1966. The industry has experienced fluctuating levels of exploration, development, and production activity over the succeeding decades. In the first case, the pace of exploration has varied in response to varying levels of success, changing oil prices, and the availability of government support (e.g., federal Petroleum Incentive Plan grants in the 1970s). Exploration, including both drilling and seismic activity, peaked in the early-1980s, with minor other peaks in the mid-1990s and late-2000s. This exploration led to the discovery of the Hibernia oilfield in 1979, the Hebron field in 1981, the Terra Nova and White Rose fields in 1984, and discoveries in the Flemish Pass, including Mizzen (2009), Harpoon (2013), and Bay du Nord (2013).

The first development activity did not occur until 1990. Since then, four Grand Banks oilfields, as well as satellite developments such as North Amethyst and the Hibernia South Extension, have been brought into production.

Offshore activity began in 1963. Since then, four oilfields have been brought into production.

Hibernia

The approximately $5.2 billion development of this field, 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 topsides were mated in early 1997, and the complete platform was towed to the field in time for first oil production in November 1997. **Hibernia produced its one billionth barrel of oil in December 2016 and production in 2017 totaled 53.0 million barrels of oil.** The Hibernia project had an estimated 589.4 million barrels of recoverable reserves remaining at the end of 2017 and is expected to continue producing until at least 2040 (NLDF 2018). Cumulative production since first oil at Hibernia was 1,015 million barrels by March 31, 2017 (C-NLOPB 2017a).

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 approximately $2.8 billion.** The total production of oil from Terra Nova in 2017 was 11.2 million barrels, a decrease of 0.9 million barrels, or 7.4%, compared to 2016. As of March 2017, total production since first oil was 394.8 million barrels (C-NLOPB 2017a; NLDF 2018).

Hebron platform - tow out 2017

White Rose

Work developing this field started in 2002. Like Terra Nova, White Rose uses an FPSO with a hull built in South Korea. Much of the topsides fabrication and installation work for the SeaRose FPSO occurred in Marystown, Placentia Bay, while some fabrication work, and the testing of some sub-sea components, took place at Bull Arm. **The project had a total capital cost of approximately $2.35 billion and first oil was produced in November 2005.** In 2017, White Rose (including North Amethyst) produced 15.6 million barrels of oil, an increase of 0.7 million barrels over 2016, bringing the total life-of-field production to 273.7 million barrels (C-NLOPB 2017a; NLDF 2018).

In late 2014, Husky announced it was deferring development of the West White Rose Project. Final investment decision to proceed was announced in May 2017. The project will be developed using a Concrete Gravity Structure (CGS) with Topsides, tied back to existing infrastructure at the White Rose field including the SeaRose FPSO production vessel. The CGS is being constructed in a purpose-built graving dock in Argentia, Placentia Bay. First oil is targeted for 2022.

Hebron

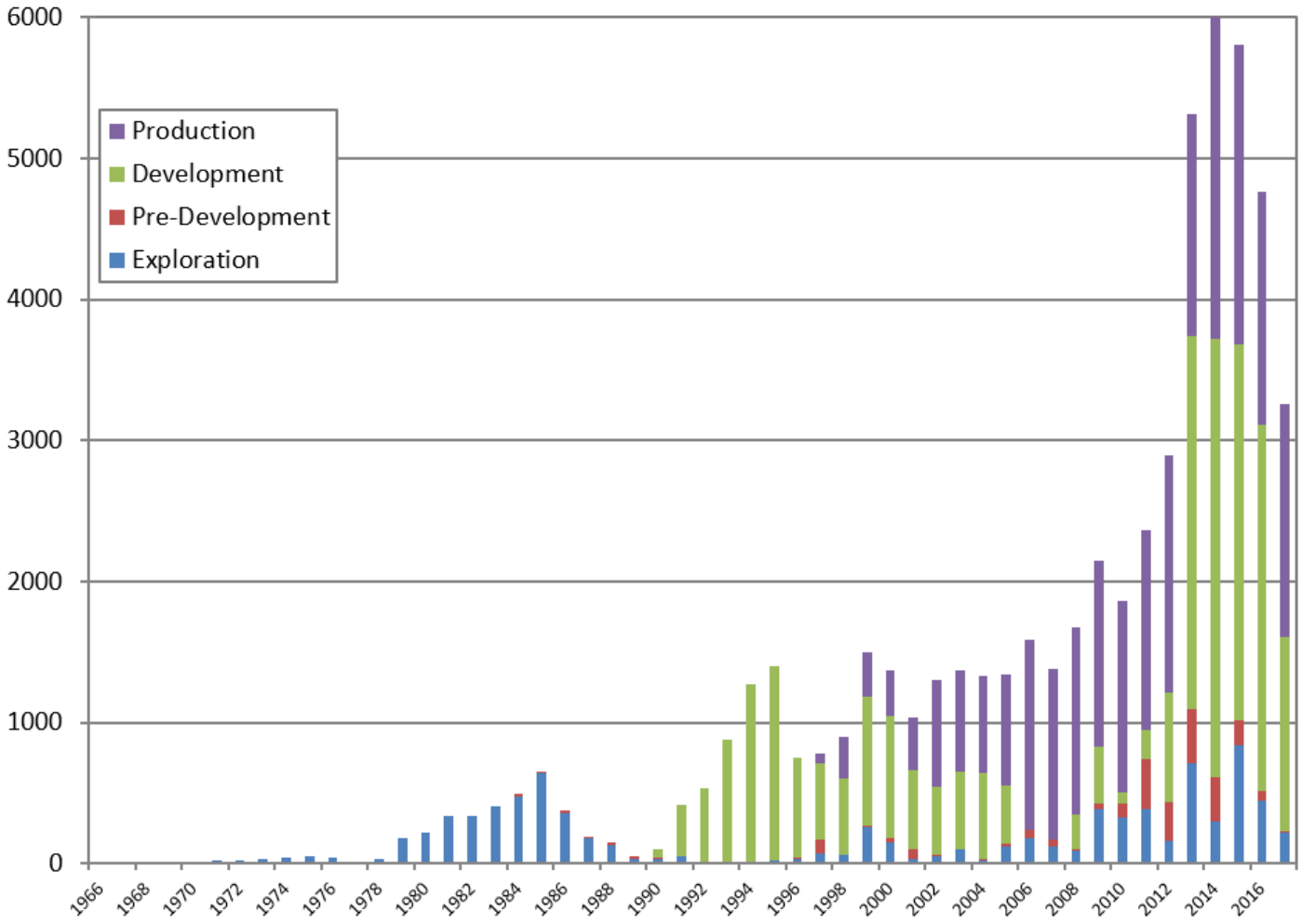
The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) approved the Hebron development plan application in 2012. The project was sanctioned by ExxonMobil and its partners (Chevron Canada, Suncor Energy Inc., Equinor (previously Statoil Canada), and Nalcor Energy) in 2013. Construction of the Hebron GBS began at the Bull Arm Fabrication Site in 2012, and **four of the six components of the topsides of the GBS were produced at various locations throughout the province,** including Bull Arm, Port aux Basques, Marystown, and Mount Pearl. Integration of the topsides modules and mating onto the GBS was completed in December 2016, and the platform was towed out and placed on the ocean floor in June 2017. Hook up and commissioning were completed in the fall of 2017 and the project produced first oil on November 27, 2017. Hebron production totaled 0.8 million barrels in 2017, and it is estimated that the project had 706.2 million barrels of recoverable reserves remaining at the end of the year. The capital cost for the project is estimated at $14 billion and it is estimated to have a 30-year lifespan (NLDF 2018).

Seadrill - West Aquarius

In aggregate, economic activity in Newfoundland and Labrador slowed in 2015 after a decade of significant growth. This was due to weaker commodity, including oil, markets. Oil and gas industry expenditures also decreased from previous years as major projects, including Hebron, moved past their peak of development activity.

In 2015, industry expenditures, having reached record levels of $6.3 billion in 2014, totaled approximately $5.8 billion. In 2016 and 2017, oil and gas expenditures continued to fall and totaled $4.8 million and $3.3 million, respectively (Figure 2-1). Since 1966, cumulative expenditures to the end of 2017 total $59.4 billion (C-NLOPB 2017b; NLDF 2015, 2016, 2017).

Since 1966, cumulative industry expeditures to the end of 2017 total almost $60 billion



Newfoundland and Labrador Offshore Petroleum Activity and Area Expenditures, 1966-2017

Figure 2.1

Source: C-NLOPB

Between 2014 and 2015, annual oil production decreased by 20.5 percent, from 78.9 million barrels to 62.7 million barrels, as a result of natural declines at the existing fields. Production rose to 76.7 million barrels, an increase of 22.5 percent, in 2016, and another 5.0 percent to 80.6 million barrels in 2017. **Newfoundland and Labrador marked its 20th full year of oil production in 2017.** Hebron, the province's fourth standalone oil project, began production that same year (NLDF 2016, 2017, 2018).

In 2015, a resource assessment of an area of the Newfoundland and Labrador offshore spurred renewed optimism for the long-term future of the province's oil and gas sector. Nalcor Energy's resource assessment, which was completed by international petroleum consultancy firm Beicip-Franlab, covered 11 offshore parcels offered in the Flemish Pass land sale area and estimated that the in-place **oil and gas resource potential for the area was 12 billion barrels of oil and 113 trillion cubic feet of gas.** The area assessed covers less than 2% of Newfoundland and Labrador's offshore area and indicates that there is very likely much more oil to be developed in the Newfoundland and Labrador offshore (NOIA 2015).

In December 2016, the Government of Newfoundland and Labrador established an Oil and Gas Industry Development Council in support of positioning Newfoundland and Labrador globally as a preferred location for oil and gas development. The Council made a commitment to create a long-term vision for the province's oil and gas industry, with a focus on promoting development, competitiveness, and sustainability (NLDF 2018).

Thirty exploration parcels were offered during the 2015-2017 period. This resulted in the issuance of 16 exploration licenses (ELs) with the successful bidders making expenditure commitments totaling nearly $2 billion (C-NLOPB no date). During this period, the province saw seven new companies take stakes in ELs within 18 months. Annual exploration expenditures reached an all-time-record of $836.7 million in 2015, up 178.5 percent from the previous year. Exploration expenditures then decreased nearly 50 percent to $444.7 million in 2016 (C-NLOPB 2017b).

Nine new exploration wells were drilled in Newfoundland and Labrador's offshore during the study period (Table 2.1). In addition to drilling activity, seismic exploration activity was robust. Between 2015 and 2017, Husky continued development drilling at the South White Rose Extension and North Amethyst field, including near-field exploration. Equinor announced the results of a 19-month drilling program in the Flemish Pass Basin, which involved drilling nine wells, including three appraisal wells on the Bay du Nord discovery, four exploration wells in close vicinity of Bay du Nord and two exploration wells in other areas of the Flemish Pass (NLDF 2017).

Stantec - Envionmental Effects Monitoring (EEM)

Environmental work continued to be an important element in the development of the offshore between 2015

Well Name	Area	Spud Date*	Well Termination Date
Bay du Nord P-78	East NL	08-Feb-2015	28-Apr-2015
Cupids A-33	East NL	06-Apr-2015	16-Apr-2015
Bay du Nord P-76	East NL	02-May-2015	10-Jun-2015
Bay du Nord P-76Z	East NL	11-Jun-2015	12-Sep-2015
Bay d'Espoir B-09	East NL	13-Sep-2015	20-Sep-2015
Fitzroy A-12Z	East NL	11-Feb-2016	13-Mar-2016
Bay de Loup M-62	East NL	14-Mar-2016	23-Apr-2016
Baccalieu F-89	East NL	19-Mar-2016	19-May-2016
Portugal Cove E-38	East NL	15-May-2017	05-Jul-2017
***Start of drilling**			

Table 2.1 Exploration Wells in the Newfoundland and Labrador Offshore: 2015-2017

and 2017. In August 2016, Equinor provided a project description to the Canadian Environmental Assessment Agency (CEAA), for another proposed exploration drilling program in the Flemish Pass Basin. This proposed drilling program would include current and potential future licences held by Equinor and its partners in the area. In September 2016, Husky Oil Operations Limited provided a project description to the CEAA for a proposed exploration drilling program in the Jeanne d'Arc Basin and the Flemish Pass. The project includes up to 10 wells to be drilled at any time between 2018 and 2026. ExxonMobil Canada Ltd. and its co-ventures also provided a project description to the CEAA in 2016 for a proposed program of exploration drilling and associated activities in the Jeanne d'Arc and Flemish Pass regions. This proposal includes plans for a number of exploration activities including the drilling of up to 35 wells (exploration and delineation) between 2018 and 2030 (NLDF 2017). **These programs demonstrate that exploration and development hold significant opportunities for future growth in oil production, and by extension the provincial economy.**

Diversity has continued to be an important issue for both operators and contractors, who actively encourage the employment of women, Indigenous peoples, persons with disabilities and visible minorities, and business access by companies they own or operate. During the study period, Husky Energy continued implementation of the **White Rose and West White Rose Diversity Plans, and the Hebron Project proceeded with development of its Diversity Plan,** working with their major contractors and such groups as the Women in Resource Development Corporation, the Independent Living Resource Centre and the NL Organization of Women Entrepreneurs, to incorporate diversity into the projects as early as possible.

Diversity is an important issues for both operators and contractors - who actively encourage employment of women, Indigenous persons and visible minorities.

Economic Benefits 2015 - 2017

This section of the report provides a detailed picture of the economic effects of offshore petroleum activity on Newfoundland and Labrador during the 2015 to 2017 period. These findings are presented in the context of a revised analysis of the impacts discussed in the earlier reports.

The analysis was prepared by the Economic Research and Analysis Division, Department of Finance, Government of Newfoundland and Labrador. It examines the direct, indirect, and induced effects of offshore petroleum industry activity between 2010 to 2017 (the 2010-2017 period). The Department of Finance report is provided in its entirety in Appendix A.

direct, indirect and induced effects

Direct Impacts

This analysis of the total economic impacts of offshore petroleum activity on Newfoundland and Labrador is based on its direct impacts during the years 2010 to 2017 (Table 3.1), established using information from the oil companies, C-NLOPB and Statistics Canada. This information includes data on costs related to production,

	2010	2011	2012	2013	2014	2015	2016	2017
Capital Costs ($ Millions)								
Exploration	333.9	385.5	165.1	712.7	300.4	836.7	444.7	221.7
Development	177.1	568.0	1,046.2	3,027.4	3,416.0	2,848.9	2,670.0	1,383.0
Production (Sustaining)	604.1	701.6	934.5	611.0	1,623.8	1,052.0	732.3	727.8
Total	**1,115.1**	**1,655.1**	**2,145.8**	**4,351.1**	**5,340.2**	**4,737.6**	**3,847.0**	**2,332.5**
Employment (person years)								
Development	352	685	1,198	3,486	5,299	4,875	3,518	1,964
Production	2,839	3,173	3,981	4,324	4,859	4,047	3,576	3,395
Total	**3,191**	**3,858**	**5,179**	**7,810**	**10,158**	**8,922**	**7,093**	**5,359**
Oil Production (millions of bbl)	**100.7**	**97.3**	**72.2**	**83.6**	**78.9**	**62.7**	**76.7**	**80.6**
Operating costs ($ Millions)	**751.4**	**708.4**	**746.1**	**960.1**	**977.0**	**1,064.5**	**916.2**	**929.1**
Wages/Salaries & Employee Benefits ($ Millions)								
Development	28.0	50.9	91.2	287.4	507.4	510.2	326.4	185.2
Production	299.1	320.9	408.3	503.6	599.2	521.7	452.4	438.6
Total	**327.1**	**371.7**	**499.5**	**790.9**	**1106.7**	**1031.8**	**778.8**	**623.8**

Table 3.1 Direct Impacts of Offshore Petroleum Industry, Newfoundland and Labrador, 2010-2017

which shows a general pattern of increase in its overall contribution to the provincial economy, and data related to exploration and development activity, which have been more susceptible to fluctuations over time and are influenced by such factors as drilling and labour costs. The production of oil saw a general decline from a 2010 peak of 100.7 million barrels to 62.7 million barrels in 2015 but rose again to 80.6 million barrels in 2017.

As has been discussed above, levels of exploration activity in Newfoundland and Labrador have varied since it began in the 1960s. The direct economic impact of exploration continued to fluctuate during the study period, although such factors as increasing rig costs resulted in higher costs overall. Exploration spending peaked at a record $836.7 million in 2015, but this was followed by declines to $444.7 million in 2016 and $221.7 million in 2017.

The expenditures associated with development fell from $2.85 billion in 2015 to $1.38 billion in 2017, with the completion of the Hebron GBS. Wages, salaries, and benefits associated with development activity decreased over the study period, from $510.2 million in 2015 to $185.2 million in 2017. This is also likely attributable to the completion of the Hebron GBS and topsides and the general winding down of construction activity for the project during the study period.

Production activity costs declined between 2015 and 2016, falling approximately 30 percent from $1.05 billion to $732.3 million. Production costs in 2017 were very similar to 2016, at a total of $727.8 million. Wages, salaries, and benefits associated with production also declined, from $521.7 million in 2015 to $438.6 million in 2017, a decrease of 16 percent.

Indirect Impacts

A substantial portion of the local benefits from the offshore petroleum industry activity accrues to companies providing goods and services to oil companies. Supplier or indirect impacts are dependent on non-wage operating spending and capital spending by oil companies. The provincial Department of Finance's Newfoundland and Labrador Input-Output Model (NALIOM) was used to obtain indirect employment, gross domestic product (GDP) and labour income impacts. NALIOM simulates the relationships between commodity outputs and commodity inputs at an industry level under the assumption of constant returns to scale (i.e. that the proportion of factor inputs used per dollar of output remains constant). The model provides estimates of the GDP, employment and labour compensation impacts for 481 commodity purchases distributed over 235 industries.

The main types of businesses providing services to the offshore petroleum industry included: services incidental to mining and oil and gas; miscellaneous business services; air transport; water transport; wholesaling; storage; and architectural, scientific, and engineering services. In 2017, the direct and indirect nominal GDP impacts on the Newfoundland and Labrador economy were $6.3 billion.

Table 3.2 Total Economic Impacts Related to the Offshore Petroleum Industry in Newfoundland and Labrador. 2010 - 2017

	2010	2011	2012	2013	2014	2015	2016	2017	Average
GDP ($ Millions)	8,579	11,227	9,234	11,387	11,095	6,523	6,611	6,957	8,952
Share of Total (%)	31.6	35.5	30.8	35.2	34.6	23.2	23.1	23.3	29.7
Real GDP Chained ($2007 Millions)	8,262	8,293	6,805	8,202	8,010	7,228	7,939	7,744	7,810
Share of Total (%)	32.3	31.4	27.0	31.0	30.6	28.0	30.3	28.9	29.9
Household Income ($ Millions)	1,365	1,451	1,930	2,796	3,472	3,538	2,889	2,242	2,375
Share of Total (%)	7.0	6.9	8.6	11.9	14.2	14.0	11.2	8.5	10.3
Labour Income ($ Millions)	1,024	1,088	1,447	2,097	2,604	2,654	2,167	1,681	1,7845
Share of Total (%)	9.2	8.9	10.9	14.7	17.6	17.3	14.0	10.7	12.9
Other Income ($ Millions)	341	363	482	699	868	885	722	560	615
Share of Total (%)	4.1	4.1	5.3	7.5	9.0	8.9	6.9	5.2	6.4
Disposable Income ($ Millions)	942	994	1,317	1,904	2,357	2,381	1,927	1,495	1,665
Share of Total (%)	7.0	6.9	8.6	11.9	14.2	14.0	11.2	8.5	10.3
Retail Sales ($ Millions)	528	557	737	1,066	1,320	1,333	1,079	837	932
Share of Total (%)	7.1	7.1	9.0	12.4	14.8	14.9	12.0	9.1	10.8
Housing Starts	160	164	213	302	367	369	291	220	261
Share of Total (%)	4.5	4.7	5.5	10.6	17.3	21.8	20.8	15.7	12.6
Employment (000s)	15.1	16.3	21.3	28.8	33.0	31.7	26.3	19.2	24.0
Share of Total (%)	6.8	7.0	8.8	11.9	13.8	13.4	11.3	8.6	10.2
Labour Force (000s)	12.7	13.5	17.6	22.7	25.2	23.6	19.3	14.6	18.7
Share of Total (%)	4.9	5.1	6.4	8.3	9.3	8.7	7.2	5.6	6.9
Unemployment Rate (%)	-1.7	-1.8	-2.3	-3.5	-4.4	-4.5	-3.9	-2.7	-3.1
Population (000s)	21.1	22.5	29.3	37.9	42.0	39.3	32.1	24.4	31.1
Share of Total (%)	4.1	4.3	5.6	7.2	8.0	7.4	6.1	4.6	5.9

Total Impacts

Data on the direct and indirect economic impacts are key inputs to the simulation of the overall effects of the offshore petroleum industry on the economy of the province, using the Department of Finance's Newfoundland and Labrador Econometric Model (NALEM). The model provides measures of the total (i.e., direct, indirect and induced) effect of the industry on a wide range of indicators, including GDP, employment, personal income, consumer spending and population change (Table 3.2), for the 2010 to 2017 period. It also provides averages for that period.

The estimates presented in Table 3.2 indicate a substantial impact on the provincial economy. Nominal GDP was, on average, approximately $9 billion per year higher over the 2010 to 2017 period, and $7 billion higher in 2017, as a result of offshore oil activity. Oil development and production activities generated 29.7 percent of

the province's nominal GDP between 2010 and 2017. During the 2015-2017 period that is the main focus of this study, GDP impacts (i.e., the business and labour income earned within the geographic boundaries of the province) peaked in 2016, and then decreased from 30.3 percent of the total GDP (Real GDP chained) to 28.9 percent in 2017.

GDP represents the business and labour income earned within the province. However, much of the business income earned in Newfoundland and Labrador's offshore petroleum industry accrues to non-resident companies. Because of this, business income directly related to the industry generally would not accrue to residents and therefore is not reflected in the personal income impact. Personal income impacts, primarily wages and salaries, reflect only income received by provincial residents. Consequently, the personal income impacts are smaller than the GDP impacts.

Household incomes were $2.4 billion per year higher over the 2010-2017 period as a result of the offshore industry.

The total household incomes were approximately $2.4 billion per year higher over the 2010 to 2017 period as a result of the offshore oil industry, **representing 10.3 percent of all provincial household income.** The impacts were somewhat higher in 2014 and 2015, at approximately 14.2 percent and 14.0 percent respectively, because Hebron construction activity was near its peak. 2016 and 2017 saw declines from 2015 levels, at 11.5 percent and 8.2 percent, respectively.

The income impacts mainly reflect the boost to labour income resulting from the oil industry's relatively high wages as well as labour income from spin-off employment (indirect and induced). Annual disposable incomes, which are household incomes after payment of direct taxes (income tax, EI, CPP premiums), were on average $1.7 billion higher over the 2010 to 2017 period. Consequently, consumer spending in the form of annual retail sales was about $930 million or 10.8 percent higher on average.

The estimated annual employment impact averaged approximately 24,000 person-years over the 2010 to 2017 period, representing 10.2 percent of all provincial employment. On average, the unemployment rate was 3.1 percentage points lower as a result. The decline in unemployment would have been greater except that increased employment, higher average wages and a larger population encouraged more labour force participation. The estimated annual labour force impacts were approximately 19,000 on average over the 2010 to 2017 period

The housing starts attributed to industry activity declined between 2015 and 2017. They were highest in 2015, at 369, and declined to 291 in 2016 and 220 in 2017.

It is difficult to model the population effects of offshore petroleum industry activity. Any increase in economic activity and employment in the province will tend to reduce out-migration and increase in-migration. Net migration is modeled in NALEM as a function of the difference in average wages and employment rates in Newfoundland and Labrador and in Canada as a whole. 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 approximately 4.6 percent higher in 2017. It should be noted, however, that because migration is a difficult variable to model there is a high margin of error associated with the estimated population impact. Consequently, a number of other indicators that are affected by changes in population, such as labour force, the unemployment rate, and housing starts, also have a higher margin of error.

Conclusion

The analysis shows that the **offshore petroleum industry, despite some declines between 2015 and 2017, is still making a major contribution to the Newfoundland and Labrador economy,** particularly in relation to GDP and employment. The contribution to GDP from oil industry capital spending fell in 2017 with the completion of construction of the Hebron oil platform mid-way through the year. Development impacts will be lower again in 2018 because there was no Hebron development activity in that year. However, oil production and production-related benefits such as employment and personal income should grow as Hebron production increases. Construction impacts should also increase as activity ramps up on building the West White Rose wellhead platform.

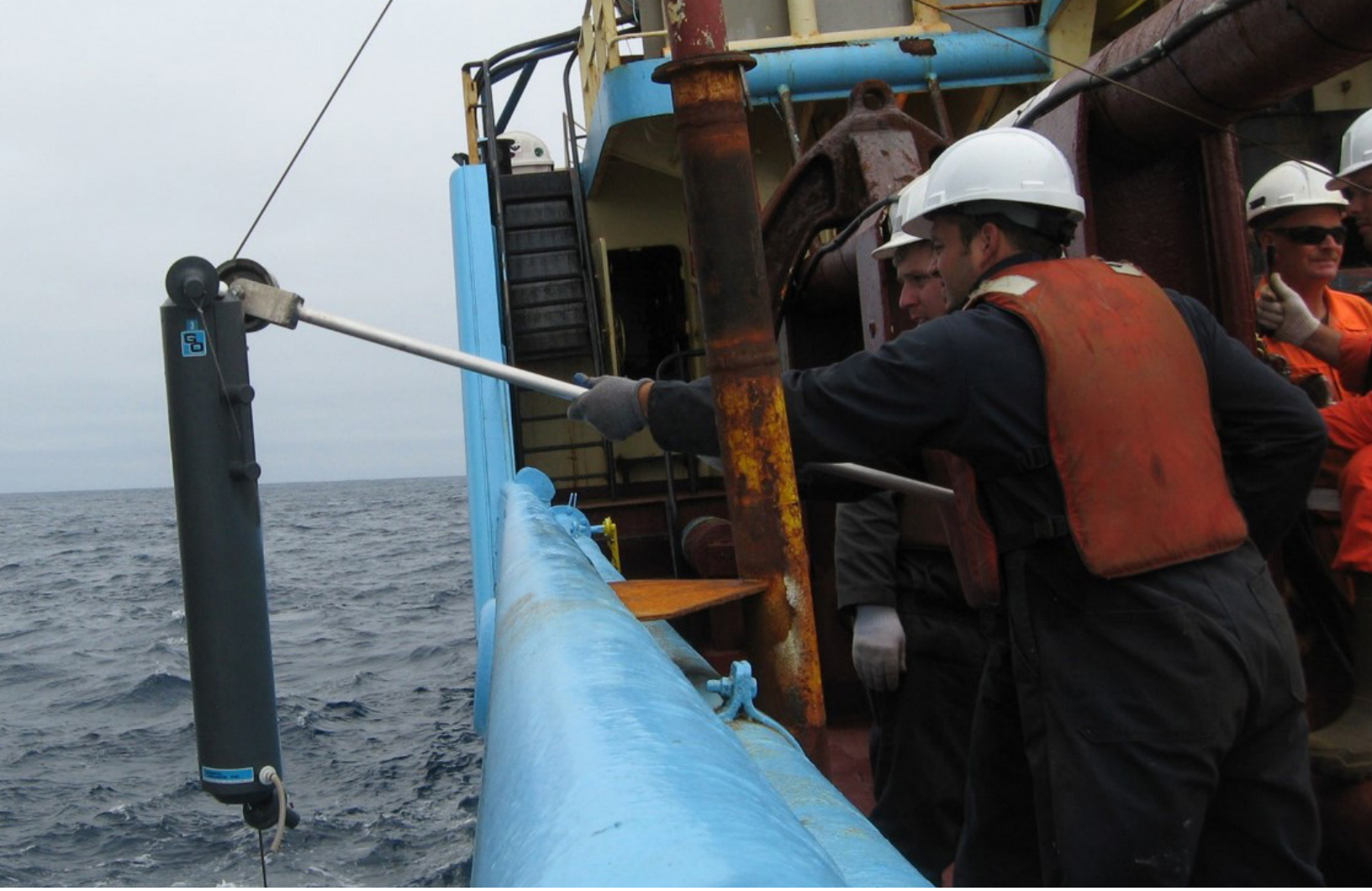
Hibernia Offshore Operations Simulator

INFRASTRUCTURE, EDUCATION AND TRAINING, AND RESEARCH AND DEVELOPMENT

Infrastructure

The ongoing development of the Newfoundland and Labrador offshore petroleum industry is supported by, and **has made a substantial contribution to, infrastructure development in Newfoundland and Labrador.** This contribution has been documented in previous reports in this series (see Section 1.0). Over the long term, the availability of infrastructure reduces the costs of development, increases the likelihood of additional petroleum industry investment in Atlantic Canada, and ultimately increases Newfoundland and Labrador's participation in the industry. Some of this infrastructure has also contributed to the diversification of Newfoundland and Labrador's economy. For example, many Newfoundland and Labrador companies have successfully leveraged harsh environment engineering expertise developed in provincial facilities to gain additional experience in Arctic environments.

The 2015 to 2017 period saw continued development and growth in supporting infrastructure for the Newfoundland and Labrador offshore petroleum industry. **For example, October 2015 saw the official opening of the Hibernia Offshore Operations Simulator Facility at the Marine Institute** (Advanced Education and Skills 2015). Funding for the new simulator was announced in 2014. It trains personnel in complex tasks such as positioning and mooring offshore structures, supply transfers, iceberg management, seismic surveys, and subsea operations. The new simulator not only helps employees gain skills and training in key industries for the province, but it will allow the province to spearhead R&D in the offshore petroleum sector (Oceans Advance, 2014).



Stantec - Envionmental Effects Monitoring (EEM)

The Hibernia Management and Development Company Ltd. (HMDC) and the Research & Development Corporation (RDC) **announced in 2015 that they would be investing approximately $16 million in a new helicopter training and R&D centre in Newfoundland and Labrador.** It is being developed and will be operated by CAE, a leading Canadian provider of training and simulation technologies. A helicopter simulator provides unprecedented realism for offshore facilities and local weather conditions and features the first approved helicopter simulator with night vision capability in Canada. The centre opened in Mount Pearl in June 2016 (Hibernia 2015).

In October 2015, **RDC announced an investment of nearly $600,000 in Technip Canada's High-Performance Computing Centre,** to strengthen the province's capacity in riser design research and development. The Centre allows Technip to process complex riser configurations with minimum processing time. The development of this technical expertise has the potential to enhance R&D capacity and open new opportunities in the field of riser design R&D. As well, through this project, Technip Canada has expended its local capabilities in providing riser design services to oil and gas industry clients around the world. The Centre, while based in St. John's, will service Technip's global clientele. The total cost of the project is $2,379,977 (NOIA 2015).

In 2017, through a funding partnership between the Town of Arnold's Cove, the provincial Department of Business, Tourism, Cultural & Rural Development (Department of Tourism, Culture, Industry and Innovation), and the federal Atlantic Canada Opportunities Agency (ACOA), **the Town of Arnold's Cove received nearly $1 million to build a new serviced business park.** It will be built as the basis of developing an oil and gas industry cluster in the community to benefit the region. Once complete, the park, which sits adjacent to various major

industrial infrastructure, such as the North Atlantic Refinery, Whiffen Head Transshipment Terminal, and the Bull Arm Fabrication facility, will benefit the businesses that service the region (Business, Tourism, Culture and Rural Development 2015; The Compass 2017).

2017 saw the opening of the world's first Centre for Environmental Genomics Applications (CEGA) by eDNAtec, Inc. Funded by the Hibernia Management and Development Company Ltd. (HMDC), RDC, and ACOA, the 3,500 ft^2 facility is dedicated to the use of genomics for environmental assessment and monitoring. The technology used at the CEGA is used by researchers to read the DNA floating in samples of seawater and determine what organisms are represented. The facility will pursue a research program that will help educate and train various stakeholders and individuals, as well as develop new methodologies for the application of environmental genomics in environmental assessment, with an emphasis on applications to oil and gas operations (Hibernia 2017; Oliver 2017).

Investments in education infrastructure, such as those described above, enhance the training abilities of education institutions. They help them to address skill gaps and plan for future needs in the oil and other industries. For instance, in 2015, the Marine Institute issued tenders to construct a breakwater and marginal wharf, as well as reconstruct the existing wharf and install evacuation training systems at its Holyrood Marine Base, which opened in 2010. Upon completion of the development, the Institute will relocate all of its at-sea safety and survival training to the Holyrood Marine Base from the Southside Marine Base. There are also plans to construct a second larger building on the site and to develop the adjacent water lot. This development will be used for various marine related training activities, and research and development of prototype ocean instruments (Marine Institute 2016a).

Marine Institute

Education and Training

In 2016, Memorial University joined Dalhousie University, Memorial University of Newfoundland and the University of Prince Edward Island (UPEI) **to create the Ocean Frontier Institute (OFI), which will focus on solutions for safe and sustainable ocean development.** The OFI was made possible through federal government funding of $100 million. Memorial's OFI will be housed in the University's Core Science Centre which is currently under construction and anticipated to be complete in 2020 (Memorial University Gazette 2016).

The study period also saw a range of further investments in student awards and scholarships, the creation of work-terms and internships, and new and existing research and training programs.

In March 2016, 19 students at Memorial University were presented with Ocean Industries Student Research Awards (OISRA). This awards program supports the development of highly-qualified researchers exploring areas relevant to Newfoundland and Labrador's ocean industries including offshore petroleum engineering, ocean technology, marine transportation, and fisheries and aquaculture. Awards range from $7,500 for bachelor degree-level programs, up to $20,000 per year for master's candidates, and up to $30,000 per year for doctoral candidates (Business, Tourism, Culture and Rural Development 2016a).

Two new subsea engineering research chairs were appointed at MUN in March 2017, expanding the University's capacity and partnerships with the offshore oil industry. Dr. Octavia Dobre, an electrical engineering professor in the Faculty of Engineering and Applied Science, was appointed as the Research Chair in Subsea Communications. Dr. Bipul Hawlader, a civil engineering professor in the faculty, was appointed as the Research Chair in Seafloor Mechanics.

In 2016, Dr. Enamul Hossain was appointed as the Equinor Chair in Reservoir Engineering and Dr. Sohrab Zendehboudi was appointed as the Equinor Chair in Reservoir Analysis. The research chairs will expand research and educational initiatives and mentor master's and doctoral students to become highly qualified personnel in the areas of study (Memorial university, Marketing and Communications 2016, 2017).

The Marine Institute received a large donation from Chevron Canada in 2016 to aid in training for the offshore petroleum industry through the Offshore Safety and Survival Centre (OSSC). OSSC offers a complete range of safety and emergency response training courses to the offshore petroleum, marine transportation, fishing and land-based industries and trains over 5000 offshore personnel annually from the Marine Institute's location in Foxtrap. Chevron's addition to the program included a 60-person free-fall lifeboat with a moulded fiberglass constructed hull to be used in at sea survival exercises, as well as personal protection equipment (PPE) ranging from bunker jackets and pants, boots, hard hats, and gloves for use by clients and instructors in training exercises (Marine institute 2016).

Undergraduate enrollment in the Faculty of Engineering and Applied Science at Memorial University was relatively constant during the study period with 1,192 full-time students in 2015, 1,183 in 2016 and 1,171 in 2017. During this period, the Faculty awarded 602 undergraduate engineering degrees (CIAP 2017). Approximately 340 Memorial University Engineering co-op students were placed with oil companies in each year (P. Sullivan, pers comm).

Research and Development

Between 2015 and 2017, R&D was an area of high activity in the provincial offshore petroleum industry, with industry, educational institutions, and research organizations providing support for the advancement of industry locally, as well as providing a mechanism for the transfer of local expertise into international markets. While various institutions and organizations were involved in funding research activity during the study period, including industry, the needs and opportunities arising directly from the industry provided the rationale for these R&D efforts.

GRI Simulations Inc., an ocean technology company, received a repayable contribution of $500,000 from the Government of Canada through ACOA in 2015 to support its work on state-of-the-art simulation and visualization solutions. The company's existing products include the Virtual Remotely Operated Vehicle Simulator System (VROV Simulator), a modular simulator system specialized to provide realistic, scenario-based simulations for ROV pilot training programs; and the Interactive Design, Engineering and Analysis Field Development Kit (IDEA-FDK), which is mainly used by offshore oil and gas field developers to simulate and model the design, installation and testing of a subsea oil field in a 3D virtual reality environment (ACOA 2015).

In June 2016, RDC announced that it was investing over $2.2 million in five commercial projects to support sensor-related research, and technology development and demonstration, in Newfoundland and Labrador. The total cost of these R&D projects is approximately $7.5 million, including funding from the private sector, RDC, and other funding agencies. Projects will help solve local technical challenges and contribute to the development of new or improved products and services with sensor-related technologies such as radar, acoustics, optics, sonar, and signal processing that can be exported around the world (RDC 2017).

Among the companies in receipt of this funding was Kraken Sonar Systems Inc., which is developing an actively-controlled, high-speed, towed platform for deploying its high-resolution Synthetic Aperture Sonar underwater seabed imaging technology. This platform, commonly referred to as a 'towfish', will be a complete solution with the sensing technology integrated onboard and may be deployed from either manned or unmanned surface vessels. It will be used for survey work offshore exploration, seabed mapping and military operations and any activities that require accurate seabed imaging of the ocean floor (Business, Tourism, Culture and Rural Development 2016b).

Another recipient of this funding was Approach Geomatics (RIS), for the development of unmanned aircraft vehicle (UAV) technology as an additional data acquisition tool for mapping, monitoring, and inspecting infrastructure and the natural environment. The primary objective of this project is to design and develop an integrated remote sensing service for mapping, monitoring and inspection. These unique services will target a large potential market, with commercial applications in offshore oil and gas, communications, coastal erosion, and government asset management (Business, Tourism, Culture and Rural Development 2016b).

In June 2017, the Governments of Canada and Newfoundland and Labrador, through RDC and ACOA, committed nearly $6 million to support projects by two companies in Newfoundland and Labrador. Fugro Geosurveys is adapting and demonstrating sensor technology for use with Autonomous Underwater Vehicles while Solace Power Inc. is focused on wireless charging technology for small electric unmanned aerial vehicles (Tourism, Culture, Industry, and Innovation 2017).

During the study period, a consortium of industry, R&D, and academic institutions across Atlantic Canada – spearheaded by this province – bid for a share of $950 million in federal funding to boost innovation in ocean and digital technologies. The Government of Canada will invest up to $950 million between 2017 and 2022 to support three to five innovation superclusters with the strongest potential to stimulate economic growth. Government will co-invest with industry in the most promising proposals, working with large anchor firms, small and medium enterprises, post-secondary and scientific research institutions to foster innovation and grow industry partnerships.

In 2018 it was announced that the Ocean Supercluster proposal was successful. It is being led by PRNL and includes companies from marine renewable energy, fisheries, aquaculture, oil and gas, defense, shipbuilding, transportation, and ocean technology. These companies will work together to share information and ideas, along with post-secondary institutions, scientific and R&D organizations, entrepreneurs, and governments, to drive technology solutions in the ocean economy.

Grieg Aquaculture Project in Placentia Bay

Case Studies

The success of the offshore petroleum industry in Newfoundland and Labrador is both a result of, and exemplified by, the success of local companies. **Within Newfoundland and Labrador, there now exists a large provincial supply and service sector.** The interests of this sector are represented by the Newfoundland and Labrador Oil and Gas Industries Association (Noia), the membership of which has grown from 566 companies in 2011 to nearly 600 in 2017 (B. Bishop, pers comm., NOIA 2018).

This section of the study summarizes the involvement of a range of such companies with the offshore petroleum industry in Newfoundland and Labrador, and the ways in which **interactions with the industry have led them variously to develop new goods and services,** hire new personnel, provide them with further training, acquire new facilities and equipment, and improve quality, health, safety, and environmental policies and practices. It also considers the way in which **the resultant increases in experience and capabilities have led to them winning petroleum industry work in other jurisdictions, and undertaking work in other industries, both locally and outside the province.**

The following case study companies have been selected to help reflect the diversity of activity in and around the province's oil and gas industry. This includes companies of different sizes, engaged in construction, manufacturing and the provision of technical and professional services, located in St. John's and elsewhere in Newfoundland and Labrador. Some companies are engaged in cutting edge engineering and R&D activity, while others provide important services around real estate, accommodations, and catering.

Offshore simulator - Virtual Marine

The growing core competencies of our supply and service sector - born from interactions with the offshore industry, has led to the continued diversification of NL's economy

DF Barnes

DF Barnes

One example of an established Newfoundland and Labrador company with ties to the oil and gas industry is **DF Barnes.** DF Barnes was founded in Newfoundland and Labrador in 1932, and began primarily as a machine, welding, and fabrication shop for the marine sector. Located in St. John's, DF Barnes operated a shipyard and was primarily involved in building ship engines and providing maintenance and repair services to marine vessels operating offshore. DF Barnes was also responsible for building the first steel-hulls for fishing vessels in the province. DF Barnes employed approximately 20 to 30 people at that time and enjoyed success in the marine sector. With the onset of the oil and gas industry in Newfoundland and Labrador in the 1990s, DF Barnes saw an opportunity for growth and diversification in offshore Newfoundland and Labrador and pursued it.

Entrance into the oil and gas industry brought on many changes at DF Barnes. In a short amount of time, the company had to adapt to new standards surrounding quality and safety to become competitive for oil and gas contracts. This change in business processes helped change the culture within the company, which is now a top service provider in the industry and places high value in quality and safety of its operations. DF Barnes developed a reputation early in the Newfoundland and Labrador oil and gas industry for its emergency maintenance and repair services on offshore drilling rigs, production platforms, and supply vessels. As a result, DF Barnes currently has crews onboard all platforms, drill rigs, and supply vessels operating in offshore Newfoundland and Labrador, providing repair and maintenance services when required.

As a result of the early success and growth that DF Barnes experienced in the oil and gas industry, the company identified other avenues for growth within the offshore sector both locally and abroad. As a result, DF Barnes expanded its business services, and has branched into the following group of companies: DFB Services, DFB Fabrication, DFB Coatings, Extreme East Rigging Services, and DFB Driver.

DFB Driver has roots in western Canada and is a product of DF Barnes' diversification and growth expanding the company into new markets. Based on its work in the offshore oil and gas industry, the company began working on projects in Canada's oil sands in Alberta. It eventually signed a joint venture agreement with JV Driver, an Edmonton company which specializes in large-scale industrial construction projects, allowed DFB Driver to take on such projects across Canada and abroad.

DF Barnes has also been able to extend their services globally. DF Barnes currently works or has worked in several countries around the world. In terms of oil and gas, DF Barnes has operated in the Gulf of Mexico, the North Sea, and the Horn of Africa. But, overall, the above expansions have allowed DF Barnes to reduce its dependency on the oil and gas industry. Where oil and gas work used to represent upwards of 90 percent of the company's revenue, it is now closer to 50 percent. This includes recently entering the fabrication business for the renewable energy sector, primarily related to offshore wind development.

DF Barnes - fabrication

Oil and Gas work used to make up 90% of DF Barnes business - which is now closer to 50% , including entering into fabrication for the renewable energy sector.

PF Collins

Another large local company that caters to the oil and gas industry is **PF Collins,** a longstanding family business based in St. John's. Newfoundland was still a colony of Great Britain when PF Collins was appointed Customs Broker for Newfoundland in 1921. International transport to and from Newfoundland was still largely marine at that time, with St. John's the key port of entry, and PF Collins participated in the development of Newfoundland's early industrial diversification and helped arrange the movement of imported goods to points around the island. After Confederation in 1949, Newfoundland's trading patterns and transportation systems began to change significantly, providing new opportunities. The company participated in such early industrial developments as the pulp and paper mills, the U.S. military bases, refineries at Holyrood and Come-By-Chance, and the Churchill Falls Hydro development.

In the 1970s, Bernard J. Collins joined the family business and took responsibility for developing its involvement in offshore petroleum exploration activities. During the 1970s, working with operators and government legislators, the company initiated many operational procedures to accommodate the then "customs-free zone" on the Continental Shelf. As the company continued to grow, it expanded services and capabilities and its international network of agents and affiliates. The offshore petroleum industry has allowed for the continued growth of the business and expansion to other parts of Canada, opening offices in Nova Scotia, New Brunswick, and Alberta. **Working for the offshore oil and gas industry has pushed PF Collins to increase efficiency and improve business functions,** allowing it to be competitive on the national and international stage.

PF Collins, St. John's, NL.

This has included increasing efficiencies and eliminate waste in both the company's physical environments and business operations. LEAN processing has been implemented throughout the company, improving processing times and increasing productivity. The introduction of an Electronic Data Management System has allowed the company to move business processes to an electronic environment, not only contributing to more efficient workflows, but also significantly reducing the amount of paper used throughout the company.

PF Collins now provides custom brokerage, freight services, warehouse and distribution services, project logistics, project administration, marine agency services, compliance consulting services and immigration consulting, with the last seeing rapid recent growth. Since 2005, the company has invested close to $20 million in infrastructure (land, offices, warehouses, and equipment) to support expanding operations. As of the end of the study period, **PF Collins employed 105 people, including 93 in Newfoundland and Labrador. Company management is proud of the fact that 48% of the company's total staff and 54% of its management team are women.**

Flight simulation - Cougar Helicopters

Cougar Helicopters

(Cougar) is a Canadian company based in St. John's, Newfoundland and Labrador. It operates a fleet of modern S-92 helicopters in support of offshore passenger transportation and search and rescue (SAR) roles. Cougar is currently the primary aviation transportation service provider for the province's local oil and gas industry.

Cougar's introduction into offshore Newfoundland and Labrador came in 1995, when it was awarded the offshore support contract for Hibernia. Since that initial contract, Cougar has provided services to Equinor and Chevron and it currently holds offshore support contracts for Hibernia, Terra Nova, White Rose, and Hebron operations. This includes producing fields and exploration platforms that are operating in the offshore environment.

Cougar has been providing SAR to the oil and gas industry since 1991. Operating from a purpose-built 27,000 sq ft facility in St. John's, Cougar's team of professionals provide 24/7 365 SAR service with a response posture of being airborne within 20 minutes. The SAR-configured S-92s (with a back-up SAR aircraft available), capabilities and duties include, but are not limited to, providing medevacs, ship hoisting, water rescue, multi-patient evacuations, rig abandonments, multi-casualty response and night hoisting. Cougar's other business lines include helideck inspection services for offshore vessels and installations and offshore aerial construction consisting primarily of flare tip replacements of offshore installations, which Cougar has completed locally and internationally.

The oil and gas industry has played in important role in the company's operations, growth, and success. As the sole operator currently serving the industry in St. John's, Cougar's business is strongly linked to oil and gas and can be affected by fluctuations in the market, both positive and negative. As such, the company is also exploring potential new industries to help diversify its operations, such as charter flights, emergency medical services and medivac services, northern and remote search and rescue, general construction, and transportation services to other industries such as government.

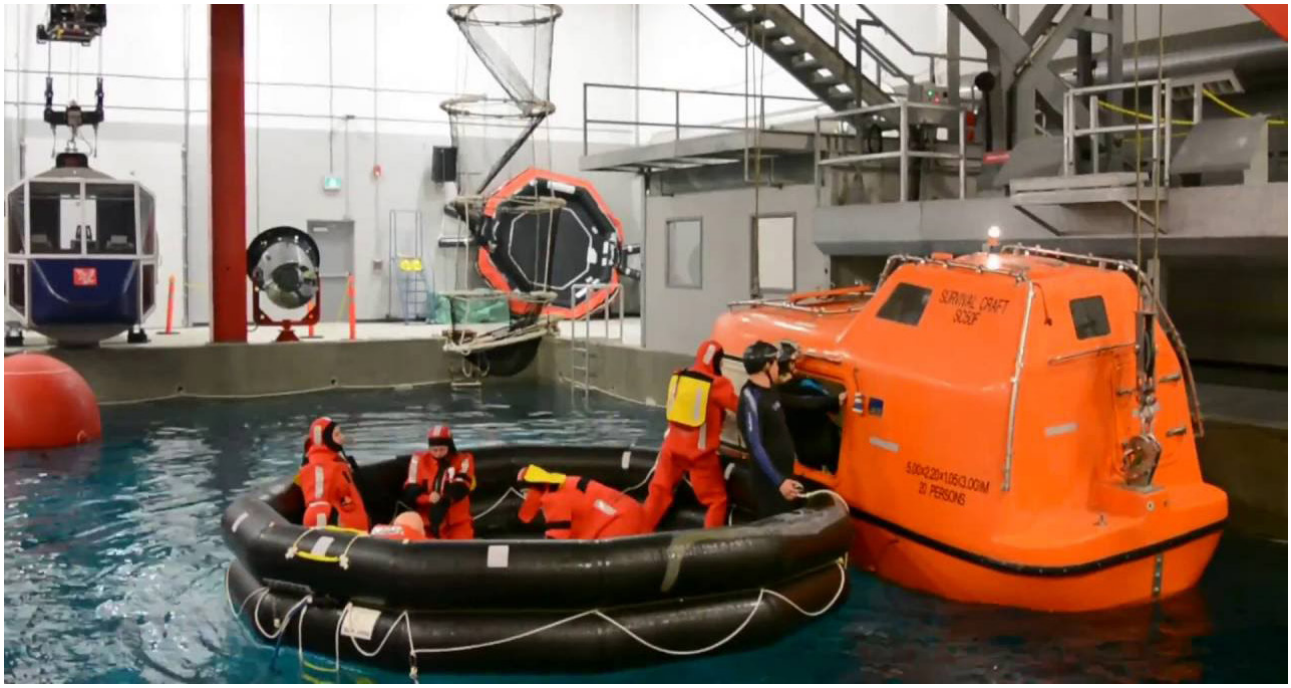
The company continues to diversify its operations to include charters, emergency medical and medivac services, search & rescue and other transportation services.

Atlantic Offshore Medical Services

(AOMS) was founded in 1978 and was successful in capturing work on the Hibernia project. The company now offers a range of harsh environment occupational health and emergency medical services, both onshore and offshore. They include audits of occupational health and safety practices, pre-access medical and physical fitness examinations, health surveillance programs, periodic medical examinations, independent medical examinations, disability management programs, health promotion programs, workplace drug testing, occupational therapy, vaccinations and immunizations, and a host of other occupational health services. AOMS also provides response teams for medical emergencies at remote sites and has extensive experience in setting up medical services for offshore producing platforms and offshore drilling rigs, including the design and establishment of sick bays and the provision of medical staff.

The company has provided its services to all the oil companies, and on most all offshore rigs and platforms, operating in the Newfoundland and Labrador offshore. AOMS also has provided medical services at the Hebron platform construction site at Bull Arm, and to the North Atlantic Refining Limited refinery in Come-by-Chance, Newfoundland. AOMS also has an operation with the same capabilities in Dartmouth Nova Scotia, which has supported ExxonMobil and Imperial Oil on the Sable gas project, SBM Offshore on the Deep Panuke gas project and most recently BP in their drilling campaign in offshore Nova Scotia. Other AOMS offshore oil industry clients include Atlantic Towing, DOF Subsea, Secunda Canada, Subsea7, Technip and many more supply and service companies supporting offshore O & G in Eastern Canada. Drawing on its Newfoundland and Labrador-developed expertise, AOMS has also provided medical support outside of Newfoundland and Labrador in the form of camp clinics for the Sunrise (Husky Energy), Shell Albian Sands Project, Kearl Oil Sands Project, and Shell Carmon Creek Project in Peace River. All oil sands projects are in Alberta.

Overall, the oil industry has played a huge role in the growth of the company, and it has used its expertise to expand into other sectors, working for such organizations as workers compensation commissions in both Newfoundland and Labrador and Nova Scotia, and for the cities of St. John's and Mount Pearl. However, the oil industry is still responsible for about half of its work and 60 percent of all revenues. Over the study period, AOMS had between 75 and 105 employees. Of these, 65 were located in Newfoundland and Labrador, and many of those in other locations were Newfoundlanders and Labradorians.



Offshore safety training simulation - Falck Safety

Falck Safety Services

Falck Safety Services is part of the **Falck Group**, which offers worldwide emergency preparedness and rescue services. Operating in 45 countries on six continents, including training for the onshore and offshore oil and gas industry, maritime sector, civilian aviation, and the armed forces. It operates at three training locations: Dartmouth (Nova Scotia), Mount Pearl (Newfoundland and Labrador), and Robert (Louisiana).

In Newfoundland and Labrador, oil and gas accounts for approximately 75% of its business. The Mount Pearl training centre was established primarily to offer courses for offshore oil and gas employees. Prior to its opening in 2014, they had to either book training at the Marine Institute or travel to Dartmouth and further abroad for training in most of the courses that are now offered at Falck's Mount Pearl facility. Falck offers a wide range of safety courses for the offshore, aviation, and marine industries, many at its survival training simulation theatre, which has a pool with full environmental effects to prepare students mentally and physically for offshore and marine work.

When the Mount Pearl office and training centre opened, the oil and gas industry in Newfoundland and Labrador was heading into a recession. To weather the storm, Falck cut staff reduced salaries, and bundled training programs. Since then the company has flourished and it is now busier than ever. **Falck's Mount Pearl location now has a staff of 26, with approximately half of its instructors being women.**

Oceans Ltd.

Judith Bobbitt established Oceans Ltd. **(Oceans)** in 1981, to carry out physical oceanography for the oil industry. The company has been carrying out oceanography contracts with Petro Canada/Suncor since it was founded. Other oil industry clients have included Husky Energy, ExxonMobil, Hibernia, Chevron, Equinor, and Marathon Oil, with Oceans also supporting the shipping industry and other marine users. It provides physical oceanography, marine weather forecasting, environmental biomonitoring, iceberg profiling, climate studies, and environmental design criteria services. Oceans opened an office in Halifax, Nova Scotia, in 2001 to support contracts with ExxonMobil on the Sable field. It has been responsible for all the initial oceanography work to characterize the high currents in Minas Passage for tide energy developments.

Oil industry work has allowed Oceans to diversify into medical research, evaluating anti-cancer properties associated with seaweed extracts.

Oceans has 37 full-time employees in the St. John's and Halifax offices, 35 of whom are scientists, engineers, and technologists. **Oceans Ltd. is a diversity company, certified by WEConnect international, with the male/female ratio approximately 50/50.**

The accumulated expertise, equipment and capital resulting from oil industry work has allowed Oceans to diversify into medical research to characterize and evaluate the anti-cancer bioactivity associated with seaweed extracts. The research has resulted in discovery of a molecule which has been shown through in-vivo studies to inhibit the growth of breast cancer. The synthesized molecule is now being tested on other cancers, and studies are being carried out on the mechanism of action to learn why the molecule is so effective.

K&D Pratt Group Inc.

(K&D Pratt) is an Atlantic Canadian company with roots in Newfoundland and Labrador. It was created by the merging of two companies, J.C. Pratt (Newfoundland and Labrador-based) and K&D Industries (Nova Scotia-based). It has a diversified portfolio, with the following business units Life Safety, Technical Services, Instrumentation, Coatings, Sanitation, and Offshore. The last includes the distribution of offshore oils and lubricants and subsea control fluids, fire and blast doors, production and test lines, and drilling and refining products. These business units provide services to multiple industries. These include: offshore oil and gas, industrial facilities, construction sites, transportation, utilities, manufacturing, mining, healthcare, educational facilities, food processing, and municipal and provincial government.

The offshore oil and gas sector is K&D Pratt's biggest source of business, but it only accounts for approximately 30 to 40 percent of the company's total revenue. The company has been involved in the local oil and gas sector since Hibernia began production in 1997, and it still services much of the industry today.

Rutter

Rutter is a Newfoundland and Labrador-based company that specializes in high-resolution radar processing equipment and offers R&D services that help support the offshore industry, both locally and internationally. The company was incorporated in 1998 and is headquartered in St. John's NL. It also has a small sales and R&D office located in Germany. **Rutter began with approximately five employees working in its product division, but this has increased to approximately 30. Rutter operates locally and has expanded its operations to serve clients on every continent.**

Rutter's product line has evolved over its history. The company's operations began with the development of voyage data recorders (VDR) for offshore vessels and radar systems. Rutter divested the VDR product in 2011 and its primary focus is now on its state of art radar technology. Its Sigma S6 product line includes radar systems designed to track and monitor sea ice, oil spill detection and monitoring, and small target surveillance. Rutter also provides real time wave and current monitoring in the offshore environment to support navigation through its WaMoS® II system.

Rutter has been servicing the oil and gas industry in Newfoundland and Labrador since the early 2000s, and currently services the offshore production platforms with its technology here in Newfoundland and Labrador. In addition, Rutter also supports the vessels that service these platforms, along with other contracted drilling rigs that are operating in Newfoundland and Labrador. This has allowed Rutter to foster and develop a strong working relationship with the offshore oil and gas industry in the province and is one that both parties have been able to benefit from. Rutter can work with operators and use the offshore industry in Newfoundland as an active R&D platform to test out new products or innovations, and will work with operators to develop new technologies, or to improve existing products and services. Operators benefit from receiving new technologies for their operations and being actively involved in helping to solve problems in the offshore environment, and Rutter benefits by having new products and services tested in real world scenarios and receive feedback on how to improve their products before they go to market.

Because of this strong relationship with the oil and gas industry in Newfoundland and Labrador, Rutter has been able to expand its products and services internationally and into different industries. In addition to oil and gas, Rutter also provides products and services for other industries, such as coastal surveillance, border services, the cruise industry, and military operations. Many of these business lines are international, and approximately 90 percent of Rutter's business comes from outside of Canada.

This diversification has allowed Rutter to manage downturns in the oil economy by focusing on its other business lines to remain competitive and successful. **It is able to continuously reinvest into R&D to improve its products and remain an industry leader, all while maintaining a local presence and bringing economic activity into the province.**

Because of the offshore industry, these companies have expanded their products and services internationally

Provincial Aerospace

The aerospace and the oil and gas industries have a storied history of mutual support and benefits. This is especially true Atlantic Canada, and Newfoundland and Labrador in particular. **As the Atlantic offshore oil and gas industry grew and expanded, so too did St. John's-based Provincial Aerospace Ltd. (PAL) grow alongside it into a global leader in the aerospace and defense sector.**

With operating divisions including: PAL Aerospace, CarteNav, DECA Aviation, PAL Aviation Services, AirPro (a joint venture with Airbus DS), PAL Airlines, Moncton Flight College, Air Borealis, PAL LLC, and Atlantic Avionics Inc, PAL provides highly-tailored airborne and maritime surveillance solutions, including: custom aircraft design and modification; passenger and cargo airline services throughout Atlantic Canada; and mission operations, design, training, and support around the world.

The company's involvements with the oil and gas industry started with ice surveillance flights in the early 1980s, working with Mobil Oil and Husky Bow Valley. As the industry grew, the requirement for detailed, quality ice surveillance data grew with it. Additionally, in the wake of the Ocean Ranger disaster, an increased emphasis was placed on safety-related requirements, especially in the area of ice response. This provided a challenge to which PAL responded by adapting military anti-submarine technology to ice surveillance. This also saw PAL moving away from simple ice data collection towards the provision of more fulsome ice management including the coordination of ice risk mitigation operations.

The Force Multiplier - Dash 8 Q300 - Provincial Aerospace

PAL's success has always been directly linked to this ability to innovate and deliver industry-leading solutions to meet the specific needs of clients. For example, PAL was the first company to deploy the anti-submarine radar on an airplane for iceberg tracking, and the first to integrate airborne automatic identification systems for use in monitoring marine vessel traffic. Recently, members of the PAL team were also responsible for managing, and helping to develop the new International Organization of Standardization (ISO) 35104:2001 Standard for Ice Management. PAL's experience and expertise in the field is widely acknowledged as the best in the industry.

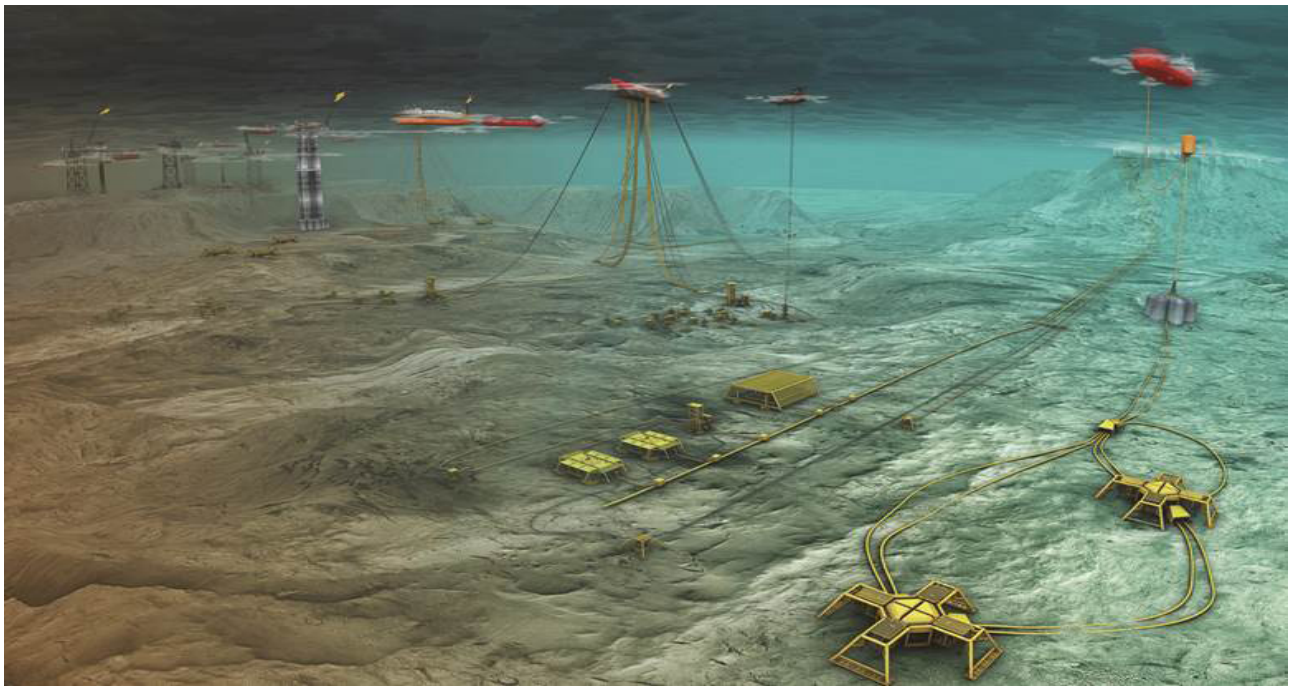
With the decline in oil exploration activities in the late 1980s, PAL redeployed knowledge and capabilities originally developed to support the industry and diversified into fisheries monitoring. This increased stability and allowed the company to develop PAL Airlines, which has in turn grown to become the largest independent regional carrier in Atlantic Canada. Shortly after, PAL further extended its operations into products and services related to sovereignty protection, search and rescue, maritime security, environmental management, pollution detection and monitoring, drug interdiction and smuggling, customs and immigration patrol, disaster relief and general law enforcement.

Canada's FWSAR Replacement - Airbus C295W

In 2017, PAL Aerospace in partnership with Airbus Defense and Space, won the multi-year, multi-billion-dollar contract for Canada's Fixed Wing Search and Rescue Aircraft Replacement (FWSAR). The Airbus C295W will replace aging CC115 Buffalo and CC130 Hercules aircraft in their roles as the Canadian Forces' principal Search and Rescue assets. PAL Aerospace will be responsible for the in-service support of the Airbus C295W and work alongside Royal Canadian Air Force technicians in the execution of first-line maintenance of the aircraft. The company is also responsible for repairs, second and third line maintenance, future aircraft modification work, and will establish supply chain management protocols in support of FWSAR.

The company continues to explore the use of new technologies and innovations. This includes moving forward with commercial applications of drone technology, and investigating the challenges posed by distant deep-water activity. This philosophy has also guided PAL's development of the Force Multiplier (FM), a new on-demand contract Intelligence, Surveillance and Reconnaissance (ISR) platform for domestic and international special missions. Modified, owned, operated and maintained by PAL Aerospace, and available for operation worldwide, FM is a Bombardier Dash-8 Q300 equipped with a full-mission system suite designed to accommodate a diverse range of ISR applications.

Given PAL's success in innovation and diversification, the oil industry is now directly responsible for less than 10 percent of PAL's aerospace and defense work. PAL remains involved supporting the industry in Newfoundland and Labrador, across Canada, and internationally with work in Greenland for Cairn Energy, Husky Energy and Shell.



Technip FMC

Technip FMC

Both Technip and FMC set up a presence in Newfoundland and Labrador in 1997 as part of the Grand Banks Alliance, formed to develop the Terra Nova Project. Since then they have been responsible for the Engineering, Procurement, Construction, and Installation (EPCI) of subsea equipment, including umbilicals, risers and flowlines, for most of the Newfoundland and Labrador offshore oil projects.

TechnipFMC employs 120 people in St. John's. With the downturn in both the international and local subsea markets in 2014 the company assigned international work to St. John's in order to keep core competence in the province. The St. John's office completed 185,000 hours of direct work on international projects over the study period, with an additional approximately 15 percent workhours for indirect support positions. Other local employees were seconded to work at other locations around the world.

The St. John's office worked on over 100 projects in Brazil, Norway, Gulf of Mexico, UK, West Africa, and Asia Pacific. **Some of the largest subsea deep-water projects in the world have been supported from St. John's,** including: MOHO, Kaombo, Ten, BP Quad, and Jangkrit. The peak international workload was in 2015, when nearly half of the St. John's team were working on deep-water projects in West Africa.

This international work has allowed TechnipFMC in Newfoundland and Labrador to build specialty skill sets in international diving support and dynamic analysis. The dynamic analysis department has been using

advanced computing and machine learning to optimize dynamic riser analysis. In 2014 the Research and Development Corporation invested in the High-Performance Computing Center, which has been instrumental in TechnipFMC being able to complete this international work.

Research and development has long been a priority for TechnipFMC, with a total expenditure of about $5 million since 2012. Major areas of interest have included:

- **Marginal Field Program: Over $2 million (RDC contribution: $750,000) was spent on the marginal field development collaboration project with C-CORE. The intent was to reduce the costs associated with subsea developments in iceberg infested areas. This program has resulted in several papers being presented at the Arctic Technology Conference in Houston.**
- **Concrete SPAR: This major research program, a collaboration between TechnipFMC, C-CORE, Frontier, Stantec, and the National Research Council (NRC)), designed a concrete SPAR for the Flemish Pass area.**

TechnipFMC spends about $400,000 on direct learning and personnel development (i.e. not including peoples' time) annually. Two local employees are recognized as Experts in the TechnipFMC Expert Network: Andrew Blundon in the area of offshore lifting and Fred Turner in dynamic analysis.

Through all of this work, TechnipFMC makes a major direct contribution to the provincial and local economy, as is shown by its local supply chain spend over the study period:

- **2015: Total local supply chain spend = $7,886,884, 154 local suppliers**
- **2016: Total local supply chain spend = $14,166,764, 152 local suppliers**
- **2017: Total local supply chain spend = $9,641,832, 141 local suppliers**

In addition to the above, TechnipFMC St. John's central services and administration spends about $4-million a year purchasing goods and services from approximately 400 local companies that range in size from the GJ Cahill Group to Manna Bakery.

TechnipFMC St. John's spends nearly $4-million a year purchasing goods and services from approx. 400 local companies.

Vallen

Brenkir (now Vallen) began in 1985, as a venture from two Marystown business owners who saw an opportunity to provide a service to industrial workers for personal protective equipment (PPE). As a result, they began their business by providing industrial PPE to workers at the local shipyard in Marystown out of the back of a vehicle. Eventually, as a result of their success and strong reputation for customer service in the province, Brenkir was acquired by Seafair Capital in 2009. After the purchase, it decided to open up an additional location in Mount Pearl, and one temporary location in Long Harbour to service Vale's nickel processing plant during its construction.

In 2017, Brenkir was acquired by Vallen Canada, a large industrial supply company in Canada. This was the result of Vallen Canada seeking a stronger presence on the east coast of Canada, including Newfoundland and Labrador, and Brenkir wanting to position itself to better service the large operations in the province. The Marystown location closed after the acquisition, along with the temporary location in Long Harbour due to the end of construction of the processing plant. Currently, there are eight full-time employees at the Vallen location in Mount Pearl servicing the province.

Vallen has three main Newfoundland and Labrador business lines: supply of industrial PPE; Maintenance, Repair, and Operation Services; and Janitorial and Sanitation Services. The oil and gas industry plays a large role in the company's operations. Vallen / Brenkir's first experiences with oil and gas came in the 1980s and 1990s, by providing supplies and PPE for construction of offshore oil and gas components, and providing supplies related to a drilling campaign by Transocean. Since that time, other clients have included Husky Energy, Atlantic Towing, Maersk, and Worley Parsons. Vallen / Brenkir helped provide industrial supplies to Worley Parsons during the construction of the living quarters of the Hebron Project.

Dynamic Air Shelters

Not all offshore oil industry activity occurs in the St. John's metropolitan area. For example, construction activity for the Hibernia, Terra Nova, White Rose, North Amethyst, and Hebron projects was concentrated around the Isthmus of Avalon and Marystown areas, rig mobilization and refurbishment work has occurred at both Bull Arm and Marystown, and oil transshipment occurs at a terminal near Arnold's Cove on Placentia Bay. Dynamic Air Shelters, based in Grand Bank on the Burin Peninsula, approximately 360 km west of St. John's, is an example of a company outside St. John's that is providing goods and services to the global oil and gas / petrochemical refining industry.

Dynamic received its start with the local offshore petroleum industry, but has branched out substantially, both in terms of client-base and geography. Its core products are currently its blast resistant air shelters, and it also builds inflatable shelters for mining and construction projects, rapid emergency response, as well as for promotional purposes. **Dynamic's involvement in the oil industry has had an important influence on its product development,** and it was through the industry that this Calgary-based company first began working in Newfoundland and Labrador in 2002, eventually leading to moving its manufacturing operations to Grand Bank in 2004.

The company evolved from Aero Dynamics Inflatable Shelters Inc., which was formed in Calgary in 2000. Aero Dynamics initially focused on designing and manufacturing inflatable shelters for promotional events,

Table 5.1 Total Sales by Region

Region	Total Sales (%)
North America	60
Caribbean	5
Middle East	5
UK	25
Other Asia	5

using technology and engineering adapted from hot air balloon production and design. The company began engineering and testing their shelters for explosion resistance in response to growing oil industry demand. **A turning point came when the company demonstrated that it could produce a structure that could withstand pressures from an explosion of up to four pounds per square inch (psi).** Later tests by global petroleum companies concluded that the structure would likely withstand blast pressures of up to nine or ten psi. Dynamic shelters are now used on work sites for offices, lunch rooms and warehouses.

Engineering and manufacturing capabilities originally developed to meet oil industry requirements have helped Dynamic market their product to other sectors. Blast resistant structures are also in demand for construction and fabrication industries, and the company has also worked with the Canadian Armed Forces to provide protective structures for use in military operations. The company estimates that about 25 percent of its business comes from construction and fabrication projects, many of which are linked to the oil industry, while the remaining 25 percent is split between military applications, promotional structures, and emergency response shelters.

In 2009, the American Petroleum Institute initiated an extensive study on the use of soft-walled structures in over pressure zones, and in 2014 it released a best practices document (API 756) to help occupational health and safety officials regulate site facilities. Dynamic's recent growth can be attributed to this API initiative,

combined with repeat sales in the North America and including new sales in foreign markets; non-North American customers account for 40 percent of sales (Table 5.1, pg 43).

Dynamic's 2017 Newfoundland and Labrador payroll was in excess of $2 million. The Burin Peninsula operation (which currently includes activity in both Grand Bank and Fortune) employed 50 individuals full-time and another five are available for call-in during peak production. The company also employs 12 individuals in its Calgary office (finance, marketing, and engineering) and another two in its Houston office. The company supports local business where possible, including local purchases of: wooden crates; truck, taxi and bus transportation; restaurant meals; and, hotel and B&B accommodations.

Dynamic has branched out substaintially both in terms of client base and geography

Dynamic Air Shelters

Staff photo - SubC Imaging

SubC Imaging

SubC Imaging is another successful company which is located outside of St. John's. Based in Clarenville, SubC Imaging is an ocean technology company that focuses on providing clients with state-of-the-art optical imaging systems for offshore and subsea markets. The main business lines within the company include:

- **Premium quality high-definition 4K and ultra-high-resolution digital stills cameras with complementary lighting, lasers and batteries**
- **Topside video management for recording and overlaying with other sensor data the video being transmitted to the surface.**
- **Fully integrated and tested custom systems for client specific applications and custom engineering for client projects.**

SubC Imaging was founded in 2010 and began with an idea from one individual who was working in offshore Newfoundland and Labrador. Chad Collett had extensive knowledge of cameras and subsea imaging and recognized a need and opportunity that could be capitalized on regarding providing higher quality subsea imaging and videos to operators and other companies operating in the offshore environment. He decided to pursue this opportunity, and along with Adam Rowe and Ron Collier, began to develop the company. Since that time, the company **has witnessed considerable growth, and now has over 20 employees and provides products and services to over 130 clients around the world** - in Canada, the United States, Brazil, China, Japan, United Kingdom,

Norway, Italy, Australia, the Netherlands, and others.

The company began its work in the offshore oil and gas industry in Newfoundland and Labrador in 2011 when they were awarded a contract to support Subsea 7 with its work on the SeaRose FPSO. At that time, the company consisted of three employees. Since that initial contract, SubC Imaging has expanded to provide products and services to Husky Energy, Suncor Energy, and ExxonMobil for their operations in offshore Newfoundland and Labrador. It also provides services to other companies including DOF subsea, Frontier Subsea, Van-Oord, and Pro Dive Marine Services.

SubC Imaging's early work in the oil and gas sector both in Newfoundland and Labrador and in other countries, has allowed the company to diversify. Currently, SubC Imaging works in three main business lines: Oil and Gas, Ocean Science Research, and Naval Defense. The company has been awarded a contract to provide cameras and lights to the University of Washington's Regional Scale Nodes Ocean Observatory. Other notable projects include a partnership with OceanGate Inc. to use SubC designed cameras on an expedition to record high-definition photos and video of the Titanic shipwreck. Oil and gas related work is still an important part of SubC Imaging's portfolio, representing approximately 60 to 70 percent of their business. However, its work and early success in the local oil and gas industry has enabled the company to build and improve its service lines and has allowed it to diversify into other industries while maintaining a strong presence in Newfoundland and Labrador.

Getting its start in the offshore, SubC Imaging has since evolved to design cameras capable of capturing and recording expeditions to the Titanic shipwreck

Offshore simulator - Virtual Marine

Virtual Marine

Virtual Marine (VM) was founded in 2004 and is based in St. John's, Newfoundland and Labrador. The company specializes in providing marine simulation products and services to the oil and gas, defence, and commercial shipping industries. This includes simulation software related to lifeboat, fast response craft, electronic navigation equipment, and ice management. VM's simulators allow for training in scenarios, including emergency response in harsh weather, such as waves and ice. VM's simulators range in size from full room simulators with hydraulic systems, down to virtual reality headsets that individuals can use in small spaces. The simulators can be deployed with an automated curriculum for self-study, or as instructor-led systems allowing for creation of new scenarios. Currently, VM has simulators onboard the Hibernia platform and SeaRose FPSO, two producing installations in offshore Newfoundland.

VM has since evolved its business lines. In its early years, the company focused on the development of prototype simulators and associated software and training curriculums. Now that its products are commercially successful and used by multiple clients, VM is studying human behaviour and assessment of personnel who train with these simulators. VM can acquire data during simulations to analyze and understand how participants react to certain situations. This includes identifying strengths and weaknesses of trainees and tailoring curriculum to their individual needs to improve performance. This information informs clients how to prepare for certain scenarios, and can help clients strategically develop their staff, or structure offshore teams so that they are the most efficient in the case of an emergency event.

Early in the current decade, VM focused on expanding its operations into international markets and seeking approval from governments to allow their products to be used overseas. Since that time, VM has received approval from major regulators world-wide, and now operates globally,

with approximately 90 percent of its business being in other parts of the world, including Norway, the UK, United States, Germany, and Australia.

In addition to serving the oil and gas industry, VM has also increased its presence in the defence industry and has several contracts both domestically and internationally. In 2017, the Canadian Defence Review identified VM as one of the top 75 defence companies in the country. This has allowed VM to diversify its portfolio and complement the operations that it already has in the oil and gas industry. The early success and investment into R&D in the oil and gas industry has allowed VM to continuously improve its products and services and branch out into other offshore sectors to capture new markets while providing quality service to all clients.

Kraken Robotics

Kraken Robotics

Kraken Robotics is a marine technology company, founded in Newfoundland in Labrador in 2012, that specializes in the design, development, and marketing of state-of-the-art marine sensors that can be used for unmanned underwater vehicles. It also develops underwater vehicles, which include the KATFISH (tethered underwater vehicle) and THUNDERFISH (autonomous underwater vehicle). The company uses its Synthetic Aperture Sonar (SAS) subsea imaging technology to provide extremely accurate and high-resolution subsea images of the seabed, and with a wider coverage rate than traditional seabed mapping methods. Currently, Kraken employs approximately 52 people worldwide. The company's headquarters is in St. John's, but it also has offices in Halifax, the United States, and Germany. Approximately 90 percent of Kraken Robotics staff are Newfoundlanders and Labradorians.

The company began its work with the oil and gas industry in 2014, with a contract to conduct survey work on a portion of the Nord Stream natural gas pipeline in the Baltic Sea. Due to the wide range of coverage from the SAS technology, Kraken was able to survey multiple portions of the pipeline so that they only need to run the survey once, as opposed to traditional methods that would need multiple passes to cover the same area.

Kraken has also been working with PRNL on a project to develop underwater sensors and robotics to aid in the digitalization of operations within Newfoundland and Labrador's offshore oil and gas sector. This includes such aspects as reducing potential future downtimes through integrated asset integrity management. The project is aimed at demonstrating the use of new and innovative technologies to provide improved processes for data collection, analysis, and decision-making for oil field inspection, maintenance, and repair; and to demonstrate

the efficiencies that can be realized from a cost, safety, and environmental perspective using this new technology. Kraken has also explored innovations that are relatable to ice management, ship hull inspection and maintenance, and environmental surveying and monitoring.

Currently, the defence industry provides most of Kraken's business. The company has completed work for defence organizations throughout the world, including the US Navy. Kraken's technology has also been employed on some high-profile recovery initiatives, including the finding of the Avro Arrow test model planes in Lake Ontario, and the search for the missing Malaysia Airlines Flight MH370 in the Indian Ocean.

Strategic Concepts

Strategic Concepts is a highly-specialized company that was established in 1990 to assist small businesses with business planning and marketing. However, driven largely by offshore oil projects and associated regulatory requirements and processes, the company's principals recognized that there were opportunities associated with forecasting and demonstrating the economic impacts of large resource development projects for their proponents and interested stakeholders.

Strategic Concepts subsequently expanded its offerings to include: cash flow and economic impacts analysis, the provision of strategic advice with respect to advancing projects, studies of project labour requirements and potential supply, and the negotiation and implementation of Impact and Benefits Agreements. Through a subsidiary it also provides software for project-related tasks such as the monitoring of project benefits and commitments, contacts management, skills inventory, and health and safety tracking. SCI has been recognized by government, industry and indigenous groups for its experience and approach to industrial benefits monitoring.

Local oil industry clients of Strategic Concepts have included ExxonMobil, Husky Energy, Equinor and Chevron. The company's local success has led to its software being adopted for projects elsewhere in Canada, including the Kearl oil sands projects for ExxonMobil and the Surmont oil sands project for ConocoPhillips. The software has also found a market in non-oil projects, such as Vale's Voisey's Bay Mine and Mill, Nalcor's Muskrat Falls hydro development, Rio Tinto's Carol Lake mine, Emera's Maritime Link power transmission project, and DeBeers Canada's Victor mine in norther Ontario. As a result, by the end of the study period oil industry work was only responsible for 20 to 25 percent of the company's turnover, but 40 percent of its software business.

Strategic Concepts success has led to its specialized software being used by projects across the country, outside of oil and gas.

PanGeo Subsea

PanGeo Subsea was co-founded in 2006 by Moya Cahill and Jacques Guigne with a vision to commercialise 3D synthetic aperture sonar acoustic sub-bottom imaging technology to provide better and more cost-effective site investigation solutions to the oil and gas sector. PanGeo attracted talent from both academia and industry, building an R&D team of some 35 geoscientists, engineers and technologist by 2010.

Acoustic Corer- PanGeo Subsea

With significant investment from Norway and the United States, as well as R&D funding support from the Government of Newfoundland and Labrador and federal government, PanGeo commercialized two technologies: the Acoustic Corer and the Sub Bottom Imager. The Acoustic Corer eliminates the risks associated with hitting unknown shallow geohazards, like boulders, cobbles, and compact clays, during offshore installation activities. The Sub-Bottom Imager provides more reliable depth of burial of pipelines/cables and characterization of properties of seabed sediment than is offered by other technologies. By doing so, it can reduce costs associated with rock coverage in pipe-laying operations, as well as identifying geohazards such as boulders and unexploded ordnance.

PanGeo turned to the Norwegian sector, and to Equinor and DOF SubSea, to launch its technology in the oil and gas sector. In 2010, through a $4 million Joint Industry Project involving the Norwegian Research Council's Demo 2000 Program, PanGeo successfully showcased the Acoustic Corer. Conoco Phillips Norway then became the true champions of the new technology, awarding PanGeo contracts in three consecutive years.

While the Acoustic Corer was gaining a solid footing in the oil and gas market, PanGeo's engineering team in St. John's was working in parallel on the development of the Sub-Bottom Imager. In 2011, PanGeo brought together the Norwegian cable and pipeline giants Statnet and Gassco to support the Sub-Bottom Imager's industry roll out. With the expansion of interconnector cable infrastructure in Europe, the Sub Bottom Imager with its unique ability to image cables at depths of 5-7 metres was soon the technology of choice for depth of burial cable surveys. Recognizing the importance of the North Sea oil and gas sector and Europe's growing offshore renewable energy sector, PanGeo opened an operations office in Aberdeen, Scotland, in 2012, supplementing its sales representatives in Norway and Denmark.

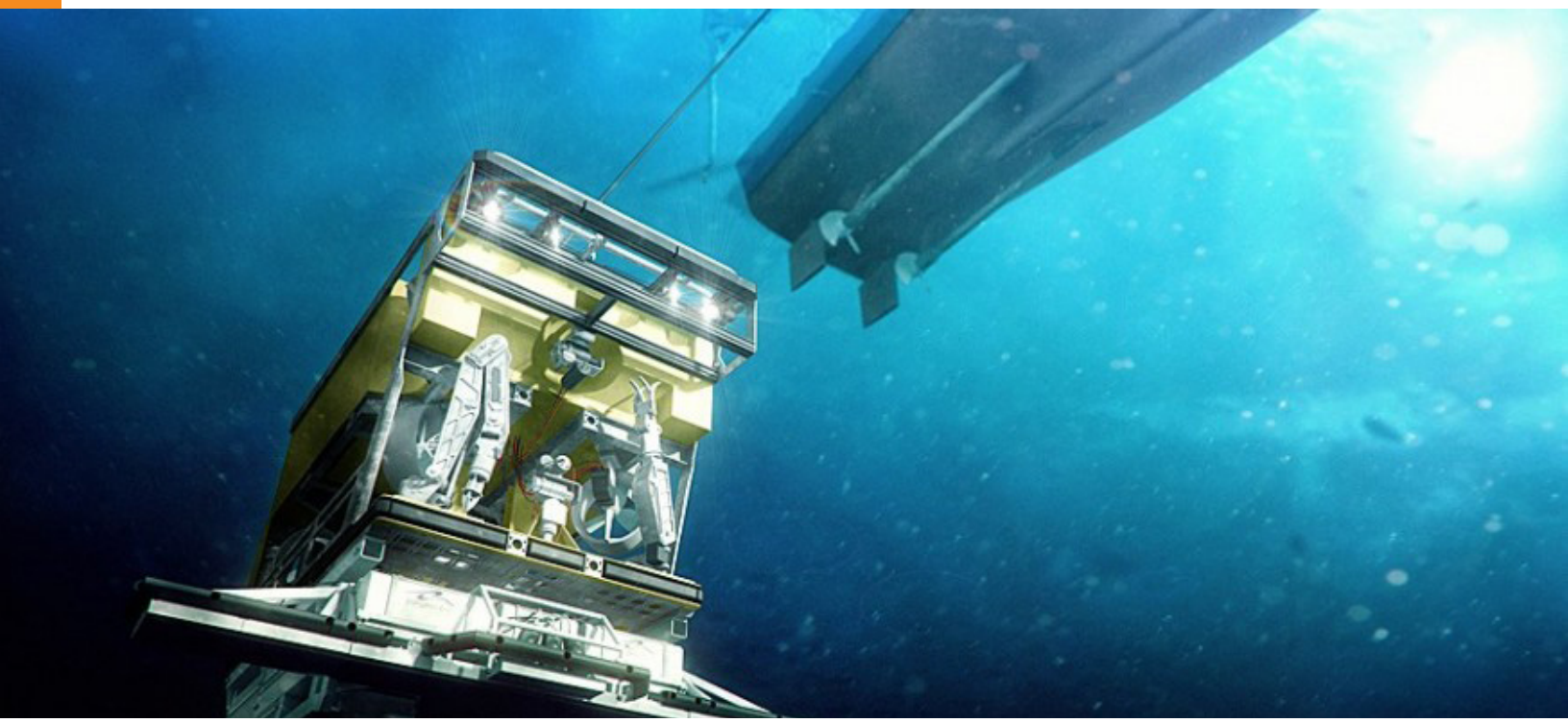
Parallel to these efforts in Europe, PanGeo was keen to apply its technology to the complex seabed of the Newfoundland Grand Banks. It received such an opportunity through Husky Energy's Newfoundland and Labrador R&D program in 2014. The data from the Husky-funded trial provided valuable insight for PanGeo's next generation of software enhancement and led to the Sub-Bottom Imager being selected for use during Husky's 2018 geophysical program for Argentia Harbour.

While the offshore oil industry drove the creation of Pangeo and its technologies, the renewable energy sector in Europe and the United States is driving the company's growth and by the end of the study period was responsible for about 80% of Pangeo's revenue. Its client base includes such European operators as Orsted (Dong Energy), EnBW, EDF, Mainstream, EON and TenneT. PanGeo entered the United States market in 2015, working with Rhode Island based operator Deepwater Wind. PanGeo's acoustic coring campaign provided invaluable sub-seabed data to facilitate the successful siting of the piles supporting the installation of the five offshore jackets for Deepwater Wind's Block Island wind farm. PanGeo plans to build on the success of its clients by following them into new frontiers; China and Taiwan have aggressive forecasts for their offshore renewable markets and are expected to be next on PanGeo's expansion.

The company currently employs some 45 high-tech personnel in St John's, with plans to hire additional geoscientists, engineers and technicians in the near future.

Diversification into the renewable energy sector in the US and Europe now accounts for 80% of Pangeo's revenue.

Sub-Bottom Imager- PanGeo Subsea



East Coast Catering

East Coast Catering (ECC) was established in St. John's in 1984, largely on the basis of perceived opportunities related to offshore oil exploration activity. Currently, ECC is the preferred provider of catering and housekeeping services in Atlantic Canada and is contracted to the majority of production platforms, drilling rigs, and offshore marine support vessels in the region. ECC's current offshore oil clients include ExxonMobil, Suncor, Husky, Transocean, Noble Drilling, Seadrill, Atlantic Towing, and Teekay.

Acquired by Compass Group Canada in 2014, ECC is focused on maintaining its strong reputation and locally-based expertise to capitalize on opportunities within a growing local marketplace. This delivers local employment opportunities for many Atlantic Canadians; ECC employs over 600 people throughout Atlantic Canada, with including 450 in Newfoundland and Labrador. ECC is committed to both gender equity inclusion and persons from traditionally underrepresented groups in its hiring practices. Approximately 40 percent of ECC's total workforce are women, and 30% of ECC's total workforce have self-identified as First Nations.

East Coast Catering is currently engaged in a number of extremely successful First Nation joint venture partnerships in Newfoundland and Labrador, Nova Scotia, and Ontario. These partnerships have resulted in ECC continuing to expand its business offering across land-based opportunities in mining, oil and gas, and industrial construction while bringing significant value to the respective First Nations groups. The most recent example of this has been the partnership with the Mi'kmaq of Nova Scotia where ECC provides its services onboard two offshore oil rigs in Nova Scotia, a first of its kind in Canada's offshore.

Searose Offshore NL

Hungry Heart Cafe

Hungry Heart Cafe

The Hungry Heart Café opened its doors in 2008 as a social enterprise of Stella's Circle, which provides housing, counselling and employment services to adults facing many barriers, such as mental health issues, poverty, homelessness, and long periods of unemployment. As part of the organization's division of Employment Services, Stella's Circle started a restaurant and catering business to provide participants with work experience in the food services sector. **It has provided 90,000 hours of employment and 50,000 workplace-based training hours to its participants.** It has also won accolades for the quality of its food, including being in the top ten rated restaurants in the St. John's area on TripAdvisor. The Café has grown to include pop up events, theme dinners, and guest chef nights.

The support of the oil industry has been a key driver of the Café's success. The industry has wholeheartedly embraced the Hungry Heart as a catering option for meetings and special events, hosting some within the restaurant and catering others offsite. The Café and Stella's Circle has also played a role in Husky Energy's annual Diversity Forum, providing the catering, a speaker on the impact of employment, and entertainment by the Stella's Circle Inclusion Choir.

Chevron Canada and Husky Energy have made substantial financial contributions to Stella's Circle, particularly in the area of Employment Services. Chevron Canada has supported CanDo, a transitional employment program, which has spawned Clean Start, a commercial cleaning business, while Husky Energy contributed to the renovation of the building that houses Employment Services.

Hometel on Signal Hill

In the early 2000s, aware of the difficulty that visiting oil and gas workers had in finding short-term accommodations in St. John's, the owners of Hometel on Signal Hill saw an opportunity to provide luxurious temporary accommodations to these visitors, who often needed to stay in the city for more than just a couple of nights. Hometel, with ten brownstones at the base of Signal Hill, offers just that. Guests can book an entire three-bedroom brownstone or just a room in a home, depending on their needs and length of stay. Each room is a full hotel room complete with ensuite. Daily, weekly and monthly rates are offered.

When Hometel first opened, the oil and gas industry provided the majority of its business. Oil and gas events, such as conferences, have also been a source of business for the company. However, the hotel now hosts guests from a wide range of industries. In addition to tourists to Newfoundland and Labrador, the hotel accommodates wedding groups, members of the Canadian military, and people involved in the local television and film industry. **One of Hometel's major clients is Memorial University, which often refers visiting professors, doctors, and conference attendees to the hotel.**

Hometel on Signal Hill

Newfoundland Transshipment Limited

Newfoundland Transshipment Limited (NTL) was formed to construct, manage, and operate a transshipment facility for Grand Banks oil. Construction of the Terminal at Whiffen Head, Placentia Bay, was completed in 1998 and it has been in operation ever since. It is equipped with large storage tanks, an access causeway, and two fully outfitted piers. Crude oil is delivered to the Terminal from the oilfields by a dedicated fleet of suezmax shuttle tankers. It is then re-delivered to many locations, including the eastern seaboard of North America, as well as Europe, Asia, and South America, using larger 'aframax' tankers.

The Terminal has 21 unionized and 10 non-unionized employees and contracts out spill response, laboratory work, and maintenance of the pipelines, security, project engineering, and other eeervices. NTL's head office in St. John's has nine full-time employees and oversees scheduling, inventory control, finance and accounting, and document control. NTL also owns two Canship Ugland Limited-operated tugs, the Placentia Pride and Placentia Hope, which were constructed in Marystown, Newfoundland. Each tug has five crew on each shift for a total of 20 employees, as well as a Master Mariner who is the Superintendent of Operations. The tugs must be dry-docked twice in every five-year cycle, and NTL has used the Newfoundland Dockyard in St. John's for all of this work. NTL's annual operations budget can exceed $30 million, most of which is spent in Newfoundland and Labrador.

Placentia Bay is one of Canada's largest ports based on tonnage, and a compulsory pilotage port under the Atlantic Pilotage Authority, through the Vessel Traffic Management Center in Argentia. All vessels are vetted

internally and by an independent external agency, Canadian Maritime Agency Limited (CMAL), during their calls at the Terminal. CMAL has nine personnel located in the local area to service the Terminal and the neighboring refinery.

In addition to the Terminal's direct and indirect employment, NTL has a strong presence in the communities of Arnold's Cove and Come by Chance and is a significant contributor to the economy of the region. Since operations commenced, NTL have supported the Tricentia Academy literacy program and a Memorial University Scholarship for children of local fishers. NTL has an excellent record of safety and environmental stewardship. In August 2018, NTL celebrated 21 years without a lost time incident at the Terminal, during which time over 3,700 vessel visits transshipped approximately 2.7 billion barrels of oil.

Success in using oil industry - developed expertise has allowed many NL companies to explore new markets.

Newfoundland Transshipment Limited

Conclusion

The socio-economic effects of the Newfoundland and Labrador offshore petroleum industry have been 'large, widely distributed, and long-term'

At the beginning of the 2015-2017 period, Newfoundland and Labrador experienced a decline in economic activity and saw a decrease in oil and gas industry expenditures. At that time, Hebron project construction activity was beginning to decline, and oil production had begun to decrease as a result of natural declines in existing fields.

However, 2015 saw renewed optimism in the province's oil and gas sector with Nalcor Energy's resource assessment, which estimated that the in-place oil and gas resource potential for the area was 12 billion barrels of oil and 113 trillion cubic feet of gas. During the 2015-2017 period, 16 ELs were awarded and seven new companies took stakes in ELs within 18 months. Annual exploration expenditures reached a record $836.7 million in 2015 and project descriptions were submitted for several proposed exploration drilling programs in the Flemish Pass and Jeanne d'Arc Basins. And in November 2017 Hebron, the province's fifth oilfield, began production.

While local companies have been negatively affected by declining oil industry expenditures, the effects on many of them have been cushioned by the substantial supply and service community focus on supporting ongoing long-term production, and by success in using oil industry-developed expertise to diversify into other markets and industries. Market pressures have also driven greater efficiencies,

leading to increased competitiveness.

Newfoundland and Labrador's continued commitment to developing the province's oil and gas sector was furthered with the establishment in 2016 of the Oil and Gas Industry Development Council. The aim of this Council is to support Newfoundland and Labrador as a preferred location for oil and gas development and to create a long-term vision for the province's oil and gas industry, with a focus on promoting development, competitiveness, and sustainability. This will help ensure that the offshore oil industry will continue to be a major contributor to the economy of, and economic development in, Newfoundland and Labrador for decades to come.

Appendix A

The Macroeconomic Impacts of the Offshore Oil Industry on the Economy of Newfoundland and Labrador - Update 2018

Prepared for Stantec Consulting Ltd.
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I. Introduction

This report estimates the economic impact of the offshore oil industry on the Newfoundland and Labrador economy for the period of 2010 to 2017.

It builds upon previous work that was originally completed in 2003, and subsequently updated in 2005, 2008, 2012 and 2015. This update of the study estimates average annual impacts of the offshore oil industry on key economic indicators such as gross domestic product (GDP), employment and labour compensation for the eight year period from 2010 to 2017. Over this time frame, there have been fluctuations in production and development related activity in the oil industry.

The following sections describe the economic models used in the analysis, the input data and the methodology followed in applying the models. The paper ends with a presentation and discussion of the results.

II. Economic Models

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

NALEM models the relationships between key economic variables affecting the provincial economy. It is used by the government of Newfoundland and Labrador for economic forecasting and for assessing the economic impacts created by major development projects as well as government policy changes. Additional information on NALEM is provided in Appendix A.

NALIOM simulates the relationships between commodity outputs and commodity inputs at an industry level under the assumption of constant returns to scale (i.e. that the proportion of factor inputs used per dollar of output remains constant). The model provides estimates of the GDP, employment and labour compensation impacts for 481 commodity purchases distributed over 236 industries. The strength of NALIOM lies in its ability to capture indirect impacts that arise from the production of intermediate inputs by other industries. The Department of Finance has versions of NALIOM for all years between 1996 and 2014.

NALIOM is used in this study to obtain the indirect oil industry impacts. These indirect impacts are combined with the direct impacts and induced (i.e. impacts related to the spending of workers who are directly or indirectly employed as a result of oil industry activity) multipliers estimated using NALEM to complete the impact estimates. The direct, indirect and induced impacts are then summed together to get the total economic impacts of the offshore oil industry on the provincial economy.

III. Data

Data from Statistics Canada and industry sources were used as inputs for the analysis. The highlights are summarized in **Table 1.**

Table 1: Summary Data								
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Capital Costs ($ millions)								
Exploration	333.9	385.5	165.1	712.7	300.4	836.7	444.7	221.7
Development	177.1	568.0	1,046.2	3,027.4	3,416.0	2,848.9	2,670.0	1,383.0
Production (Sustaining)	604.1	701.6	934.5	611.0	1,623.8	1,052.0	732.3	727.8
Total	**1,115.1**	**1,655.1**	**2,145.8**	**4,351.1**	**5,340.2**	**4,737.6**	**3,847.0**	**2,332.5**
Employment (person years)								
Development	352	685	1,198	3,486	5,299	4,875	3,518	1,964
Production	2,839	3,173	3,981	4,324	4,859	4,047	3,576	3,395
Total	**3,191**	**3,858**	**5,179**	**7,810**	**10,158**	**8,922**	**7,093**	**5,359**
Oil production (millions of bbl)	**100.7**	**97.3**	**72.2**	**83.6**	**78.9**	**62.7**	**76.7**	**80.6**
Operating costs ($ millions)	**751.4**	**708.4**	**746.1**	**960.1**	**977.0**	**1064.5**	**916.2**	**929.1**
Wages/Salaries & Employee Benefits ($ millions)								
Development	28.0	50.9	91.2	287.4	507.4	510.2	326.4	185.2
Production	299.1	320.9	408.3	503.6	599.2	521.7	452.4	438.6
Total	**327.1**	**371.7**	**499.5**	**790.9**	**1106.7**	**1031.8**	**778.8**	**623.8**

Model Simulations

i. Indirect Impacts from NALIOM

A significant portion of the local benefits from oil industry activity accrues to companies providing goods and services to the oil industry. Indirect impacts (or supplier impacts) are dependent on non-wage operating expenses and capital spending. NALIOM was used to obtain indirect GDP, employment and labour compensation impacts. The main types of services provided to the oil industry included services incidental to mining and oil and gas; miscellaneous business services; air transport; water transport; wholesaling; storage; and architectural, scientific, and engineering services. Over the eight year period from 2010 to 2017, annual direct and indirect nominal GDP impacts averaged roughly $8.3 billion, and annual direct and indirect employment impacts averaged roughly 16,200 person years. In 2017, direct and indirect nominal GDP impacts were lower ($6.3 billion) than the eight year average because of lower oil prices which reduced production GDP. On a real basis, 2017 GDP is similar to the eight year average.

ii. NALEM Simulation

NALEM generated multipliers and ratios were used to estimate the induced economic impacts of the offshore oil industry during the reference period. In addition to estimating the induced economic impacts, NALEM also allowed impacts to be measured across a broader array of indicators, such as personal income, retail sales and population. These results are summarized in Table 2.

IV. Macroeconomic Results

The macroeconomic impact estimates, which are presented in Table 2 below, point to a substantial impact on the provincial economy. Nominal GDP was, on average, roughly $9 billion per year higher over the 2010 to 2017 period, and approximately $7 billion higher in 2017 as a result of offshore oil activity. Oil development and production activities generated 29.7% of the province's nominal GDP between 2010 and 2017. In 2017 the share was 23.3%. GDP represents the business income and labour compensation earned within the geographic boundaries of the province.

It should be noted, however, that much of the company profits 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. Business income directly related to the industry generally does not accrue to residents and therefore has limited spill-over onto other economic indicators. Consequently, impacts on other economic indicators such as personal income and employment are smaller than the GDP impacts.

Household income was, on average, roughly $2.5 billion per year higher over the reference period as a result of the offshore oil industry (10.3% of total household income). The impacts were somewhat higher in 2014 and 2015 at roughly 14.2% and 14.0%, respectively, due to the fact that construction activity on the Hebron project was near its peak.

The income impacts mainly reflect the boost to labour compensation resulting from the oil industry's high wages as well as labour compensation from spinoff employment (indirect and induced). Annual disposable income, which is household income after payment of direct taxes (income tax, EI, CPP premiums), was on average $1.7 billion higher over the 2010 to 2017 period. Consequently, consumer spending in the form of annual retail sales was $930 million or 10.8% higher on average.

In fiscal year 2017-18, the Government of Newfoundland and Labrador received $944 million in offshore oil royalties. Income taxes and consumption taxes from labour compensation generated by the offshore oil industry and corporate income taxes paid on oil company profits are other significant sources of revenue for the Provincial Government, but this information is confidential and not available for this report.

The estimated annual employment impact averaged roughly 24,000 over the reference period (10.2% of total employment). On average, the unemployment rate was 3.1 percentage points lower as a result. The decline in unemployment would have been greater except that increased employment, higher average

wages and a larger population encouraged more labour force participation. The estimated annual labour force impacts were roughly 19,000 on average over the 2010 to 2017 period.

Table 2
Economic Impacts of Offshore Oil Industry, 2010-2017

	2010	2011	2012	2013	2014	2015	2016	2017	Average
GDP ($ Millions)	8,579	11,227	9,234	11,387	11,095	6,523	6,611	6,957	8,952
Share of Total (%)	31.6	35.5	30.8	35.2	34.6	23.2	23.1	23.3	29.7
Real GDP Chained ($2007 Millions)	8,262	8,293	6,805	8,202	8,010	7,228	7,939	7,744	7,810
Share of Total (%)	32.3	31.4	27.0	31.0	30.6	28.0	30.3	28.9	29.9
Household Income ($ Millions)	1,365	1,451	1,930	2,796	3,472	3,538	2,889	2,242	2,460
Share of Total (%)	7.0	6.9	8.6	11.9	14.2	14.0	11.2	8.5	10.3
Labour Compensation ($ Millions)	1,024	1,088	1,447	2,097	2,604	2,654	2,167	1,681	1,845
Share of Total (%)	9.2	9.0	10.9	14.7	17.6	17.3	14.0	10.7	12.9
Other Income ($ Millions)	341	363	482	699	868	885	722	560	615
Share of Total (%)	4.1	4.1	5.3	7.5	9.0	8.9	6.9	5.2	6.4
Disposable Income ($ Millions)	942	994	1,317	1,904	2,357	2,381	1,927	1,495	1,665
Share of Total (%)	7.0	6.9	8.6	11.9	14.2	14.0	11.2	8.5	10.3
Retail Sales ($ Millions)	528	557	737	1,066	1,320	1,333	1,079	837	932
Share of Total (%)	7.1	7.1	9.0	12.4	14.8	14.9	12.0	9.1	10.8
Housing Starts	160	164	213	302	367	369	291	220	261
Share of Total (%)	4.5	4.7	5.5	10.6	17.3	21.8	20.8	15.7	12.6
Employment (000s)	15.1	16.3	21.3	28.8	33.0	31.7	26.3	19.2	24.0
Share of Total (%)	6.8	7.0	8.8	11.9	13.8	13.4	11.3	8.6	10.2
Labour Force (000s)	12.7	13.5	17.6	22.7	25.2	23.6	19.3	14.6	18.7
Share of Total (%)	4.9	5.1	6.4	8.3	9.3	8.7	7.2	5.6	6.9
Unemployment Rate (%)	-1.7	-1.8	-2.3	-3.5	-4.4	-4.5	-3.9	-2.7	-3.1
Population (000s)	21.1	22.5	29.3	37.9	42.0	39.3	32.1	24.4	31.1
Share of Total (%)	4.1	4.3	5.6	7.2	8.0	7.4	6.1	4.6	5.9

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 assumed to be a function of the employment impacts. Changes in migration led to a population that was roughly 4.6% higher in 2017. It should be noted, however, that since migration is a difficult variable to model there is a high margin of error associated with the estimated population impact. Consequently, a number of other indicators that are affected by changes in population, such as labour force, the unemployment rate and housing starts, also have a higher margin of error.

Despite the uncertainty surrounding population impacts, the analysis does show that the offshore oil industry is making a substantial contribution to the Newfoundland and Labrador economy, particularly in relation to GDP, labour compensation and employment. The contribution to GDP from oil capital spending was down in 2017 as construction of the Hebron oil platform was completed mid-way through the year. Development impacts will be lower again in 2018 since there was no Hebron development activity this year. However, oil production and production-related benefits such as employment and personal income should increase as Hebron production ramps up. Construction impacts should also improve in the coming years as activity ramps up, first on West White Rose construction, and later on the Bay du Nord project.

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

NALEM is a macroeconomic model of the economy designed to capture the fundamental relationships among major economic variables affecting the provincial economy. NALEM provides a representation of the current structure (e.g. basic economic relationships) of the provincial economy. As this structure changes (i.e. 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 economic relationships.

NALEM contains over 370 mathematical equations and 600 data series which are designed to represent key aspects of the provincial economy and 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 (i.e. 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 (e.g. "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 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.

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 (i.e. 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 Department of Finance's Economic and Project Analysis Division.